MASTER OF SCIENCE (MATHEMATICS)

CURRICULUM & SYLLABUS

(For students admitted from the academic year 2015-2016)

UNDER CHOICE BASED CREDIT SYSTEM

DEPARTMENT OF MATHEMATICS

FACULTY OF SCIENCE AND HUMANITIES

SRM INSTITUTE OF SCIENCE AND TECHNOLOGY

SRM NAGAR, KATTANKULATHUR – 603203

DETAILS OF THE CREDITS

Course	Total number of credits
Major subjects and project	80

Eligibility

The candidates seeking admission to the M.Sc. Degree program shall be required to have passed B.sc. Mathematics recognized by any university.

Duration and Structure of the M. Sc Programme

2 Years (4 Semesters)

M. Sc Mathematics
Curriculum – 2015
(Applicable for students admitted from the Academic Year 2015-16 onwards)

SEMESTER I							
Career String Title	**Course Code**	**Course Name**	**L**	**T**	**P**	**Total of TLP**	**C**
Major Core	PMA15101	Algebra	4	1	0	5	4
Major Core	PMA15102	Real Analysis	4	1	0	5	4
Major Core	PMA15103	Partial Differential Equations	4	1	0	5	4
Major Core	PMA15104	Numerical Methods	4	1	0	5	4
Major Core	PMA15105	Mathematical Software I (MATLAB)	0	2	4	6	3
Major Core	PMA15106	Computational Mathematical Lab I	0	2	4	6	3
Total No. of Credits			16	8	8	**32**	**22**

SEMESTER II							
Career String Title	**Course Code**	**Course name**	**L**	**T**	**P**	**Total of TLP**	**C**
Major Core	PMA15201	Complex Analysis	4	1	0	5	4
Major Core	PMA15202	Calculus of Variations	4	1	0	5	4
Major Core	PMA15203	Transform Techniques	4	1	0	5	4
Major Core	PMA15204	Advanced Operations Research	4	1	0	5	4
Major Core	PMA15205	Computational Mathematical Lab II	0	2	4	6	3
Non Major Elective		Open Elective	2	0	0	2	2
Total No. of Credits			18	6	4	**28**	**21**

SEMESTER III							
Career String Title	**Course Code**	**Course name**	**L**	**T**	**P**	**Total of TLP**	**C**
Major Core	PMA15301	Mathematical Software – II (MAPLE)	**0**	2	4	6	3
Major Core	PMA15302	Functional Analysis	4	1	0	5	4
Major Core	PMA15303	Fluid Dynamics	4	1	0	5	4
Major Core	PMA15304	Fuzzy sets and Applications	4	1	0	5	4
Non Major Elective		Open Elective	2	0	0	2	2
Total No. of Credits			14	5	4	23	**17**

SEMESTER IV							
Career String Title	**Course Code**	**Course name**	**L**	**T**	**P**	**Total of TLP**	**C**
Major Core	PMA15401	Topology	4	1	0	5	4
Major Core		Elective - I	4	1	0	5	4
Major Core		Elective - II	4	1	0	5	4
Major Core	PMA15402	Project work	0	0	12	12	8

Total No. of Credits	12	3	12	**27**	**20**
Grand Total	**60**	**22**	**28**	**110**	**80**

Legend:
L - Number of lecture hours per week
T - Number of tutorial hours per week
P - Number of practical hours per week
C - Number of credits for the course

ELECTIVE - I

- PMA 15E01- Artificial intelligence
- PMA 15E02- Non linear partial differential equations with applications
- PMA 15E03- Applied integral functions
- PMA 15E04- Graph theory
- PMA 15E05- Data Structures and Algorithms

ELECTIVE - II

- PMA 15E 11- Stochastic process
- PMA 15E 12- Cryptography
- PMA 15E 13- Artificial neural networks
- PMA 15E 14- Algorithm design techniques
- PMA 15E 15- Boolean algebra and its applications
- PMA 15E 16-Analytic number theory

SEMESTER I

COURSE CODE	COURSE TITLE	L	T	P	Total of LTP	C
PMA15101	**ALGEBRA**	**4**	**1**	**0**	**5**	**4**

	INSTRUCTIONAL OBJECTIVES
1.	Learn basic ideas of group theory and widely used is a Sylow theorem
2.	Be familiar with Euclidean rings
3.	Be exposed to roots of polynomials
4.	Be thorough with canonical forms
5.	Understand unitary and normal forms

UNIT - I

Counting principle – Sylows theorem – Direct products – Finite abelian group

UNIT - II

Euclidean ring – A perpendicular Euclidean ring – Polynomial ring – Polynomial ring over rational fields – Modules

UNIT - III

Extension of Fields – Roots of Polynomials – More about Roots – The elements of Galois Theory – Galois Groups of all the rationals.

UNIT - IV

Canonical Forms – Triangular Forms – Nilpotent forms – Jordan canonical forms – Rational canonical forms

UNIT - V

Trace and Transpose – Hermitian – Unitary and Normal Transformations – Finite fields – Wedderburns theorem.

TEXT BOOK:

I.N.Herstein, Topics in Algebra, John Wiley & Sons, New Delhi, 2008.

Unit I: Chaper 2: Sec - 2.11, 2.12 & 2.15

Unit II: Chapter 3: Sec - 3: 3.7 – 3.10 & 4.5

Unit III: Chapter 5: Sec - 5: 5.1, 5.3, 5.5 & 5.6

Unit IV: Chapter 6: 6.4 - 6.7

Unit V: Chapter 6: 6.8, 6.10, 7.1, 7.2

REFERENCES:

1. S.Lang, Algebra, 2nd Edition, Addison Wesley, 2004.
2. John B.Fraleigh, A First Course in Abstract Algebra, 2nd Edition, Addison Wisley, 2002.

COURSE CODE	COURSE TITLE	L	T	P	Total of LTP	C
PMA15102	**REAL ANALYSIS**	**4**	**1**	**0**	**5**	**4**

	INSTRUCTIONAL OBJECTIVES
1.	Understand the integration of vector valued functions
2.	Be thorough with convergence and continuity of functions
3.	Be exposed to some special functions
4.	Be familiar with the contraction principle and theorems
5.	Have sound knowledge in measure theory

UNIT - I

Definition and Existence of the Integral , Properties of the Integral, Integration and Differentiation, Integration of Vector - Valued Functions, Rectifiable curves

UNIT - II

Discussion of Main Problem, Uniform Convergence, Uniform Convergence and Continuity, Uniform Convergence and Integration, Uniform Convergence and Differentiation, Equicontinuous Families of Functions, The Stone-Weierstrass Theorem

UNIT - III

Some Special Functions: The Algebraic Completeness of the Complex Field, The Gamma Function

UNIT - IV

The Contraction Principle, The Inverse Function Theorem, The Implicit Function Theorem, The Rank Theorem

UNIT - V

The Lebesgue Theory: Set Functions, Construction of the Lebesgue Measure, Measure Spaces, Measurable Functions, Simple Functions, Integration

TEXT BOOK:

Walter Rudin, Principles of Mathematical Analysis, McGraw-Hill International Edition, 3rd edition, McGraw-Hill Education India Pvt. Ltd., India, 2001.

Unit I: Chapter 6 - Page 120 – 152; Unit II: Chapter 7 - Page 153 – 171; Unit III: Chapter 8 - Page 184 – 203; Unit IV: Chapter 9 - Page 220 – 231; Unit V: Chapter 11 - Page 300 – 321

REFERENCES:

1. Richard R.Goldberg, Methods of Real Analysis, Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi, 2010.
2. Shanty Narayan, A Course of Mathematical Analysis, 12th Edition, S.Chand & Company Ltd., 2005.

3. Tom M. Apostol, Mathematical Analysis, Pearson, Narosa Publishing House, New Delhi, 2nd Edition , Reprint, 2002.
4. S.C.Malik & Savitha Aruna, Mathematical Analysis, 4th Edition, New Age International (P) Ltd. Publisher, New Delhi, 2012.

COURSE CODE	COURSE TITLE	L	T	P	Total of LTP	C
PMA15103	PARTIAL DIFFERENTIAL EQUATIONS	4	1	0	5	4

	INSTRUCTIONAL OBJECTIVES
1.	Be familiar with formulation and solution of PDE
2.	To study in detail the solutions of second order PDE
3.	Get exposed to physical problems
4.	To study the applications of PDE
5.	Be thorough with Fourier series and boundary value problems

UNIT - I

Formulation of P.D.E – Elimination of Arbitrary Function and Elimination of Arbitrary Constants, Compatibility – Classification of Integrals – Langrange's method, Charpit's Method – Jacobi Method – Special types of First Order Equations – Cauchy's Method.

UNIT - II

(A) Origin of Second Order P.D.E. – Linear P.D.E – Solution of Reducible Equations - Solution of Irreducible Equations with Constant Co-efficients – Rules for finding C.I and P.I – (B) Classification of Second Order P.D.E., Canonical Forms, Adjoint Operator, – Riemann's Method.

UNIT - III

Fourier series- Dirichlet conditions, convergence statement, half range expansion, Parseval Formula.

UNIT - IV

Laplace and Poisson Equations in Cartesian and Polar form, Boundary Value Problems – Maximum-principle, Dirichlet and Neumann problem for a rectangle and Circle.

UNIT - V

(A) Diffusion Equation - Diffusion Equation in cylindrical and spherical coordinates – Transmission Line Problems – Maximum Principle, uniqueness Theorem, (B) Wave Equation – Solution of 1D Wave Equation, Boundary and initial value problem for 2D Wave Equation, Uniqueness result and Duhamel's Principle.

TEXT BOOKS:

1. J.N.Sharma & Kehar Singh, Partial Differential Equations for Engineers and Scientists, Narosha Publishing House, Reprint, 2011. Unit I: Chapter 1: Sec 1.1 – 1.9; Unit II (A): Chapter 2: Sec 2.1 – 2.3, Unit V(A): Chapter 4: 4.1-4.8.

2. K.Sankara Rao, Introduction to Partial Differential Equations, Prentice-Hall of India, 3rd Edition, 2010. Unit II Chapter 1: 1.2-1.5, Unit IV: Chapter 2: 2.1 – 2.10, Unit V (B): Chapter 4:4.1-4.7, 4.11-4.12.
3. P.Kandasamy, K.Thilagavathy & K.Gunavathy, Engineering Mathematics, Vol.III, S.Chand & Company, 2008. Unit III: Chapter 1 (Full)

REFERENCES:

1. Donald Greenspan, Introduction to Partial Differential Equations, Courier Dover Publications, 2000.

2. Ian. N. Snedden, Elements of Partial Differential Equations, Dover Publications, 2006.
3. TynMyint.U and Lokenath Debnath, Linear Partial Differential Equations for Scientists and Engineers, North Holland, New York, 2007.
4. M.D. Raisinghania, Advanced Differential Equations, 5th Edition, S. Chand & Company Ltd., New Delhi, 2010.
5. Robert C. McOwen, Partial Differential Equations Methods and Applications, Pearson Education, 2004.

COURSE CODE	COURSE TITLE	L	T	P	Total of LTP	C
PMA15104	**NUMERICAL METHODS**	**4**	**1**	**0**	**5**	**4**

	INSTRUCTIONAL OBJECTIVES
1.	To familiarize with numerical solution of equations
2.	To get exposed to finite differences and interpolation
3.	To be thorough with the numerical Differentiation and integration
4.	To find numerical solutions of ordinary differential equations
5.	To find numerical solutions of partial differential equations

UNIT - I

Mathematical Modeling, Numerical Methods and Problem Solving, Numerical solutions of algebraic and transcendental equations by Newton-Raphson method and their rate of convergence.

Unit – II

Solution of simultaneous linear system of equations by Gauss-elimination method, Gauss-Jordan method, Matrix inversion by Gauss-Jordan method, Iterative method for solving linear equations by Gauss-Jacobi and Gauss-Seidel method.

Unit – III

Finite differences, Difference operators Interpolation: Newton's forward and backward interpolation formulae, Lagrange's interpolation formula, Divided differences, Newton's divided difference formula, Inverse interpolation.

Unit – IV

Numerical differentiation based on Newton's forward and backward interpolation formula, Numerical integration by Trapezoidal rule, Simpson's 1/3 rule, Simpson's 3/8 rule, error estimates of the rules, Gaussian quadrature formulae (2-point, 3-point formulae).

Unit – V

Numerical solutions of ordinary differential equation using Taylor Series method, Euler method, Modified Euler's method, Runge-Kutta method of order four, Predictor-Corrector methods, Milne's method, Adam-Bashforth method.

TEXT BOOKS:

1. Steven C. Chapra, Applied Numerical Methods with MATLAB for Engineers and Scientists, 2nd edition, McGraw-Hill Higher Education, 2008.Unit I: Chapter 2 - 2.1 – 2.5, 6.2, 6.3, 6.5

2. T.Veerarajan & T.Ramachandran, 2nd Edition, Tata McGraw-Hill Pvt.Ltd., 2006.Unit II: Chapter 4 – 4.1, 4.2, 4.3, 4.5; Unit III: Chapter 5 – 5.1- 5.4, 5.6, 5.7, Chapter 6 – 6.1 - 6.6, Chapter 7 – 7.1 – 7.3, 7.6; Unit IV: Chapter 8 – 8.1, 8.2, 8.6, 8.28 Unit V: Chapter 10 – 10.1 – 10.16, 10.35 – 10.40

REFERENCES:

1. Steven C Chapra, Raymond P Canale, Numerical Methods for Engineers, 6th edition, McGraw-Hill Higher Education, 2009.
2. Gerald C.F, and Wheatley P.O, "Applied Numerical Analysis", 6th Edition, Pearson Education Asia, New Delhi 2002.
3. Balagurusamy E, "Numerical Methods", Tata McGraw Hill Pvt. Ltd., New Delhi, 1999.
4. Burden R.L, and Faires T.D, "Numerical Analysis", 7th Edition, Thomson Asia Pvt. Ltd., Singapore, 2002.

COURSE CODE	COURSE TITLE	L	T	P	Total of LTP	C
PMA15105	**MATHEMATICAL SOFTWARE I (MATLAB)**	**0**	**2**	**4**	**6**	**3**
	INSTRUCTIONAL OBJECTIVE					
At the end of the course the students should be able to apply the knowledge gained in solving problems by numerical methods						

UNIT - I

Introduction to Matlab – Variables & workspace – Define & Examine numbers, characters, string, text – Workspace command – Built in functions – Mathematical functions

UNIT - II

Graphical in Matlab – M-files – Loops – Logicals – Timing – Online documentation – Reading & writing data files – Copying to & from word and other applications

UNIT - III

Vectors – products, division & powers of vectors – Matrices – System of linear equations

UNIT - IV

Numerical linear systems: Gaussian elimination method, Gauss Seidal iteration method. Interpolation and Quadrature: Newton divided difference and finite difference interpolation, Composite Simpson and Composite Gaussian quadratures

UNIT - V

Numerical methods for ODE: Euler's method, Fourth order RK method, Adams – Bashforth multi-step method, Finite difference method for BVPs: Elliptics equations, Parabolic equations, Hyperbolic equations

TEXT BOOK:

Palm III, "Introduction to Matlab for Engineers", Tata McGraw Hill, New Delhi, 2011.

REFERENCES:

1. Steven C. Chopra, "Applied Numerical methods with Matlab for Engineers and Scientists", Tata McGraw Hill Company Limited, New Delhi, Second Edition, 2007.
2. David F.Griffith, "Introduction to Matlab", 2005. www.maths.dundee.ac.uk/uftp/na-reports/matlabnotes.pdf.

COURSE CODE	COURSE TITLE	L	T	P	Total of LTP	C
PMA15106	COMPUTATIONAL MATHEMATICAL LAB I	0	2	4	6	3

INSTRUCTIONAL OBJECTIVE

This is the first of two-semester Computational Mathematical Laboratory sequence. In this sequence, we will emphasize the fundamentals of numerical computation and analysis: to explain how, why, and when numerical methods can be expected to work along with soft computational techniques using C++.

UNIT- I

Plotting Curves - Composition of functions, inverses - Sequences and series (finite and infinite sum) - Slope of a line, a secant, a tangent - Equations of tangents - Limit and continuity - 2-D and 3-D graphs - Symbolic - Differentiation and Symbolic Integration - Conversion of coordinates, Areas in Polar coordinates- Symbolic manipulation on matrices - Solution to equations - Solution to Differential equations.

UNIT- II

Non-Linear Equations Bisection Method - Regula-falsi Method, Newton-Raphson Method, Secant Method, Fixed Point Iteration. System of linear Equations - Gauss Elimination, Gauss-Seidel Method

UNIT– III

Lagrange's Interpolation Formula, Newton's forward and backward Interpolation Formula Numerical Differentiation, Differentiation using limits, Differentiation using Extrapolation

UNIT– IV

Composite Trapezoidal Rule, Composite Simpson's 1/3 Rule, Numerical Solution to Differential Equations, Euler's Method, Taylor's Method of order 4, Runge-Kutta Method of order 4, Milne-Simpson Method.

UNIT– V

Formation of frequency distribution- Calculation of moments – mean and variance - Computation of correlations and regression coefficients, Fitting and probability distributions- ANOVA (one-way, two-way) -Tests of significance based on t and F.

TEXT BOOK:

Robert J. Schilling & Sandra L. Harris, "Applied Numerical Methods for Engineers using SCILAB & C", Thomson Brooks / Cole.

REFERENCES :

1. P. N. Wartikar and J. N. Wartikar, "Elements of Applied Mathematics", Volume 1 and 2, Vidyarthi Prakashan, 1978
2. S. S. Shastri, "Engineering Mathematics", Vol-2, PHI, 2nd Edition, 1994.
3. S.S. Shastri, "Introductory Methods of Numerical Methods" Vol-2, PHI, 2nd Edition, 1994.
4. S. C. Gupta,V. K. Kapoor, "Fundamentals of Mathematical Statistics", Sultan Chand & Sons, 1971.
5. Shantinarayan, A text book of matrices, 2nd edition, S.Chand Publication House, Delhi,1957.
6. T. Veerarajan, "Probability, Statistics and Random Processes", Tata McGraw-Hill Education, 2002.
7. Dr.B.S.Grewal, Higher Engineering Mathematics, Khanna Publications, 42th Edition, 2012.
8. Erwin Kreyszing, "Advanced Engineering Mathematics", John Wiley & Sons, 2010.
9. John H. Mathews, "Numerical Methods for Mathematics, Science & Engineering", Prentice Hall, 1992.

SEMESTER – II

COURSE CODE	COURSE TITLE	L	T	P	Total of LTP	C
PMA15201	**COMPLEX ANALYSIS**	**4**	**1**	**0**	**5**	**4**

	INSTRUCTIONAL OBJECTIVES
1.	Be familiar with families of analytic functions
2.	Be thorough with conformal mappings
3.	Be exposed to complex integration
4.	Be thorough with harmonic functions
5.	Be thorough with power series expansions

UNIT – I : COMPLEX FUNCTIONS

Function of a Complex Variable - Spherical representation of complex numbers – Analytic function – Limits and continuity – Analytic Functions – Polynomials – Rational functions – Elementary theory of Power series – Sequences – Series – Uniform Convergence – Power series – Abel's limit theorem – Exponential and Trigonometric functions – Periodicity – The Logarithm.

UNIT – II: ANALYTICAL FUNCTIONS AS MAPPINGS

Analytical Functions as Mappings – Conformality - Arcs and closed curves – Analytic functions in Regions – Conformal mapping – Length and area – Linear transformations –Linear group – Cross ratio – Symmetry – Oriented Circles –Families of circles –Elementary conformal mappings –Use of level curves – Survey of Elementary mappings – Elementary Riemann surfaces.

UNIT – III: COMPLEX INTEGRATION

Complex Integration – Fundamental Theorems – Line integrals –Rectifiable Arcs-Line Integrals as Arcs – Cauchy's Theorem

for a Rectangle and in a disk – Cauchy's Integral Formula – Index of point with respect to a closed curve- The Integral formula – Higher order derivatives – Local properties of analytic functions – Taylor's Theorem – Zeros and Poles –Local mapping - Maximum Principle.

UNIT – IV: COMPLEX INTEGRATION (CONTED)

The general form of Cauchy's Theorem – Chains and Cycles – Simple connectivity – Homology – General statement of cauchy's theorem – Proof of Cauchy's theorem – Locally exact differentials – Simply connected region - Multiply connected regions – Calculus of residues – Residue Theorem – Argument Principle-Evaluation of Definite Integrals – Using Contour integrations.

Unit – V : HARMONIC FUNCTIONS AND POWER SERIES EXPANSIONS

Harmonic Functions – Definition and basic properties- Mean-Value Property-Poisson's formula's –Schwarz's Theorem – Reflection Principle- Weierstrass's theorem- Taylor's series – Laurent series.

TEXT BOOK:

Lars F.Ahlfors, Complex Analysis, 3rd Edition, McGraw Hill Book Company, New York, 2010.

Chapter 1 : Sections 2.4 and Chapter 2 : Sections 1 to 3; Chapter 3 : Sections 2 to 4; Chapter 4 : Sections 1 to 3; Chapter 4 : Sections 4 and 5; Chapter 4 : Sections 6 and Chapter 5 : Sections1

REFERENCES:

1. S.Ponnusamy, Foundations of Complex Analysis, Narosa Publ. House, New Delhi, 2004.
2. J.B.Conway, Functions of one complex variables, Springer – Verlag, International Student Edition, Narosa Publishing Co., 2002.
3. S.Lang, Complex-Analysis, Addison – Wesley Mass,2010.

COURSE CODE	COURSE TITLE	L	T	P	Total of LTP	C
PMA15202	**CALCULUS OF VARIATIONS**	**4**	**1**	**0**	**5**	**4**

	INSTRUCTIONAL OBJECTIVES
1.	Fully understand the properties of geometrical problems
2.	Be familiar with various problems
3.	Be familiar isoperimetric problems
4.	Be thorough with methods for solving boundary value problems
5.	Get exposed to residual methods and applications to fluid dynamics problems

UNIT – I

Introduction – Functionals – Euler's equation – Different forms of Euler's equations – Solutions of Euler's equation – Geometrical problems

UNIT - II

Geodesics – Variational problems involving several unknown functions – Functionals dependent on Higher order derivatives - Variational problems involving several independent variables – Constraints and Lagrange's multipliers

UNIT – III

Isoperimetric problems – The general variation of a functional - Functionals involving higher order derivatives – Moving boundaries – Approximate solution of boundary value problems – Rayleigh-Ritz method

UNIT – IV

Weighted residual methods – Galerkin's method – Hamilton's principle – Lagrange's equations – Sturm-Liouville's problem and Variational methods: Rayleigh's principle

UNIT - V

Kantrovich method – Applications to fluid dynamics problems and Electrostatic problems

TEXT BOOKS:

1. Dr. M. K. Venkatraman, "Higher Engineering Mathematics", National Publishing Company, 2012.
   Unit I: Chapter 9: Sec 1 – 9; Unit II: Chapter 9: Sec 10 – 15; Unit III: Chapter 9: 15 – 21
2. Dr. B. S. Grewal, **"**Higher Engineering Mathematics", Khanna Publishers, Delhi, 40th Edition, 2007.
   Unit IV: Chapter 33: Sec 2 - 10; Unit V: Chapter 33: Sec 11 – 12
3. A.S. Gupta, "Calculus of Variations with Applications", Prentice-Hall Of India Pvt. Limited, 2004.
   Unit V: Chapter 6: Sec 6.9; Chapter 4: Sec 4.5; Chapter 1: Sec 1.7; Chapter 5: Sec 5.6

REFERENCE:

L. Elsgolts, "Differential Equations and the Calculus of Variations", University Press of the Pacific, 2003**.**

COURSE CODE	COURSE TITLE	L	T	P	Total of LTP	C
PMA15203	TRANSFORM TECHNIQUES	4	1	0	5	4

	INSTRUCTIONAL OBJECTIVES
1.	Be familiar with Laplace transform and Fourier transform
2.	Be familiar with solution of linear ODE of second order with constant co-efficients by using Laplace transform
3.	Be exposed to Z-transform
4.	Be familiar with solution of heat equation, wave equation using Laplace and Fourier transforms
5.	Be thorough with solution of difference equations using Z-transforms

UNIT - I

Transforms of simple functions – Transform of error function – Bessel's function - Basic operational properties – Transforms of derivatives and integrals – Initial and final value theorems – Inverse transforms – Convolution theorem – periodic functions – Applications of Laplace transforms for solving linear ordinary differential equations up to second order with constant coefficients only.

UNIT - II

Fourier integral theorem - Fourier transform pairs - sine and cosine transforms - Finite Fourier transforms – Fast Fourier transforms – Convolution theorem – Parseval's identity – Properties of Fourier transform.

UNIT - III

Solutions for displacement in a long string, displacement in a long string under its weight - a bar with prescribed force on one end - Free vibrations of a string - Laplace transform methods for

one-dimensional wave equation - Longitudinal vibration of an elastic bar.

UNIT - IV

Fourier transforms methods for one-dimensional heat conduction problems in infinite and semi-infinite rod - Applications to heat conduction problems using finite Fourier transforms and applications to wave equations using infinite Fourier transforms.

UNIT - V

Z-transforms - Region of convergence - Inverse z-transforms using residue theorem, partial fraction and long division – initial value theorem – final value theorem - convolution theorem - z-transform properties - Solving difference equations using z transform.

TEXT BOOKS:

1. T.Veerarajan, Engineering Mathematics, 3rd Edition, Tata McGraw Hill Pvt. Ltd., 2012.
   Unit I: Chapter 5 – Sec 5.1 – 5.11
2. T.Veerarajan, Transforms & Partial Differential Equations, 1st Edition updated, Tata McGraw Hill Pvt. Ltd., 2012.
   Unit II: Chapter 2 – Sec 2.1 – 2.7; Unit V: Chapter 5 – Sec 5.1 – 5.5
3. K.Sankara Rao, Introduction to Partial Differential Equations, 3rd Edition, PHI learning Pvt. Ltd., 2011.
   Sec 6.1 – 6.6; Unit III: Chapter 6 – Sec 6.13 – 6.13.2;
   Unit IV: Chapter 7 – Sec 7.10 – 7.10.2 & 7.11 – 7.12

REFERENCES:

1. J.N.Sharma & Kehar Singh, Partial Differential Equations for Engineers and Scientists, Narosha Publishing House, 2011.

2. P.Kandasamy, K.Thilagavathy & K.Gunavathy, Engineering Mathematics, Vol.III, S.Chand & Company, 2008.
3. M.D. Raisinghania, Advanced Differential Equations, S. Chand & Company Ltd., New Delhi, 2010.

COURSE CODE	COURSE TITLE	L	T	P	Total of LTP	C
PMA15204	ADVANCED OPERATIONS RESEARCH	4	1	0	5	4

	INSTRUCTIONAL OBJECTIVES
1.	Apply mathematical techniques to model and analyze decision problems
2.	Familiar with optimization techniques to solve real life problems
3.	Be exposed to determine the optimum level of inventory in manufacturing problems
4.	Be exposed to Non-linear programming problem and its applications
5.	Be thorough with solution dynamic programming problem

UNIT – I : LINEAR PROGRAMMING

Transportation problem – IBFS-VAM – Optimum solution (Modi method) – Degeneracy in TPP – Unbalanced TPP – Duality – Assignment problem – Travelling salesman problem.

UNIT – II : INTEGER PROGRAMMING

Dual Simplex method - Pure and mixed integer programming problems and applications – Gomory's cutting plane algorithm.

UNIT - III: INVENTORY MODELS

Deterministic models – single item static model without price breaks – probabilistic models – Single period problem with and without set-up cost.

UNIT – IV: NON LINEAR PROGRAMMING

Lagrangian multiplier method – Necessary and Sufficient conditions due to Kuhn Tucker – Quadratic Programming by Wolfe's Method.

UNIT – V: DYNAMIC PROGRAMMING

Characteristics of Dynamic Programming – Optimal subdivision problem - Solution of LPP by dynamic programming.

TEXT BOOK:

Kanti Swarup, P.K. Gupta, and Manmohan, Operations Research, 15th edition, Sultan Chand & Sons, Reprint 2009.
Unit I: Chapter 10: Sec 10.9, 10.12, 10.13, Chapter 5: Sec 5.2, 5.3,5.4, 5.7, Chapter 11: 11.1 – 11.7; Unit II: Chapter 5: 5.9; Chapter 7: Sec 7.1 - 7.4, 7.5, 7.6; Unit III: Chapter 19: Sec 19.10, 19.11; Chapter 20: 20.2, 20.4, 20.5 & 20.6; Unit IV: Chapter 27: Sec 27.3 – 27.5; Unit V: Chapter 13: Sec 13.3, 13.4 & 13.7

REFERENCES:

1. Frederick S. Hillier & Gerald J. Lieberman, Introduction to Operations Research, McGraw-Hill: Boston MA; 8th. (International) Edition, 2005.
2. Ravindran, Philips and Soleberg," Operations Research – Principle and Practice" Second Edition, John Wiley and sons, 2007.
3. Hadley.G, "Non-linear and dynamic programming", Addison Wesley, 1964.
4. Hira,Gupta "Operaions Research" S.Chand Limited, 2008.

COURSE CODE	COURSE TITLE	L	T	P	Total of LTP	C
PMA15205	COMPUTATIONAL MATHEMATICAL LAB II	0	2	4	6	3

	INSTRUCTIONAL OBJECTIVE
	At the end of the course the students should be able to apply code C++ in solving linear programming problems.

Solve linear programming problem by developing a code in C++ and verify the results using LINDO and TORA package

LINEAR PROGRAMMING:
Transportation problem – Assignment problem – Dual Simplex method – Gomory's cutting plane algorithm.

NON-LINEAR PROGRAMMING:
Quadratic programming by Wolfe's method

DYNAMIC PROGRAMMING:
Solution of LPP by dynamic programming
REFERENCES:

1. Hamdy A. Taha, "Operations Research an Introduction", 8th Edition, Pearson Education, 2004.
2. F.S.Hillier & G.J. Lieberman, "Introduction to Mathematical programming", McGraw-Hill International Edition, 2010.
3. S.S. Rao, "Optimization: Theory and Applications", 2nd Edition, Wiley Eastern Company, 2010.
4. Bazaara, Shetty and Sherali, "Non-linear Programming: Theory and Algorithms", Wiley Eastern Company, 2006.
5. Robert E. Larson and John L.Casti, "Principles of Dynamic Programming", reprint, 2011.

SEMESTER III

COURSE CODE	COURSE TITLE	L	T	P	Total of LTP	C
PMA15301	MATHEMATICAL SOFTWARE II (MAPLE)	0	2	4	6	3

	INSTRUCTIONAL OBJECTIVE
	At the end of the course the students should be able to acquire knowledge and equip them with hands-on-training in software skills using MAPLE.

UNIT - I

Document and Worksheet Mode

UNIT - II

Symbolic and Numeric computations- Integer Operations- Solving Equations - Units and Scientific constants- Algebra- Calculus-Optimization-Statistics.

UNIT - III

Creating Plots - Customizing Plots-Analyzing Plots - Creating and Using Data Structures-Working with Maple Expressions

UNIT - IV

Flow Control- Iterative Commands-Procedures

UNIT - V

Latex programming – Flow charts – Commands – Procedures - Problems

REFERENCES:

Unit-I: Chapter-1 Sec: 1.1-1.7
Chapter-2 Sec: 2.1-2.10
Unit-II:Chapter-3 Sec: 3.1-3.6
Chapter-4 Sec: 4.1-4.7
Unit-III:Chapter-5 Sec: 5.1-5.4
Unit-IV:Chapter-7 Sec: 7.1-7.3
Unit-V: Chapter-8 Sec: 8.1-8.4

Sec: 8.1-8.4

REFERENCES:

1. Maple 13 MANUAL
2. M. B. Monagan, Maple Introductory Programming Guide, Maplesoft, 2005.
3. Richard E. Klima, Neil Sigmon, Ernest Stitzinger, Applications of Abstract Algebra with MAPLE, CRC Press, 2000.
4. Greene (Ronald L) Classical Mechanics with MAPLE, Springer, 1995.
5. Beltzer, Engineering Analysis with Maple / Mathematica , Academic Press, 1995
6. Portela and Charaf, Finite Elements using MAPLE, Springer, 2002.
7. Articolo, George A, Partial Differential Equations and Boundary Value Problems with MAPLE, Academic Press, 2009.

COURSE CODE	COURSE TITLE	L	T	P	Total of LTP	C
PMA15302	FUNCTIONAL ANALYSIS	4	1	0	5	4

	INSTRUCTIONAL OBJECTIVES
1.	Be thorough with linear transformations, related theorems
2.	Be exposed to orthonormal sets and operators
3.	Be familiar with the spectral theorem

UNIT - I : ALGEBRAIC SYSTEMS

Linear Spaces - Dimensions of linear spaces - Linear transformations - Operators - Algebras - Definition of Banach spaces with examples .

UNIT - II : BANACH SPACES

Continuous linear transformations – The Hahn-Banach theorem - Natural imbedding of a space into its second conjugate space - Open mapping theorem – Closed graph theorem - Conjugate of an operator - Banach Steinhaus's Uniform Boundedness Theorem.

UNIT - III: HILBERT SPACES

Definition and properties – Orthogonal complements – Orthonormal sets - Conjugate space H*.

UNIT - IV: OPERATORS ON HILBERT SPACES

Adjoint of an operator – Self-adjoint operators – Normal and unitary operators – Projections.

UNIT - V: FINITE DIMENSIONAL SPECTRAL THEORY

Matrices representation of operators – Determinants and the spectrum of an operator – The spectral theorem.

TEXT BOOKS:

G.F.Simmons, "Introduction to Topology and Modern Analysis", Tata McGraw-Hill International Ed.2004,Fourteenth reprint 2010.

UNIT – I -Chapter 8 - Sections: 42, 43, 44, 45 and Chapter 9 - Section 46.
UNIT - II - Chapter 9 - Sections: 47, 48, 49, 50, 51.
UNIT – III -Chapter 10 - Sections: 52,53,54,55.
UNIT – IV -Chapter 10 - Sections: 56,57,58,59.
UNIT – V - Chapter 11 - Sections: 60,61,62.

REFERENCES:

1. Walter Rudin, "Functional Analysis", TMH Edition, 2006.
2. B.V. Limaye, "Functional Analysis", 2nd edition, New Age International, 1996.

COURSE CODE	COURSE TITLE	L	T	P	Total of LTP	C
PMA15303	**FLUID DYNAMICS**	**4**	**1**	**0**	**5**	**4**

		INSTRUCTIONAL OBJECTIVES
1.		Understand the fluids, their characteristics
2.		Be familiar with Bernoulli's equation and potential theorems
3.		To be thorough with two dimensional flow in cylindrical polar coordinates
4.		Be thorough with the conformal transformation, its uses
5.		Be exposed to stress analysis

UNIT - I

Real and ideal fluids – velocity – Acceleration – Streamlines – Pathlines – Steady & Unsteady flows – Velocity potential – Vorticity vector – Local and particle rates of change – Equation of continuity – Conditions at a rigid boundary

UNIT - II

Pressure at a Point in a fluid – Boundary conditions of two inviscid immiscible fluids – Euler's equations of motion – Bernoulli's equation – Some potential theorems – Flows involving axial symmetry.

UNIT - III

Two Dimensional flows – Use of cylindrical polar co-ordinates – Stream function, complex potential for two-dimensional flows, irrotational, incompressible flow – Complex potential for standard two-dimensional flows – Two dimensional image systems – Milne-Thomson circle theorem – Theorem of Blasius – Mathematical formulation and solution procedures.

UNIT - IV

Use of conformal transformations – Hydrodynamical aspects of conformal mapping – Schwarz Christoffel transformation – Vortex rows.

UNIT - V

Stress – Rate of strain – Stress analysis – Relation between stress and rate of strain – Coefficient of viscosity – Laminar Flow - Navier-Stokes equations of motion – Some problems in viscous flow.

TEXT BOOK:

Frank Chorlton, "Textbook of Fluid Dynamics", Van Nostrand Co., 2004. Unit I: Chapter 2: Sec 2.1 – 2.10; Unit II: Chapter 3: Sec 3.1 – 3.7; Unit III: Chapter 5: Sec 5.1 – 5.8; Unit IV & V: Chapter 8.1 – 8.10, 8.15

REFERENCES:

1. Batchelor G.K., "An Introduction to Fluid Dynamics", Cambridge University Press, 2008.
2. White F.M., "Fluid Mechanics", Tata McGraw-Hill Education, 2011.
3. Milne Thomson L.M., "Theoretical Hydrodynamics", 5, reprint, Courier Dover Publications, 2011.
4. White F.M., "Viscous Fluid Flow", Tata McGraw-Hill Education, 2011.

COURSE CODE	COURSE TITLE	L	T	P	Total of LTP	C
PMA15304	FUZZY SETS AND APPLICATIONS	4	1	0	5	4

		INSTRUCTIONAL OBJECTIVES
1.		Understand the basic knowledge of fuzzy sets and fuzzy logic
2.		Be familiar with the concept of fuzzy numbers and arithmetic operations
3.		To gain knowledge in fuzzy relations
4.		Be thorough with the concept of Logical connectives and fuzzy graphs
5.		Be exposed to basic fuzzy system modelling methods and knowledge of fuzzy information processing

UNIT - I

Fuzzy sets – Basic definitions, level sets, convex fuzzy sets – Basic operations on fuzzy sets – Types of fuzzy sets – Cartesian products – Algebraic products bounded sum and difference

UNIT - II

Extension principle and application – Zadeh extension principle, image and inverse image of fuzzy sets – Fuzzy numbers – Elements of fuzzy arithmetic

UNIT - III

Fuzzy relations on fuzzy sets, The union and intersection of fuzzy relation - Composition of fuzzy relations – Min-max composition and its properties – Fuzzy equivalence relation

UNIT-IV

Fuzzy decision-Fuzzy linear programming problem- Symmetric fuzzy linear programming problem-Fuzzy linear programming with crisp objective function-Fuzzy graph

UNIT - V

Fuzzy logic: An overview of classic logic, its connectives – Tautologies – Contradiction fuzzy logic – Fuzzy quantities – Logical connectives for fuzzy logic – Applications to control theory.

TEXT BOOKS:

1. Didier DuBois, Henri M. Prade, "Fuzzy Sets and Systems: Theory and Applications", Academic Press, 1994.
   Unit I: Part II – Chapter 1: A, B, C, D, E, F & G; Unit II: Part II – Chapter 2: A, B & C; Unit III: Part II – Chapter 3: A, B & C; Unit IV: Part III – Chapter 4: A & B.

2. H. J. Zimmermann, Fuzzy set theory and its applications, Allied publishers Ltd., New Delhi, 2001. Unit V: Chapter 9.1 – 9.2.2

REFERENCES:

1. G. J. Klir & B. Yuan, “Fuzzy sets and Fuzzy logic; Theory and Applications”, Prentice Hall of India 1995
2. Trimothy J. Ross, “Fuzzy Logic with Engineering Applications”, McGraw Hill, International Editions, 2010.
3. Buckley, James J., Eslami, Esfandiar, “An Introduction to Fuzzy Logic and Fuzzy Sets”, Physica Verlag Heidelberg, 2002.
4. Guanrong Chen, Trung Tat Pham, “Introduction to fuzzy sets, fuzzy logic, and fuzzy control systems”, CRC Press LLC, N.W. Florida, 2000.

SEMESTER IV

COURSE CODE	COURSE TITLE	L	T	P	Total of LTP	C
PMA15401	**TOPOLOGY**	**4**	**1**	**0**	**5**	**4**

	INSTRUCTIONAL OBJECTIVES	
1.		To gain basic knowledge of topological spaces, types of topologies, open and closed sets
2.		To learn about continuity, product and metric topologies
3.		To gain knowledge about connected, compact spaces and locally connected spaces – these concepts in metric spaces and on the real time.
4.		To learn about countability axiom, separation axiom, Urysohr's theorem and metrization theorem.
5.		To learn about Tietze extension theorem, Tychonoff Theorem for compactness of arbitrary compact spaces, Stone-Cech Compactification, completeness and compactness in metric spaces in detail.

UNIT - I

Topological spaces – Basis for a Topology – The Order Topology – The Product Topology on $X \times Y$ – The Subspace Topology – Closed Sets and Limit Points

UNIT – II

Continuous Functions – The Product Topology – The Metric Topology - The Metric Topology (continued).

UNIT – III

Connected Spaces – Components and Local connectedness - Compact Subspaces – Limit Point Compactness

UNIT - IV

The Countability Axioms – The Separation Axioms – Normal Spaces – The Urysohn Lemma – The Urysohn Metrization Theorem

UNIT - V

The Tietze Extension Theorem -The Tychonoff Theorem – The Stone-Cech Compactification – Complete Metric Spaces – Compactness in Metric Spaces .

TEXT BOOK:

James R. Munkres, "Topology", 2nd Edition, Pearson Education Pvt. Ltd., Delhi-2002 (Third Indian Reprint).

Unit I: Chapter 2 - Sec 12, 13, 14, 15, 16, 17; Unit II: Chapter 2 - Sec 18, 19, 20, 21

Unit III: Chapter 3 - Sec 23, 24, 25, 26, 27, 28; Unit IV:Chapter 4 - Sec 30, 31, 32, 33, 34; Unit V: Chapter 4 - Sec 35, Chapter 5 - Sec 37,38 and Chapter 7- Sec 43,45 (up to 45.2).

REFERENCES:

1. James Dugundji , "Topology", Allyn and Bacon publishers, 2003.
2. George F.Simmons, "Introduction to Topology and Modern Analysis", Tata McGraw-Hill Education, 2004.
3. J.L. Kelly, "General Topology", Reprint, Springer, 1997.
4. L.Steen and J.Subhash, "Counter Examples in Topology", 2nd edition Reprint, Dover Publications, 1995.
5. S.Willard, "General Topology", Reprint, Dover Publications, 2004

ELECTIVE I

COURSE CODE	COURSE TITLE	L	T	P	Total of LTP	C
PMA15E01	**ARTIFICIAL INTELLIGENCE**	**4**	**1**	**0**	**5**	**4**

	INSTRUCTIONAL OBJECTIVES
1.	To provide a strong foundation of fundamental concepts in Artificial Intelligence.
2.	To provide a basic exposition to the goals and methods of Artificial Intelligence.
3.	To enable the students apply these techniques in applications which involve perception, reasoning and learning.

UNIT - I

Intelligent Agents – Agents and environments - Good behavior – The nature of environments – structure of agents - Problem Solving - problem solving agents – example problems.

UNIT – II

Informed search and exploration – Informed search strategies – heuristic function – local search algorithms and optimistic problems – Constraint satisfaction problems (CSP) – Backtracking search and Local search for CSP – Structure of problems - Adversarial Search.

UNIT - III

First order logic – representation revisited – Syntax and semantics for first order logic – Inference in First order logic – propositional versus first order logic – Knowledge representation.

UNIT - IV

Learning from observations - forms of learning - Inductive learning - Learning decision trees - Ensemble learning - Knowledge in learning – Logical formulation of learning – Explanation based learning – Learning using relevant information –Statistical learning methods - Learning with complete data - Learning with hidden variable - EM algorithm - Reinforcement learning – Passive reinforcement learning - Active reinforcement learning

UNIT - V

Communication – Communication as action –Syntactic analysis – Semantic interpretation – Ambiguity and disambiguation – Probabilistic language processing - Probabilistic language models – Information retrieval – Information Extraction – Machine translation.

TEXT BOOK:

Stuart Russell, Peter Norvig, "Artificial Intelligence – A Modern Approach", 2nd Edition, Pearson Education India, 2003.

Unit I: Chapter 2: 2.1 – 2.4; Chapter 3: 3.1, 3.2; Unit II: Chapter 4: 4.1 – 4.3; Chapter 5: 5.1 – 5.4; Chapter 6: 6.1, 6.2

Unit III: Chapter 8: 8.1, 8.2; Chapter 9: 9.1; Chapter 10: 10.1, 10.2Unit IV: Chapter 18: 18.1 – 18.4; Chapter 19: 19.1 – 19.4, Chapter 20: 20.2, 20.3; Chapter 21: 21.2, 21.3

Unit V: Chapter 22: 22.1, 22.3, 22.5, 22.6; Chapter 23: 23.1, 23.2, 23.4

REFERENCES:

1. Elaine Rich and Kevin Knight, "Artificial Intelligence", 2nd Edition, Tata McGraw-Hill, New Delhi, 2008.
2. Herbert A. Simon, "The Sciences of the Artificial Intelligence", 3rd Edition, MIT Press, 1996.
3. N.J. Nilson, "Principles of Artificial Intelligence", Narosa Publishing House Pvt. Ltd., 2002.

COURSE CODE	COURSE TITLE	L	T	P	Total of LTP	C
PMA15E02	NONLINEAR PARTIAL DIFFERENTIAL EQUATIONS WITH APPLICATIONS	4	1	0	5	4

	INSTRUCTIONAL OBJECTIVES
1.	Understand first order non-linear equations and applications
2.	Be thorough with boundary value problems using Fourier transforms
3.	Be exposed to conservation laws and shock waves and their solutions

UNIT - I

First order PDE, Linear Equations of first order, Charpit's method, Jacobi's method, Quasi-linear equations

UNIT – II

First-Order Nonlinear Equations and Their Applications- The Generalized Method of Characteristics- Complete Integrals of Certain Special Nonlinear Equations- The Hamilton–Jacobi Equation and Its Applications

UNIT - III

Second-Order Linear Equations and Method of Characteristics- The Method of Separation of Variables- Fourier Transforms and Initial Boundary-Value Problems

UNIT - IV

Nonlinear Model Equations and Variational Principles - Basic Concepts and Definitions - Some nonlinear Model Equations- Variational Principles and the Euler–Lagrange Equations - The Variational Principle for Nonlinear Klein–Gordon Equations.

UNIT - V

Conservation Laws and Shock Waves - Conservation Laws - Discontinuous Solutions and Shock Waves- Weak or Generalized Solutions.

TEXT BOOKS:

1. Lokenath Debnath, "Nonlinear Partial Differential Equations for Scientists and Engineers", 2nd edition, Springer, 2005.
   Unit II: Chapter 4: 4.1, 4.2, 4.3, 4.4 ; Unit III: Chapter 1: 1.5, 1.6, 1.7 Unit IV: Chapter 2: 2.1, 2.2, 2.3, 2.4, 2.5 ; Unit V: Chapter 5: 5.1, 5.2, 5.3, 5.4
2. T. Amaranath, "An Elementary Course in Partial Differential Equations", Narosa Publications, 2008
   Unit I: Chapter 1: 1.1 – 1.10

REFERENCES:

1. K.Sanakra Rao, "Introduction to Partial Differential Equations", Prentice Hall, India, 2006.
2. J.David Logan, "An Introduction to Non-linear Partial Differential Equations", John Wiley and Sons, 2010.
3. Lawrence C.Evans, "Partial Differential Equations", 2nd Edition, Vol.19, American Mathematical Society, 2010.

COURSE CODE	COURSE TITLE	L	T	P	Total of LTP	C
PMA15E03	**APPLIED INTEGRAL EQUATIONS**	**4**	**1**	**0**	**5**	**4**

	INSTRUCTIONAL OBJECTIVES	
1.		Be thorough with different types of integral equations
2.		Be exposed to the series solution method
3.		Understand and apply Abel's problem

UNIT - I

Definition-Classification of integral equations-Solution of an integral equation-Converting Volterrato equation to ODE-Converting IVP to Volterra equation-Converting BVP to Fredholm equation.

UNIT - II

Fredholm integral equation - The Decomposition method – The Modified Decomposition method - The Direct computation method - The successive approximations method – The method of successive substitutions - Comparison between alternative methods-Homogeneous Fredholm equations.

UNIT - III

Volterra integral equation - The Adomian Decomposition method - The Modified Decomposition method - The series solution method-Converting Volterra equation to IVP - Successive approximations method - The method of successive substitutions - Comparison between alternative methods - Volterra equations of the first kind

UNIT - IV

Fredholm integro - differential equations - The direct computation and the Adomian Decomposition method-

Converting to Fredholm integral equations - Volterra integro - differential equations - The series solution method - The Decomposition method - Converting to Volterra integral equations - Converting to initial value problems.

UNIT – V

Singular integral equations-Abel's problem-The generalized Abel's integral equation-The weakly singular Volterra equation.

TEXT BOOK:

Abdul Majid Wazwaz, "A first course in integral equations", World Scientific Publishing Company Pvt. Ltd., 1997
Unit I: Chapter 1.1 – 1.6; Unit II: Chapter 2.1 – 2.7
Unit III: Chapter 3.1 – 3.8; Unit IV: Chapter 4.1, 4.2, 4.3 (4.3.4)
Unit V: Chapter 5.1 – 5.3

REFERENCES:

1. Ram P.Kanwal, "Linear integral equations theory and technique", Birkhauser Boston, 2012.
2. David Porter and David S.G. Stirling, "Integral equations a practical treatment from spectral theory to applications", Cambridge University Press, 1990.
3. F.G. Tricomi, "Integral equations", Courier Dover Publications, 1985.
4. Francis B.Hiildebrand, "Methods of applied maths", Dover Publications; 2nd edition 1992.

COURSE CODE	COURSE TITLE	L	T	P	Total of LTP	C
PMA15E04	GRAPH THEORY	4	1	0	5	4

		INSTRUCTIONAL OBJECTIVES
1.		Be familiar with graphs and subgraphs
2.		Be exposed to connectivity and cycles
3.		Be thorough with matchings and colourings
4.		Understand fully the planar graphs and the colour theorems

UNIT - I: GRAPHS, SUBGRAPHS AND TREES

Graphs and simple graphs - Graph Isomorphism - The Incidence and Adjacency Matrices - Subgraphs - Vertex Degrees - Paths and Connection - Cycles - Trees - Cut Edges and Bonds - Cut Vertices.

UNIT - II: CONNECTIVITY, EULER TOURS AND HAMILTON CYCLES

Connectivity - Blocks - Euler tours - Hamilton Cycles.

UNIT-III: MATCHINGS, EDGE COLOURINGS

Matchings - Matchings and Coverings in Bipartite Graphs - Edge Chromatic Number - Vizing's Theorem.

UNIT-IV: INDEPENDENT SETS AND CLIQUES, VERTEX COLOURINGS

Independent sets - Ramsey's Theorem - Chromatic Number - Brooks' Theorem - Chromatic Polynomials.

UNIT-V: PLANAR GRAPHS

Plane and planar Graphs - Dual graphs - Euler's Formula - The Five-Colour Theorem and the Four-Colour Conjecture.

TEXT BOOK:

J.A.Bondy and U.S.R. Murthy, Graph Theory and Applications, Springer, 2008.

Chapter 1: (Section 1.1 - 1.7) Chapter 2: (Section 2.1 - 2.3); Chapter 3: (Section 3.1 - 3.2) Chapter 4: (Section 4.1 - 4.2); Chapter 5: (Section 5.1 - 5.2) Chapter 6: (Section 6.1 - 6.2); Chapter 7: (Section 7.1 – 7.2) Chapter 8: (Section 8.1 – 8.2, 8.4); Chapter 9: (Section 9.1 - 9.3, 9.6).

REFERENCE BOOKS:

1. J.Clark and D.A.Holton, "A First look at Graph Theory", Allied Publishers, New Delhi, 1995.
2. R. Gould, "Graph Theory", Dover Publications, Reprint Edition, 2012.
3. A.Gibbons, "Algorithmic Graph Theory", Cambridge University Press, Cambridge, 1999.
4. R.J. Wilson, "Introduction to Graph Theory", Pearson Education, 4th Edition, 2004, Indian Print.
5. S.A.Choudum, "A First Course in Graph Theory", MacMillan India Ltd. 2000.

COURSE CODE	COURSE TITLE	L	T	P	Total of LTP	C
PMA15E05	**DATA STRUCTURES AND ALGORITHMS**	**4**	**1**	**0**	**5**	**4**
	INSTRUCTIONAL OBJECTIVES					
1.	To study the various design techniques and general methods for solving problems using computer programming					
2.	To apply them as algorithms to solve specific problems and analyze and compare these algorithms					

UNIT – I

Introduction: What is an Algorithm - Specifications – Introduction – Recursive algorithms – Performance Analysis – Space Complexity – Time Complexity – asymptotic Notation – Practical Complexities – performance measurement.

UNIT – II

Divide and Conquer method: General method – Binary Search – Finding the maximum and minimum – Mergesort – Quicksort – Performance Measurement.

UNIT – III

Greedy Method : General method – Job sequencing with deadlines – Minimum cost spanning tree – Prim's algorithm – Kruskual's algorithm – Single Source shortest paths.

UNIT – IV

Dynamic programming: General method – multistage graphs – all pairs shortest paths – single source shortest paths – general weights – The traveling salesman problem.

UNIT – V

Basic traversal and search Techniques: Techniques for Binary Trees – Techniques for graphs – Breadth first Search and Traversal – Depth first search and traversal – Connected components and spanning trees.

TEXT BOOKS :

1. Seymour Lipschutz, Theory and Problems of Data Structures, Schaum's Series, Tata McGraw Hill, 2002.
2. Ellis Horowitz, Sartaj Sahni, Sanguthevar Rajasekaran, Fundamentals of Computer Algorithms, Galgotia Publications private Limited, 2008.

Unit Chapter/section
I Chapter-1 1.1 to 1.3
II Chapter-3 3.1 to 3.4, 3.5.1
III Chapter-4 4.1, 4.4, 4.5.1, 4.5.2, 4.8
IV Chapter-5 5.1 to 5.4, 5.9; V Chapter-6 6.1 to 6.3

ELECTIVE II

COURSE CODE	COURSE TITLE	L	T	P	Total of LTP	C
PMA15E11	**STOCHASTIC PROCESSES**	**4**	**1**	**0**	**5**	**4**

	INSTRUCTIONAL OBJECTIVES	
1.		Understand different types of stochastic processes
2.		Be thorough with Markov chain problems
3.		Be exposed to renewal and branching processes

UNIT - I

Basic concepts: definition and examples of stochastic process, classification of general stochastic processes into discrete / continuous state spaces, type of stochastic processes, elementary problems.

UNIT - II

Markov chains discrete in time, examples, classification of states of a markov chain. Recurrence – Basic limit theorem of Markov chains – Absorption probabilities – Criteria for recurrence.

UNIT - III

Continuous time Markov chain: Pure birth process and Poisson process, birth and death process, problems.

UNIT - IV

Renewal process – definition and examples, elementary renewal theorem, Martingales – Examples.

UNIT - V

Branching process: Definition and examples of discrete time branching process, probability generating function mean and variance, probability of extinction, problems.

TEXT BOOKS:

1. Samuel Karlin and Howard M.Taylor, "A Second Course in Stochastic Processes", Academic Press, 1981.
   Unit I: Chapter 1: 2, 3
2. Medhi J., "Stochastic Processes", New Age International, 2012.
   Unit I: Chapter 1: 1.5 -1.5.1; Unit II: Chapter 2: 2.1.1, 2.1.2, 2.4 – 2.4.3, 2.4.4; unit III: Chapter 3: 3.1 – 3.2, 3.3 – 3.3.3, 3.4 – 3.4.1; Unit IV: Chapter 6: 6.1 - 6.1.1, 6.1.2, 6.1.3, 6.1.4, 6.1.5, 6.5 – 6.5.1, 6.5.2, Chapter 5: 5.1, 5.2, 5.3 (only statements), 5.3.2 (with proof); Unit V: Chapter 9: 9.1, 9.2, 9.3

REFERENCES:

1. Ross S.M., "Stochastic Processes", John Wiley & Sons, 3rd Edition, 2010.
2. T.Veerarajan, "Probability, Statistics and Random Processes", Tata McGraw Hill Publishing Company Ltd., 2003.

COURSE CODE	COURSE TITLE	L	T	P	Total of LTP	C
PMA15E12	**CRYPTOGRAPHY**	**4**	**1**	**0**	**5**	**4**
	INSTRUCTIONAL OBJECTIVES					
1.	Understand the time estimates for arithmetic and the Euclidean algorithm					
2.	Be thorough with Pseudo primes and their applications					
3.	Be exposed to elliptic curves' characteristics					

UNIT – I

Time estimates for doing arithmetic - Divisibility and the Euclidean algorithm – Congruences - Modular exponentiation - Some applications to factoring

UNIT – II

Finite Fields - Multiplicative generators – Uniqueness of fields with prime power elements - Quadratic residues and reciprocity

UNIT – III

Some simple crypto systems - Digraph transformations - Enciphering Matrices - Affine enchipering transformations RSA - Discrete Log - Diffie-Hellman key exchange - The Massey – Omura cryptosystem - Digital Signature standard - Computation of discrete log

UNIT – IV

Pseudo primes - Strong pseudo primes - Solovay-Strassen Primality test – Miller - Rabin test - Rho method - Fermat factoring and factor bases - Quadratic sieve method

UNIT – V

Elliptic Curves - Elliptic curve primality test - Elliptic Curve factoring - Pollard's p - 1 method -Elliptic curve reduction modulo n - Lenstras Method.

TEXT BOOK:

Neal Koblitz, "A course in Number Theory and Cryptography", 2nd Edition, Springer-Verlag, 2010.

Unit I: Chapter 01 (1-4); Unit II: Chapter 02 (1-2); Unit III: Chapter 03 (1-2) & Chapter 04 (1-5); Unit IV: Chapter 05 (1-5); Unit V: Chapter 06 (1-4)

REFERENCE:

Menezes A, Van Oorschot and Vanstone S.A, “Hand book of Applied Cryptography”, Taylor & Francis, 1996.

COURSE CODE	COURSE TITLE	L	T	P	Total of LTP	C
PMA15E13	**ARTIFICIAL NEURAL NETWORKS**	**4**	**1**	**0**	**5**	**4**

	INSTRUCTIONAL OBJECTIVES
1.	To learn the basics of ANN and comparing with Human brain
2.	To learn the various architectures of building an ANN and its applications
3.	To learn the pattern classification techniques , advanced methods of representing information in ANN

UNIT - I

Definition of ANN-Biological Neural Networks-Applications of ANN-Typical Architectures-Setting the weights-Common Activation functions-Development Of Neural Networks-cCulloch-Pitts Neuron

UNIT – II

General discussion - Hebb net – Perceptron - Adaline - Backpropagation neural net – Architecture – Algorithm - Applications

UNIT – III

Training Algorithm for Pattern Association - Heteroassociative memory neural network - Autoassociative net - Iterative Autoassociative net - Bidirectional Associative Memory

UNIT – IV

Fixed Weights Competitve Nets - Kohonen's Self - Organizing Map – Learning Vector Quantization - Counter Propagation Network.

UNIT – V

Motivation – Basic Architecture - Basic Operation - ART1-ART2-Architecture - Algorithm – applications – Analysis - Probablistic Neural Net - Cascade Correlation - Neocognitron: Architecture — Algorithm.

TEXT BOOK:

Laurene Fausett, "Fundamentals Of Neural Networks-Architectures, Algorithms and Applications", Prentice-Hall, Englewood Cliffs, NJ, 1994.

Unit I: Chapter 1.1 – 1.6; Unit II: Chapter 2.1 – 2.4; Unit III: Chapter 3.1 – 3.5;

Unit IV: Chapter 4.1 – 4.4; Unit V: Chapter 5.1 – 5.3

REFERENCES :

1. James. A.Freeman and David.M.Skapura, "Neural Networks: Algorithms, Applications and Programming Techniques ", Pearson Education, 2002.
2. B.Yegnanarayana, "Artificial Neural Networks", PHI Learning Pvt. Ltd., 2004.
3. Simon Haykin, "Neural Networks - A Comprehensive Foundation' Prentice Hall, 2008.
4. L.O.Chua , T.Roska, "Cellular Neural Networks and Visual computing- Foundations and Applications", Cambridge University Press, 2002
5. D.J.Mackay, "Information Theory, Inference and Learning Algorithms", Cambridge University Press, 2003.

COURSE CODE	COURSE TITLE	L	T	P	Total of LTP	C
PMA15E14	ALGORITHM DESIGN TECHNIQUES	4	1	0	5	4

	INSTRUCTIONAL OBJECTIVES
1.	To study the fundamentals of algorithm and solving problems
2.	To study various properties of algorithm
3.	To understand multistage graphs
4.	To get exposed to dynamic programming, assignment problem

UNIT - I

Introduction – Notion of Algorithm – Fundamentals of Algorithmic Solving – Important Problem types – Fundamentals of the Analysis Framework – Asymptotic Notations and Basic Efficiency Classes. Mathematical Analysis of Non-recursive Algorithm – Mathematical Analysis of Recursive Algorithm – Example: Fibonacci Numbers – Empirical Analysis of Algorithms – Algorithm visualization.

UNIT – II

Brute Force – Selection Sort and Bubble Sort – Sequential Search and Brute - force string matching – Divide and conquer – Merge sort – Quick Sort – Binary Search – Binary tree-Traversal and Related Properties – Decrease and Conquer – Insertion Sort – Depth first Search and Breadth First Search.

UNIT - III

Tree Vertex Splitting– Multistage Graphs – All pairs shortest paths– Single – Source Shortest paths – Flow shop scheduling.

UNIT - IV

Transform and conquer – Presorting – Balanced Search trees – AVL Trees – Heaps and Heap sort – Dynamic Programming –

Warshall's and Floyd's Algorithm – Optimal Binary Search trees – Greedy Techniques – Prim's Algorithm – Kruskal's Algorithm – Dijkstra's Algorithm – Huffman trees.

UNIT - V

Backtracking – n-Queen's Problem – Hamiltonian Circuit problem – Subset - Sum problem – Branch and bound – Assignment problem – Knapsack problem – Traveling salesman problem.

TEXT BOOKS:

1. Thomas H Cormen, Charles E Lieserson, Ronald L Rivest and Clifford Stein, Introduction to Algorithms, Second Edition, MIT Press, McGraw-Hill Book Company, 2001.
   Unit I: Chapter 3; Unit III: Chapters 24, 25, 26; Unit IV: Chapters 24, 25; Unit V: Chapters 34, 35.
2. Michael T Goodrich and Roberto Tamassia, Algorithm Design: Foundations, Analysis, and Internet Examples, John Wiley & Sons, 2006.
   Unit I: Chapter 1; Unit II: Chapter 1, 4; Unit IV: Chapters 3, 4, 5, 6 & 7.

REFERENCES:

1. Sara Baase and Allen Van Gelder, "Computer Algorithms - Introduction to Design and Analysis", 3 rd edition,Pearson Education Asia, 2003.
2. A.V.Aho, J.E. Hopcroft and J.D.Ullman, "The Design and Analysis Of Computer Algorithms", Pearson Education, 2003.
3. Anany Levitin, "Introduction to the Design and Analysis of Algorithm", Pearson Education Asia, 2008.

COURSE CODE	COURSE TITLE	L	T	P	Total of LTP	C
PMA15E15	BOOLEAN ALGEBRA AND ITS APPLICATIONS	4	1	0	5	4

	INSTRUCTIONAL OBJECTIVES
1.	To introduce the students to the fundamentals of Boolean algebra and its applications to Integrated Circuits and Digital systems.
2.	To equip the students with problem solving, critical thinking and algorithm techniques that may be used to solve a host of very practical real-world problems.

UNIT - I : INTRODUCTION TO BOOLEAN ALGEBRA

Introduction to Boolean algebra, Laws of Boolean algebra, Boolean functions, Disjunctive normal forms, Conjunctive normal forms, Representation of a Boolean algebra.

UNIT - II : LOGIC GATES AND BOOLEAN FUNCTIONS

Logic gates, universal logic gates, multiple input logical gates, truth table representation, other Boolean functions, realization of Boolean functions using logic gates.

UNIT-III : SIMPLIFICATION OF BOOLEAN FUNCTIONS

Canonical logic forms, complete systems, algebra of propositions, tabulation method, Karnaugh map and Quine-McClausky methods.

UNIT - IV : SWITCHING ALGEBRA

Algebra of series-parallel (switching) circuits, representation of Boolean functions using switching circuits - design and simplification, symmetric functions and their circuits, non-series-parallel circuits, bridge circuit, n-terminal circuits.

UNIT - V : COMBINATIONAL CIRCUITS

Design Procedure of Combinational (Logical) Circuits, Binary Adders, Subtractors, Encoder, Decoders.

TEXTBOOKS:

1. J. Eldon Whitesitt, "Boolean Algebra and its Applications", Dover publications, 1961.
   [UNIT – I - Chapter 2 - Sections: 2.3 - 2.6., UNIT – III - Chapter 3 - Sections 3.2, 3.3, 3.5, 3.6, 3.10., UNIT – IV - Chapter 4 - Sections: 4.1 - 4.7., UNIT – V - Chapter 6 - Sections: 6.1 - 6.7.]
2. John R. Gregg, "Ones and Zeros: Understanding Boolean Algebra, Digital Circuits and the Logic of Gates", IEEE Press,1998.
   [UNIT - II - Chapter 1 -Sections: 1.1 - 1.4, Chapter 2 - Sections: 2.1- 2.8, Chapter 4 - Sections 4.1 - 4.5, Chapter 5 - Sections: - 5.1 - 5.3, 5.5-5.7., UNIT-III - Chapter 4 - Sections - 4.6, 4.7, Chapter 8 - Sections 8.1-8.6, 8.13]
3. Kenneth H. Rosen, "Discrete Mathematics and its applications", Tata Mcgraw Hill Publications, 2007, 6th edition(Special Indian Edition)
   [UNIT - I - Chapter 10 - Section: 10.1,10.2., UNIT - III - Chapter 10 - Section: 10.4., UNIT - V - Chapter 10 - Section: 10.3.]

REFERENCES:

1. Ralph Grimaldi, “Discrete and Combinatorial Mathematics: An Applied Introduction”, Pearson Education, India.
2. Bernard Kolman, Robert Busby and Shron Ross, “Discrete Mathematical Structures”, Prentice Hall, 2008.
3. John Savage, “Models of Computation: Exploring the Power of Computing”, Addison-Wesley, 1998. (Chapter 2).

COURSE CODE	COURSE TITLE	L	T	P	Total of LTP	C
PMA15E16	**ANALYTIC NUMBER THEORY**	**4**	**1**	**0**	**5**	**4**

	INSTRUCTIONAL OBJECTIVES
1.	To introduce the concepts of arithmetic function, Dirichlet multiplication, averages of arithmetic functions, congruence’s and quadratic residues and teach some techniques of solving problems.
2.	To introduce the analytical methods used in Number Theory.

Review topics : Divisibility in integers, , G.C.D, L.C.M - prime numbers – Fundamental theorem of arithmetic – Euclidean Division algorithm- Mersene numbers and Fermat’s numbers.

UNIT – I

The Mobius function $\mu(n)$– The Euler totient function $\phi(n)$ – A relation connecting μ and ϕ - A product formula for $\phi(n)$ – The Dirichlet product of arithmetical functions – Dirichlet inverses and the Mobius inversion formula – The Mangoldt function $\Lambda(n)$ –Multiplicative functions – Inverse of a completely multiplicative function.

UNIT – II

Functions periodic modulo k - Ramanujan’s sum and generalizations - Multiplicative properties of the sums - Gauss

sums associated with Dirichlet characters - Dirichlet characters with nonvanishing Gauss sums - Induced moduli and primitive characters - Primitive characters and separable Gauss sums.

UNIT - III

Basic properties – Residue classes and complete residue systems – linear congruences – Reduced residue systems and Euler Fermat theorem – Polynomial congruences modulo p – Lagrange's theorem – Applications – Simultaneous linear congruences – The Chinese remainder theorem – Polynomial congruences with prime power moduli

UNIT - IV

Quadratic Residues – Legendre's symbol and its properties – Evaluation of (-1 | p) and (2 | p) – Gauss' lemma – The Quadratic Reciprocity law – Applications – The Jacobi symbol.

UNIT - V

Exponent of a number mod m – primitive roots and reduced residue system – Non existence of p-roots $\bmod 2^{\alpha}\ (\alpha \geq 3)$ - existence of p-roots mod p for odd primes p – primitive roots & Quadratic residues – Existence of p-root $\bmod p^{\alpha}$ - p-root $\bmod 2p^{\alpha}$ - Non existence of p-roots in other cases.

TEXT BOOK:

Tom M. Apostol, "Introduction to Analytic Number Theory", Springer International Student Edition, 1998.
Unit I : Chapter 2: Sec 2.1 – 2.9, 2.11;
Unit II : Chapter 8: Sec 8.1, 8.3 – 8.7, 8.10
Unit III : Chapter 5: Sec 5.1 – 5.9;
Unit IV : Chapter 9: Sec 9.1 – 9.7;
Unit V : Chapter 10: Sec 10.1 – 10.8

REFERENCES:

1. Ivan Niven, Herbert S.Zuckermann, “An Introduction to the Theory of Numbers”, John Wiley & Sons, 5th Edition, 2008.
2. Jones & Jones, “Elementary Number Theory”, Springer, 2012.
3. William Stein, “Elementary Number Theory”, Springer 2009
4. W.J.Leveque, “Topics in Number Theory”, Courier Dover Publications, 1990.
5. Bressoud, D., Wagon, S., “A Course in Computational Number Theory”, John Wiley & Sons, 2008.