Amrita University's Amrita Values Programme (AVP) is a new initiative to give exposure to students about richness and beauty of Indian way of life. India is a country where history, culture, art, aesthetics, cuisine and nature exhibit more diversity than nearly anywhere else in the world.

Amrita Values Programmes emphasize on making students familiar with the rich tapestry of Indian life, culture, arts, science and heritage which has historically drawn people from all over the world.

Post-graduate students shall have to register for any one of the following courses, in the second semester, which may be offered by the respective school.

Courses offered under the framework of Amrita Values Programme:

**Art of Living through Amma**
Amma's messages can be put to action in our life through pragmatism and attuning of our thought process in a positive and creative manner. Every single word Amma speaks and the guidance received in on matters which we consider as trivial are rich in content and touches the very inner being of our personality. Life gets enriched by Amma's guidance and She teaches us the art of exemplary life skills where we become witness to all the happenings around us still keeping the balance of the mind.

**Insights from the Ramayana**
Historical significance of Ramayana, the first Epic in the world – Influence of Ramayana on Indian values and culture – Storyline of Ramayana – Study of leading characters in Ramayana – Influence of Ramayana outside India – Misinterpretation of Ramayana by Colonial powers and its impact on Indian life - Relevance of Ramayana for modern times.

**Insights from the Mahabharata**
Historical significance of Mahabharata, the largest Epic in the world – Influence of Mahabharata on Indian values and culture – Storyline of Mahabharata – Study of leading characters in Mahabharata – Kurukshetra War and its significance – Importance of Dharma in society – Message of the Bhagavad Gita - Relevance of Mahabharata for modern times.

**Insights from the Upanishads**
Introduction: Sruti versus Smrti - Overview of the four Vedas and the ten Principal Upanishads - The central problems of the Upanishads – Ultimate reality – the nature of Atman - the different modes of consciousness - Sanatana Dharma and its uniqueness - The Upanishads and Indian Culture – Relevance of Upanishads for modern times – A few Upanishad Personalities: Nachiketas, Satyakama Jabala, Aruni, Shvetaketu.

**Insights from Bhagavad Gita**

**Swami Vivekananda and his Message**
Brief Sketch of Swami Vivekananda's Life – Meeting with Guru – Disciplining of Narendra - Travel across India - Inspiring Life incidents – Address at the Parliament of Religions – Travel in United States and Europe – Return and reception India – Message to Indians about our duties to the nation.

**Great Spiritual Teachers of India**
Sri Rama, Sri Krishna, Sri Buddha, Adi Shankaracharya, Sri Ramanujacharya, Sri Madhvacharya, Sri Ramakrishna Paramahamsa, Swami Vivekananda, Sri Ramana Maharshi, Mata Amritanandamayi Devi

**Indian Arts and Literature:**
The aim of this course is to present the rich literature and culture of Ancient India and help students appreciate their deep influence on Indian Life - Vedic culture, primary source of Indian Culture – Brief introduction and appreciation of a few of the art forms of India - Arts, Music, Dance, Theatre, Paintings, Sculpture and architecture – the wonder language, Sanskrit and ancient Indian Literature

**Importance of Yoga and Meditation in Life:**
The objective of the course is to provide practical training in YOGA ASANAS with a sound theoretical base and theory classes on selected verses of Patanjali’s Yoga Sutra and Ashtanga Yoga. The coverage also includes the effect of yoga on integrated personality development.

**Appreciation of Kerala’s Mural Art Forms:**
A mural is any piece of artwork painted or applied directly on a wall, ceiling or other large permanent surface. In the contemporary scenario Mural painting is not restricted to the permanent structures and are being done even on canvas. A distinguishing characteristic of mural painting is that the architectural elements of
the given space are harmoniously incorporated into the picture. Kerala mural paintings are the frescos depicting mythology and legends, which are drawn on the walls of temples and churches in South India, principally in Kerala. Ancient temples, churches and places in Kerala, South India, display an abounding tradition of mural paintings mostly dating back between the 9th to 12th centuries CE when this form of art enjoyed Royal patronage. Learning Mural painting through the theory and practice workshop is the objective of this course.

Practicing Organic Farming
Life and nature are closely linked through the healthy practices of society for maintaining sustainability. When modern technological knowhow on microorganisms is applied in farming using the traditional practices we can avoid damage to the environment. The course will train the youth on modern practices of organic farming. Amma says "we have to return this land to the coming generations without allowing even the slightest damage to happen to it". Putting this philosophy to practice will bring about an awakening and enthusiasm in all to strive for good health and to restore the harmony in nature"

Ancient Indian Science and Technology
Science and technology in ancient and medieval India covered all the major branches of human knowledge and activities, including mathematics, astronomy, physics, chemistry, medical science and surgery, fine arts, mechanical, civil engineering, architecture, shipbuilding and navigation. Ancient India was a land of sages, saints and seers as well as a land of scholars and scientists. The course gives an awareness on India's contribution to science and technology.

15CUL501 CULTURAL EDUCATION 200 P/F
Objective: Love is the substratum of life and spirituality. If love is absent life becomes meaningless. In the present world if love is used as the string to connect the beads of values, life becomes precious, rare and beautiful like a fragrant blossom. Values are not to be learned alone. They have to be imbibed into the inner spirit and put into practice. This should happen at the right time when you have vitality and strength, when your hearts are open.

The present course in value education is a humble experience based effort to lead and metamorphosis the students through the process of transformation of their inner self towards achieving the best. Amma's nectarous words of wisdom and acts of love are our guiding principles. Amma's philosophy provides an insight into the vision of our optimistic future.

1. Invocation, Satsang and Question - Answers
2. Values - What are they? Definition, Guiding Principles with examples Sharing own experiences

REFERENCES:
1. Swami Amritaswaroopananda Puri - Awaken Children (Volume VII and VIII)
2. Swami Amritaswaroopananda Puri - Amma's Heart
3. Swami Ramakrishnanda Puri - Rising Along the Razor's Edge
4. Deepak Chopra - Book 1: Quantum Healing; Book 2: Alpha and Omega of God; Book 3: Seven Spiritual Rules for Success
5. Dr. A. P. J. Abdul Kalam - 1. Ignited Minds 2. Talks (CD)
6. Swami Ramakrishnanda Puri - Ultimate Success
7. Swami Jnananandananda Puri - Upadesamritham (Trans: Malayalam)
8. Vedanta Kesari Publication - Values - Key to a meaningful life
9. Swami Ranganathananda - Eternal values for a changing society
10. David Megginson and Vivien Whitaker - Cultivating Self Development
11. Elizabeth B. Hurlock - Personality Development, Tata McGraw Hill
12. Swami Jagatatmananda - Learn to Live (Vol.1 and 2), RK Ashram, Mylapore

SYLLABI Master of Science - Mathematics 2015 admissions onwards
3. Values - Key to meaningful life. Values in different contexts
4. Personality - Mind, Soul and Consciousness - Q and A. Body-Mind-Intellect and the Inner psyche Experience sharing
5. Psychological Significance of samskara (with eg. From Epics)
6. Indian Heritage and Contribution and Q and A; Indian Ethos and Culture
7. Self Discipline (Evolution and Practice) – Q and A
8. Human Development and Spiritual Growth - Q and A
9. Purpose of Life plus Q and A
10. Cultivating self Development
11. Self effort and Divine Grace - their roles – Q and A; - Vedanta and Creation - Understanding a spiritual Master
12. Dimensions of Spiritual Education; Need for change Lecture – 1; Need for Perfection Lecture - 2
13. How to help others who have achieved less - Man and Nature Q and A, Sharing of experiences

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Review: Groups and Rings

Unit 1
Rings: Euclidean Rings, Polynomial Rings, Polynomial Rings over the Rational Field, Polynomial Rings over Commutative Rings. (Sec. 3.7 to 3.11).

Unit 2
Fields: Definition of Fields, Field Extensions, Finite, Algebraic Field Extensions and Their Properties. The Transcendence of ‘e’. (Sec. 5.1 to 5.2).
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Unit 3  
Fields (contd): Roots of Polynomials, Remainder Theorem, Splitting Field and its Uniqueness, Classical Ruler and Compass Constructions, Distinct and Multiple Roots, Simple Extension of a Field. (Sec. 5.3 to 5.5).

Unit 4  
Fields (contd): The Elements of Galois Theory, Solvability by Radicals, Galois Groups over the Rationals. (Sec. 5.6 to 5.8).

Unit 5  
Groups: Direct products, Finite Abelian Groups. (Sec. 2.13 and 2.14).

(Seminar/self study topics)

TEXTBOOK:  

REFERENCES:  

15MAT502 ADVANCED REAL ANALYSIS 4 0 0 4

Unit 1  
Functions of Bounded Variation and Rectifiable Curves:  
Introduction, Properties of monotonic functions, Functions of bounded variation, Total Variation, Additive property of total variation, Total variation on as a function of .

Unit 2  
Functions of bounded variation expressed as the difference of increasing functions, Continuous functions of bounded variation. (Chapter 6: 6.1-6.8)

Unit 3  

Unit 4  
Sequences and Series of Functions: Sequence of functions and its point-wise limit, Discussion of main problems, Uniform convergence, Uniform convergence and continuity, Uniform convergence and integration, Uniform convergence and Differentiation, Equicontinuous Families of Functions, The Stone-Weierstrass Theorem.

Unit 5  

TEXTBOOK:  

REFERENCE BOOKS:  

15MAT503 TOPOLOGY 4 0 0 4

Unit 1  
Chapter 9: Sec 9.1 to 9.6 (Text Book 1)

Unit 2  

Unit 3  

Unit 4  
Chapter 3: Sec 23, 24, 26, 27 (Text Book 2)
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Unit 5
Chapter 4: Sec 30 to 34 (Text Book 2)

TEXTBOOKS:

REFERENCE BOOKS:
1. J. Dugundji: Topology (Allyn and Bacon, Boston, 1966.)

15MAT504  ORDINARY DIFFERENTIAL EQUATIONS  4004

Unit 1

Unit 2

Unit 3
Complex n-dimensional space, Systems as vector equations, Existence and uniqueness of solutions to systems, Existence and Uniqueness of linear systems, Equations of order n.

Unit 4

Unit 5

Oscillations and the Sturm Separation theorem, The Sturm comparison theorem.

TEXTBOOK:

REFERENCES:
1. T. W. Gamelin, Complex Analysis, Springer-Verlag, 2001

15MAT511  ADVANCED COMPLEX ANALYSIS  4004

Unit 1
Analytic Continuation: Direct Analytic Continuation, Monodromy Theorem, Poisson Integral Formula, Analytic Continuation via Reflection.

Unit 2
Representations for Meromorphic and Entire Functions: Infinite Sums and Meromorphic functions, Infinite Product of Complex Numbers, Infinite Products of Analytic Functions.

Unit 3

Unit 4
Mapping Theorems: Open Mapping Theorem and Hurwitz' Theorem, Basic Results on Univalent Functions, Normal Families.

Unit 5

TEXTBOOK:

REFERENCES:
1. T. W. Gamelin, Complex Analysis, Springer-Verlag, 2001

15MAT512  FUNCTIONAL ANALYSIS  4004

Unit 1
Normed Linear Spaces: Linear Spaces – Normed Linear Spaces – The Metric on a Normed Linear Space – Linear Subspaces – Bounded Linear Transformations.
Sections: 3.1 to 3.5 (Text Book – 1)
Unit 2
Linear Homeomorphisms – An Elementary Integral – Regulated Mappings – Integration and Differentiation - Review of Compact Metric Spaces – Basic Results on Compact Subsets of a Metric Space – Separability of Compact Metric Spaces – Conditions Equivalent to Compactness - Borel – Lebesgue Theorem. Sections: 3.7 to 3.9 and 4.1 to 4.2 (Text Book – 1)

Unit 3
Compactness and Continuity – Dini’s Theorem - Finite Dimensional Normed Linear Spaces – Completeness – Stone Weierstrass Theorem – Weierstrass Theorem on approximation of periodic functions by trigonometric polynomials – Extension of Stone-Weierstrass Theorem to $C_c(X)$ - Separability of $C_c(X)$ - Ascoli-Arzela Theorem – Peano’s Theorem. Sections: 4.3 to 4.6 (Text Book – 1)

Unit 4

Unit 5
A Theorem on Convex Sets – The Riesz Representation Theorem – Hergoltz’s Theorem. Sections 5.5 to 5.7 (Text Book – 1)

TEXTBOOKS:

15MAT513
GRAPH THEORY 4 0 0 4

Unit 1

Trees: Trees, cut-edges and cut-vertices, spanning trees, minimum spanning trees, DFS, BFS algorithms.

Unit 2
Connectivity: Graph connectivity, k-connected graphs and blocks.

Euler and Hamilton Graphs: Euler graphs, Euler’s theorem. Fleury's algorithm for

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Unit 3
Matching; Matchings, maximal matchings, Coverings and minimal coverings. Berge's theorem, Hall's theorem, Tutte's perfect matching theorem, Job assignment problem.

Coverings, Independent Sets and Cliques; Basic Relations.

Unit 4

Unit 5

TEXTBOOK:

REFERENCES BOOKS:

15MAT514 PARTIAL DIFFERENTIAL EQUATIONS 4 0 0 4

Unit 1 First order PDE - Geometrical Interpretation of a First-Order Equation, Method of Characteristics and General Solutions, Canonical Forms of First-Order Linear Equations.

Unit 2 Second-Order Linear Equations - Second-Order Equations in Two Independent Variables, Canonical Forms, Equations with Constant Coefficients.


Unit 4 Boundary-Value Problems - Boundary-Value Problems, Maximum and Minimum Principles, Uniqueness and Continuity Theorems.

Unit 5 Dirichlet Problem for a Circle, Dirichlet Problem for a Circular Annulus,
SYLLABI Master of Science - Mathematics 2015 admissions onwards

Neumann Problem for a Circle, Dirichlet Problem for a Rectangle . Dirichlet Problem Involving the Poisson Equation, The Neumann Problem for a Rectangle

TEXTBOOK:

REFERENCES:

15MAT601 ADVANCED TOPOLOGY 4 0 0 4


Unit 3 Complete metric spaces. Compactness in metric spaces. Pointwise and compact convergence. And Ascoli’s theorem.

Unit 4 Baire spaces. Introduction to dimension theory.


TEXTBOOK:

REFERENCE BOOKS:
1. J. Dugundji: Topology (Allyn and Bacon, Boston, 1966.)

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fluid - Units and dimensions – Properties of fluids – density, specific weight, specific gravity, temperature, viscosity, compressibility, vapour pressure, capillary and surface tension – Fluid statics: concept of fluid static pressure, absolute and gauge pressures – pressure measurements by manometers and pressure gauges.


Unit 3 Fluid Dynamics: Fluid dynamics - equations of motion - Euler’s equation along a streamline - Bernoulli’s equation – applications - Venturi meter, Orifice meter, Pitot tube - dimensional analysis - Buckingham’s? Theorem - applications - similarity laws and models.

Unit 4 Incompressible Fluid Flow: Viscous flow - Navier-Stoke's equation (Statement only) - Shear stress, pressure gradient relationship - laminar flow between parallel plates - Laminar flow through circular tubes (Hagen poiseuille’s).

Unit 5 Hydraulic and energy gradient - flow through pipes - Darcy-weisback’s equation - pipe roughness - friction factor - Moody's diagram -minor losses - flow through pipes in series and in parallel - power transmission - Boundary layer flows, boundary layer thickness, boundary layer separation - drag and lift coefficients.

TEXTBOOKS:

REFERENCE:

15MAT603 MEASURE AND INTEGRATION 4 0 0 4
Unit 1 Measure on the Real Line: Lebesgue Outer Measure - Measurable Sets – Regularity - Measurable Functions - Borel and Lebesgue Measurability. (Sections 2.1 to 2.5).
Unit 2
Integration of Functions of a Real Variable: Integration of Non-Negative Functions - The General Integral - Integration of Series - Riemann and Lebesgue Integrals. (Sections 3.1 to 3.4).

Unit 3
Abstract Measure Spaces: Measures and Outer Measures - Extension of a Measure - Uniqueness of the Extension - Completion of a Measure - Measure Spaces - Integration with Respect to a Measure (Sections 5.1 to 5.6).

Unit 4
Inequalities and the $L^p$ Spaces: The $L^p$ Spaces - Convex Functions - Jensen's Inequality - The Inequalities of Holder and Minkowski - Completeness of $L^p(\mu)$. (Sections 6.1 to 6.5).

Unit 5
Signed Measures and their Derivatives: Signed Measures and the Decomposition - The Jordan Decomposition - The Radon-Nikodym Theorem - Some Applications of the Radon-Nikodym Theorem (Sections 8.1 to 8.4).

TEXTBOOKS:

Unit 1

Unit 2

Unit 3
Baire's Theorem – Nowhere Differentiable Continuous Functions – Pointwise Limits of Continuous Functions – The Principle of Uniform Boundedness – The Open Mapping Theorem – The Closes Graph Theorem. Sections: 8.1 to 8.5 and 8.8 (Text Book – 1)
SYLLABI Master of Science - Mathematics 2015 admissions onwards

TEXTBOOK:

REFERENCE BOOKS:

15MAT631 ALGEBRAIC GEOMETRY 3 0 0 3

Unit 1
AFFINE AND PROJECTIVE VARIETIES:
Noetherian rings and modules; Emmy Noether’s theorem and Hilbert’s Basissatz; Hilbert’s Nullstellensatz; Affine and Projective algebraic sets; Krull’s Hauptidealsatz; topological irreducibility, Noetherian decomposition; local ring, function field, transcendence degree and dimension theory; Quasi-Compactness and Hausdorffness; Prime and maximal spectra; Example: linear varieties, hypersurfaces, curves.

Unit 2
MORPHISMS:
Morphisms in the category of commutative algebras over a commutative ring; behaviour under localization; morphisms of local rings; tensor products; Product varieties; standard embeddings like the segre- and the d-uple embedding.

Unit 3
RATIONAL MAPS:
Relevance to function fields and birational classification; Example: Classification of curves; blowing-up.

Unit 4
NONSINGULAR VARIETIES:
Nonsingularity; Jacobian Criterion; singular locus; Regular local rings; Normal rings; normal varieties; Normalization; concept of desingularisation and its relevance to Classification Problems; Jacobian Conjecture; relationships between a ring and its completion; nonsingular curves.

Unit 5
INTERSECTIONS IN PROJECTIVE SPACE:
Notions of multiplicity and intersection with examples.

SYLLABI Master of Science - Mathematics 2015 admissions onwards

15MAT632 ALGEBRAIC TOPOLOGY 3 0 0 3

Unit 1

Simplicial Homology Groups: Chains, cycles, Boundaries and homology groups, Examples of homology groups; The structure of homology groups.

Unit 2
The Euler Poincare’s Theorem; Pseudomanifolds and the homology groups of Sn. [Chapter 1 Sections 1.1 to 1.4 & Chapter 2 Sections 2.1 to 2.5 from the text].

Unit 3
Simplicial Approximation: Introduction; Simplicial Approximation; Induced homomorphisms on the Homology groups; The Brouwer fixed point theorem and related results;

Unit 4
The Fundamental Group: Introduction; Homotopic Paths and the Fundamental Group; The Covering Homotopy Property for S1; [Chapter 3 Sections 3.1 to 3.4; Chapter 4 Sections 4.1 to 4.3]

Unit 5
Examples of Fundamental Groups; The Relation Between H1(K) and p1(iK); Covering Spaces: The definition and some examples. Basic properties of covering spaces. Classification of covering spaces. Universal covering spaces. Applications. [Chapter 4: Sections 4.4, 4.5; Chapter 5 Sections 5.1 to 5.5 from the text]

TEXTBOOK:

REFERENCES:
SYLLABI Master of Science - Mathematics 2015 admissions onwards

15MAT633 CODING THEORY 3 0 0 3

Unit 1
Introduction to linear codes and error correcting codes, Encoding and decoding of a linear code.

Unit 2
Dual codes. Hamming codes and perfect codes.

Unit 3
Cyclic codes. Codes with Latin Squares, Introduction to BCH codes, Reed Solomon Codes.

Unit 4
Weight Enumerators and MDS codes.

Unit 5
Linear coding theory problems and conclusions.

TEXTBOOKS:

REFERENCES:

15MAT634 COMMUTATIVE ALGEBRA 3 0 0 3

Unit 1
Rings and ideals, modules and operations on them (tensor product, Hom, direct sum and product).

Unit 2
Rings and modules of Fractions, primary decomposition.

Unit 3
Integral dependence and Valuations, Chain Conditions.

Unit 4
Noetherian Rings and Artin Rings.

15MAT635 LIE ALGEBRAS 3 0 0 3

Unit 5
Discrete valuation Rings and Dedekind Domains, Dimension theory.

TEXTBOOKS/REFERENCES:
SYLLABI  Master of Science - Mathematics  2015 admissions onwards

15MAT636  THEORY OF MANIFOLDS  3 0 0 3

Unit 1
Definition of Manifolds, Differentiable and Analytic Manifolds, Examples of Manifolds, Product of Manifolds, Mappings between Manifolds, Submanifolds, Tangent Vectors.

Unit 2

Unit 3

Unit 4

Unit 5

TEXTBOOKS/ REFERENCES:

15MAT641  FIXED POINT THEORY  3 0 0 3

Unit 1
Contraction Principle, and its variants and applications.

Unit 2
Fixed points of non-expansive maps and set valued maps, Brouwer-Schauder fixed point theorems.

Unit 3
Ky Fan Best Approximation Theorem, Principle and Applications of KKM - maps, their variants and applications.

Unit 4
Fixed Point Theorems in partially ordered spaces and other abstract spaces.

Unit 5
Application of fixed point theory to Game theory and Mathematical Economics.

TEXTBOOKS/ REFERENCES BOOKS:
SYLLABI

Master of Science - Mathematics
2015 admissions onwards


15MAT642 Fractals 3 0 0 3

Unit 1
Classical Fractals, Self-similarity, Metric Spaces, Equivalent Spaces.

Unit 2
The Space of Fractals, Transformation on Metric Spaces.

Unit 3
Contraction Mapping and Construction of fractals from IFS.

Unit 4
Fractal Dimension, Hausdorff measure and dimension, fractal Interpolation Functions.

Unit 5
Hidden Variable FIF, Fractal Splines, Fractal Surfaces, Measures on Fractals.

TEXT REFERENCES BOOKS:

15MAT643 Harmonic Analysis 3 0 0 3

Unit 1

Unit 2
Summability – Metric theorems – Pointwise summability – Positive definite sequences – Herglotz’s theorem – The inequality of Hausdorff and Young.

Unit 3
The Fourier integral – Kernels on R. The Plancherel theorem – Another convergence theorem – Poisson summation formula – Bochner’s theorem – Continuity theorem.

Unit 4
Characters of discrete groups and compact groups – Bochner’s theorem – Minkowski’s theorem.

Unit 5
Hardy spaces - Invariant subspaces – Factoring F and M. Rieza theorem – Theorems of Szego and Beuoling.

TEXTBOOK:
Henry Helson, Harmonic Analysis, Hindustan Book Agency, Chapters 1.1 to 1.9, 2.1 to 3.5 and 4.1 to 4.3.

15MAT644 Nonlinear Partial Differential Equations 3 0 0 3

Review of first order equations and characteristics.

Unit 1
Weak solutions to hyperbolic equations - discontinuous solutions, shock formation, a formal approach to weak solutions, asymptotic behaviour of shocks.

Unit 2
Diffusion Processes - Similarity methods, Fisher’s equation, Burgers’ equation, asymptotic solutions to Burgers’ equations.

Unit 3
Reaction diffusion equations - traveling wave solutions, existence of solutions, maximum principles and comparison theorem, asymptotic behaviour.

Unit 4
Elliptic equations - Basic results for elliptic operators, eigenvalue problems, stability and bifurcation.

Unit 5
Hyperbolic system.

TEXTBOOK:
**SYLLABI**

**15MAT645**
**WAVELET ANALYSIS**

Unit 1

Unit 2

Unit 3
Complete Orthonormal Sets in Hilbert Spaces, $L^2([\pi, \pi])$ and Fourier Series, The Fourier Transform and Convolution on $\mathbb{Z}_N$, First-Stage Wavelets on $\mathbb{Z}$.

The Iteration Step for Wavelets on $\mathbb{Z}$, Implementation and Examples.

Unit 4
$L^2(\mathbb{R})$ and Approximate Identities, The Fourier Transform on $\mathbb{R}$, Multiresolution Analysis and Wavelets.

Unit 5
Construction of Multiresolution Analyses, Wavelets with Compact Support and Their Computation.

**TEXTBOOK:**

**REFERENCES:**

**15MAT646**
**MATHEMATICAL PHYSICS**

Objective: This course intends to introduce applications of various mathematical techniques to problems of Theoretical Physics. Examples could be chosen from all 4 traditional divisions of Modern Fundamental Theoretical Physics – Classical Mechanics, Electrodynamics, Quantum Mechanics and Statistical Physics.

Unit 1
Vector calculus and applications in electromagnetic theory and fluid mechanics.

Unit 2
Introduction to tensor calculus: review of basics, index notation, tensors in physics and geometry, Levi-Civita tensor, transformations of vectors, tensors and vector fields, covariance of laws of physics.

Unit 3
Calculus of variations and extremal problems, Lagrange multipliers to treat constraints, Introduction to the Lagrangian and Hamiltonian formulations of classical mechanics with applications.

Unit 4
Gamma and Beta functions, Dirac delta function, Special functions, Review of Legendre, Bessel functions and spherical harmonics (with applications to Quantum mechanics), series solutions, generating functions, orthogonality and completeness.

Unit 5
Applied linear Algebra: Dirac notation, dual vectors, projection operators, symmetric hermitian, orthogonal and unitary matrices in physics, diagonalization, orthogonality and completeness of eigenvectors, spectral decomposition and representation, simultaneous diagonalization, normal matrices, applications to coupled vibrations, Schrodinger equation in matrix form.

**TEXTBOOKS:**

**15MAT651**
**QUEUING THEORY AND INVENTORY**

Unit 1
Inventory concept – Components of Inventory model.

Unit 2
Deterministic Continuous Review model - Deterministic Periodic Review model.

Unit 3
The classical EOQ – Non zero lead time – EOQ with and without shortages.

Unit 4
Deterministic Multi echelon Inventory models for supply chain management.

Unit 5
A stochastic continuous review model – A stochastic single period model for perishable products.
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**TEXTBOOKS:**

**15MAT652**

**RANDOM PROCESS**

**3 0 0 3**

**Probability and Statistics:**

**Unit 1**

Review of one and two random variables, stochastic independence of random variables, Poisson, uniform, exponential and normal distributions, Chebyshev’s theorem central limit theorem, transformation of random variables, covariance and correlation, bivariate normal distribution function.

**Random Processes:**

**Unit 2**


**Special Processes:**

**Unit 3**

Binomial and Poisson processes - Poisson points, properties and theorems on Poisson process - Gaussian processes - description of normal processes, first and second order normal processes, standard normal process, processes depending on Gaussian process, random walk and Wiener process.

**Spectrum estimation:**

**Unit 4**

Introduction - Ergodicity, ensemble and time averages, types of ergodic processes - mean ergodic theorem - Power spectrum – power spectral density function and properties, Wiener-Khinchine theorem, systems with stochastic inputs.

**Markov process – Markov chains:**

**Unit 5**


**REFERENCES:**


**15MAT653**

**STATISTICAL PATTERN CLASSIFICATIONS**

**3 0 0 3**

**Unit 1**

Introduction and Bayesian Decision Theory


**Unit 2**

Maximum-likelihood and Bayesian Parameter Estimation


**Unit 3**

Nonparametric Techniques and Linear Discriminant Functions


**Unit 4**

Nonmetric methods and Algorithm-independent Machine Learning


**Unit 5**

Unsupervised Learning and Clustering

TEXT AND REFERENCE BOOKS:

15MAT654 STATISTICAL QUALITY CONTROL AND SIX SIGMA QUALITY ANALYSIS

Unit 1

Unit 2
Quality Circles - 7 Quality Control tools - 7 New Quality Control tools.

Unit 3
ISO 9000 Quality system Standards - Project Planning, Process and measurement system capability analysis - Area properties of Normal distribution.

Unit 4

Unit 5
Taguchi methods, Loss functions and orthogonal arrays and experiments.

TEXT AND REFERENCE BOOKS:

15MAT655 THEORY OF SAMPLING AND DESIGN OF EXPERIMENTS

Unit 1
Stratified random sampling, estimation of the population mean, total and proportion, properties of estimators, various methods of allocation of a sample, comparison of

15MAT656 TIME SERIES ANALYSIS

Unit 1
Time series, components of time series, additive and multiplicative models, determination of trend, analysis of seasonal fluctuations.

Unit 2
Test for trend and seasonality, exponential and moving average smoothing, holt-winter smoothing, forecasting based on smoothing.
Unit 3
Time series as a discrete parameter stochastic process, auto covariance and auto correlation functions and their properties, stationary processes, test for stationarity, unit root test, stationary processes in the frequency domain, spectral analysis of time series.

Unit 4
Detailed study of the stationary processes: moving average (MA), autoregressive (AR), autoregressive moving average (ARMA) and autoregressive integrated moving average (ARIMA) models.

Unit 5
Estimation of ARMA models, maximum likelihood method (the likelihood function for a Gaussian AR(1) and a Gaussian MA(1)) and Least squares, Yule-Walker estimation for AR Processes, choice of AR and MA periods, forecasting, residual analysis and diagnostic checking.

TEXTBOOKS:

15MAT661 ADVANCED BOUNDARY LAYER THEORY 3 0 0 3

Unit 1
Introduction – limitations of ideal fluid dynamics – Importance of Prandtl’s boundary layer theory - boundary layer equations in two dimensional flows – boundary layer flow over a flat plate – Blasius solution – Boundary layer over a wedge.

Unit 2
Energy integral equation for two-dimensional laminar boundary layers in incompressible flow – application of Von Karman’s integral equations to boundary layer with pressure gradient.

Unit 3
Displacement, momentum, energy thickness – axially symmetric flows – momentum equation for laminar boundary layer by von Karman – Wall shear and drag force on a flat plate due to boundary layer – coefficient of drag. Boundary layer equations for a 2D viscous incompressible fluid over a plane wall – Similar solutions – Separation of boundary layer flow.

TEXTBOOKS/ REFERENCES:
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TEXTBOOKS/REFERENCE BOOKS:

15MAT663 FINITE ELEMENT METHODS

Unit 1

Unit 2
Global and local finite element models in one dimension - derivation of finite element equation.

Unit 3
Finite element interpolation - polynomial elements in one dimension, two dimensional elements, natural coordinates, triangular elements, rectangular elements, Lagrangian and Hermite elements for rectangular elements - global interpolation functions.

Unit 4
Local and global forms of finite element equations - boundary conditions - methods of solution for a steady state problem - Newton-Raphson continuation.

Unit 5
One dimensional heat and wave equations.

TEXT AND REFERENCE BOOKS:

15MAT664 MAGNETO-HYDRO DYNAMICS

Unit 1

Unit 2
Magnetohydrostatics and steady states – Hydromagnetic equilibria and Force free magnetic fields – Chandrasekhar’s theorem – General solution of force free magnetic field when | is constant – Some examples of force free fields.

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Unit 3
Steady laminar motion – Hartmann flow. Tensor electrical conductivity, Hall current and ion slip – simple flow problems with tensor electrical conductivity.

Unit 4

Unit 5

TEXTBOOKS/REFERENCES:

15MAT665 MATHEMATICAL FOUNDATIONS OF INCOMPRESSIBLE FLUID FLOW

Unit 1

Unit 2

Unit 3
Lagrange’s hydrodynamical equations — Bernoulli’s equation and its applications - Motion in two-dimensions and sources and sinks – irrotational motion – complex potential - Milne-Thomson circle theorem – Blasius theorem.

Unit 4
General theory of irrotational motion – flow and circulation – Stoke’s theorem – Kelvin’s Circulation theorem – Permanence of irrotational motion - Kelvin’s minimum
**SYLLABI**

Master of Science - Mathematics  
2015 admissions onwards

energy theorem  
Viscous Incompressible flow - Dimensional Analysis – Buckingham theorem.

**Unit 5**


**TEXTBOOKS/ REFERENCES:**

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**SYLLABI**

Master of Science - Mathematics  
2015 admissions onwards

**TEXTBOOKS:**

**REFERENCE:**

**15MAT671 DATA STRUCTURES AND ALGORITHMS 3 0 0 3**

**Unit 1**


**Unit 2**


**Unit 3**


**Unit 4**

Graph traversal (DFS, BFS with analysis) – biconnected components – strong connectivity; shortest path algorithms (along with analysis) – Dijkstra – Bellman Ford – Floyd Warshall. All pairs shortest path algorithm – minimum spanning tree (with analysis) – Kruskal – Prim’s – Baruvka’s.

**Unit 5**

NP problems: definition, P, NP, NP complete, NP hard & co-NP, examples – P, NP.

**TEXTBOOK:**

**REFERENCES:**
**SYLLABI**

**15MAT672**  
**ADVANCED GRAPH THEORY**  

**Unit 1**  
Binomial coefficients, convexity. Inequalities: Jensen's, AM-GM, Cauchy Schwarz. Graphs, subgraphs, connectedness.

**Unit 2**  
Euler circuits, cycles, trees, bipartite graphs and other basic concepts.

**Unit 3**  
Vertex colourings. Graphs with large girth and large chromatic number.

**Unit 4**  
Extremal graph theory: Dirac's theorem, Ore's theorem, Mantel's theorem, Turan's theorem (several proofs including probabilistic and analytic).

**Unit 5**  

**TEXT AND REFERENCE BOOKS**

1. B Bollobas, Modern Graph Theory, Springer
2. D.B. West, Introduction to Graph Theory, PHI 2010

**15MAT673**  
**COMPUTER AIDED DESIGN OF VLSI CIRCUITS**  

**Unit 1**  

**Unit 2**  

**Unit 3**  
Placement, Partitioning and Floor Planning; Types of Placement Problems – Placement Algorithms – K-L Partitioning Algorithm. Optimization Problems in Floor planning - Shape Function and Floor plan Sizing.

**SYLLABI**

**15MAT674**  
**CRYPTOGRAPHY**

**Unit 1**  

**Unit 2**  
Private-key encryption: Chosen plaintext attacks, Randomised encryption, Pseudorandomness, Chosen ciphertext attacks.

**Unit 3**  
Message authentication codes: Private-key authentication, CBC-MAC, Pseudorandom functions, CCA-secure private-key encryption.

**Unit 4**  
Hash function: Integrity, Pre-image resistance, 2nd pre-image resistance, Collision freeness.

**Unit 5**  
Digital Signatures: RSA signatures, RSA-FDH and RSA-PSS signatures, DSA signatures.

**TEXT/REFERENCE BOOKS:**

**SYLLABI**

**15MAT675**  
**FUZZY SETS AND ITS APPLICATIONS**  
3 0 0 3  

**Unit 1**  

**Unit 2**  

**Unit 3**  
Fuzzy Relations: Binary Fuzzy relations, Fuzzy Equivalence Relations, Fuzzy Compatibility Relations.

**Unit 4**  
Fuzzy Logic: Classical Logic, Multivalued Logic, Fuzzy Propositions, Fuzzy Quantifiers, Linguistic Hedges, Inference from Conditional Fuzzy Propositions, Conditional and Qualified Propositions and Quantified Propositions.

**Unit 5**  

**TEXT AND REFERENCE BOOKS:**
functions - static members – Objects – pointers and objects – constant objects – nested classes – local classes.

Unit 2

Unit 3
Function and class templates - Exception handling – try-catch-throw paradigm – exception specification – terminate and Unexpected functions – Uncaught exception.

Unit 4

Unit 5
Python Programming.

TEXTBOOK:

REFERENCES:

15MAT690 LIVE-IN-LAB. 2 cr
This initiative is to provide opportunities for students to get involved in coming up with solutions for societal problems. The students shall visit villages or rural sites during the vacations (after second semester) and if they identify a worthwhile project, they shall register for a 2-credit Live-in-Lab project, in the third semester. The objectives and projected outcome of the project should be reviewed and approved by the Dept. Chairperson and a faculty assigned as the project guide. On completion of the project, the student shall submit a detailed project report. The report shall be evaluated and the students shall appear for a viva-voce test on the project.

16MAT696 DISSERTATION 10 cr
Every student is required to register for a project under a faculty member, within or outside the Department. At the completion of the Project work, the student will submit a bound volume of the project report in the prescribed format. The project work will be evaluated by a team of duly appointed examiners. The evaluation is based on contents, presentation and viva-voce.