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 IV) (2020-2021)

Lesson Plan

Subject: Engineering Mathematics IV (ECC401)

Credits-4

CONTENTS :

Syllabus

Course Code	Course Name	Teaching Scheme			Credits Assigned			
		Theory	Practical and Oral	Tutorial	Theory	Practical and Oral	Tutorial	Total
ECC401	Engineering Mathematics - IV	03	--	01	03	--	01	04

Course Code	Course Name	Examination Scheme							
		Theory Marks					Term Work	Practical Oral	Total
		Internal assessment			End Sem. Exam	Exam duration Hours			
		Test 1	Test 2	Avg of Test 1 and Test 2					
ECC401	Engineering Mathematics - IV	20	20	20	80	03	25	--	125

Pre-requisite:

Engineering Mathematics - I, Engineering Mathematics - II,
Engineering Mathematics - III, Binomial Distribution.

Course Objectives: The course is aimed;

1. To studythe line and contour integrals and expansion of complex valued function in a power series.
2. To understand the basic techniques of statistics for data analysis, Machine learning and AI.
3. To study the probability distributions and expectations.
4. To acquaint with the concepts of vector spaces used in the field of machine learning and engineering problems.
5. To familiarize withthe concepts of Quadratic forms and Singular value decomposition.
6. To learn the concepts of Calculus of Variations.

Course Outcomes:

On successful completion of course, learner will be able to;

1. Use the concepts of Complex Integration for evaluating integrals, computing residues & evaluate various contour integrals.
2. Demonstrate the use of Correlation and Regression to the engineering problems in data science, machine learning and AI.
3. Illustrate understanding of the concepts of probability and expectation for getting the spread of the data and distribution of probabilities.
4. Apply the concept of vector spaces and orthogonalization process in Engineering Problems.
5. Use the concept of Quadratic forms and Singular value decomposition in various Engineering applications.
6. Find the extremals of the functional using the concept of Calculus of variation.

Module No.	Detailed Contents	Hrs.
01	**Complex Integration** 1.1 Line Integral, Cauchy's Integral theorem for simple connected and multiply connected regions (without proof), Cauchy's Integral formula (without proof). 1.2 Taylor's and Laurent's series (without proof). 1.3 Definition of Singularity, Zeroes, poles of *f(z)*, Residues, Cauchy's Residue Theorem (without proof). **Self-learning Topics:** Application of Residue Theorem to evaluate realintegrations, Z-Transform.	7
02	**Statistical Techniques** 2.1 Karl Pearson's Coefficient of correlation (r) . 2.2 Spearman's Rank correlation coefficient (R) (repeated and non-repeated ranks) 2.3 Lines of regression. 2.4 Fitting of first and second degree curves. **Self-learning Topics:** Covariance, fitting of exponential curve.	6
03	**Probability Distributions** 3.1. Baye's Theorem, Random variable: Probability distribution for discrete and continuous random variables, Density function and distribution function. 3.2 Expectation, mean and variance. 3.3 Probability distribution: Poisson & normal distribution. **Self-learning Topics:** Moments, Moment Generating Function, Applications of Probability Distributions in Engineering.	7
04	**Linear Algebra: Vector Spaces** 4.1 Vectors in n-dimensional vector space, norm, dot product, The Cauchy Schwarz inequality (with proof), Unit vector. 4.2 Orthogonal projection, Orthonormal basis, Gram-Schmidt process for vectors. 4.3 Vector spaces over real field, subspaces. **Self-Learning Topics**:- Linear combinations, linear Dependence andIndependence, QR decomposition.	6

05	**Linear Algebra: Quadratic Forms** 5.1 Quadratic forms over real field, Linear Transformation of Quadratic form, Reduction of Quadratic form to diagonal form using congruent transformation. 5.2 Rank, Index and Signature of quadratic form, Sylvester's law of inertia, Value-class of a quadratic form-Definite, Semidefinite and Indefinite. 5.3 Reduction of Quadratic form to a canonical form using congruent transformations. 5.4 Singular Value Decomposition. **Self-learning Topics:** Orthogonal Transformations**,** Applications of Quadratic forms and SVD in Engineering.	7
06	**Calculus of Variations:** 6.1 Euler- Lagrange equation(Without Proof), When F does not contain y, When F does not contain x, When F contains x,y,y'. 6.2 Isoperimetric problems-Lagrange Method. 6.3 Functions involving higher order derivatives: Rayleigh-Ritz Method. **Self-Learning Topics:-**Brachistochrone Problem, Variational Problem,Hamilton Principle, Principle of Least action,Several dependent variables.	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 401.1. *Demonstrate* basic knowledge of calculus of variation
ECC 401.2. *Identify* vector spaces as an algebraic structure
ECC 401.3. *Understand* concepts of quadratic forms and singular value decomposition
ECC 401.4. Able to *apply* Bayes' theorem and theoretical distributions (Poisson and Normal) to some of the real life situations
ECC 401.5 *Demonstrate* basic knowledge of correlation and regression
ECC 401.6 D*emonstrate* basic knowledge of the contour integral.

CO- PO mapping

Course	PO1
ECC401.1	2
ECC401.2	1
ECC401.3	1
ECC401.4	3
ECC401.5	3
ECC401.6	3
TOTAL	13
Direct Attainment	2.17 (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:

ECC401.1: **Direct Methods (80%):** Tutorial 5+ End Exam

CO1 dm = 0.5xtutorial5+0.5x end exam

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

CO1 idm =1xCES

ECC401.1 = (0.8 x CO1 dm) + (0.2 x CO1 idm)

ECC401.2: **Direct Methods (80%):** Test 2+Tutorial 4+ End Exam

CO2 dm = 0.3xtest2+0.35xtutorial4+0.35x end exam

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

CO2 idm =1xCES

ECC401.2 = (0.8 x CO2 dm) + (0.2 x CO2 idm)

ECC401.3: **Direct Methods (80%):** Tutorial 6+ End Exam

CO3 dm = 0.5xtutorial6+0.5x end exam

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

CO3 idm =1xCES

ECC401.3 = (0.8 x CO3 dm) + (0.2 x CO3 idm)

ECC401.4: **Direct Methods (80%):** Test 2+Tutorial 3+ End Exam

CO4 dm = 0.35xtest2+0.3xtutorial3+0.35x end exam

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

CO4 idm =1xCES

ECC401.4 = (0.8 x CO4 dm) + (0.2 x CO4 idm)

ECC401.5: **Direct Methods (80%):** Test 1+ Tutorial 2+ End Exam

CO5dm = 0.3xtest1+0.3xtutorial2+0.4xend exam

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

CO5 idm =1xCES

ECC401.5 = (0.8 XCO5 dm) + (0.2*x CO5 idm)

ECC401.6: **Direct Methods (80%):** Test 1+ Tutorial 1+ End Exam

CO6dm = 0.3xtest1+0.3xtutorial1+0.4xend exam

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

CO6 idm =1xCES

ECC401.6 = (0.8 XCO6 dm) + (0.2*x CO6 idm)

LESSON PLAN

Course Content and Lesson plan (Change is subject to UT 1, Euphoria and UT 2)					
Module 1: **Complex Integration**					
Week	**Lecture No.**	**Date**		**Topic**	**Remarks (If any)**
		Planned	**Actual**		
1	1	25 – 01 – 21	25 – 01 – 21	Introduction to line integral	
	2	28 – 01 – 21	28 – 01 – 21	Examples on line integral	
	3	29 – 01 – 21	29 – 01 – 21	Examples on line integral	
2	4	01 – 02 – 21	01 – 02 – 21	Cauchy's theorem and integral formula	
	5	04 – 02 – 21	04 – 02 – 21	Cauchy's theorem and integral formula	
	6	05 – 02 – 21	05 – 02 – 21	Cauchy's theorem and integral formula	
3	7	08 – 02 – 21	08 – 02 – 21	Taylor's and Laurent's series	
	8	11 – 02 – 21		Taylor's and Laurent's series	
	9	12 – 02 – 21		Residues	
4	10	15 – 02 – 21		Cauchy's residue theorem	
	11	18 – 02 – 21		Correlation coefficient	
	-	19 – 02 – 21			Holiday
	Module 2: **Statistical Techniques**				
5	12	22 – 02 – 21		Rank correlation	
	13	25 – 02 – 21		Lines of regression	
	14	26 – 02 – 21		Lines of regression	
6	15	01 – 03 – 21		Fitting of curves	
	Module 3: **Probability Distribution**				
	16	04 – 03 – 21		Discrete and continuous random variables	
	17	05 – 03 – 21		Expectation and variance	
7	18	08 – 03 – 21		Poisson distribution	
	-	11 – 03 – 21			Holiday
	19	12 – 03 – 21		Normal distribution	
	Module 4: **Linear Algebra - Vector Spaces**				
8	20	15 – 03 – 21		Vector spaces examples	
	21	18 – 03 – 21		Vector spaces examples	

	22	19 – 03 – 21		Gram-Schmidt orthogonal process	
9	23	22 – 03 – 21		Gram-Schmidt orthogonal process	
	24	25 – 03 – 21		Vector subspace	
	Module 5: **Linear Algebra – Quadratic Forms**				
	25	26 – 03 – 21		Quadratic form	
10	-	29 – 03 – 21			Holiday
	26	01 – 04 – 21		Linear transformation of quadratic form	
	-	02 – 04 – 21			Holiday
11	27	05 – 04 – 21		Rank, signature Index of quadratic forms	
	28	08 – 04 – 21		Value class of a quadratic form	
	29	09 – 04 – 21		Singular value decomposition	
Module 6: **Calculus of Variation**					
12	30	12 – 04 – 21		Euler-Lagrange equation	
	31	15 – 04 – 21		Euler-Lagrange equation	
	32	16 – 04 – 21		Isoperimetric problems	
13	33	19 – 04 – 21		Rayleigh-Ritz method	

Tutorial Plan			
Tutorial No. 1 *Complex Integration*			
Batch	*Dates*		
	Planned	*Actual*	
Entire Class	*25 – 02 – 2021*	*25-02-2021*	
Tutorial No. 2 *Correlation and Regression*			
Entire Class	*18 – 03 – 2021*	18-03-2021	
Tutorial No. 3 *Bayes' Theorem and Theoretical Distributions*			
Entire Class	*08 – 04 – 2021*	08-04-2021	
Tutorial No. 4 *Vector Spaces*			
Entire Class	*06 – 05 – 2021*	06-05-2021	
Tutorial No. 5 *Calculus of Variations*			
Entire Class		*Home Assignment*	
Tutorial No. 6 *Quadratic Forms*			
Entire Class		*Home assignment*	

Course Outcomes Target:

ECC401.1
TARGET RANGE: 2

ECC401.2
TARGET RANGE: 2.5

ECC401.3.
TARGET RANGE: 2.5

ECC401.4
TARGET RANGE: 2

ECC401.5
TARGET RANGE: 2.5

ECC401.6
TARGET RANGE: 2