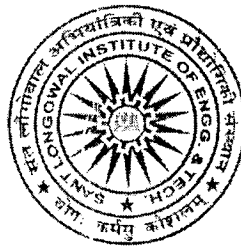


**Integrated Certificate Diploma Programme
and
Under Graduate Programme**

SYLLABUS & SCHEME

(From the Academic Year 2021-22 Onwards)

BOARD OF STUDY



**DEPARTMENT OF MATHEMATICS
SANT LONGOWAL INSTITUTE OF ENGINEERING & TECHNOLOGY
(Deemed to be University under Ministry of Education, Govt. of India)
Longowal – 148106 (Punjab) INDIA**

Subject: Minutes of meeting of Board of Studies of Mathematics.

This is in reference to your letter No. SLIET/Dean (A)/2021/364 dated 16.06.2021, the meeting of Board of Studies of Department of Mathematics was held on 13.07.2021 at 4:00 pm. Following members attended the meeting:

External Members:

1. Prof. Joydip Dhar, ABV IITM, Gwalior-474015
2. Prof. P.G. Siddeshwar, Christ University, Bangalore-560029

Internal Members:

1. Prof. S.S. Dhaliwal
2. Prof. Mandeep Singh
3. Prof. Vinod Mishra
4. Prof. Sushma Gupta
5. Prof. V.K. Kukreja
6. Prof. J.R. Sharma
7. Prof. R.K. Mishra
8. Prof. R.K. Guha
9. Sh. R.K. Goyal, AS^T
10. Sh. Yogesh Kapil, AF
11. Dr. Sudhir Kumar, AP

Alumni Member:

Ashutosh Singh, Research Scholar, Department of Mathematics, IIT Patna, Bihar

Parent Member:

Mr. Rishipal F/O Ms. Renu (M.Sc. Reg. No. 1850503)

After thorough discussion in the BoS meeting the mathematics syllabi of ICD and UG and scheme and syllabi of PG (Mathematics) were finalized, which are enclosed herewith for your necessary perusal.

Kalyan
16.07.2021
HOD (Mathematics)

Dean (Academic)

SLIET/Maths/103
16/07/2021

Integrated Certificate Diploma Programme

Title of the course : **Mathematics - I**
 Subject Code : **AM - 111**
 Weekly load : 5 Hrs.
 Credit : 5 (Lecture 4; Tutorial 1; Practical 0)

LTP 4-1-0

Unit	Main Topics	Course outlines	Lecture(s)
Unit-1	1. Algebra	Arithmetic and Geometric Progression, to find $\sum n$, $\sum n^2$, $\sum n^3$ Mathematical Induction- simple problems. Fundamental principle of counting, Permutations: with distinct and non-distinct objects, Combinations, simple problems.	10
	2. Binomial Theorem	Binomial theorem for positive integral index (without proof), general and particular terms. Binomial theorem for any index (without proof), simple problems.	8
	3. Trigonometry	Introduction to trigonometric formulae, Trigonometric ratios of multiple and sub-multiple angles (2A, 3A, A/2), Product formulae, conversion from sum or difference to product and vice-versa (without proof), Solutions of simple trigonometric equations, Inverse trigonometric functions and their properties.	12
Unit-2	4. Complex Numbers	Complex number in the form of $a + ib$, Argand diagram, algebra of complex numbers, modulus and argument of a complex number, polar form and exponential form, square root of a complex number.	6
	5. Straight Line	Distance and section formulae. Equation of straight line in various standard forms, intersection of two straight lines, angle between two lines, condition for two lines to be parallel and perpendicular, perpendicular distance of a point from a line.	12
	6. Conic Section	General equation of a circle, diameter form, centre and radius of a circle, circle through three non-collinear points. Parabola, ellipse and hyperbola (standard equations only) and their properties.	12

Total = 60

Recommended Books:

1. Mathematics - Text books for class XI, NCERT, New Delhi.
2. Mathematics for class XI, Kalyani Publishers.

Handwritten signatures and names:
 Siddheshwar, Ashwini, Rm, Rm, Sudhir, [Redacted],
 [Redacted], Anub, [Redacted], Yog, Rm, [Redacted],
 Mohr, [Redacted], [Redacted], Kaly.

Integrated Certificate Diploma Programme

Title of the course : **Mathematics - II**
 Subject Code : **AM - 121**
 Weekly load : 5 Hrs.
 Credit : 5 (Lecture 4; Tutorial 1; Practical 0)

LTP 4-1-0

Unit	Main Topics	Course outlines	Lecture(s)
Unit-1	1. Limit and Continuity	Functions, types of functions, composite function, invertible function, domain and range. Concept of limit, Standard limits. Continuity of a function at a point and in an interval.	8
	2. Differentiation	Physical & geometrical meaning of derivative of a function, differentiation of x^n , $\sin x$, $\cos x$, and a^x from the first principle. Differentiation of sum, difference, product and quotient of functions. Differentiation of function of a function (Chain rule), differentiation of inverse trigonometric functions, Logarithmic and parametric differentiation, Differentiation of implicit functions, Second order derivative.	10
	3. Application of Differentiation	Rolle's theorem and Lagrange's mean value theorem (without proof). Rate of change of quantities, increasing and decreasing functions, tangent and normal, Maxima and Minima of a function second derivative test, maximum and minimum values of a function in a closed interval.	12
Unit-2	4. Integration	Integration as anti-derivative, fundamental integrals involving algebraic, trigonometric, exponential and logarithmic functions. Integration by substitution and by parts. Partial fractions and integration using partial fractions. Integration of rational and irrational functions.	16
	5. Definite Integral	Definite integral, evaluation of definite integral by substitution. Properties of definite integral and simple problems.	7
	6. Application of Integration	Area under a curve. Area between two curves (involving line, circle, parabola and ellipse only).	7

Total=60

Recommended Books:

1. Mathematics - Text books for class XII, Part I and II, NCERT, New Delhi.

Handwritten signatures and initials:
 Siddheshwar, J. K. Singh, R. M., Sushir, Ashutosh Singh, K. J., Manoj, V. M., R. M., J. P. Yoj, G. C., and other illegible signatures.

Integrated Certificate Diploma Programme

Title of the course : **Applied Mathematics**
 Subject Code : **AM – 211/ AM - 221**
 Weekly load : **4 Hrs.**
 Credit : **4 (Lecture 3; Tutorial 1; Practical 0)**

LTP 3-1-0

Unit	Main Topics	Course outlines	Lecture(s)
	1. Matrices and Determinants	Introduction to matrices, types of matrices, operations on matrices, transpose of a matrix, symmetric and skew-symmetric matrices, elementary operations (transformation) on a matrix. Determinants, minors, cofactors, expansion of a determinant, properties of determinants. Adjoint of a matrix.	7
	2. Applications of Matrices and Determinants	Inverse of a matrix. Solution of linear simultaneous equations up to three variables by Cramer's rule and by matrix method.	6
	3. Three Dimensional Geometry	Introduction, Direction Cosine and Direction Ratios of a line, Plane, Equations of plane in various forms, Angle between two planes, Distance of a point from a plane. Angle between line and plane. Equation of line in space, Coplanarity of Two Lines, Angle between two lines, Shortest distance between two skew lines.	10
Unit-2	4. Statistics	Measures of dispersion: Range, Mean Deviation, Standard Deviation, Coefficient of Variation, Analysis of frequency distributions using coefficient of variation.	7
	5. Probability	Introduction, Random experiment, Event, Axiomatic approach to probability, Conditional Probability, Independent Events.	8
	6. Differential Equations	Ordinary differential equations, order and degree. Formation of a differential equation. General and particular solution of a differential equation. Solution of a differential equation of first order and first degree - variable separable method, homogeneous differential equation, solution of first order linear differential equation.	7

Total = 45

Recommended Books:

1. Mathematics - Text books for class XII, Part I and II, NCERT, New Delhi.

Handwritten signatures and initials:
 Siddheshwar, I. S. Khan, P. K. M., R. M., S. K. S.,
 J. K., J. D., J. G., R. M.,
 M. S., V. S., I. M. S.,
 Ashish Singh, K. S.

Degree Programme

Title of the course : **Engineering Mathematics - I**
 Subject Code : **BSMA – 401**
 Weekly load : 4 Hrs.
 Credit : 4 (Lecture 3; Tutorial 1; Practical 0)

LTP 3-1-0

Unit	Main Topics	Course outlines	Lecture(s)
Unit-1	1. Matrices	Rank of a matrix, System of linear equations, Symmetric, skew-symmetric and orthogonal matrices, Orthogonal transformation, Eigenvalues and eigenvectors. Diagonalization of matrices, Cayley – Hamilton theorem, Complex matrices: Hermitian, skew-Hermitian and unitary matrices and their properties.	8
	2. Differential Calculus	Mean-value theorem, Taylor's and Maclaurin's theorems with remainder, indeterminate forms, L'Hospital's rule, Curve tracing.	9
	3. Integral Calculus	Evaluation of improper integrals. Beta and Gamma functions and their properties. Fourier series, Change of interval, odd even functions, Half range series.	7
Unit-2	4. Calculus of Several Variables	Limit, continuity and partial derivatives, total derivative. Tangent plane and normal line, Maxima, Minima and saddle points, Method of Lagrange's multiplier.	8
	5. Sequences and Series	Convergence of sequences and series, tests for convergence: comparison test, integral test, ratio test, root test. Power series, Taylor's series, series for exponential, trigonometric and logarithm functions.	6
	6. Vector Differentiation	Scalar and vector fields, differentiation of vectors, vector differential operators: Del, Gradient, Divergence and Curl, their physical interpretations. Formulae involving Del applied to vector point function and their products, Directional derivatives.	7

Total=45

Recommended Books:

1. G.B. Thomas and R.L. Finney, Calculus and Analytic Geometry, 9th Edition, Pearson, Reprint, 2002.
2. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
3. B.V. Ramana., Higher Engineering Mathematics, Tata McGraw Hill, New Delhi, 11th Reprint, 2010.
4. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 44th Edition, 2018.
5. Babu Ram, Engineering Mathematics, Pearson Education, 2009.

Course Outcomes: Upon completion of this course, students will be able to:

1. Learn essential concept of matrices and linear algebra in comprehensive manner.
2. Understand the differential - integral calculus, curve tracing and their real life applications.
3. Deal with functions of several variables and their applications in engineering.
4. Learn sequences and series, power series, Fourier series and their convergence analysis.
5. Apply vector calculus (differentiation only) in engineering and physical applications.

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	S	S	S	M	M	S	M	S	S	M	M
CO2	S	S	S	S	M	M	S	M	S	S	M	M
CO3	S	S	S	S	M	M	S	M	S	S	M	M
CO4	S	S	S	S	M	M	S	M	S	S	M	M
CO5	S	S	S	S	M	M	S	M	S	S	M	M

Middherwal *Sharma* *Tom* *RAM* *Sudhir* *Ashutosh Singh*

Yog *Mishra* *Rishi* *Mishra* *Koj*

Degree Programme

Title of the course : **Engineering Mathematics - II**
 Subject Code : **BSMA- 402**
 Weekly load : 4 Hrs.
 Credit : 4 (Lecture 3; Tutorial 1; Practical 0)

LTP 3-1-0

Unit	Main Topics	Course outlines	Lecture(s)
Unit-1	1. Multivariable Calculus (Integration)	Double integrals (cartesian and polar): Change in order of Integration, Change of Variables. Its applications to find area. Triple Integrals (Cartesian): Applications involving volumes of cube, sphere and rectangular parallelepiped.	7
	2. Ordinary Differential Equations	Exact, Linear and Bernoulli's differential equations, Higher order linear differential equations with constant coefficients, method of variation of parameters, Cauchy-Euler equation.	6
	3. Laplace Transform	Laplace transform of elementary functions, properties of Laplace transform, transform of derivatives and integrals, inverse Laplace transform, Convolution theorem, Solution of ordinary differential equations using Laplace transform, Unit step function and unit impulse function, their Laplace transforms.	8
Unit-2	4. Complex Variable-Differentiation	Differentiation, Cauchy-Riemann equations, analytic functions, harmonic functions, harmonic conjugate. Elementary analytic functions exponential, trigonometric, logarithm and their properties. Conformal mapping.	8
	5. Complex Variable-Integration	Contour integrals, Cauchy-Goursat theorem (without proof), Cauchy Integral formula (without proof), Liouville's theorem and maximum-modulus theorem (without proof); Taylor's series, zeros of analytic functions, singularities, Laurent's series. Cauchy residue theorem (without proof), Residue theorem and its applications to real integrals: Integration around unit circle.	9
	6. Vector Integration	Line, surface and volume integrals. Theorems of Green (in plane), Gauss and Stoke (without proof) - their verification and applications.	7

Total=45

Recommended Books:

1. G.B. Thomas & R.L. Finney, Calculus and Analytic Geometry, 9th Edition, Pearson, Reprint, 2002.
2. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
3. W.E. Boyce & R.C. DiPrima, Elementary Differential Equations & Boundary Value Problems. 9th Edn., Wiley, 2009.
4. J.W. Brown and R.V. Churchill, Complex Variables and Applications, McGraw-Hill, 7th Edn., 2011.
5. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 44th Edition, 2018.

Course Outcomes: Upon completion of this course, students will be able to:

1. Solve the multivariable integral calculus and its engineering applications.
2. Solve the ordinary differential equations by different methods.
3. Learn Laplace transform and its applications to solve engineering problems.
4. Learn differentiation and integration of functions of complex variable and their applications.
5. Apply vector calculus (integration only) in engineering and physical applications.

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	S	S	S	M	M	S	M	S	S	M	M
CO2	S	S	S	S	M	M	S	M	S	S	M	M
CO3	S	S	S	S	M	M	S	M	S	S	M	M
CO4	S	S	S	S	M	M	S	M	S	S	M	M
CO5	S	S	S	S	M	M	S	M	S	S	M	M

Handwritten signatures and initials:
 highdherwal, J.P. Jogi, RKM, Sushir, Kalyan Singh, Mande RMC, and others.

Degree Programme

Title of the course : **Numerical and Statistical Methods**
 Subject Code : **BSMA- 501**
 Weekly load : 3 Hrs.
 Credit : 3 (Lecture 3; Tutorial 0; Practical 0)

LTP 3-0-0

Unit	Main Topics	Course outlines	Lecture(s)
Unit-1	1. Errors and Solution of Equations	Errors in arithmetic operations and functions: Round-off, truncation, absolute, relative, percentage errors. Intermediate value property, Bisection method, Method of false position, Secant Method, Newton-Raphson method, Iteration method and their convergence. Gauss elimination method (without pivoting). Jacobi, Gauss-Seidel methods.	10
	2. Finite Difference 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.	6
	3. 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. Error in integration.	7
Unit-2	4. Numerical solution of ODEs	Solution of ODE of first order: Taylor series method, Picard's method, Euler method, Modified Euler's method and Runge-Kutta second and fourth order methods.	5
	5. Curve fitting, and Correlation	Curve fitting by the method of least squares: fitting of straight lines, second degree parabolas. Introduction to correlation coefficient, Karl Pearson coefficient and rank correlation.	8
	6. Probability and Its distributions	Definition and laws of probability, Baye's theorem, Random variable, Mathematical Expectation, Probability distributions: Binomial, Poisson and Normal.	9

Total = 45

Recommended Books:

1. S.S. Sastry, Introductory Method of Numerical Analysis, PHI (2005).
2. M.K. Jain, S.R.K. Iyengar & R.K. Jain, Numerical Methods for Scientific & Engineering Computations, New Age Int. (2007).
3. B.S. Grewal, Numerical Methods in Engineering & Science, Khanna Publishers, 2011.
4. S.C. Gupta & V.K. Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand & Sons (2014).
5. S.P. Gupta, Statistical Methods, S. Chand & Co., 43rd Edition, 2017.

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

1. Find the roots of nonlinear equations, system of linear equations and error analysis.
2. Understand the concept of different operators and their applications in numerical differentiation and integration.
3. Solve numerically ordinary differential equations of first order.
4. Understand the concept of data handling using curve fitting, central tendency, dispersion and correlation.
5. Understand the concept of probability and its implementation in discrete and continuous distributions.

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	S	S	S	M	M	S	M	S	S	M	M
CO2	S	S	S	S	M	M	S	M	S	S	M	M
CO3	S	S	S	S	M	M	S	M	S	S	M	M
CO4	S	S	S	S	M	M	S	M	S	S	M	M
CO5	S	S	S	S	M	M	S	M	S	S	M	M

Middherwal, Ishar, RKM, Sudhir, Ashish Singh

[Handwritten signatures and initials]

Degree Programme

Title of the course : **Numerical and Statistical Methods Lab**
Subject Code : **BSMA- 502**
Weekly load : 2 Hrs.
Credit : 1 (Lecture 0; Tutorial 0; Practical 2)

LTP 0-0-2

List of Programmes

1. Finding roots of the equation $f(x) = 0$
 - i) Bisection Method
 - ii) Secant Method
 - iii) Method of false position
2. Finding roots of the equation $f(x) = 0$
 - 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. Interpolation using
 - i) Newton's forward difference formula
 - ii) Newton's backward difference formula
5. Interpolation using
 - i) Newton's divided difference formula
 - ii) Lagrange's interpolation formula
6. Numerical differentiation using
 - i) Newton's forward interpolation formula
 - ii) Newton's backward interpolation formula
7. Numerical Integration using
 - i) Trapezoidal rule
 - ii) Simpson's 1/3rd rule
 - iii) Simpson's 3/8th rule
8. Solution of 1st order ordinary differential equations using
 - i) Taylor's series method
 - ii) Picard's method
 - iii) Euler's method
 - iv) Euler's modified method
9. Solution of 1st order ordinary differential equations using Runge-Kutta methods.
10. Fitting a curve using given data.
 - i) linear curve
 - ii) quadratic curve
 - iii) cubic curve
 - iv) any other
11. Finding the following, using given data:
 - i) mean, median and mode.
 - ii) standard deviation and mean deviation.
 - iii) correlation coefficient.

Handwritten signatures and initials:
Middherwal, J. K. Singh, R. M. S., Sudhir, [Redacted],
G. S., J. D. Yogi, Manish, R. M. S., Akhilesh Singh,
V. M. K.

Degree Programme

Title of the course : **Engineering Mathematics (only for LEET students)**
 Subject Code : **OEMA-6:1**
 Weekly load : 3 Hrs.
 Credit : 3 (Lecture 3; Tutorial 0; Practical 0)

LTP 3-0-0

Unit	Main Topics	Course outlines	Lecture(s)
Unit-1	1. Ordinary Differential Equations and Laplace Transform	Exact, linear and Bernoulli's differential equations, Second order linear differential equations with constant coefficients, Laplace transform and its properties, inverse Laplace transform, solution of ordinary differential equations using Laplace transform, Unit step function and unit impulse function.	6
	2. Sequences and Series	Convergence of sequences and series, tests for convergence: Integral Test, Comparison Test, Ratio Test, Root Test. Fourier series: Half range sine and cosine series.	8
	3. Matrices	Rank of a matrix, system of linear equations, symmetric, skew-symmetric and orthogonal matrices, orthogonal transformation, eigenvalues and eigenvectors, diagonalization of matrices, Cayley – Hamilton theorem.	8
Unit-2	4. Multivariable Calculus (Differentiation)	Limit, continuity and partial derivative, total derivative. Tangent plane and normal line. Maxima, Minima and saddle points, Method of Lagrange's multiplier.	8
	5. Multivariable Calculus (Integration)	Multiple Integration: Double integral (Cartesian and polar), Change in order of Integration in double integrals, Change of Variables (Cartesian and polar), Applications to area and volume, Triple Integral (Cartesian), Simple applications involving cubes, sphere and rectangular box.	8
	6. Complex Variable-Differentiation	Differentiation, Cauchy-Riemann equations, analytic functions, harmonic functions, finding harmonic conjugate, elementary analytic functions (exponential, trigonometric, logarithm) and their properties.	7

Total=45

Recommended Books:

1. G.B. Thomas and R.L. Finney, Calculus and Analytic Geometry, 9th Edition, Pearson, 2002.
2. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006
3. T. Veerarajan, Engineering Mathematics for first year, Tata Mc Graw-Hill, New Delhi, 2008
4. B.V. Ramana, Higher Engineering Mathematics, Tata McGraw Hill, New Delhi, 11th Reprint, 2010.
5. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 44th Edition, 2018.

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

1. Solve ODEs, learn Laplace transform, its properties and their applications to solve engineering problems.
2. Sequences and Series, Fourier series and their convergence analysis.
3. The essential concept of matrices and linear algebra in comprehensive manner.
4. The multivariable differential and integral calculus and its engineering applications.
5. The differentiation and integration of functions of complex variable and their applications.

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	S	S	S	M	M	S	M	S	S	M	M
CO2	S	S	S	S	M	M	S	M	S	S	M	M
CO3	S	S	S	S	M	M	S	M	S	S	M	M
CO4	S	S	S	S	M	M	S	M	S	S	M	M
CO5	S	S	S	S	M	M	S	M	S	S	M	M

Middhewal *Sharma* *km* *RMM* *Sudhir* *Ashutosh Singh*

Applicable with effect from academic session 2021-22

Page 9

[Handwritten signatures and marks]

Degree Programme

Title of the course : **Operations Research**
 Subject Code : **OEMA-612**
 Weekly load : **3 Hrs.**
 Credit : **3 (Lecture 3; Tutorial 0; Practical 0)**

LTP 3-0-0

Unit	Main Topics	Course outlines	Lecture(s)
Unit-1	1. Introduction to LPP	Introduction to Optimization Techniques. Basic concept and notations. Formulation of Linear Programming Problem (LPP). Graphical Solution. Basic solution and Basic Feasible Solutions (BFS) of system of linear equations, Convex set, Extreme points, adjacent point of a convex set.	7
	2. Simplex Method	Standard Form of an LPP. Fundamental theorem of LPP. Slack, Surplus & Artificial variables Simplex method. Degeneracy. Nature of the solution of LPP through simplex method. Big M method. Two phase method.	7
	3. Duality Theory & Post Optimality Analysis	Primal and Dual problem. Duality theory, Complimentary Slackness Conditions, Solution of primal and Dual and vice versa. Post Optimality Analysis and Sensitivity Analysis	8
Unit-2	4. Transportation and Assignment Problem	Basic concepts, notations. Balanced & unbalanced TP. Initial BFS of TP by using different methods. Improving an initial BFS of a TP to optimal solution. Introduction to Assignment Problem, Hungarian method.	7
	5. Game Theory	Introduction to game theory. The maximin & Minimax Criterion. Existence of saddle point. Game without saddle point. Mixed strategy. Solution of 2X2 game and rectangular game by mixed strategy (by Algebraic method). Dominance & its use to solve 2X2 game. 2XN & NX2 game. Graphical method, Solution of Game by LPP method and iterative method.	8
	6. Queuing Theory	Basic concept of queuing theory. Introduction to Poisson and exponential distribution and Poisson process. Pure Birth and pure death process. Analysis of queue model M/M/1/∞/FCFS and its properties. Analysis of M/M/1/C/FCFS and its properties.	8

Total=45

Recommended Books:

1. J.G. Chakravorty and P.R. Ghosh, Linear Programming and game Theory, Moulik Library (2009).
2. S.K. Gupta, Linear Programming & Network Models, Affiliated East-West Private Ltd. (1985).
3. Kanti Swarup, P.K. Gupta & Man Mohan, Operations Research, S. Chand & Sons (1994).
4. H.A. Taha, Operations Research, PHI (2007).

Course Outcomes:

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

1. Formulation of real life problems into LPP and its solution by graphical, simplex, big M and two phase methods.
2. Construct Dual Problem and using Duality theory can check the optimality of primal and Dual LPP by CSC.
3. Formulate and find the optimal solution of transportation and assignment problem.
4. Learn applications of game theory in real life problem and their solution by various methods.
5. Applications of queuing theory to practical problems.

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	S	S	S	M	M	S	M	S	S	M	M
CO2	S	S	S	S	M	M	S	M	S	S	M	M
CO3	S	S	S	S	M	M	S	M	S	S	M	M
CO4	S	S	S	S	M	M	S	M	S	S	M	M
CO5	S	S	S	S	M	M	S	M	S	S	M	M

Middheshwar *Star* *TRM* *Sudhir*

Applicable with effect from academic session 2021-22

Yog *Mand* *RMM* *Ashish Singh*

Degree Programme

Title of the course : **Mathematical Methods**
 Subject Code : **OEMA - 621**
 Weekly load : 3 Hrs.
 Credit : 3 (Lecture 3; Tutorial 0; Practical 0)

LTP 3-0-0

Unit	Main Topics	Course outlines	Lecture(s)
Unit-1	1. Series solution of Differential Equations	Power series solutions: Legendre polynomial, Bessel functions of the first kind and their properties, Recurrence formulae, Orthogonality of Bessel's function and Legendre Polynomials.	7
	2. Partial Differential Equations	Formation of PDE, Linear and non-linear equations of first order, Charpit's method, Homogeneous linear equation with constant coefficients, complementary function and particular integral.	7
	3. 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
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. Applications	Applications of Fourier transforms in solving partial differential equations (Laplace, Heat and Wave equations).	8
	6. Z-Transforms	Z transforms and its properties, Z transform of polynomial functions, trigonometric functions and hyperbolic functions. Convolution theorem, inverse Z-transform. Solution of difference equations with constant coefficients using Z-transform.	7

Total=45

Recommended Books:

1. R.K. Jain and S.R.K. Iyengar, Advanced Engg. Mathematics, Narosa Publishing House (2007).
2. B.V. Ramana, Higher Engineering Mathematics, Tata McGraw Hill (2006).
3. Michael D Greenberg, Advanced Engg. Mathematics, Pearson (1998).
4. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 44th Edition, 2018.

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

1. Understand series solution of differential equations.
2. Formation and solution of first order linear and non-linear partial differential equations.
3. Learn to obtain Fourier series expansion of a function.
4. Learn Fourier transformation and its applications to solution of partial differential equations.
5. Learn to apply Z-transform to solve difference equation.

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	S	S	S	M	M	S	M	S	S	M	M
CO2	S	S	S	S	M	M	S	M	S	S	M	M
CO3	S	S	S	S	M	M	S	M	S	S	M	M
CO4	S	S	S	S	M	M	S	M	S	S	M	M
CO5	S	S	S	S	M	M	S	M	S	S	M	M

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Abhishek Singh
Vinod Mishra
Kuljeet

Degree Programme

Title of the course : **Discrete Mathematics**
 Subject Code : **OEMA – 622**
 Weekly load : 3 Hrs.
 Credit : 3 (Lecture 3; Tutorial 0; Practical 0)

LTP 3-0-0

Unit	Main Topics	Course outlines	Lecture(s)
Unit-1	1. Logic	Mathematical Logic: Statement and notations proposition and logic operations, connectives (conjunction, disjunction, negation), statement formulae and truth tables, propositions generated by set, equivalence of formulae and implication laws of logic, propositions over a universe, variables, quantifiers.	9
	2. Relations and Functions	Relation and Function: Binary relations, Properties of binary relation in set. Equivalence relations, Composition of binary relations. Partial Order set, principal of mathematical induction and Pigeon-hole Principle.	8
	3. Recurrence Relations	Recurrence relations, Difference equations as recurrence relations and their solutions, generating functions and their solutions.	5
Unit-2	4. Lattice	Lattice and Algebraic systems, Principle of duality, Basic properties of Algebraic systems, Distributed & Complemented Lattices, Boolean Lattices	7
	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, degree Paths, Circuits, Graph connectivity, Weighted graphs. Trees, Spanning trees, Properties of tree, planar graphs. Eulerian graphs (Eulerian paths and circuit), Hamiltonian graphs and their properties, Kruskal's algorithm and Prim's algorithm for finding minimum spanning tree.	10

Total=45

Recommended Books:

1. J. P. Trembley and R. Manohar, A First Course in Discrete Structure, Tata McGraw-Hill (1999).
2. M. K. Das, Discrete Mathematical Structures, Narosa Publishing House (2007).
3. Babu Ram, Discrete Mathematics, Vinayak Publications (2004).
4. N. Deo, Graph Theory, Prentice Hall of India Pvt. Ltd. (1987).
5. K.H. Rosen, Discrete Mathematics and Its Applications, Tata Mc-Graw Hill (2017).

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

1. Construct mathematical arguments using logical connectives and quantifiers.
2. Validate the correctness of an argument using statement and predicate calculus.
3. Work with some of the discrete structures which include sets, relations, functions and recurrence relations.
4. Understand how lattices and Boolean algebra can be used as tools in the study of computer networks.
5. Understand various fundamental concepts of graph theory, its properties and applications in real life problems.

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	S	S	S	M	S	S	M	S	S	M	M
CO2	S	S	S	S	M	S	S	M	S	S	M	M
CO3	S	S	S	S	M	S	S	M	S	S	M	M
CO4	S	S	S	S	M	S	S	M	S	S	M	M
CO5	S	S	S	S	M	M	S	M	S	S	M	M

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Applicable with effect from academic session 2021-22

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Degree Programme

Title of the course : **Mathematical Statistics**
 Subject Code : **OEMA – 711**
 Weekly load : 3 Hrs.
 Credit : 3 (Lecture 3; Tutorial 0; Practical 0)

LTP 3-0-0

Unit	Main Topics	Course outlines	Lecture(s)
Unit-1	1. Correlation and Regression	Partial and multiple correlation (three variables case only), Regression analysis up to three variables.	6
	2. Probability	Definition of probability using different approaches, Discrete and continuous random variables, Probability mass function, Probability density function, Probability distribution function.	9
	3. Distributions	Exponential distribution, Gamma distribution, Chi-square distribution, Student's t distribution and F distribution.	7
Unit-2	4. Moment Generating and Characteristic Functions	Moments, Moment generating functions, Characteristic function, Joint distribution function, Marginal and conditional distributions, Bi-variate normal distribution.	7
	5. Testing of hypothesis	Fundamental notions, Tests based on Normal, t, Chi-square and F distributions.	8
	6. ANOVA technique	Analysis of variance: Completely Randomized Design and Randomized Block Design.	8

Total=45

Recommended Books:

1. P.L. Meyer, Introduction to Probability and Statistical Applications, Oxford & IBH (2007).
2. A.M. Goon, M.K. Gupta and B. Dasgupta, An Outline of Statistical Theory, Vol. I, World Press Pvt. Ltd (2013).
3. T.W. Anderson, An Introduction to Multivariate Statistical Analysis, John Wiley (2003).
4. S.P. Gupta, Statistical Methods, S. Chand & Co., 43rd Edition, 2017.
5. S.C. Gupta & V.K. Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand & Sons (2014).

Course Objectives: After the completion of this course, the student will be able to:

1. Analyse the correlated data and fit the linear regression model
2. Compute the probability of composite events
3. Understand the random variable, expectation, moments and distributions
4. Understand the concept of sampling distribution and its importance.
5. Perform the testing of hypothesis.

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	S	S	S	M	M	S	M	S	S	M	M
CO2	S	S	S	S	M	M	S	M	S	S	M	M
CO3	S	S	S	S	M	M	S	M	S	S	M	M
CO4	S	S	S	S	M	M	S	M	S	S	M	M
CO5	S	S	S	S	M	M	S	M	S	S	M	M

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