Sacred Heart College (Autonomous), Tirupattur District

1.2.1 List of New Courses

M.Sc. Mathematics

Sem	Subject Code	Course Title	Type	Hrs/ Week	Credits	Marks		
						Int	SE	Total
I	M740	Abstract Algebra	MC	6	5	40	60	100
	M741	Real Analysis	MC	6	5	40	60	100
	M742	Ordinary Differential Equations	MC	6	5	40	60	100
	M743	Mathematical Statistics	MC	6	5	40	60	100
	M744A M744B M744C	A1. Calculus of Variations and Linear Integral Equations A2. Discrete Mathematics A3. Skill Enhancement I – Algebra	ME	6	3	40	60	100
	Total			30	23	200	300	500
II	M840	Advanced Linear Algebra	MC	6	5	40	60	100
	M841	Partial Differential Equations	MC	6	5	40	60	100
	M842	Advanced Graph Theory	MC	6	5	40	60	100
	M843	Classical Mechanics	MC	6	5	40	60	100
	M844A M844B	B1. Mathematical Models in Biology B2. Fuzzy Mathematics	ME	6	3	40	60	100

	M844C	B3. Skill Enhancement II – Linear Algebra						
	M845X - Formal Languages and Automata **(SSP)** **1*** M846X - Comprehensive Algebra (**Certificate Program**) 2* M847X - R Language for Statistics (**Certificate Program**) 2*							
	Total			30	23+5*	200	300	500
III	M946	Mathematical Analysis	MC	6	5	40	60	100
	M947	Topology	MC	6	5	40	60	100
	M948	Operations Research	MC	6	5	40	60	100
	M949	Fluid Dynamics	MC	6	5	40	60	100
	M950A M950B M950C	 C1. Differential Geometry C2. Nonlinear Differential Equations C3. Skill Enhancement III – Real Analysis	ME	6	3	40	60	100
	M951X - LaTex for Mathematics (**Certificate Program**) 2* M952X - Mathematics for Competitive Examinations – I (**IDC**) 2*							
	Total			30	23+2*	200	300	500
IV	M1043	Complex Function Theory	MC	6	5	40	60	100
	M1044	Functional Analysis	MC	6	5	40	60	100
	M1045	Difference Equations	MC	5	4	40	60	100
	M1046A M1046B	D1. Stochastic Processes D2. Reliability Theory and Queuing Processes	ME	5	3	40	60	100

	M1046C	D3. Skill Enhancement IV – Complex Analysis						
		Human Rights		2	1	40	60	100
	M1047J	Project	MC	6	3	20	80	100
	M1048X - Mathematics for Competitive Examinations – II (**IDC**) 2*							
	Total			30	21+2*	220	380	600
	Grand Total			**120**	**90 +9***	**820**	**1280**	**2100**

Sacred Heart College (Autonomous), Tirupattur District

1.2.1 List of New Courses

Department: M.SC. Mathematics

S. No	Course Code	Course Name
1.	M844B	Fuzzy Mathematics
2.	M845X	Formal Language and Automata(SSP)
3.	M950A	Differential Geometry
4.	M950B	Nonlinear Differential Equations
5.	M950C	Skill Enhancement III- Real Analysis
6.	M1046A	Stochastic Processes
7.	M1046B	Reliability Theory and Queuing Processes
8.	M1046C	Skill Enhancement IV- Complex Analysis

SYLLABUS

Book for St

Semester – II | Hours/Week: 6

Code: M844B (Elective) | Credits: 3

FUZZY MATHEMATICS

Objective: This course aims to introduce fuzzy graphs, fuzzy relations, fuzzy logic and fuzzycomposition and initiate the learners into the application of these ideas.

Unit – I: Basics

Crispsets– Fuzzy sets: Basic types – Basic concepts – Additional properties of α-cuts – Representation of Fuzzy sets – Extension principle for Fuzzy sets (Chapter1, Sections: 1.2to1.4 and Chapter2, Sections: 2.1 to2.3)

Unit – II: Operations on Fuzzy sets

Types of Operations– Fuzzy complements– Fuzzy intersections: t-norms–Fuzzy unions: t-Conorms–Combinations of operations. (Chapter 3,Sections: 3.1to 3.5)

Unit – III: Fuzzy Arithmetic

Fuzzy numbers – Linguistic variables – Arithmetic operations on intervals –Arithmetic Operations on Fuzzy numbers – Lattice of Fuzzy numbers – Fuzzy equations.(Chapter4,Sections: 4.1 to 4.6)

Unit – IV: Fuzzy Relations

Crisp versus Fuzzy relations – Binary Fuzzy relations – Binary relations on a single set– Fuzzy Equivalence relations – Fuzzy compatibility relations – Fuzzy ordering relations – Sup – icompositions of Fuzzy relations – Inf -ωicompositions of Fuzzy relations.(Chapter 5, Sections: 5.1, 5.3 to 5.7, 5.9 and 5.10)

Unit–V: Constructing Fuzzy Sets

Methods of construction: An overview – Direct methods with one expert – Direct methods with multiple experts – Indirect methods with one expert - Indirect methods with multiple experts – (Chapter 10, Sections: 10.2 to 10.7Book for Study

George J.Klirand Yuan.B, Fuzzy Sets and Fuzzy Logic: Theory and Applications, Prentice Hall India Private Ltd, 2007.

Books for Reference

H. J. Zimmerman, Fuzzy Set Theory and its Applications, 2-e Kluwer Academic Publishers, London, 1996.

Kaufmann, Introduction to Theory of Fuzzy Subsets, Volume1, Fundamental Theoretical Elements, Academic Press.

Pundir and Pundir, Fuzzy sets and their Applications, A Pragati Edition, 2006.

Timothy J. Ross, Fuzzy logic with engineering Applications, McGraw Hill Inc. New Delhi, 2004.

V. Novak, Fuzzy Sets and their Applications, Adam Hilger, Bristol, 1969.

Learning Outcomes

To understand the basic concepts of Crispsets andFuzzy sets

To observed the Constructions from sample data

3.To learn the concept of Operations on Fuzzy sets.

E–Learning Source:

http://nptel.ac.in/courses/105108081/module9/lecture36/lecture.pdf

Self-Study Paper – Formal Languages and Automata

Year/Semester: I / II Credits: 1*

Objective: To obtain knowledge about finite automata, regular expressions and regular grammars, properties of context free languages

Unit – I

Phrase – Structure Languages. (Chapter – 2)

Unit – II

Closure Operations. (Chapter – 3)

Unit – III

Context – Free Languages. (Chapter – 4)

Unit – IV

Finite State Automata. (Chapter – 5)

Unit – V

Pushdown Automata. (Chapter – 6)

Book for Study

Dr. Rani Siromoney, Formal Languages and Automata, The Christian Literature Society, Madras, 1984.

Books for Reference

D. Goswami and K. V. Krishna, Formal Languages and Automata Theory, November 5, 2010.

ShyamalenduKandar, Introduction to Automata Theory, Formal Languages and Computation, Pearson Education India; First edition, 2013.

C.K. Nagpal, Formal Languages and Automata Theory, Oxford, 7 April 2011.

Learning outcomes

Students can able

To know about finite automata, regular expressions and regular grammars,

To know and understand about properties of context free languages.

E-Learning source:http://nptel.ac.in/courses/111103016/

https://www.iitg.ernet.in/dgoswami/Flat-Notes.pdf.

Semester – III Hours/Week: 6

Code: M950A (Elective) Credits: 3

DIFFERENTIAL GEOMETRY

Objective: This course introduces space curves and their intrinsic properties of a surface and geodesics. Further the non – intrinsic properties of surfaces are explored.

Unit – I: Space curves

Introductory remarks about Space Curves, Definitions – Arc Length – tangent –normal and binormal – curvature and torsion of a curve given as the intersection of two surfaces – contact between curves and surfaces – tangent surface, involutes and Evolutes - Intrinsic equations – fundamental Existence Theorem for space curves- Helices. (Chapter I, Sections: 1 to 9)

Unit – II: The metric: Local Intrinsic Properties of a Surface

Definition of a surface – curves on a surface– Surface of revolution – Helicoids – Metric – Direction coefficients – Families of curves – Isometric correspondence – Intrinsic Properties. (Chapter II, Sections: 1 to 9)

Unit – III: Geodesics

Geodesics – Canonical geodesic equations – Normal Property of geodesics – Existence Theorems – Geodesic parallels. (Chapter II, Sections: 10 to 14)

Unit – IV: Geodesics (Contd…)

Geodesics curvature – Gauss – Bonnet Theorem – Gaussian curvature – surface of constant curvature. (Chapter II, Sections: 15 to 18)

Unit – V: The Second Fundamental form: Local non-intrinsic Properties of a Surface

The Second fundamental form – Principal Curvature – Lines of Curvature – Developables- Developables associated with space curves and with curves on surfaces – Minimal surfaces- Ruled surfaces. (Chapter III, Sections: 1 to 8)

Book for Study

T.J. Wilmore, An introduction to Differential Geometry, Oxford University Press, (17th Impression) New Delhi 2002. (Indian Print).

Books for Reference

D. Somasundaram, Differential Geometry, Narosa Publication House, Chennai, 2005.

J. A. Thorpe, Elementary topics in Differential Geometry, Under–Graduate Texts in Mathematics, Springer Verlag 1979.

Kobayashi. S. and Nomizu. K., Foundations of Differential Geometry, Interscience Publishers, 1963.

K. P. Gupta, G. S. Malik, Differential Geometry, 3-e, PragatiPrakasam, Meerut, India, 2005.

Struik, D. T., Lectures on Classical Differential Geometry, Addison – Wesley, Mass.1950.

Wilhelm Klingenberg, A course in Differential Geometry, Graduate Texts in Mathematics, Springer Verlag 1978.

Learning Outcomes

At the end of the course, the student will be able

To understand space curves, Curves between surfaces, metrics on a surface, fundamental form of a surface and Geodesics.

To study these concepts with related examples.

E–Learning source: http://www.math.ku.dk/noter/filer/geom1.pdf

Semester – III Hours/Week: 6

Code: M950B (Elective) Credits: 3

NONLINEAR DIFFERENTIAL EQUATIONS

Objective: Tolearn and apply phase plane analysis and stability techniques to problems in Science and technology.

Unit – I: Plane Autonomous Systems and Linearization

The general phase plane - Some population models - Linear approximation at equilibrium points - The general solution of linear autonomous plane systems - The phase paths of linear autonomous plane systems - Scaling in the phase diagram for a linear autonomous system - Constructing a phase diagram.

(Chapter 2, Sections: 2.1 to 2.7)

Unit – II: Periodic Solutions and Averaging methods

An energy-balance method for limit cycles - Amplitude and frequency estimates: polar coordinates - An averaging method for spiral phase paths - Periodic solutions: harmonic balance - The equivalent linear equation by harmonic balance.

(Chapter 4, Sections: 4.1 to 4.5)

Unit – III: Perturbation Methods

Non-autonomous systems: forced oscillations - The direct perturbation method for the undampedDuffing’s equation - Forced oscillations far from resonance - Forced oscillations near resonance with weak excitation - The amplitude equation for the undamped pendulum

- The amplitude equation for a damped pendulum - Soft and hard springs - Amplitude–phase perturbation for the pendulum equation - Periodic solutions of autonomous equations (Lindstedt's method) - Forced oscillation of a self-excited equation - The perturbation method and Fourier series.

(Chapter 5, Sections: 5.1 to 5.11)

Unit – IV: Stability

Poincaréstability (stability of paths) - Paths and solution curves for general systems - Stability of time solutions: Lyapunov stability - Lyapunov stability of plane autonomous linear systems - Structure of the solutions of n-dimensional linear systems. (Chapter 8, Sections: 8.1 to 8.5)

Unit – V: Stability (Continued)

Structure of n-dimensional inhomogeneous linear systems –Stability and boundedness for linear systems - Stability of linear systems with constant coefficients - Linear approximation at equilibrium points for first-order systems in n variables – Stability of a class of non-autonomous linear systems in n dimensions - Stability of the zero solutions of nearly linear systems. (Chapter 8, Sections: 8.6 to 8.11)

Book for Study

D. W. Jordan and P. Smith, Nonlinear Ordinary Differential Equations:An introduction for Scientists and Engineers,Fourth Edition, Oxford University Press, 2007.

Books for Reference

D. A. Sanchez, Freeman, Ordinary Differential Equations and Stability Theory,
Dover Publications, Inc. New York, 1968.

G. F. Simmons, Differential Equations, Tata McGraw Hill, New Delhi, 1979.

J. K. Aggarwal,Notes on Nonlinear Systems, Van Nostrand, 1972.

M. D. Raisinghania,Advanced Differential Equations, S.Chand& Company Ltd., New Delhi, 2001.

Learning Outcomes

At the end of the course, the student will be able

To understand phase plane analysis and stability techniques to problems in Science and technology.

To study these concepts with related examples.

E–Learning source:https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-243j-dynamics-of-nonlinear-systems-fall-2003/

Semester – III Hours/Week: 6

Code: M950C (Elective) Credits: 3

SKILL ENHANCEMENT III – REAL ANALYSIS

Objective: Empowering students to crack competitive examinations such as NET, SET and TRB. To complement the theoretical content of the subject with exercise problems.

Unit – I: Real number system and Infinite Series

Field Structures and Order Structure – Bounded and Unbounded sets: Supremum, Infimum – Completeness in the Set of Real Numbers – Absolute Value of a Real Number – Limit Points of a set – Closed Sets: Closure of a set – Countable and Uncountable Sets – Sequences - Limits Point of a Sequences – Limits Inferior and Superior – Convergent Sequences – Non-Convergent sequences – Cauchy General Principle of Convergence – Algebra of Sequences – Some Important Theorems – Monotonic Sequences – Positive Term series – Comparison tests for Positive term Series – Cauchy's Root, D'Alembert's Ratio, Raabe's, Logarithmic, Integral and Gauss Tests – Series with Arbitrary terms – Rearrangement of Terms (Chapters 1 to 4 – Examples and exercises)

Unit – II: Functions of a Single Variable

Limits – Continuous Functions – Functions Continuous on Closed Intervals – Uniform Continuity – Derivative – Continuous Functions – Increasing and Decreasing Functions – Darboux's, Rolle's, Lagrange's Mean Value and Cauchy's Mean Value Theorems - Higher Order Derivatives (Chapters 5, 6 – Examples and exercises).

Unit – III: Riemann and Improper Integrals

Definitions and Existence of the Integral –Refinementof Partitions – Darboux's Theorem – Conditions of Integrability – Integrability of the sum and Difference of Integrable Functions – The Integral as a Limit of Sums – Some Integrable Functions – Integration and differentiation – The Fundamental Theorem of Calculus – Mean Value Theorems of Integral Calculus – Integration by Parts – Change of Variables in an Integral – Second Mean Value Theorem –Integration of Unbounded Functions with Finite Limits of Integration – Comparison Tests for Convergence at 'a' in $\int_a^b f(x)\,dx$ – Infinite Range of Integration – Integrand as a Product of Functions – Pointwise Convergence – Uniform Convergence on an Interval – Tests for Uniform Convergence – Properties of Uniformly Convergent Sequences and Series – The Weierstrass Approximation Theorem (Chapters 9, 11, 12 – Examples and exercises)

Unit – IV: Functions of Several Variables

Explicit and Implicit Functions – Continuity – Partial derivatives – Differentiability – Partial Derivatives of Higher Order – Differentials of Higher Order – Function of functions – Change of Variables – Taylor's Theorem – Extreme Values: Maxima and Minima – Functions of Several Variables – Jacobians – Stationary Values under Subsidiary Conditions (Chapters 15, 16 – Examples and exercises)

Unit – V: Metric Spaces and Lebesgue Integral

Metric Spaces – Measurable Sets – Sets of Measure Zero – Borel Sets – Non-Measurable Sets – Measurable Functions – Measurability of the sum, difference, product and quotient Measurable functions – Lebesgue Integral – Properties of Lebesgue Integral for Bounded Measurable Functions - Lebesgue Integral for Bounded set of finite measure and unbounded Functions – The General Integral – Some Fundamental Theorems – Lebesgue Theorem on Bounded Convergence – Integrability and Measurability – Lebesgue Integral on unbounded sets or intervals – Comparison with Riemann Integral for Unbounded Sets (Chapters 20 – Examples and exercises)

Book for Study

S.C. Malik, Savita Arora, Mathematical Analysis, New age International Publishers, New Delhi, 2011.

Books for Reference

E. Fischer, Intermediate Real Analysis, Springer Verlag, 1983.

P.N. Arora and Ranjit Singh, First course in Real Analysis, Third edition, Sultan Chand and Sons Publishers, New Delhi, 1981.

Richard R. Goldsberg, Methods of Real Analysis, Oxford & IBH Publishing Co. Pvt. Ltd, New Delhi, 1970.

Robert G.Bartle and Donald R.Sherbert, Introduction to Real Analysis, 2-e John Wiley and Sons, 2000.

S. Arumugam, Modern Analysis, New Gamma Publishers, Palayamkottai, 1993.

Learning Outcomes

At the end of the course, the student will be able

To crack competitive examinations such as NET, SET and TRB.

To apply the theoretical content of the subject with exercise problems.

E-Learning Source:https://ocw.mit.edu/courses/mathematics/18-100c-real- analysis-fall-2012/.

Semester – IV Hours/Week: 5

Code: M1046 A (Elective) Credits: 3

Stochastic Processes

Objective: To introduce to the students the basic ideas of Stochastic processes, Markov chains, Markov process and Renewal process and to motivate research in these areas.

Unit – I: Stationary Process

Specification of Stochastic processes – Stationary processes – Markov chains – Definitions andExamples– Higher Transition Probabilities – Generalization of Independent Bernoulli trails – Sequence of chain dependent trials. (Chapter 2, Sections: 2.2 to 2.3; Chapter 3,Sections:3.1 to 3.3)

Unit – II: Markov Chains

Stability of a Markov system – Graph theoretic approach–Markov chain with denumerable Number of states – Reducible chains – Statistical inference for Markov chains. (Chapter 3, Sections: 3.6 to 3.10)

Unit – III: Markov Processeswith Discrete State Space: Poisson process and its extensions

Poisson process – Poisson process and related distributions – Generalizations of Poisson process –Birth and death process – Markov process with discrete state space (Continuous time Markov chains). (Chapter 4, Sections: 4.1 to 4.5)

Unit – IV: Markov Processeswith Continuous State Space

Brownian motion–Wiener process – Differential equations for a Wiener process – KolmogorovEquations– First Passage time distribution for Wiener process. (Chapter 5, Sections: 5.1 to 5.5)

Unit – V: Renewal Processes and Theory

Renewal process – Renewal process in continuous time – Renewal equation – Stopping time: Wald's equation – Renewal theorems– Delayed and equilibrium renewal processes. (Chapter 6,Sections: 6.1 to 6.6)

Book for Study

J.Medhi, Stochastic Processes, Second edition, New Age International Publication, New Delhi, 2002.

Books for Reference

ErhanCinlar, Introduction to Stochastic process, Prentice Hall Inc., 1975

SamauelKarlin, A first course in Stochastic process, 2-e, Academic press 1968.

S. K. Srinivasan and A. Vijayakumar, Stochastic Process, Narosa Publishing House, New Delhi, 2003.

V. NarauyanBhat, Elements of Applied Stochastic Processes, John Wileyand sons, 1972.

Learning Outcomes

To understand the concept of stochastic processes, Markov chains, Markov process and Renewal process.

To know about Simple MarkovianQueueing models

E–Learning source: www.expocentral.com/directory/scence/math/stochastic/process

Semester – IV Hours/Week: 5

Code: M1046 B (Elective) Credits: 3

Reliability Theory and Queuing Process

Objective: To introduce the subject of Reliability Engineering which provides the working knowledge to determine the Reliability of a System and suggests approaches to enhance System Reliability. Also includes Queuing theory, a Mathematical Approach to Analysis of Waiting Lines.

Unit – I: Reliability Definition and Failure Data Analysis

Introduction – Definition of Reliability – Failure Data – Mean Failure Rate h – Mean Time To Failure(MTTF) – Mean Time Between Failures (MTBF) – Graphical Plots – Four important Points – MTTF in terms of Failure Density – Generalization – Reliability in terms of Hazard Rate and Failure Density – Integral form – Mean Time to Failure in Integral Form.

(Book – 1: Chapter 2, Sections: 2.1 & 2.2 and Chapter 3, Sections: 3.2 to 3.11)

Unit – II: System Reliability

Introduction – Series Configuration – Parallel Configuration – Mixed Configurations – Application to Specific Hazard Models – An r out-of-n structure – Methods of solving Complex Systems. (Book – 1: Chapter 6, Sections: 6.1 to 6.7)

Unit – III: Markov Models and Reliability Improvement

Markov Models –Reliability Improvement: Introduction – Improvement of Components – Redundancy – Element Redundancy – Unit Redundancy – Standby Redundancy. (Book – 1: Chapter 6, Section: 6.11 and Chapter 7, Sections: 7.1 to 7.6)

Unit – IV: Introduction to Queuing Process

Measuring System Performance – Some General Results - Simple Data Bookkeeping for Queues – Poisson process and the Exponential distribution – Markovian Property of the Exponential distribution.(Book – 2: Chapter 1, Sections: 1.4 to 1.8)

Unit – V: Simple Markovian Queuing Models

Birth Death Processes – Single Server Queues(M/M/1).

(Book – 2: Chapter 2, Sections: 2.1 & 2.2)

Books for Study

Srinath. L.S., Reliability Engineering, East West Press, 4-ed, New Delhi.Reprint, 2013.

Donald Gross, John F. Shortle, James M. Thompson and Carl M. Harris, Fundamentals of Queueing Theory, Wiley India. Reprint 2014.

Books for Reference

Cox. D. R. and H. D. Miller, Theory of Stochastic Processes, Methuen, London, 1965.

Cramer. H. and M. Leadbetter, Stationary and Related Stochastic Processes, Wiley, New York, 1966.

Karlin. S and H. Taylor, A First course in Stochastic Processes, 2nd edition, Academic Press, New York, 1975.

Learning Outcomes

To understand the concept of System Reliability and to know about methods of solving complex systems involving mixed configurations.

To improve the System Reliability.

To know about Simple MarkovianQueueing models.

E- Learning Source:https://en.wikipedia.org/wiki/Reliability_engineering

https://en.wikipedia.org/wiki/Queueing_theory

Semester – IV Hours/Week: 5

Code: M1046 C (Elective) Credits: 3

Skill Enhancement IV– Complex Analysis

Objective: Empowering students to crack competitive examinations such as NET, SET and TRB. To complement the theoretical content of the subject with exercise problems

Unit – I: Analytic Functions and Power Series

Differentiability and Cauchy–Riemann Equations –Harmonic Functions –Power Series as an Analytic Function – Exponential and Trigonometric Functions – Logarithmic Functions – Inverse Functions. (Chapter 3, Sections: 3.1 to 3.6)

Unit – II: Complex Integration

Curves in the Complex Plane – Properties of Complex Line Integrals – Cauchy–Goursat Theorem – Consequence of Simply Connectivity – Winding Number or Index of a Curve – Cauchy Integral Formula – Taylor's Theorem – Zeros of Analytic Functions – Laurent Series. (Chapter 4, Sections: 4.1 to 4.5, 4.7, 4.10 to 4.12)

Unit – III: Conformal Mappings and Mobius Transformations

Principle of Conformal Mapping – Basic Properties of Mobius Maps – Fixed Points and Mobius Maps – Triples to Triples under Mobius Maps – The Cross-Ratio and its Invariance Property – Conformal Self-maps of Disks and Half-planes. (Chapter 5, Sections: 5.1 to 5.6)

Unit – IV: Maximum Principle, Schwarz' Lemma and Liouville's Theorem

Maximum Modulus Principle – Schwarz' Lemma and its Consequences – Liouville's Theorem –Doubly Periodic Entire Functions – Fundamental Theorem of Algebra - Zeros of certain Polynomials. (Chapter 6, Sections: 6.1, 6.3 to 6.7)

Unit – V: Classification of Singularities

Isolated and Non-isolated Singularities – Removable Singularities – Poles – Further Illustrations through Laurent's Series – Isolated Singularities at Infinity – Meromorphic Functions – Residue at a Finite Point – Residue at the Point at Infinity – Residue Theorem – Number of Zeros and Poles – Rouche's Theorem. (Chapter 7, Sections: 7.1 to 7.6 and Chapter 8, Sections: 8.1 to 8.5)

Book for Study

S. Ponnusamy, Foundations of Complex Analysis, Second Edition, Narosa Publishing House, New Delhi, 2012.