FR. Conceicao Rodrigues College of Engineering
Father Agnel Ashram, Bandstand, Bandra-west, Mumbai-50
Department of Humanities & Sciences

S.E. (Electronics and Computer Science) (Semester III) (2020-2021)

Lesson Plan

Subject: Engineering Mathematics III (ECC301)

Credits-4

CONTENTS :

Syllabus

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tutorial	Theory	TW/Pract.	Tutorial	Total
ECC301	Engineering Mathematics - III	03	-	01	03	-	01	04

Course Code	Course Name	Examination Scheme							
		Theory							
		Internal Assessment			End Sem Exam	Term Work	Pract.	Oral	Total
		Test 1	Test 2	Avg of Test 1 & 2					
ECC301	Engineering Mathematics-III	20	20	20	80	25	-	-	125

Pre-requisite:

Engineering Mathematics-I, Engineering Mathematics-II, Scalar and Vector Product: Scalar and vector product of three and four vectors

Course Objectives: The course is aimed

1. To familiarize with the Laplace Transform, Inverse Laplace Transform of various functions, and its applications.
2. To acquaint with the concept of Fourier Series, its complex form and enhance the problem solving skills
3. To familiarize the concept of complex variables, C-R equations, harmonic functions, its conjugate and mapping in complex plane.
4. To understand the basics of Linear Algebra and its applications
5. To use concepts of vector calculus to analyze and model engineering problems.

Course Outcomes: On successful completion of course learner will be able to;

1. Apply the concept of Laplace transform to solve the real integrals in engineering problems.
2. Apply the concept of inverse Laplace transform of various functions in engineering problems.
3. Expand the periodic function by using Fourier series for real life problems and complex engineering problems.
4. Find orthogonal trajectories and analytic function by using basic concepts of complex variables.
5. Illustrate the use of matrix algebra to solve the engineering problems.
6. Apply the concepts of vectorcalculus in real life problems.

Module No	Contents	Hrs.
01	**Laplace Transform** 1.1 Definition of Laplace transform, Condition of Existence of Laplace transform. 1.2 Laplace Transform (L) of Standard Functions like $e^{at}, sin(at), cos(at), sinh(at), cosh(at)$ and $t^n, n \geq 0$. 1.3 Properties of Laplace Transform: Linearity, First Shifting theorem, Second Shifting Theorem, change of scale Property, multiplication by *t*, Division by *t*, Laplace Transform of derivatives and integrals (Properties without proof). 1.4 Evaluation of integrals by using Laplace Transformation. **Self-learning Topics:** Heaviside's Unit Step function, Laplace Transform of Periodic functions, Dirac Delta Function.	7
02	**Inverse Laplace Transform** 2.1. Inverse Laplace Transform, Linearity property, use of standard formulae to find inverse Laplace Transform, finding Inverse Laplace transform using derivatives. 2.2 Partial fractions method to find inverse Laplace transform. 2.3 Inverse Laplace transform using Convolution theorem (without proof). **Self-learning Topics:** Applications to solve initial and boundary value problems involving ordinary differential equations.	6
03	**Fourier Series** 3.1 Dirichlet's conditions, Definition of Fourier series and Parseval's Identity (without proof). 3.2 Fourier series of periodic function with period 2π and $2l$. 3.3 Fourier series of even and odd functions. 3.4 Half range Sine and Cosine Series. **Self-learning Topics:** Complex form of Fourier Series, Orthogonal and orthonormal set of functions.Fourier Transform.	7
04	**Complex Variables** 4.1 Function *f*(z)of complex variable, limit, continuity and differentiability of *f*(z)Analytic function, necessary and sufficient conditions for *f*(z) to be analytic (without proof). 4.2 Cauchy-Riemann equations in cartesian coordinates (without proof). 4.3 Milne-Thomson method to determine analytic function *f*(z)when real part (u) or Imaginary part (v) or its combination (u+v or u-v) is given. 4.4 Harmonic function, Harmonic conjugate and orthogonal trajectories **Self-learning Topics:** Conformal mapping, linear, bilinear mapping, cross ratio,fixed points and standard transformations.	7

05	**Linear Algebra: Matrix Theory** 5.1 Characteristic equation, Eigen values and Eigen vectors, Example based on properties of Eigen values and Eigen vectors.(Without Proof). 5.2 Cayley-Hamilton theorem (Without proof), Examples based onverification of Cayley-Hamilton theorem and compute inverse of Matrix. 5.3 Similarity of matrices, Diagonalization of matrices. Functions of square matrix **Self-learning Topics:** Application of Matrix Theory in machine learning and google page rank algorithms, derogatory and non-derogatory matrices**.**	6
06	**Vector Differentiation and Integral** 6.1 **Vector differentiation**:Basics of Gradient, Divergence and Curl (Without Proof). 6.2 **Properties of vector field:** Solenoidal and irrotational(conservative) vector fields. 6.3 **Vector integral:**Line Integral,Green's theorem in a plane(Without Proof), Stokes' theorem (Without Proof) only evaluation. **Self-learning Topics:**Gauss' divergence Theorem and applications of Vector calculus.	6
	Total	**39**

Term Work:

General Instructions:

1. Students must be encouraged to write at least 6 class tutorials on entire syllabus.
2. A group of 4-6 students should be assigned a self-learning topic. Students should prepare a presentation/problem solving of 10-15 minutes. This should be considered as mini project in Engineering Mathematics. This project should be graded for 10 marks depending on the performance of the students.

   The distribution of Term Work marks will be as follows –

1.	Attendance (Theory and Tutorial)	05 marks
2.	Class Tutorials on entire syllabus	10 marks
3.	Mini project	10 marks

Assessment:

Internal Assessment Test:

Assessment consists of two class tests of 20 marks each. The first-class test (Internal Assessment I) is to be conducted when approx. 40% syllabus is completed and secondclass test (Internal Assessment II) when additional 35% syllabus is completed. Duration of each test shall be one hour.

Course Outcomes:

Upon completion of this course students will be able to:

ECC 301.1. *Understand* the concept of Laplace transform and its application to solve the real integrals in engineering problems.
ECC 301.2. *Understand* the concept of inverse Laplace transform of various functions and its applications engineering problems.
ECC 301.3. T*ranslate* the periodic function by using Fourier series for real life problems and complex engineering problems.
ECC 301.4. *Understand* complex variable theory, application of harmonic conjugate to get orthogonal trajectories and analytic function.
ECC 301.5. *Use* matrix algebra to solve the engineering problems.
ECC 301.6. *Understand* the concepts of vector calculus in real life problems.

CO- PO mapping

Course	PO1
ECC301.1	3
ECC301.2	3
ECC301.3	2
ECC301.4	3
ECC301.5	3
ECC301.6	1
TOTAL	15
Direct Attainment	2.5 (M)

Justification:

Above CO's are mapped to the following PO's as explained below:

PO1 Provides the basic knowledge required for identifying and analyzing problems related to Electronics and Computer Science (ECS) Engineering Program.

CO Assessment Tools:

ECC301.1: **Direct Methods (80%):** Test 1+Tutorial 1+ End Exam

CO1 dm = 0.4xtest1+0.2xtutorial1+0.4x end exam

Indirect Methods (20%): Course Exit Survey(CES)

CO1 idm =1xCES

ECC301.1 = (0.8 x CO1 dm) + (0.2 x CO1 idm)

ECC301.2: **Direct Methods (80%):** Test 1+Tutorial 2+ End Exam

CO2 dm = 0.4xtest1+0.2xtutorial2+0.4x end exam

Indirect Methods (20%): Course Exit Survey(CES)

CO2 idm =1xCES

ECC301.2 = (0.8 x CO2 dm) + (0.2 x CO2 idm)

ECC301.3: **Direct Methods (80%):** Test 2+Tutorial 3+ End Exam

CO3 dm = 0.4xtest2+0.2xtutorial3+0.4x end exam

Indirect Methods (20%): Course Exit Survey(CES)

CO3 idm =1xCES

ECC301.3 = (0.8 x CO3 dm) + (0.2 x CO3 idm)

ECC301.4: **Direct Methods (80%):** Test 2+Tutorial 4+ End Exam

CO4 dm = 0.4xtest2+0.2xtutorial4+0.4x end exam

Indirect Methods (20%): Course Exit Survey(CES)

CO4 idm =1xCES

ECC301.4 = (0.8 x CO4 dm) + (0.2 x CO4 idm)

ECC301.5: **Direct Methods (80%):** Tutorial 5+ End Exam

CO5dm = 0.4xtutorial5+0.6xend exam

Indirect Methods (20%): Course Exit Survey(CES)

CO5 idm =1xCES

ECC301.5 = (0.8 XCO5 dm) + (0.2*x CO5 idm)

ECC301.6: **Direct Methods (80%):** Tutorial 6+ End Exam

CO6dm = 0.4xtutorial6+0.6xend exam

Indirect Methods (20%): Course Exit Survey(CES)

CO6 idm =1xCES

ECC301.6 = (0.8 XCO6 dm) + (0.2*x CO6 idm)

LESSON PLAN

Module 1: **Laplace Transform**					
Week	**Lecture No.**	**Date**		**Topic**	**Remarks (If any)**
		Planned	**Actual**		
1	1	14 – 07 – 20	14 – 07 – 20	Laplace Transform – Introduction	Online Classes (Till Aug 10)
	2	15 – 07 – 20	15 – 07 – 20	Laplace Transform - Combinations of standard functions	
	3	16 – 07 – 20	16 – 07 – 20	Laplace Transform – Properties	
2	4	21 – 07 – 20	21 – 07 – 20	Laplace Transform - Properties (continued)	
	5	22 – 07 – 20	22 – 07 – 20	Laplace Transform - Open Book Test	
	Module 2: **Inverse Laplace Transform and its applications**				
	6	23 – 07 – 20	23 – 07 – 20	Inverse Laplace Transform	
3	7	28 – 07 – 20	28 – 07 – 20	Inverse Laplace Transform (continued…)	
	8	29 – 07 – 20	29 – 07 – 20	Inverse Laplace Transform (problem solving)	
	9	30 – 07 – 20	30 – 07 – 20	Fourier Series	
	Module 3: **Fourier Series**				
4	10	04 – 08 – 20	04 – 08 – 20	Fourier Series (continued…)	
	11	05 – 08 – 20	05 – 08 – 20	Fourier Series – Even/Odd Functions, Parseval's identity	
	12	06 – 08 – 20	06 – 08 – 20	Half-Range Fourier Series	
As per the time table from August 11, 2020					
5	13	11 – 08 – 20	11 – 08 – 20	Module No. 03 Topic: Practice problems on Fourier Series	
	Module 4: **Complex Variables**				
	14	12 – 08 – 20	12 – 08 – 20	Module Nos. 03 and 04: Topics: Practice problems on Fourier Series + Complex Variable - Limit and Continuity	
	15	13 – 08 – 20	13 – 08 – 20	Module No. 04: Topic: Analytic Functions	
6	16	18 – 08 – 20	18 – 08 – 20	Module No. 04: Topic: Analytic Functions (continued...)	
	17	19 – 08 – 20	19 – 08 – 20	Module No. 04: Topic: Milne-Thomson Method	
	18	20 – 08 – 20	20 – 08 – 20	Module No. 04: Topic: Milne-Thomson Method (continued...) and Practice Problems on Complex Variable	
Revision Sessions					
7	19	25 – 08 – 20	25 – 08 – 20	Module 01: Laplace Transform - Problems	
	20	26 – 08 – 20	26 – 08 – 20	Module 02: Inverse Laplace Transform – Problems	

	21	27 – 08 – 20	27 – 08 – 20	Module 03: Fourier Series – Problems	Holiday due to Ganesh Festival
8	22	01 - 09 – 20	01 - 09 – 20	Module 03: Fourier Series - Problems (continued...)	
	23	02 - 09 – 20	02 - 09 – 20	Module 04: Complex Variable - Problems	
	24	03 - 09 – 20	03 - 09 – 20	Module 04: Complex Variable - Problems (continued...)	
9	25	08 - 09 – 20	08 - 09 – 20	Problem Set 01: Miscellaneous Examples	
	26	09 - 09 – 20	09 - 09 – 20	Problem Set 02: Miscellaneous Examples	
	27	10 - 09 – 20	10 - 09 – 20	Problem Set 03: Miscellaneous Examples	
10				Unit Test 1 (15-17, September 2020)	
Module 5: **Linear Algebra: Matrix Theory**					
11	28	22 - 09 – 20	22 - 09 – 20	Module 05: Linear Algebra: Matrix Theory - Eigen Values and Eigen Vectors	
	29	23 - 09 – 20	23 - 09 – 20	Module 05: Topic: Properties of eigen values and eigen vectors	
	30	24 - 09 – 20	24 - 09 – 20	Module 05: Topic: Examples based on the properties of eigen values and eigen vectors	
12	31	29 - 09 – 20	29 - 09 – 20	Module 05: Topic: Examples on eigen values and eigen vectors	
	32	30 - 09 – 20	30 - 09 – 20	Module 05: Topic: Diagonalisation	
	33	01 – 10 – 20	01 – 10 – 20	Module 05: Topic: Orthogonally and Unitarily Similar Matrices	
13	34	06 – 10 – 20	06 – 10 – 20	Module 05: Topic: Cayley-Hamilton Theorem	
	35	07 – 10 – 20	07 – 10 – 20	Module 05: Topic: Function of Square Matrix	
	36	08 – 10 – 20	08 – 10 – 20	Module 05: Topic: Function of Square Matrix (continued...)	
Module 6: **Vector Differentiation and Integral**					
14	37	13 – 10 – 20	13 – 10 – 20	Module 06: Vector Differentiation and Integral: Topic - Gradient	
	38	14 – 10 – 20	14 – 10 – 20	Module 06: Vector Differentiation and Integral: Topic - Gradient (continued)	
	39	15 – 10 – 20	15 – 10 – 20	Module 06: Examples on Vector Differentiation - Gradient	
15	40	20 – 10 – 20	20 – 10 – 20	Module 06: Examples on Vector Differentiation - Gradient (continued...)	
	41	21 – 10 – 20	21 – 10 – 20	Module 06: Examples on Vector Differentiation - Divergence and Curl	
	42	22 – 10 – 20	22 – 10 – 20	Module 06: Vector Differentiation and Integral - Topic - Examples on Curl and Divergence	
16	43	27 – 10 – 20	27 – 10 – 20	Module 06: Vector Differentiation and Integral - Topic - Examples on Curl, Gradient and Divergence	

	44	28 – 10 – 20	28 – 10 – 20	Module 06: Vector Differentiation and Integral - Topic - Line Integral	
	45	29 – 10 – 20	29 – 10 – 20	Module 06: Vector Differentiation and Integral - Topic - Examples on Line Integral	
17	46	03 – 11 – 20	03 – 11 – 20	Module 06: Vector Differentiation and Integral - Topic - Examples on Work Done	
	47	04 – 11 – 20	04 – 11 – 20	Module 06: Vector Differentiation and Integral - Topic - Green's Theorem in the Plane	
		05 – 11 - 20	----	Lecture stands cancelled due to event: Motivational session by Mr. Gaurav Sen Topic: My Story	
18		10 – 11 - 20	----	Lecture converted as Tutorial	
	48	11 – 11 - 20	11 – 11 – 20	Module 06: Vector Differentiation and Integral - Topic - Green's Theorem in the Plane (continued...) and Stokes' Theorem [Syllabus Over]	
19				Diwali Holiday (12-18, November 2020)	
		19 – 11 - 20			
		24 – 11 - 20		Unit Test 2 (24-26, November 2020)	
		25 – 11 - 20			
		26 – 11 - 20			

Tutorial Plan

Tutorial No. 1 Laplace Transform

Batch	*Dates*		
	Planned	*Actual*	
Entire Class	*25 – 07 – 2020*	*25 – 07 – 2020*	

Tutorial No. 2 Inverse Laplace Transform

Entire Class	*01 – 08 – 2020*	*01 – 08 – 2020*	

Tutorial No. 3 Fourier Series

Entire Class	*22 – 08 – 2020*	*22 – 08 – 2020*	

Tutorial No. 4 Analytic Functions

Entire Class	*12 – 09 – 2020*	*19 – 09 – 2020*	

Tutorial No. 5 Matrices

Entire Class	*19 – 09 – 2020*	*26 – 09 – 2020*	

Tutorial No. 6 Vector Calculus

Entire Class	*26 – 09 – 2020*	*09 – 10 – 2020*	

Course Outcomes Target:

ECC301.1
TARGET RANGE: 2.2

ECC301.2
TARGET RANGE: 2.2

ECC301.3.
TARGET RANGE: 2.2

ECC301.4
TARGET RANGE: 2

ECC301.5
TARGET RANGE: 2.5

ECC301.6
TARGET RANGE: 2