Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	TW/Pract	Tut.	Total
ITC401	Engineering Mathematics-IV	03	-	01	03	-	01	04

Course Code	Course Name	Examination Scheme							
		Theory				Term Work	Pract	Oral	Total
		Internal Assessment			End Sem Exam				
		Test1	Test2	Avg of Test 1 & 2					
ITC401	Engineering Mathematics-IV	20	20	20	80	25	-	-	125

Pre-requisite: Engineering Mathematics-I, Engineering Mathematics-II, Engineering Mathematics-III, Binomial Distribution.

Course Objectives:

Sr. No.	Course Objectives
The course aims:	
1	To study Matrix algebra and its application in engineering problems.
2	To learn Line and Contour integrals and expansion of complex valued function in a power series.
3	To study Z-Transforms and Inverse Z-Transforms with its properties.
4	To acquaint with the concepts of probability distributions and sampling theory for small samples.
5	To study and apply Linear and Non-linear programming Techniques to solve the optimization problems

Course Outcomes:

Sr. No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	Apply the concepts of eigen values and eigen vectors to solve engineering problems.	L1, L2, L3
2	Illustrate the use of concepts of Complex Integration for evaluating integrals, computing residues & evaluate various contour integrals.	L3
3	Apply the concept of Z- transformation and its inverse in engineering problems.	L1,L2,L3

4	Apply the concept of probability distribution to engineering problems & testing hypothesis of small samples using sampling theory.	L3
5	Apply the concept of Linear Programming to solve the optimization problems	L1, L2, L3
6	Use the Non-Linear Programming techniques to solve the optimization problems.	L3

Module	Detailed Contents	Hours	CO Mapping
01	**Module: Linear Algebra (Theory of Matrices)** 1.1 Characteristic Equation, Eigenvalues and Eigenvectors and properties (without proof) 1.2 Cayley-Hamilton Theorem (without proof), verification and reduction of higher degree polynomials 1.3 Similarity of matrices, diagonalizable and non-diagonalizable matrices **Self-learning Topics:** Derogatory and non-derogatory matrices, Functions of Square Matrix, Linear Transformations, Quadratic forms.	7	CO1
02	**Module: Complex Integration** 2.1 Line Integral, Cauchy's Integral theorem for simple connected and multiply connected regions (without proof), Cauchy's Integral formula (without proof). 2.2 Taylor's and Laurent's series (without proof). 2.3 Definition of Singularity, Zeroes, poles of *f(z)*, Residues, Cauchy's Residue Theorem (without proof) **Self-learning Topics:** Application of Residue Theorem to evaluate real integrations.	7	CO2
03	**Module: Z Transform** 3.1 Definition and Region of Convergence, Transform of Standard Functions: $\{k^n a^k\}$, $\{a^{\lvert k\rvert}\}$, $\{{}^{k+n}C_n . a^k\}$, $\{c^k \sin(\alpha k + \beta)\}$, $\{c^k \sinh \alpha k\}$, $\{c^k \cosh \alpha k\}$. 3.2 Properties of Z Transform: Change of Scale, Shifting Property, Multiplication, and Division by k, Convolution theorem. 3.3 Inverse Z transform: Partial Fraction Method, Convolution Method. **Self-learning Topics:** Initial value theorem, Final value theorem, Inverse of Z Transform by Binomial Expansion	5	CO3
04	**Module: Probability Distribution and Sampling Theory** 4.1 Probability Distribution: Poisson and Normal distribution 4.2 Sampling distribution, Test of Hypothesis, Level of Significance, Critical region, One-tailed, and two-tailed test, Degree of freedom. 4.3 Students' t-distribution (Small sample). Test the significance of mean and Difference between the means of two samples. Chi-Square Test: Test of goodness of fit and independence of attributes, Contingency table. **Self-learning Topics:** Test significance for Large samples, Estimate parameters of a population., Yate's Correction.	7	CO4
05	**Module: Linear Programming Problems**	6	

	5.1 Types of solutions, Standard and Canonical of LPP, Basic and Feasible solutions, slack variables, surplus variables, Simplex method. 5.2 Artificial variables, Big-M method (Method of penalty) 5.3 Duality, Dual of LPP and Dual Simplex Method **Self-learning Topics: Sensitivity** Analysis, Two-Phase Simplex Method, Revised Simplex Method		CO5
06	**Module: Nonlinear Programming Problems** 6.1 NLPP with one equality constraint (two or three variables) using the method of Lagrange's multipliers 6.2 NLPP with two equality constraints 6.3 NLPP with inequality constraint: Kuhn-Tucker conditions **Self-learning Topics:** Problems with two inequality constraints, Unconstrained optimization: One dimensional search method (Golden Search method, Newton's method). Gradient Search method	7	CO6

References:

1. Advanced Engineering Mathematics, Erwin Kreyszig, John Wiley & Sons.
2. Advanced Engineering Mathematics, R. K. Jain and S. R. K. Iyengar, Narosa.
3. Complex Variables and Applications, Brown and Churchill, McGraw-Hill education.
4. Probability, Statistics and Random Processes, T. Veerarajan, McGraw-Hill education.
5. Operations Research: An Introduction, Hamdy A Taha, Pearson.
6. Engineering Optimization: Theory and Practice, S.S Rao, Wiley-Blackwell.
7. Operations Research, Hira and Gupta, S. Chand Publication.

Online References:

Sr. No.	Website Name
1.	https://www.nptel.ac.in

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 second class test (Internal Assessment II) when additional 35% syllabus is completed. Duration of each test shall be one hour.

End Semester Theory Examination:

1. Question paper will comprise of total 06 questions, each carrying 20 marks.
2. Total 04 questions need to be solved.
3. Question No: 01 will be compulsory and based on entire syllabus wherein 4 sub-questions of5 marks each will be asked.
4. Remaining questions will be randomly selected from all the modules.
5. Weightage of each module will be proportional to number of respective lecture hours as mentionedin the syllabus.