

Course Code	20MAC509T	Course Name	Applied Mathematics for Embedded and Communication Engineers	Course Category	BS	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:			Program Learning Outcomes (PLO)															
CLR-1 :	Solving Initial boundary value problem (IBVP) and Boundary value problem (BVP) using Integral transforms	1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
CLR-2 :	Knowing the special functions like Bessel's function and Legendre polynomial and their properties.	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Disciplinary Knowledge	Critical Thinking	Problem Solving	Analytical Reasoning	Research Skills	Team Work	Scientific Reasoning	Reflective Thinking	Self-Directed Learning	Multicultural Competence	Ethical Reasoning	Community Engagement	ICT Skills	Leadership Skills	Life Long Learning	
CLR-3 :	Knowing the discrete Z transforms and its properties				H	H	H	M	M	-	H	L	L	-	-	H	-	-	L	-
CLR-4 :	Understand random variables and random processes				M	M	L	M	L	-	L	L	-	-	-	H	L	-	-	-
CLR-5 :	Gain sufficient knowledge in principles of Queueing theory				H	H	M	H	H	M	H	M	M	-	M	H	-	-	M	-
					M	M	M	M	H	-	M	M	M	-	H	H	-	M	M	
Course Learning Outcomes (CLO):		At the end of this course, learners will be able to:																		
CLO-1 :	Students will be able apply the Laplace transform and Fourier transform to solve BVP and IBVP	2	85	80																
CLO-2 :	Students will be to apply Bessel's function and Legendre polynomial to find the approximate solution of some problems	2	85	80																
CLO-3 :	Students will be able to apply Discrete z transforms to solve finite Difference equation.	2	85	80																
CLO-4 :	Students will be able to define random variables and random process and apply some of the signal process	2	85	80																
CLO-5 :	Students will be able to formulate concrete problems using queuing theoretical approaches.	2	85	80																

		Learning Unit / Module 1	Learning Unit / Module 2	Learning Unit / Module 3	Learning Unit / Module 4	Learning Unit / Module 5
Duration (hour)		12	12	12	12	12
S-1	SLO-1	Introduction to boundary value problems and types of boundary value problems	Introduction to Series solutions	Fourier transforms introduction	Discrete Probability distributions	Introduction to Markovian queueing models
	SLO-2	Dirichlet, Neumann and Mixed BVPs	Series solution to ordinary differential equations	Inverse Fourier transform and sine and cosine transform definitions	Mean, Variance, MGF, Characteristic functions of discrete probability distributions	Queueing discipline
S-2	SLO-1	Characteristics of Parabolic PDE and it's solutions	Introduction to Ordinary, regular singular and irregular singular points	Discrete Fourier transforms definition and examples	Continuous Probability distributions	Kinds of queueing models M/M/1: ∞/FIFO; M/M/S: ∞/FIFO; M/M/1: K/FIFO; M/M/S: K/FIFO
	SLO-2	Characteristics of Hyperbolic and elliptical PDEs and it's solutions	Finding Ordinary, regular singular and irregular singular points for some differential equations.	Properties of Discrete Fourier transforms	Mean, Variance, MGF, Characteristic functions of continuous probability distributions	Little's formula
S-3	SLO-1	Canonical form of PDE	Bessel's equation and its regular singular points	Properties of Fourier transform	Discrete multi-dimensional random variables	M/M/1: ∞/FIFO queueing model
	SLO-2	Standard PDEs and canonical form	Finding Bessel's functions and it's kinds	Fourier Sine and Cosine transform properties	Continuous multi-dimensional random variables	Model problem for M/M/1: ∞/FIFO queueing model
S-4	SLO-1	Problem solving using tutorial sheet 1	Problem solving using tutorial sheet 4	Problem solving using tutorial sheet 7	Problem solving using tutorial sheet 10	Problem solving using tutorial sheet 13
	SLO-2					
S-5	SLO-1	Introduction to D'Alembert's Solution	Bessel's functions and its properties	Fourier representation of finite sequences	Function of random variables	M/M/S: ∞/FIFO queueing model
	SLO-2	D'Alembert's Solution to Wave equation	Generating function for Bessel's function	Fourier representation of finite sequences	Joint density function, Marginal density functions	Model problem for M/M/S: ∞/FIFO queueing model
S-6	SLO-1	Laplace transform and its properties	Legendre's equation and its regular singular points	Fourier representation of finite time sequences	Introduction to Random processes and classification	Model problem for M/M/S: ∞/FIFO queueing model

	SLO-2	Laplace transform for partial derivatives	Finding Legendre's polynomials	Fourier representation of finite time sequences	Stationary process and Expectation of stationary process	M/M/1: K/FIFO queueing model
S-7	SLO-1	Inverse Laplace transform definition	Generating function	Problems based on Fourier Series	Wide sense stationary process	Model problem for M/M/1: K/FIFO queueing model
	SLO-2	Properties of Inverse Laplace transform	Generating function for Legendre's polynomials	Z- transform introduction and Some Z transform results	Expectation of product of process at different time interval	Model problem for M/M/1: K/FIFO queueing model
S-8	SLO-1	Problem solving using tutorial sheet 2	Problem solving using tutorial sheet 5	Problem solving using tutorial sheet 8	Problem solving using tutorial sheet 11	Problem solving using tutorial sheet 14
	SLO-2					
S-9	SLO-1	Laplace transform to Wave equation with long string and it's solution	Orthogonality of Legendre's polynomials	Properties of Z transform	Properties of Auto correlation function	M/M/S: K/FIFO queueing model
	SLO-2	Laplace transform to Wave equation for long string with weight and it's solution	Rodrigue's formula	Inverse Z transform	Properties of Cross correlation function	Model problem for M/M/S: K/FIFO queueing model
S-10	SLO-1	Laplace transform to heat equation with prescribed force at one end	Finding Legendre's polynomials using Rodrigue's formula	Some results pertaining to inverse Z transform	Joint wide sense stationary process	Model problem for M/M/S: K/FIFO queueing model
	SLO-2	Solution of heat equation with specified condition through Laplace transform	Recurrence relation	Z transform of Unit step/impulsive sequence	Expectation of product of process two different process	Non Markovian model M/G/I: ∞ /GD
S-11	SLO-1	Laplace transform to heat equation with free vibration	Recurrence relation of Legendre's polynomials and Bessel's function	Difference equations	Poisson process	Pollaczek-Khinchine formula
	SLO-2	Solution of heat equation with free vibration through Laplace transform	Orthogonal properties of Bessel's functions	Solving difference equations using Z transform	Expected values of Poisson process	Model problem for Non Markovian model M/G/I: ∞ /GD
S-12	SLO-1	Problem solving using tutorial sheet 3	Problem solving using tutorial sheet 6	Problem solving using tutorial sheet 9	Problem solving using tutorial sheet 12	Problem solving using tutorial sheet 15
	SLO-2					
Learning Resources	1. Sankara Rao K., "Introduction to Partial Differential Equations", PHI, 3 rd Edition, 2011. 2. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers., 44 th Edition, 2017 3. Veerajan T, "Probability and Statistics, Random Processes and Queueing Theory", McGrawHill, 1 st Edition, 2019, 4. Taha H.A., "Operations Research : An introduction", Pearson, 10 th Edition, 2017 5. Sharma J K, "Operational Mathematics: Theory and Application", Laxmi Publications Pvt. Ltd, 6 th , 2017 6. Richard A. Johnson, Miller and Freund : "Probability and Statistics for Engineers", Pearson Publishers, 9 th Edition, 2017					

Learning Assessment								
	Bloom's Level of Thinking	Continuous Learning Assessment (60% weightage)					Final Examination (40% weightage)	
		CLA – 1 (20%)		CLA – 2 (25%)		CLA – 3 (15%)#	Theory	Practice
		Theory	Practice	Theory	Practice	Theory		
Level 1	Remember Understand	30%	-	30%	-	30%	30%	-
Level 2	Apply Analyze	40%	-	40%	-	40%	40%	-
Level 3	Evaluate Create	30%	-	30%	-	30%	30%	-
	Total	100 %		100 %		100 %	100 %	

CLA – 3 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers:							
(a) Experts from Industry							
1	Mr.V.Maheshwaran	CTS, Chennai	maheshwaran@yahoo.com				
(b) Experts from Higher Technical Institutions							
1	Dr. Y.V.S.S. Sanyasiraju	IIT Madras, Chennai	sryedida@iitm.ac.in	2	Dr.K.C.SivaKumar	IIT Madras, Chennai	kcskumar@iit m.ac.in
(c) Internal Experts							
1	Dr.A.Govindarajan Dr. K. Ganesan	SRMIST SRMIST	govindaa@srmist.edu.in ganesank@srmist.edu.in	2	Dr. V. Subburayan Dr. Narsu Sivakumar	SRMIST SRMIST	subburav@srmist.edu.in narsusic@srmist.edu.in