Course Code	Course Name	Credits
CSC301	Engineering Mathematics-III	4

Pre-requisite: Engineering Mathematics-I, Engineering Mathematics-II	
Course Objectives: The course aims:	
1	To learn the Laplace Transform, Inverse Laplace Transform of various functions, its applications.
2	To understand the concept of Fourier Series, its complex form and enhance the problem-solving skills.
3	To understand the concept of complex variables, C-R equations with applications.
4	To understand the basic techniques of statistics like correlation, regression, and curve fitting for data analysis, Machine learning, and AI.
5	To understand some advanced topics of probability, random variables with their distributions and expectations.
Course Outcomes: On successful completion, of course, learner/student will be able to:	
1	Understand the concept of Laplace transform and its application to solve the real integrals in engineering problems.
2	Understand the concept of inverse Laplace transform of various functions and its applications in engineering problems.
3	Expand the periodic function by using the Fourier series for real-life problems and complex engineering problems.
4	Understand complex variable theory, application of harmonic conjugate to get orthogonal trajectories and analytic functions.
5	Apply the concept of Correlation and Regression to the engineering problems in data science, machine learning, and AI.
6	Understand the concepts of probability and expectation for getting the spread of the data and distribution of probabilities.

Module		Detailed Contents	Hours
1	**Laplace Transform**		7
	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, Multiplication by *t*, Division by *t,* Laplace Transform of derivatives and integrals (Properties without proof).	
	1.4	Evaluation of real improper integrals by using Laplace Transformation.	
	1.5	**Self-learning Topics:** Laplace Transform: Periodic functions, Heaviside's Unit Step function, Dirac Delta Function, Special functions (Error and Bessel)	
2	**Inverse Laplace Transform**		7
	2.1	Definition of Inverse Laplace Transform, Linearity property, Inverse Laplace Transform of standard functions, 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)	
	2.4	**Self-learning Topics:** Applications to solve initial and boundary value	

		problems involving ordinary differential equations.	
3	**Fourier Series:**		7
	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.	
	3.5	**Self-learning Topics:** Orthogonal and orthonormal set of functions, Complex form of Fourier Series, Fourier Transforms.	
4	**Complex Variables:**		7
	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: Determine analytic function $f(z)$when real part (u), imaginary part (v) or its combination (u+v / u-v) is given.	
	4.4	Harmonic function, Harmonic conjugate and Orthogonal trajectories.	
	4.5	**Self-learning Topics:** Conformal mapping, Linear and Bilinear mappings, cross ratio, fixed points and standard transformations.	
5	**Statistical Techniques**		6
	5.1	Karl Pearson's coefficient of correlation (r)	
	5.2	Spearman's Rank correlation coefficient (R) (with repeated and non-repeated ranks)	
	5.3	Lines of regression	
	5.4	Fitting of first- and second-degree curves.	
	5.5	**Self-learning Topics:** Covariance, fitting of exponential curve.	
6	**Probability**		6
	6.1	Definition and basics of probability, conditional probability.	
	6.2	Total Probability theorem and Bayes' theorem.	
	6.3	Discrete and continuous random variable with probability distribution and probability density function.	
	6.4	Expectation, Variance, Moment generating function, Raw and central moments up to 4^{th} order.	
	6.5	**Self-learning Topics:** Skewness and Kurtosis of distribution (data).	

References:	
1	Higher Engineering Mathematics, Dr. B. S. Grewal, Khanna Publication.
2	Advanced Engineering Mathematics, Erwin Kreyszig, Wiley Eastern Limited.
3	Advanced Engineering Mathematics, R. K. Jain and S. R. K. Iyengar, Narosa Publication.
4	Complex Variables and Applications, Brown and Churchill, McGraw-Hill Education.
5	Probability, Statistics and Random Processes, T. Veerarajan, McGraw-Hill Education.
6	Theory and Problems of Fourier Analysis with applications to BVP, Murray Spiegel, Schaum's Outline Series.

Term Work:	
General Instructions:	
1	Batch wise tutorials have to be conducted. The number of students per batch will be as per University pattern for practical.
2	Students must be encouraged to write at least 6 class tutorials on the entire syllabus.
3	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 will be considered as a mini project in Engineering Mathematics. This project will be graded out of 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:	
The assessment consists of two class tests of 20 marks each. The 1stclass test (Internal Assessment I) has to be conducted when approximately 40% of the syllabus is completed. The 2nd class test has to be conducted (Internal Assessment II) when an additional 35% syllabus is completed. The duration of each test will be for one hour.	
End Semester Theory Examination:	
1	The question paper will comprise a total of 6 questions, each carrying 20 marks.
2	Out of the 6 questions, 4 questions have to be attempted.
3	Question 1, based on the entire syllabus, will have 4sub-questions of 5 marks each and is compulsory.
4	Question 2 to Question 6 will have 3 sub-questions, each of 6, 6, and 8 marks, respectively.
5	Each sub-question in (4) will be from different modules of the syllabus.
6	Weightage of each module will be proportional to the number of lecture hours, as mentioned in the syllabus.