ACADEMIC CURRICULA

UNDERGRADUATE/ INTEGRATED POST GRADUATE DEGREE PROGRAMMES

(With exit option of Diploma)

(Choice Based Flexible Credit System)

Regulations 2021

Volume – 3
(Syllabi for Higher Semester Mathematics Courses-All Programmes)

SRM INSTITUTE OF SCIENCE AND TECHNOLOGY

(Deemed to be University u/s 3 of UGC Act, 1956)

Kattankulathur, Chengalpattu District 603203, Tamil Nadu, India

Contents (Volume - 3)

Syllabi for Higher Semester (3 - 8) Mathematics Courses

Course Code	21MAB201T	Course Name	TRANSFORMS AND BOUNDARY VALUE PROBLEMS	Course Category	B	BASIC SCIENCES	L	T	P	C
							3	1	0	4

Pre-requisite Courses	*Nil*	Co- requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Mathematics*	Data Book / Codes / Standards		*Nil*	

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*
CLR-1:	*analyze partial differential equations, and interpret the solutions related to PDE in engineering problems*
CLR-2:	*compute the Fourier series expansion and express the sine and cosine series*
CLR-3:	*analyze one-dimensional wave and heat equations using PDE and Fourier series concepts*
CLR-4:	*analyze Fourier transforms and their properties*
CLR-5:	*analyze Z transform for solving discrete-time Signal problems*

Course Outcomes (CO):	*At the end of this course, learners will be able to:*	Program Outcomes (PO)												Program Specific Outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12			
		Engineering Knowledge	Problem Analysis	Design/development of solutions	Conduct investigations of complex problems	Modern Tool Usage	The engineer and society	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO-1	PSO-2	PSO-3
CO-1:	*construct and solve partial differential equations using various techniques*	*3*	*3*	-	-	-	-	-	-	-	-	-	-	-	-	-
CO-2:	*explain the Fourier series expansion of a function in terms of sine and cosine series*	*3*	*3*	-	-	-	-	-	-	-	-	-	-	-	-	-
CO-3:	*identify partial differential equations and utilize Fourier series techniques to solve one dimensional wave and heat equations*	*3*	*3*	-	-	-	-	-	-	-	-	-	-	-	-	-
CO-4:	*apply Fourier transforms techniques in signal analysis*	*3*	*3*	-	-	-	-	-	-	-	-	-	-	-	-	-
CO-5:	*solve discrete-time signal problems using Z transforms*	*3*	*3*	-	-	-	-	-	-	-	-	-	-	-	-	-

Unit-1 - Partial Differential Equations	***12 Hour***
Formation of partial differential equations by eliminating arbitrary constants & arbitrary functions- Solutions of standard types of first order partial differential equations – Lagrange's linear equation – Linear partial differential equations of second and higher order with constant coefficients of homogeneous types.	
Unit-2 - Fourier Series	***12 Hour***
Dirichlet's conditions – General Fourier series – Odd and even functions - Half range sine and cosine series - Parseval's identity – Harmonic Analysis	
Unit-3 - Applications of Partial Differential Equations	***12 Hour***
Classification of second order partial differential equations - Method of separation of variables – Solutions of one dimensional wave equation - One dimensional equation of heat conduction (Insulated edges excluded) - Steady state condition with zero boundary - Steady state condition with non-zero boundary conditions	
Unit-4 - Fourier Transforms	***12 Hour***
Fourier transform pair – Properties -Fourier sine and cosine transforms – Properties– Transforms of simple functions - Convolution theorem (without proof) – Parseval's identity.	
Unit-5 – Transforms	***12 Hour***
Z - transforms – Properties of Z transforms – Inverse Z transforms – Convolution theorem (without Proof) – Solution of linear difference equations with constant coefficients using Z-transform	

Learning Resources	1. *Erwin kreyszig, Advanced Engineering Mathematics, 10th Edition, John Wiley & Sons, 2015.* 2. *B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 43rd Edition, 2015.* 3. *Veerarajan T., Transforms and Partial Differential Equations, Tata McGraw-Hill, New Delhi, 3rd edition,2012.Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 2010 3rd Edition*	4. *N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, New Delhi, 10th edition,2016.* 5. *Kandasamy P., etal. Engineering Mathematics, Vol.II & Vol.III (4th revised edition), S. Chand & Co., New Delhi,2000*

Learning Assessment

	Bloom's Level of Thinking	*Continuous Learning Assessment (CLA)*				*Summative Final Examination (40% weightage)*	
		Formative CLA-1 Average of unit test (50%)		*Life-Long Learning CLA-2 (10%)*			
		Theory	*Practice*	*Theory*	*Practice*	*Theory*	*Practice*
Level 1	*Remember*	*20%*	-	*20%*	-	*20%*	-
Level 2	*Understand*	*20%*	-	*20%*	-	*20%*	-
Level 3	*Apply*	*30%*	-	*30%*	-	*30%*	-
Level 4	*Analyze*	*30%*	-	*30%*	-	*30%*	-
Level 5	*Evaluate*	-	-	-	-	-	-
Level 6	*Create*	-	-	-	-	-	-
	Total	*100 %*		*100 %*		*100 %*	

Course Designers

Experts from Industry	**Experts from Higher Technical Institutions**	**Internal Experts**
1. *Mr. Madhan Shanmugasundaram, Infosys Technologies, madshan@gmail.com*	1. *Prof. Y.V.S.S. Sanyasiraju, IIT Madras, sryedida@iitm.ac.in*	1. *Dr. B.Vennila, SRMIST*
	2. *Prof. K.C. Sivakumar, IIT Madras, kcskumar@iitm.ac.in*	

Course Code	21MAB202T	Course Name	NUMERICAL METHODS	Course Category	B	BASIC SCIENCES	L	T	P	C
							3	1	0	4

Pre-requisite Courses	*Nil*	Co- requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Mathematics*	Data Book / Codes / Standards		*Nil*	

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*
CLR-1:	*apply the numerical techniques for solutions of algebraic, transcendental and simultaneous equations*
CLR-2:	*understand the concept of interpolation for finding intermediate values of well-known data*
CLR-3:	*interpret the concept of numerical differentiation and integration in physical problems*
CLR-4:	*apply the numerical techniques for solutions of ordinary differential equations*
CLR-5:	*apply the numerical techniques for solutions of partial differential equations*

Course Outcomes (CO):	*At the end of this course, learners will be able to:*	Program Outcomes (PO)												Program Specific Outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12			
		Engineering Knowledge	Problem Analysis	Design/development of solutions	Conduct investigations of complex problems	Modern Tool Usage	The engineer and society	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO-1	PSO-2	PSO-3
CO-1:	*solve the numerical solutions of algebraic, transcendental and simultaneous equations*	*3*	*3*	-	-	-	-	-	-	-	-	-	-	-	-	-
CO-2:	*apply finite differences concepts and various interpolation methods*	*3*	*3*	-	-	-	-	-	-	-	-	-	-	-	-	-
CO-3:	*utilize various numerical methods in numerical differentiation and integration-related problems in engineering*	*3*	*3*	-	-	-	-	-	-	-	-	-	-	-	-	-
CO-4:	*identify and solve the numerical solutions of ordinary differential equations*	*3*	*3*	-	-	-	-	-	-	-	-	-	-	-	-	-
CO-5:	*analyze the numerical solutions of partial differential equations*	*3*	*3*	-	-	-	-	-	-	-	-	-	-	-	-	-

Unit-1 - Numerical Solution of Algebraic Equations	***12 Hour***
Solution of nonlinear equations - False position method - Fixed point iteration method - Newton Raphson method - Solution of linear system of equations: Gaussian elimination method - Gauss Jacobi method - Gauss Seidel method - Eigenvalues of a matrix by power method.	
Unit-2 - Curve Fitting and Interpolation	***12 Hour***
Curve fitting – Method of least squares – Interpolation: Newton's forward and backward difference - Divided differences – Newton's divided difference - Lagrange's interpolation – Inverse interpolation.	
Unit-3 - Numerical Differentiation and Integration	***12 Hour***
Numerical differentiation by using Newton's forward, backward and divided differences - Numerical integration by trapezoidal and Simpson's 1/3rd and 3/8th rules.	
Unit-4 - Numerical Solution of Ordinary Differential Equation	***12 Hour***
Single step methods: Taylor's series method, Euler and Improved Euler methods, fourth order Runge – Kutta method – Multistep methods: Milne's predictor - corrector method.	
Unit-5 - Numerical Solution of Partial Differential Equations	***12 Hour***
Finite difference techniques: Solution of two dimensional Laplace's equations by Liebmann's iterative process and Poisson's equations – Solution of one dimensional heat equation using Bender Schmidt and Crank Nicholson difference schemes -Solution of one dimensional wave equation by explicit scheme.	

Learning Resources	1. *S.S. Sastry, Introductory Methods of Numerical Analysis, Prentice - Hall of India Pvt Ltd, New Delhi, 2003.* 2. *M.K.Jain, SRK Iyengar and R.L.Jain, Numerical Methods for Scientific and Engineering Computation, Wiley Eastern Ltd., 4th edition, 2003.* 3. *F. B. Hildebrand, Introduction to Numerical Analysis (2nd edition), Dover Publications, 2013.*	4. *Steven C.Chapra and Raymond P. Canale, "Numerical Methods for Engineers with Programming and Software Applications", McGraw-Hill, 2004.* 5. *B.S. Grewal, Numerical Methods in Engineering and Science, Khanna Publishers, 42nd edition, 2012.* 6. *D. R. Kincaid, E.W. Cheney, Numerical Analysis Mathematics of Scientific Computing, The University of Texas at Austin. Brooks/Cole Publishing Company, 1991.*

Learning Assessment

	Bloom's Level of Thinking	*Continuous Learning Assessment (CLA)*				*Summative Final Examination (40% weightage)*	
		Formative CLA-1 Average of unit test (50%)		*Life-Long Learning CLA-2 (10%)*			
		Theory	*Practice*	*Theory*	*Practice*	*Theory*	*Practice*
Level 1	*Remember*	*20%*	-	*20%*	-	*20%*	-
Level 2	*Understand*	*20%*	-	*20%*	-	*20%*	-
Level 3	*Apply*	*30%*	-	*30%*	-	*30%*	-
Level 4	*Analyze*	*30%*	-	*30%*	-	*30%*	-
Level 5	*Evaluate*	-	-	-	-	-	-
Level 6	*Create*	-	-	-	-	-	-
	Total	*100 %*		*100 %*		*100 %*	

Course Designers

Experts from Industry	**Experts from Higher Technical Institutions**	**Internal Experts**
1. *Mr. Madhan Shanmugasundaram, Infosys Technologies, madshan@gmail.com*	1. *Prof. Y.V.S.S. Sanyasiraju, IIT Madras, sryedida@iitm.ac.in*	1. *Dr. V. Subburayan, SRMIST*
	2. *Prof. K.C. Sivakumar, IIT Madras, kcskumar@iitm.ac.in*	2. *Dr. R. Perumal, SRMIST*

Course Code	21MAB203T	Course Name	PROBABILITY AND STOCHASTIC PROCESSES	Course Category	B	BASIC SCIENCES	L	T	P	C
							3	1	0	4

Pre-requisite Courses	*Nil*	Co- requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Mathematics*	Data Book / Codes / Standards		*Nil*	

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*
CLR-1:	*describe the applications on discrete and continuous random variables*
CLR-2:	*assess the applications of two-dimensional random variables*
CLR-3:	*infer the various modes of convergence of random variables and their limit theorems*
CLR-4:	*relate the specialized knowledge in random processes in signals and systems*
CLR-5:	*determine the applications of spectral density functions and linear time-invariant systems*

Course Outcomes (CO):	*At the end of this course, learners will be able to:*	Program Outcomes (PO)												Program Specific Outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12			
		Engineering Knowledge	Problem Analysis	Design/development of solutions	Conduct investigations of complex problems	Modern Tool Usage	The engineer and society	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO-1	PSO-2	PSO-3
CO-1:	*evaluate the characteristics of discrete and continuous random variables*	*3*	*3*	-	-	-	-	-	-	-	-	-	-	-	-	-
CO-2:	*explain the model and analyze systems using two-dimensional random variables*	*3*	*3*	-	-	-	-	-	-	-	-	-	-	-	-	-
CO-3:	*classify limit theorems and evaluate upper bounds using various inequalities*	*3*	*3*	-	-	-	-	-	-	-	-	-	-	-	-	-
CO-4:	*analyze the characteristics of random processes*	*3*	*3*	-	-	-	-	-	-	-	-	-	-	-	-	-
CO-5:	*examine problems in spectral density functions and linear time-invariant systems*	*3*	*3*	-	-	-	-	-	-	-	-	-	-	-	-	-

Unit-1 - One-Dimensional Random Variable and Probability Distributions ***12 Hour***

One-dimensional random variable: Discrete Case-Probability function, Cumulative Distribution Function, continuous random variable-Probability density function, Cumulative distribution function-properties, Problems on one-dimensional random variable, Expectation, variance, Moments - raw and central moments, Binomial distribution –moments, Binomial distribution-Applications, Poisson distribution-moments, Poisson distribution –Applications, Exponential distribution-moments, Exponential distribution-Applications, Normal Distribution-moments, Normal Distribution-Applications, Uniform Distribution-moments, Uniform Distribution-Applications, Function of a random variable, Applications of random variables in engineering.

Unit-2 - Two-Dimensional Random Variable and Correlation Functions ***12 Hour***

Two-dimensional random variables-Discrete cases, Probability function of (X, Y) - Marginal probability distribution, Conditional probability distribution of (X, Y), Problems on discrete random variables, Continuous random variables – Joint PDF, Marginal Probability distributions, Conditional probability distribution of (X, Y), Problems on continuous two-dimensional random variables, Independent random variables, Cumulative distribution function-properties of F(x, y), Expected values of two-dimensional random variables, Covariance and correlation, Conditional expected values, Problems on uncorrelated random variables, Functions of two-dimensional random variables, Probability density functions of the type Z=XY, Probability density functions of the type Z=X-Y, Probability density functions of the type Z=X/Y. Application of two-dimensional random variables in engineering.

Unit-3 - Probability Bounds and Central Limit Theorems ***12 Hour***

Limit theorems--Markov's inequality, Chebyshev's inequality without proof, Chebyshev's inequality - Applications, Chebyshev's inequality – Applications using Binomial distribution, Chebyshev's inequality– Applications using Exponential distribution, The weak law of large numbers, Central limit theorem without proof, Central limit theorem - Applications, Central limit theorem- Applications using Poisson random variables, Central limit theorem- Applications using Exponential random variables, The strong law of large numbers, The strong law of large numbers, One-sided Chebychev's inequality, Cauchy Schwartz inequality, Chernoff bounds, Chernoff bounds for the standard normal variate, Chernoff bounds for the Poisson random variate, Jenson's inequality, Applications of Central Limit Theorem in engineering.

Unit-4 - Random Processes and Stationary Processes	**12 Hour**
Random Processes-Introduction, Classification of random processes, Distribution of the process, Averages of the process, Stationary, SSS, WSS processes, Problems on stationary and SSS processes, Problem, Problems on WSS process, Problems on WSS process, Autocorrelation function -properties, Proof of properties, Problems on autocorrelation function, Application of autocorrelation function, Cross-correlation-properties, Proof of properties, Problems on Cross-correlation function, Ergodicity, Mean ergodic process, Mean ergodic theorem, Applications of random process in engineering.	
Unit-5 - Spectral Density of Random Process and Linear System with Random Inputs	**12 Hour**
Power spectral density function- properties, Proof of properties, Problems on power spectral density function, Problems on power spectral density function, Power density spectrum, Problems based on power density spectrum, Linear systems with random inputs, Representation of system in the form of convolution, Unit impulse response of the system, Properties, Applications of unit impulse function, Einstein Weiner-Khinchine Relationship, Cross-power density spectrum-problems, Cross-power density spectrum Cross-power density spectrum, Applications of power spectral density functions in engineering, Applications of power spectral density functions in engineering.	

Learning Resources	1. *A. Papoulis, S. Unnikrishna Pillai, Probability, Random Variables and Stochastic Processes 4th Edition, Mcgraw Hill, 2002.* 2. *Henry Stark, Probability and Random Processes with Applications to Signal Processing, Third Edition, Pearson 2004* 3. *Sheldon Ross, A first course in Probability, Sixth Edition, 2011.*	4. *S.C. Gupta, V.K. Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand & Sons, 11th Edition, 2015.* 5. *Jay L DeVore, Probability and Statistics for Engineering and the Sciences, 8th Edition, Cengage Learning India Pvt. Ltd, 2012.* 6. *T. Veerarajan, Probability, Statistics and Random Processes with Queueing Theory and Queueing Networks, 4th Edition, McGraw-Hill Education, New Delhi, 2015.*

Learning Assessment

	Bloom's Level of Thinking	*Continuous Learning Assessment (CLA)*				*Summative Final Examination (40% weightage)*	
		Formative CLA-1 Average of unit test (50%)		*Life-Long Learning CLA-2 (10%)*			
		Theory	*Practice*	*Theory*	*Practice*	*Theory*	*Practice*
Level 1	*Remember*	*20%*	-	*20%*	-	*20%*	-
Level 2	*Understand*	*20%*	-	*20%*	-	*20%*	-
Level 3	*Apply*	*30%*	-	*30%*	-	*30%*	-
Level 4	*Analyze*	*30%*	-	*30%*	-	*30%*	-
Level 5	*Evaluate*	-	-	-	-	-	-
Level 6	*Create*	-	-	-	-	-	-
	Total	*100 %*		*100 %*		*100 %*	

Course Designers

Experts from Industry	**Experts from Higher Technical Institutions**	**Internal Experts**
1. *Mr. Madhan Shanmugasundaram, Infosys Technologies, madshan@gmail.com*	1. *Prof. Y.V.S.S. Sanyasiraju, IIT Madras, sryedida@iitm.ac.in*	1. *Dr. V. Subburayan, SRMIST*
	2. *Prof. K.C. Sivakumar, IIT Madras, kcskumar@iitm.ac.in*	2. *Dr. G. Vijayalakshmi, SRMIST*

Course Code	21MAB204T	Course Name	PROBABILITY AND QUEUEING THEORY	Course Category	B	BASIC SCIENCES	L	T	P	C
							3	1	0	4

Pre-requisite Courses	*Nil*	Co- requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Mathematics*	Data Book / Codes / Standards		*Nil*	

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*
CLR-1:	*describe the properties of a random variable*
CLR-2:	*gain knowledge of discrete and continuous distributions*
CLR-3:	*understand the basic concepts of two-dimensional random variables, correlation, and regression lines*
CLR-4:	*interpret the system characteristics of queueing models*
CLR-5:	*create Markov chains and investigate stationary state distribution*

Course Outcomes (CO):	*At the end of this course, learners will be able to:*	Program Outcomes (PO)												Program Specific Outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12			
		Engineering Knowledge	Problem Analysis	Design/development of solutions	Conduct investigations of complex problems	Modern Tool Usage	The engineer and society	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO-1	PSO-2	PSO-3
CO-1:	*evaluate the characteristics of discrete and continuous random variables and apply them in science and engineering*	*3*	*3*	-	-	-	-	-	-	-	-	-	-	-	-	-
CO-2:	*identify the random variables and model them using various distributions*	*3*	*3*	-	-	-	-	-	-	-	-	-	-	-	-	-
CO-3:	*infer results from two dimensional random variables which describe real life phenomenon*	*3*	*3*	-	-	-	-	-	-	-	-	-	-	-	-	-
CO-4:	*examine the significant results of various queueing models*	*3*	*3*	-	-	-	-	-	-	-	-	-	-	-	-	-
CO-5:	*determine the transition probabilities and classify the states of the Markov chain*	*3*	*3*	-	-	-	-	-	-	-	-	-	-	-	-	-

Unit-1 - Random Variables	***12 Hour***
Probability concepts - Discrete and continuous random variables - Probability distribution function, Cumulative distribution function - Moments - Central and raw moments, Expectation and variance - Moment generating function (MGF) –Tchebycheff's inequality – Function of a random variable.	
Unit-2 - Theoretical Distributions	***12 Hour***
Discrete distribution - Binomial distribution, Poisson distribution - MGF, Mean, Variance, Theoretical frequencies and applications – Continuous distribution - Exponential and normal distributions – MGF, Mean, Variance and applications.	
Unit-3 - Two-Dimensional Random Variables	***12 Hour***
Joint distributions - Marginal and conditional distributions – Covariance – Correlation and linear regression – Central limit theorem (for independent and identically distributed random variables)	
Unit-4 - Queueing Theory	***12 Hour***
Queueing theory – Characteristics of a queueing Model – Kendal's notation – Poisson queues - (M/M/1): (∞/FIFO) Model – System characteristics – Applications - (M/M/s): (∞/FIFO) Model - System characteristics – Applications - (M/M/1): (k/FIFO) Model - System characteristics – Applications.	
Unit-5 - Markov Chain	***12 Hour***
Markov process – Markov chain – One step transition probability matrix – Chapman Kolmogorov theorem – Limiting probabilities – Classification of states of a Markov chain.	

Learning Resources	1. *Sheldon Ross, A first course in probability, Pearson, 9th Edition, 2019.* 2. *S.C. Gupta, V.K. Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand & Sons, 12th Edition, 2018.* 3. *K. S Trivedi, Probability and Statistics with Reliability, Queuing and Computer Science Applications, Prentice Hall of India, New Delhi, 2nd Edition, 2016.*	4. *Arnold O. Allen, Probability, Statistics and Queueing Theory with Computer Science Applications, Academic Press, 2nd Edition, 1990.* 5. *D. Gross, John F. Shortle, James M. Thompson, Carl M. Harris- Fundamentals of Queueing Theory, Wiley India Pvt. Ltd. 4th Edition, 2013.* 6. *T. Veerarajan, Probability, Statistics and Random Processes with Queueing Theory and Queueing Networks, Tata McGraw-Hill, New Delhi, 4th Edition 2015*

Learning Assessment

	Bloom's Level of Thinking	*Continuous Learning Assessment (CLA)*				*Summative Final Examination (40% weightage)*	
		Formative CLA-1 Average of unit test (50%)		*Life-Long Learning CLA-2 (10%)*			
		Theory	*Practice*	*Theory*	*Practice*	*Theory*	*Practice*
Level 1	*Remember*	*20%*	-	*20%*	-	*20%*	-
Level 2	*Understand*	*20%*	-	*20%*	-	*20%*	-
Level 3	*Apply*	*30%*	-	*30%*	-	*30%*	-
Level 4	*Analyze*	*30%*	-	*30%*	-	*30%*	-
Level 5	*Evaluate*	-	-	-	-	-	-
Level 6	*Create*	-	-	-	-	-	-
	Total	*100 %*		*100 %*		*100 %*	

Course Designers

Experts from Industry	**Experts from Higher Technical Institutions**	**Internal Experts**
1. *Mr. Madhan Shanmugasundaram, Infosys Technologies, madshan@gmail.com*	1. *Prof. Y.V.S.S. Sanyasiraju, IIT Madras, sryedida@iitm.ac.in*	1. *Dr. V. Subburayan, SRMIST*
	2. *Prof. K.C. Sivakumar, IIT Madras, kcskumar@iitm.ac.in*	2. *Dr. H. Merlyn Margaret, SRMIST*

Course Code	21MAB206T	Course Name	NUMERICAL METHODS AND ANALYSIS	Course Category	B	BASIC SCIENCES	L	T	P	C
							3	1	0	4

Pre-requisite Courses	*Nil*	Co- requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Mathematics*	Data Book / Codes / Standards		*Nil*	

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*
CLR-1:	*understand the methodologies to solve algebraic and transcendental equations*
CLR-2:	*gain knowledge on interpolating and extrapolating methods in various intervals in real life*
CLR-3:	*understand the concept of numerical differentiation and integration*
CLR-4:	*solve initial and boundary value problems in differential equations using numerical methods*
CLR-5:	*solve initial and boundary value problems in partial differential equations using numerical methods*

Course Outcomes (CO):	*At the end of this course, learners will be able to:*	Program Outcomes (PO)												Program Specific Outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12			
		Engineering Knowledge	Problem Analysis	Design/development of solutions	Conduct investigations of complex problems	Modern Tool Usage	The engineer and society	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO-1	PSO-2	PSO-3
CO-1:	*obtain numerical solutions to algebraic and transcendental equations*	*3*	*3*	-	-	-	-	-	-	-	-	-	-	-	-	-
CO-2:	*learn about various interpolating and extrapolating methods*	*3*	*3*	-	-	-	-	-	-	-	-	-	-	-	-	-
CO-3:	*compute numerical differentiation and Integration*	*3*	*3*	-	-	-	-	-	-	-	-	-	-	-	-	-
CO-4:	*interpret initial and final value problems in differential equations*	*3*	*3*	-	-	-	-	-	-	-	-	-	-	-	-	-
CO-5:	*interpret initial and boundary value problems in partial differential equations*	*3*	*3*	-	-	-	-	-	-	-	-	-	-	-	-	-

Unit-1 - Numerical Solutions of Algebraic and Transcendental Equations	***12 Hour***
Numerical Solution of Algebraic and Transcendental equation—Iteration Method, Bisection Method, Method of False Position, Newton-Raphson method and it's rate of convergence; Solving System of Simultaneous Linear Algebraic Equations — Gauss Elimination Method, Gauss Jordon Method, Jacobi Method, Gauss-Seidel Method.	
Unit-2 - Finite Differences and Interpolation	***12 Hour***
Introduction to Finite Differences—Forward and Backward Differences, Relation Between Operators, Differences of a polynomial—Factorial Polynomial, Newton's interpolation—Newton's forward and Backward Interpolation for Equal Intervals; Divided Differences and Properties, Interpolation with Unequal Intervals— Newton's Divided Difference Interpolation, Lagrange's Interpolation, Inverse Lagrange's Interpolation.	
Unit-3 - Numerical Differentiation and Integration	***12 Hour***
Numerical Differentiation—Newton's Forward and Backward Difference Formulae to Compute First and Higher Order Derivatives, Numerical Integration- Trapezoidal Rule, Simpson's One-Third Rule, Simpson's Three Eight Rule. Applications of Trapezoidal Rule, Applications of Simpson's One-Third Rule, Simpson's Three Eight Rule	
Unit-4 - Numerical Solution of Ordinary Differential Equations	***12 Hour***
Taylor Series Method, Euler's Method and its rate of convergence, Improved Euler's Method, Modified Euler's method, Runge-Kutta Second-Order Method, Runge-Kutta Fourth Order Method and their order of convergence.	
Unit-5 - Numerical Solutions of Partial Differential Equations	***12 Hour***
Classification of Second-Order Partial Differential Equations, Elliptic Equations-Finite Difference Scheme, Standard Five Point Finite Difference Formula, Diagonal Five Point Finite Difference Formula, Liebman's Iterative Process, Solution of Laplace Equations by Liebman's Iterative process, Solution of Poisson Equation, One Dimensional Parabolic Equation— Bender-Schmidt Scheme, Crank-Nicholson scheme	

Learning Resources	1. *Brian Bradie, a Friendly Introduction to Numerical Analysis. Pearson. (2006)* 2. *D. R. Kincaid, E.W. Cheney, Numerical Analysis Mathematics of Scientific Computing, the University of Texas at Austin. Brooks/Cole Publishing Company, (1991).* 3. *C. F. Gerald & P. O. Wheatley. Applied Numerical Analysis (7th edition), Pearson Education, India, (2008)*	4. *F. B. Hildebrand Introduction to Numerical Analysis: (2nd edition). Dover, (2013).* 5. *M. K. Jain, S. R. K. Iyengar & R. K. Jain, Numerical Methods for Scientific and Engineering Computation (6th edition). New Age International Publishers Publications. (2012).* 6. *P. Kandasamy , K. Thilagavathy & G. Gunawathy, Numerical Methods, S.Chand & Sons, 3rd Revised Edition, 2013.*

Learning Assessment

	Bloom's Level of Thinking	*Continuous Learning Assessment (CLA)*				*Summative Final Examination (40% weightage)*	
		Formative CLA-1 Average of unit test (50%)		*Life-Long Learning CLA-2 (10%)*			
		Theory	*Practice*	*Theory*	*Practice*	*Theory*	*Practice*
Level 1	*Remember*	*20%*	-	*20%*	-	*20%*	-
Level 2	*Understand*	*20%*	-	*20%*	-	*20%*	-
Level 3	*Apply*	*30%*	-	*30%*	-	*30%*	-
Level 4	*Analyze*	*30%*	-	*30%*	-	*30%*	-
Level 5	*Evaluate*	-	-	-	-	-	-
Level 6	*Create*	-	-	-	-	-	-
	Total	*100 %*		*100 %*		*100 %*	

Course Designers

Experts from Industry	**Experts from Higher Technical Institutions**	**Internal Experts**
1. *Mr. Madhan Shanmugasundaram, Infosys Technologies, madshan@gmail.com*	1. *Prof. Y.V.S.S. Sanyasiraju, IIT Madras, sryedida@iitm.ac.in*	1. *Dr. B.Vennila, SRMIST*
	2. *Prof. K.C. Sivakumar, IIT Madras, kcskumar@iitm.ac.in*	2. *Dr. Abdul Haq, SRMIST*

Course Code	21MAB209T	Course Name	TRANSFORMS AND COMPUTATIONAL TECHNIQUES	Course Category	B	BASIC SCIENCES	L	T	P	C
							3	1	0	4

Pre-requisite Courses	*Nil*	Co- requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Mathematics*	Data Book / Codes / Standards		*Nil*	

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*
CLR-1:	*compute the Fourier series expansion and express sine and cosine series*
CLR-2:	*analyze Fourier Transforms and its properties and solve discrete-time signal problems using z transforms*
CLR-3:	*construct and solve partial differential equations using various techniques., Identify partial differential equations and utilize Fourier series techniques to solve one dimensional wave and heat equations*
CLR-4:	*apply the numerical techniques for solutions of ordinary differential equations*
CLR-5:	*apply the numerical techniques for solutions of partial differential equations*

Course Outcomes (CO):	*At the end of this course, learners will be able to:*	Program Outcomes (PO)												Program Specific Outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12			
		Engineering Knowledge	Problem Analysis	Design/development of solutions	Conduct investigations of complex problems	Modern Tool Usage	The engineer and society	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO-1	PSO-2	PSO-3
CO-1:	*explain the Fourier series expansion of a function in terms of sine and cosine series*	*3*	*3*	-	-	-	-	-	-	-	-	-	-	-	-	-
CO-2:	*apply Fourier transforms techniques in signal analysis, Solve discrete-time signal problems using z transforms*	*3*	*3*	-	-	-	-	-	-	-	-	-	-	-	-	-
CO-3:	*identify partial differential equations and utilize Fourier series techniques to solve one dimensional wave and heat equations*	*3*	*3*	-	-	-	-	-	-	-	-	-	-	-	-	-
CO-4:	*solve the numerical solutions of ordinary differential equations*	*3*	*3*	-	-	-	-	-	-	-	-	-	-	-	-	-
CO-5:	*solve the numerical solutions of partial differential equations*	*3*	*3*	-	-	-	-	-	-	-	-	-	-	-	-	-

Unit-1 - Fourier Series	***12 Hour***
Dirichlet's conditions – Fourier Series – Functions having arbitrary periods – Odd and even function - Half range sine and cosine Fourier series - Parseval's identity – Harmonic Analysis.	
Unit-2 - Fourier Transforms and Z Transforms	***12 Hour***
Fourier transform pair –-Fourier sine and cosine transforms – Transforms of simple functions - Convolution theorem (without proof) – Parseval's identity - Z – transforms: Properties of Z transforms – Inverse Z transforms – Convolution theorem (without Proof) – Solution of linear difference equations with constant coefficients using Z-transform	
Unit-3 - Partial Differential Equations and Their Application	***12 Hour***
Classification of second-order partial differential equations - Linear Partial differential equations of second and higher order with constant coefficients of homogeneous type-Solutions of one dimensional wave equation - One dimensional equation of heat conduction - Steady state conditions with zero boundary	
Unit-4 - Numerical Solutions of Firstorder Ordinary Differential Equations and Numerical Integration	***12 Hour***
Solutions of first order simultaneous differential equations by Taylor's series method - Euler's method and its applications - Runge-Kutta method of fourth order (No proof) - Trapezoidal rule – Simpson's one third and Simpson's 3/8th rule.	
Unit-5 - Numerical Solutions of Partial Differential Equations	***12 Hour***
Classification of Second order PDE-Solutions of Elliptic Equations- Solutions of Laplace Equations by Liebmann's iterative process- Solutions of Poisson Equations- Solutions of Parabolic equations by Bender-Schmidt formula- Solutions of Parabolic equations by Crank-Nicolson formula- Solutions of Hyperbolic equations by Explicit formula.	

Learning Resources	1. *Erwin Kreyszig, Advanced Engineering Mathematics, 10th Edition,John Wiley & Sons, 2015.* 2. *B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 43rd Edition, 2015.* 3. *B.V. Ramana, Higher Engineering Mathematics, 3rd Edition,Tata McGraw Hill New Delhi, 2010.* 4. *M.K. Venkataraman, Numerical Methods in Science and Engineering,National Publishing Co. 2005* 5. *P.Kandasamy ET. al., Numerical Methods, S Chand & Co., New Delhi, 2003.*	6. *P. Kandasamy, et. al. Engineering Mathematics, Vol.II & Vol.III (4th revised edition), S. Chand & Co., New Delhi,2000* 7. *T. Veerarajan, Transforms and Partial Differential Equations, Tata McGraw-Hill, New Delhi, 3rd edition,2012.* 8. *B.S. Grewal, Numerical Methods in Engineering and Science,Khanna Publishers,42nd ed, 2012.*

Learning Assessment

	Bloom's Level of Thinking	*Continuous Learning Assessment (CLA)*				*Summative Final Examination (40% weightage)*	
		Formative CLA-1 Average of unit test (50%)		*Life-Long Learning CLA-2 (10%)*			
		Theory	*Practice*	*Theory*	*Practice*	*Theory*	*Practice*
Level 1	*Remember*	*20%*	-	*20%*	-	*20%*	-
Level 2	*Understand*	*20%*	-	*20%*	-	*20%*	-
Level 3	*Apply*	*30%*	-	*30%*	-	*30%*	-
Level 4	*Analyze*	*30%*	-	*30%*	-	*30%*	-
Level 5	*Evaluate*	-	-	-	-	-	-
Level 6	*Create*	-	-	-	-	-	-
	Total	*100 %*		*100 %*		*100 %*	

Course Designers

Experts from Industry	**Experts from Higher Technical Institutions**	**Internal Experts**
1. *Mr. Madhan Shanmugasundaram, Infosys Technologies, madshan@gmail.com*	1. *Prof. Y.V.S.S. Sanyasiraju, IIT Madras, sryedida@iitm.ac.in*	1. *Dr. V. Subburayan, SRMIST*
	2. *Prof. K.C. Sivakumar, IIT Madras, kcskumar@iitm.ac.in*	2. *Dr. N. Balaji, SRMIST*

Course Code	21MAB210T	Course Name	STATISTICAL MODELING	Course Category	B	BASIC SCIENCES	L	T	P	C
							3	1	0	4

Pre-requisite Courses	*Nil*	Co- requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Mathematics*	Data Book / Codes / Standards		*Nil*	

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*
CLR-1:	*apply the sampling techniques in engineering field*
CLR-2:	*describe the measures of central tendency and measures of dispersion*
CLR-3:	*understand the basics and importance of estimate of statistical data*
CLR-4:	*describe the basics and importance of non-parametric methods in testing hypothesis*
CLR-5:	*apply the procedure for Time series analysis and Forecasting*

Course Outcomes (CO):	*At the end of this course, learners will be able to:*	Program Outcomes (PO)												Program Specific Outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12			
		Engineering Knowledge	Problem Analysis	Design/development of solutions	Conduct investigations of complex problems	Modern Tool Usage	The engineer and society	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO-1	PSO-2	PSO-3
CO-1:	*choose the appropriate sampling techniques*	*3*	*3*	-	-	-	-	-	-	-	-	-	-	-	-	-
CO-2:	*comprehend the basics of statistics and statistical methods*	*3*	*3*	-	-	-	-	-	-	-	-	-	-	-	-	-
CO-3:	*evaluate statistical data using methods of estimation*	*3*	*3*	-	-	-	-	-	-	-	-	-	-	-	-	-
CO-4:	*infer from the non-parametric methods*	*3*	*3*	-	-	-	-	-	-	-	-	-	-	-	-	-
CO-5:	*illustrate the time series analysis and forecasting and apply them in the problems in science and engineering*	*3*	*3*	-	-	-	-	-	-	-	-	-	-	-	-	-

Unit-1 - Sampling Techniques	***12 Hour***
Random sampling - Sampling from finite and infinite populations - Estimates and standard error (sampling with replacement and sampling without replacement) - Sampling distribution of sample mean - stratified random sampling - Systematic sampling and cluster sampling.	
Unit-2 - Introduction to Statistics	***12 Hour***
Definition of Statistics - Basic objectives - Applications in various branches of science with examples - Collection of Data: Internal and external data, primary and secondary data - Population and sample - Representative sample - Descriptive Statistics: Classification and tabulation of univariate data - graphical representation - Frequency curves - Descriptive measures - central tendency and dispersion.	
Unit-3 - Estimation Theory and Testing Hypothesis	***12 Hour***
Point estimation - criteria for good estimates (unbiasedness, consistency) - Methods of estimation including maximum likelihood estimation - Sufficient statistic: concept and examples, complete sufficiency and their application in estimation - Test of hypothesis: concept and formulation - Type I and Type II errors - Neyman Pearson lemma.	
Unit-4 - Non-Parametric Inference	***12 Hour***
Comparison with parametric inference - Use of order statistics - Sign test - Wilcoxon signed rank test - Mann-Whitney test - Run test - Kolmogorov-Smirnov test - Spearman's and Kendall's test - Tolerance region.	
Unit-5 - Basics of Time Series Analysis and Forecasting	***12 Hour***
Basics of Time Series Analysis and Forecasting – Stationary - ARIMA Models: Identification - Estimation and Forecasting – Applications to industrial problems.	

Learning Resources	1. *Gun, M. K. Gupta and B.Dasgupta, Fundamentals of Statistics (Vol. I & Vol. II), World Press, 2016,* 2. *S.C. Gupta, V.K. Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand & Sons, 11th Edition, 2015.* 3. *M. Rajagopalan and P. Dhanavanthan, Statistical inference, PHI Learning Private Limited, New Delhi, 2012.*	4. *I.R. Miller, J.E. Freund and R. Johnson, Probability and Statistics for Engineers, 4th Edition, PHI Learning Private Limited, New Delhi, 2015.* 5. *S. C. Gupta and V. K. Kapoor, Fundamentals of Applied Statistics, 4th Revised Edition, Sultan Chand & Sons, 2019.* 6. *Chris Chatfield, The Analysis of Time Series: An Introduction, Sixth edition, Chapman and Hall/CRC, 2004.*

Learning Assessment

	Bloom's Level of Thinking	*Continuous Learning Assessment (CLA)*				*Summative Final Examination (40% weightage)*	
		Formative CLA-1 Average of unit test (50%)		*Life-Long Learning CLA-2 (10%)*			
		Theory	*Practice*	*Theory*	*Practice*	*Theory*	*Practice*
Level 1	*Remember*	*20%*	-	*20%*	-	*20%*	-
Level 2	*Understand*	*20%*	-	*20%*	-	*20%*	-
Level 3	*Apply*	*30%*	-	*30%*	-	*30%*	-
Level 4	*Analyze*	*30%*	-	*30%*	-	*30%*	-
Level 5	*Evaluate*	-	-	-	-	-	-
Level 6	*Create*	-	-	-	-	-	-
	Total	*100 %*		*100 %*		*100 %*	

Course Designers

Experts from Industry	**Experts from Higher Technical Institutions**	**Internal Experts**
1. *Mr. Madhan Shanmugasundaram, Infosys Technologies, madshan@gmail.com*	1. *Prof. Y.V.S.S. Sanyasiraju, IIT Madras, sryedida@iitm.ac.in*	1. *Dr. V. Subburayan, SRMIST*
	2. *Prof. K.C. Sivakumar, IIT Madras, kcskumar@iitm.ac.in*	2. *Dr.R.Varadharajan, SRMIST*

Course Code	21MAB301T	Course Name	PROBABILITY AND STATISTICS	Course Category	B	BASIC SCIENCES	L	T	P	C
							3	1	0	4

Pre-requisite Courses	*Nil*	Co- requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Mathematics*	Data Book / Codes / Standards		*Nil*	

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*
CLR-1:	*apply the basic rules and theorems of probability theory and evaluate the expectation and variance using random variables*
CLR-2:	*gain knowledge of theoretical distributions*
CLR-3:	*understand how to develop Null and Alternate hypothesis and draw conclusions using hypothesis tests*
CLR-4:	*apply the knowledge of regression lines and analysis of variance*
CLR-5:	*acquire knowledge to solve the problems of process control*

Course Outcomes (CO):	*At the end of this course, learners will be able to:*	Program Outcomes (PO)												Program Specific Outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12			
		Engineering Knowledge	Problem Analysis	Design/development of solutions	Conduct investigations of complex problems	Modern Tool Usage	The engineer and society	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO-1	PSO-2	PSO-3
CO-1:	*implement the concepts of probability and random variables*	*3*	*3*	-	-	-	-	-	-	-	-	-	-	-	-	-
CO-2:	*identify the random variables and model them using various distributions*	*3*	*3*	-	-	-	-	-	-	-	-	-	-	-	-	-
CO-3:	*infer results by using hypothesis testing on large and small samples*	*3*	*3*	-	-	-	-	-	-	-	-	-	-	-	-	-
CO-4:	*examine the regression lines and interpret the results in the analysis of variance*	*3*	*3*	-	-	-	-	-	-	-	-	-	-	-	-	-
CO-5:	*utilize quality control techniques to solve real-world problems*	*3*	*3*	-	-	-	-	-	-	-	-	-	-	-	-	-

Unit-1 - Probability and One-Dimensional Random Variable	***12 Hour***
Probability concepts, Types of Events, Axioms and theorems - Conditional probability, Baye's theorem (without proof) - Applications of Baye's Theorem. Random variables – Discrete case and continuous case- Mathematical expectation, Variance –discrete case and continuous case - Raw Moments - Central Moments - Moment generating function (MGF) - discrete and continuous random variable.	
Unit-2 - Theoretical Distributions	***12 Hour***
Discrete distributions – Introduction- Mean and Variance of Binomial Distribution- Fitting a Binomial distribution- MGF of Binomial Distribution- Poisson Distribution- Mean and Variance of Poisson Distribution- Fitting a Poisson distribution- MGF of Poisson distribution- Geometric distribution- mean and variance, Memoryless property- Continuous distributions – Introduction- Uniform distribution – MGF, Mean and Variance- Exponential distribution - MGF, Mean and Variance, Memoryless property- Normal distribution.	
Unit-3 - Testing of Hypothesis	***12 Hour***
Sampling Distributions – Type I and Type II errors- large sample test-Test of significance for single proportion- Test of significance for difference of proportions- Test of significance for single mean- Test of significance for difference of means- Small sample tests- Student's t- test for single mean- t- test for the difference of means- Fisher's F-test- Test of significance for two sample variances- Chi -square tes for the goodness of fit- Chi-square test for the independence of attributes.	
Unit-4 - Correlation, Regression and ANOVA	***12 Hour***
Correlation and its Properties- Karl Pearson's coefficient of correlation- Spearman's rank correlation coefficient for repeated and non-repeated ranks- Linear Regression lines and Properties- Relation between correlation and regression coefficient- Introduction to Analysis of Variance (ANOVA) - One-way Classification – two-way classification.	
Unit-5- Statistical Quality Control	***12 Hour***
Introduction – Process control – control charts for variables - $\bar{X}$ and R, $\bar{X}$ and S charts- control charts for attributes: p-chart, np-chart, c- chart and their applications in process control.	

Learning Resources	1. *S. Ross, A First Course in Probability, 8th Ed., Pearson Education India, 2010.* 2. *Johnson. R.A., Miller &Freund's, Probability and Statistics for Engineers, 8th Edition, Prentice Hall India, 2011.* 3. *Veerarajan T., Probability and Statistics, Tata McGraw-Hill, New Delhi, 2010.*	4. *Devore (JL), Probability and Statistics for Engineering and the Sciences, 8th Edition, Cengage Learning, 2012.* 5. *S.C. Gupta,V.K. Kapoor,Fundamentals of Mathematical Statistics,Sultan Chand & Sons11th ed 2015.* 6. *Vijay K. Rohatgi., A.K. Md. Ehsanes Saleh, An Introduction to Probability and Statistics, 2nd Edition, Wiley, 2008*

Learning Assessment

	Bloom's Level of Thinking	*Continuous Learning Assessment (CLA)*				*Summative Final Examination (40% weightage)*	
		Formative CLA-1 Average of unit test (50%)		*Life-Long Learning CLA-2 (10%)*			
		Theory	*Practice*	*Theory*	*Practice*	*Theory*	*Practice*
Level 1	*Remember*	*20%*	-	*20%*	-	*20%*	-
Level 2	*Understand*	*20%*	-	*20%*	-	*20%*	-
Level 3	*Apply*	*30%*	-	*30%*	-	*30%*	-
Level 4	*Analyze*	*30%*	-	*30%*	-	*30%*	-
Level 5	*Evaluate*	-	-	-	-	-	-
Level 6	*Create*	-	-	-	-	-	-
	Total	*100 %*		*100 %*		*100 %*	

Course Designers

Experts from Industry	**Experts from Higher Technical Institutions**	**Internal Experts**
1. *Mr. Madhan Shanmugasundaram, Infosys Technologies, madshan@gmail.com*	1. *Prof. Y.V.S.S. Sanyasiraju, IIT Madras, sryedida@iitm.ac.in*	1. *Dr. B.Vennila, SRMIST*
	2. *Prof. K.C. Sivakumar, IIT Madras, kcskumar@iitm.ac.in*	2. *Dr.R.Varadharajan, SRMIST*

Course Code	21MAB302T	Course Name	DISCRETE MATHEMATICS	Course Category	B	BASIC SCIENCES	L	T	P	C
							3	1	0	4

Pre-requisite Courses	*Nil*	Co- requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Mathematics*	Data Book / Codes / Standards		*Nil*	

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*
CLR-1:	*enhance the mathematical skills by applying the principles of sets and functions in storage, communication and processing the data*
CLR-2:	*culminate in extensive use and application of counting strategies in enumeration of data*
CLR-3:	*apply the rules of inference theory to design electronic circuits and to verify computer programs*
CLR-4:	*apply the knowledge of algebraic structures and coding theory to solve problems on detection and correction of errors occurring in binary communication channels*
CLR-5:	*acquire knowledge to solve problems in communication networks using graph models*

Course Outcomes (CO):	*At the end of this course, learners will be able to:*	Program Outcomes (PO)												Program Specific Outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12			
		Engineering Knowledge	Problem Analysis	Design/development of solutions	Conduct investigations of complex problems	Modern Tool Usage	The engineer and society	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO-1	PSO-2	PSO-3
CO-1:	*apply the concepts of set theory and its operations in data structures and mathematical modelling languages*	*3*	*3*	-	-	-	-	-	-	-	-	-	-	-	-	-
CO-2:	*solve problems using counting techniques and understanding the basics of number theory*	*3*	*3*	-	-	-	-	-	-	-	-	-	-	-	-	-
CO-3:	*comprehend and validate the logical arguments using concepts of inference theory*	*3*	*3*	-	-	-	-	-	-	-	-	-	-	-	-	-
CO-4:	*inculcate the curiosity for applying the concepts of algebraic structures to coding theory*	*3*	*3*	-	-	-	-	-	-	-	-	-	-	-	-	-
CO-5:	*apply graph theory techniques to solve wide variety of real world problems*	*3*	*3*	-	-	-	-	-	-	-	-	-	-	-	-	-

Unit-1 - Set Theory	***12 Hour***
Sets - Operations on sets - Laws of set theory - Partition of a set - Cartesian product of sets - Relations - Properties - Equivalence relation and partial order relation - Poset - Graphs of relations - Digraphs - Hasse diagram - Closures of relations - Transitive closure and Warshall's algorithm - Functions - Types of functions - Composition of functions - Properties - Inverse of functions - Necessary and sufficient condition for existence of inverse function - Uniqueness of identity - Inverse of composition.	
Unit-2 - Combinatorics and Number Theory	***12 Hour***
Permutation and combination - Addition and product rules - Principle of inclusion and exclusion - Pigeon-hole principle and generalized pigeon-hole principle - Divisibility and prime numbers - Fundamental theorem of arithmetic - Prime factorization - Division algorithm- Greatest common divisor - Properties - Euclid's algorithm - Least common multiple.	
Unit-3 - Mathematical Logic	***12 Hour***
Propositions and logical operators - Truth tables - Converse, inverse and contrapositive - Tautology and contradiction - Equivalences - Implications - Laws of logic - Inference theory - Rules of inference - Direct method - CP rule – Inconsistency - Indirect method - Principle of mathematical induction.	
Unit-4 - Algebraic Structures and Coding Theory	***12 Hour***
Groups - Permutation group - Cyclic group - Properties - Subgroup- Group homomorphism - Properties - Ring - Zero divisor - Integral domain- Field -Coding theory - Group code - Hamming codes - Error correction using matrices - Error correction - Decoding group codes.	
Unit-5 - Graph Theory	***12 Hour***
Definitions - Handshaking theorem - Some special graphs - Isomorphism of graphs - Paths, cycles and circuits - Connectivity in undirected graphs - Eulerian and Hamiltonian graphs - Matrix representation of graphs- Isomorphism using adjacency - Digraphs - Trees - Properties - Spanning tree - Kruskal's algorithm - Graph coloring - Chromatic number- Four color theorem (statement only).	

Learning Resources	1. *H. Kenneth Rosen, Discrete Mathematics and its Application, Seventh edition, Tata McGraw-Hill publishing company PVT. Ltd., New Delhi, 2012.* 2. *J.P. Tremblay and R. Manohar, Discrete Mathematical Structures with applications to Computer Science, 35th edition, Tata McGraw Hill Publishing Co., 2008.* 3. *Narsing Deo, Graph Theory with applications to Engineering and Computer science, Prentice-Hall of India pvt. Ltd., New Delhi, 2004*	4. *C.L. Liu, Elements of Discrete Mathematics, 4th Edition, McGraw Higher ED, 2012.* 5. *R.P. Grimaldi, Discrete and Combinatorial Mathematics: An Applied Introduction, 4th Edition, Pearson Education Asia, Delhi, 2007.* 6. *T. Veerarajan, Discrete Mathematics with Graph Theory and Combinatorics, Tata McGraw Hill, 2015.*

Learning Assessment

	Bloom's Level of Thinking	*Continuous Learning Assessment (CLA)*				*Summative Final Examination (40% weightage)*	
		Formative CLA-1 Average of unit test (50%)		*Life-Long Learning CLA-2 (10%)*			
		Theory	*Practice*	*Theory*	*Practice*	*Theory*	*Practice*
Level 1	*Remember*	*20%*	*-*	*20%*	*-*	*20%*	*-*
Level 2	*Understand*	*20%*	*-*	*20%*	*-*	*20%*	*-*
Level 3	*Apply*	*30%*	*-*	*30%*	*-*	*30%*	*-*
Level 4	*Analyze*	*30%*	*-*	*30%*	*-*	*30%*	*-*
Level 5	*Evaluate*	*-*	*-*	*-*	*-*	*-*	*-*
Level 6	*Create*	*-*	*-*	*-*	*-*	*-*	*-*
	Total	*100 %*		*100 %*		*100 %*	

Course Designers

Experts from Industry	**Experts from Higher Technical Institutions**	**Internal Experts**
1. *Mr. Madhan Shanmugasundaram, Infosys Technologies, madshan@gmail.com*	1. *Prof. Y.V.S.S. Sanyasiraju, IIT Madras, sryedida@iitm.ac.in*	1. *Dr. V. Subburayan, SRMIST*
	2. *Prof. K.C. Sivakumar, IIT Madras, kcskumar@iitm.ac.in*	2. *Dr. J. Sasikumar, SRMIST*
		3. *Dr. L. Shobana, SRMIST*

Course Code	21MAB303T	Course Name	BIOSTATISTICS FOR BIOTECHNOLOGISTS	Course Category	B	BASIC SCIENCES	L	T	P	C
							3	1	0	4

Pre-requisite Courses	*Nil*	Co- requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Mathematics*	Data Book / Codes / Standards		*Nil*	

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*
CLR-1:	*gain knowledge in measures of central tendency, measures of dispersion, skewness and kurtosis through moments on statistical data*
CLR-2:	*understand the importance of probability distributions such as Binomial, Poisson and Normal distributions to solve biotechnology related problems*
CLR-3:	*learn how to formulate and test the hypothesis of single means and difference of means, single proportion and difference of proportions for large samples and to understand the sample*
CLR-4:	*gain knowledge on hypothetical tests about means and variances for small samples using the t test and F test, and apply the Chi-square test for goodness of fit and independence of attributes in biotechnological topics, Also, to have knowledge in ANOVA in biotechnology related topics*
CLR-5:	*gain knowledge in correlation and regression lines and the non-parametric tests in biotechnology*

Course Outcomes (CO):	*At the end of this course, learners will be able to:*	Program Outcomes (PO)												Program Specific Outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12			
		Engineering Knowledge	Problem Analysis	Design/development of solutions	Conduct investigations of complex problems	Modern Tool Usage	The engineer and society	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO-1	PSO-2	PSO-3
CO-1:	*explain measures of central tendency and measures of dispersion*	*3*	*3*	-	-	-	-	-	-	-	-	-	-	-	-	-
CO-2:	*apply probability distributions applicable to biotechnology*	*3*	*3*	-	-	-	-	-	-	-	-	-	-	-	-	-
CO-3:	*examine the given problems relating to the large sample test of mean and difference of mean and Chi-square tests*	*3*	*3*	-	-	-	-	-	-	-	-	-	-	-	-	-
CO-4:	*infer from hypothesis tests by using the t-test, F- test, Chi-Square test and ANOVA*	*3*	*3*	-	-	-	-	-	-	-	-	-	-	-	-	-
CO-5:	*evaluate problems on concepts of correlation, regression and non-parametric tests*	*3*	*3*	-	-	-	-	-	-	-	-	-	-	-	-	-

Unit-1 - Measures on Statistical Data ***12 Hour***

Introduction to discrete types of statistical data - Introduction to continuous types of statistical data- Measures of central tendency-Arithmetic mean, geometric mean, harmonic mean, median, mode - Measures of dispersion - Range, quartile deviation, mean deviation, median deviation, mode deviation and standard deviation- Coefficient of dispersion-Coefficient of variation – Raw moments and central moments and their relation. Measures of skewness and kurtosis - Karl Pearson's coefficient of skewness, Bowley's coefficient of skewness.

Unit-2 – Probability ***12 Hour***

Introduction to probability concepts, random experiment, trail, events - Types of events: Impossible, Simple, Mutually Exclusive and Independent events (only definitions, properties- without proof)- Addition and Multiplication Theorems on probability- Total Probability theorem - Baye's Theorem (without proof) and its applications- Introduction to one-dimensional random variable and its types-Expectation(Mean), Variance, Moments and moment generating functions-Binomial Distribution, Poisson Distribution and Normal Distribution.

Unit-3 - Large Sample Tests ***12 Hour***

Sampling Theory- Basic concepts- Population, Sample, Sampling distribution, population parameters and sample statistic- Testing of hypothesis, Null and Alternate hypothesis, Single-tailed and Two-tailed tests, Type-I and Type–II errors- Acceptance and Rejection Regions, Level of Significance, Degrees of freedom and Confidence limits – Large sample tests based on the normal distribution (Z-test)-Z-Test for single mean and for the difference of means, Z-Test for single proportion and difference of proportions

Unit-4 - Small Sample Tests	***12 Hour***
Small sample tests based on t- distribution- For single mean and for the difference of means – Paired t-test- F-test for equality of variances-The Chi-square test for goodness of fit and for Independence of attributes using a contingency table. One-way classifications- ANOVA, Two-way classifications- ANOVA.	
Unit-5 - Correlation, Regression and Non-Parametric Tests	***12 Hour***
Karl Pearson's coefficient of correlations - Spearman's rank correlation coefficient-Regression lines and its applications- Non-parametric tests – The sign test – The Wilcoxon signed –ranked test- Rank sum tests: The Man Whitney U test -The Kruskal Walis test.	

Learning Resources	1. *Mario F. Triola, Elementary Statistics, Pearson, 13th edition, 2018.* 2. *Sheldon M. Ross, Introduction to Probability and Statistics for Engineers and Scientists, Academic press, Sixth Edition, 2021.* 3. *S.C.Gupta and V.K.Kapoor, Fundamentals of Mathematical Statistics, S.Chand & Co, Eleventh Edition, 2018*	4. *Richard I. Levin, David S. Rubin, Masood H. Siddiqui, S. Rastogi, Statistics for Management, Pearson, 8th edition, 2017.* 5. *Bernard Rosner, Fundamentals of Biostatistics, Brooks/core, 8th edition, 2015.* 6. *T. Veerarajan, Probability, Statistics and Random Processes with Queueing Theory and Queueing Networks, 4th Edition, McGraw-Hill Education, New Delhi, 2015.*

Learning Assessment

	Bloom's Level of Thinking	*Continuous Learning Assessment (CLA)*				*Summative Final Examination (40% weightage)*	
		Formative CLA-1 Average of unit test (50%)		*Life-Long Learning CLA-2 (10%)*			
		Theory	*Practice*	*Theory*	*Practice*	*Theory*	*Practice*
Level 1	*Remember*	*20%*	-	*20%*	-	*20%*	-
Level 2	*Understand*	*20%*	-	*20%*	-	*20%*	-
Level 3	*Apply*	*30%*	-	*30%*	-	*30%*	-
Level 4	*Analyze*	*30%*	-	*30%*	-	*30%*	-
Level 5	*Evaluate*	-	-	-	-	-	-
Level 6	*Create*	-	-	-	-	-	-
	Total	*100 %*		*100 %*		*100 %*	

Course Designers

Experts from Industry	**Experts from Higher Technical Institutions**	**Internal Experts**
1. *Mr. Madhan Shanmugasundaram, Infosys Technologies, madshan@gmail.com*	1. *Prof. Y.V.S.S. Sanyasiraju, IIT Madras, sryedida@iitm.ac.in*	1. *Dr. V. Subburayan, SRMIST*
	2. *Prof. K.C. Sivakumar, IIT Madras, kcskumar@iitm.ac.in*	2. *Dr. R. Senthamarai, SRMIST*

Course Code	21MAB304T	Course Name	PROBABILITY AND APPLIED STATISTICS	Course Category	B	BASIC SCIENCES	L	T	P	C
							3	1	0	4

Pre-requisite Courses	*Nil*	Co- requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Mathematics*	Data Book / Codes / Standards		*Nil*	

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*
CLR-1:	*apply the basic rules and theorems of probability theory such as Bayes' theorem to determine probabilities that help to solve engineering problems and to determine the expectation and variance of a random variable from its distribution*
CLR-2:	*appropriately choose, define and/or derive probability distributions such as the Binomial, Poisson and Normal to model and solve real-life engineering problems*
CLR-3:	*understand the principles of estimation theory and estimation techniques like a maximum-likelihood estimate*
CLR-4:	*learn the basic components of hypothesis testing and perform hypothesis tests on population means, variances and proportions*
CLR-5:	*understand how regression analysis can be used to develop an equation that estimates how two variables are related and how the analysis of variance procedure can be used to determine if means of more than two populations are equal*

Course Outcomes (CO):	*At the end of this course, learners will be able to:*	Program Outcomes (PO)												Program Specific Outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12			
		Engineering Knowledge	Problem Analysis	Design/development of solutions	Conduct investigations of complex problems	Modern Tool Usage	The engineer and society	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO-1	PSO-2	PSO-3
CO-1:	*pertain the knowledge of probability concepts to determine probabilities that help to solve engineering problems*	*3*	*3*	-	-	-	-	-	-	-	-	-	-	-	-	-
CO-2:	*gain familiarity in deriving probability distributions such as the Binomial, Poisson, Normal and apply them to the problems involving Science and Engineering*	*3*	*3*	-	-	-	-	-	-	-	-	-	-	-	-	-
CO-3:	*demonstrate competency in Consistency, efficiency and unbiasedness of estimators and method of maximum likelihood estimation*	*3*	*3*	-	-	-	-	-	-	-	-	-	-	-	-	-
CO-4:	*acquire knowledge in formulating and testing hypotheses about means, variances and proportions*	*3*	*3*	-	-	-	-	-	-	-	-	-	-	-	-	-
CO-5:	*apply the knowledge of Regression analysis, and ANOVA in real-life to problems in Science and Engineering*	*3*	*3*	-	-	-	-	-	-	-	-	-	-	-	-	-

Unit-1 - Probability and One-dimensional Random Variable	***12 Hour***
Probability concepts- Conditional probability- Baye's theorem (without proof) - Applications of Baye's Theorem-Random variables – Discrete case and continuous case- Mathematical expectation –discrete case and continuous case-Raw moments- Central moments- Moment generating function(MGF)- discrete and continuous random variables.	
Unit-2 - Theoretical Distributions	***12 Hour***
Discrete distributions – Introduction- Mean and variance of binomial distribution- Fitting a binomial distribution- MGF of binomial distribution- Poisson distribution- Mean and variance of Poisson distribution- Fitting a Poisson distribution- MGF of Poisson distribution- Geometric distribution- mean and variance, Memoryless property- Continuous distribution – Introduction- Uniform distribution – MGF, Mean and variance- Exponential distribution - MGF, Mean and variance, memoryless property- Normal distribution.	
Unit-3 - Estimation Theory	***12 Hour***
Introduction to estimation- Point estimation- Criteria for good estimates- Complete sufficiency and their application in estimation- Methods of estimation- Maximum likelihood estimation.	

Unit-4 - Testing of Hypothesis	***12 Hour***
Sampling Distributions – Type I and Type II errors- large sample test-Test of significance for single proportion- Test of significance for difference of proportions- Test of significance for single mean- Test of significance for difference of means- Small sample tests- Student's t- test for single mean- t- test for the difference of means- Fisher's F-test- Test of significance for two sample variances- Chi-square test for goodness of fit- Chi-square test for the independence of attributes.	
Unit-5 - Correlation, Regression and ANOVA	***12 Hour***
Correlation and its Properties- Karl Pearson's coefficient of correlation- Spearman's rank correlation coefficient for repeated and non-repeated ranks- Linear regression lines and Properties- Relation between correlation and regression coefficient- Introduction to - Analysis of Variance(ANOVA) – One-way classification- Two-way classification.	

Learning Resources	1. *S. Ross, A First Course in Probability, 10th Ed., Pearson Education India, 2019.* 2. *R.A. Johnson, I.Miller & J.E.Freund's, Probability and Statistics for Engineers, 9th Edition, Pearson's Education, New Delhi, 2016.* 3. *A. Gun, M. K. Gupta and B.Dasgupta, Fundamentals of Statistics (Vol. I & Vol. II), World Press, 2016.*	4. *K.Vijay, A.K.Rohatgi, and Md. Ehsanes Saleh, An Introduction to Probability and Statistics, Third Edition, Wiley india Pvt. Ltd, 2015.* 5. *Jay L DeVore, Probability and Statistics for Engineering and the Sciences, 8th Edition, Cengage Learning India Pvt. Ltd, 2012.* 6. *T. Veerarajan, Probability and Statistics, 3rd Edition, Tata McGraw-Hill, New Delhi, 2008.*

Learning Assessment

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		Theory	Practice	Theory	Practice	Theory	Practice
Level 1	*Remember*	*20%*	-	*20%*	-	*20%*	-
Level 2	*Understand*	*20%*	-	*20%*	-	*20%*	-
Level 3	*Apply*	*30%*	-	*30%*	-	*30%*	-
Level 4	*Analyze*	*30%*	-	*30%*	-	*30%*	-
Level 5	*Evaluate*	-	-	-	-	-	-
Level 6	*Create*	-	-	-	-	-	-
	Total	*100 %*		*100 %*		*100 %*	

Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
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	2. *Prof. K.C. Sivakumar, IIT Madars, kcskumar@iitm.ac.in*	2. *Dr. R. Varadharajan, SRMIST*
		3. *Dr. B. Vijayakumar, SRMIST*

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(Deemed to be University u/s 3 of UGC Act, 1956)

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