GUJARAT TECHNOLOGICAL UNIVERSITY

CIVIL & INFRASTRUCTURE ENGINEERING
MATHEMATICS FOR INFRASTRUCTURE ENGINEERING
SUBJECT CODE: 2134001
B.E. 3RD Semester

Type of course: Foundation Course for Civil & Infrastructure Engineering

Prerequisite: The course follows from Calculus and Linear algebra. The students are also required to have an introductory knowledge of Probability and Statistics.

Rationale: Mathematics is a language of Science and Engineering

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
L	T	P	C	Theory Marks			Practical Marks			
				ESE (E)	PA (M)		PA (V)		PA (I)	
					PA	ALA	ESE	OEP		
3	2	0	5	70	20	10	20	10	20	150

Content:

Sr. No.	Topics	Teaching Hrs.	Module Weightage
1	**Ordinary Differential Equations:** First order DE: Homogeneous, Exact, Linear and Bernoulli equations; Clairaut's equations; Orthogonal Trajectories; Second and Higher order Linear DE: Homogeneous equations with Constant and Variable Coefficients; Methods of Undetermined Coefficients and Variation of Parameters; Wronskian	10	17
2	**Special Functions:** Gamma and Beta functions **Fourier Series and Fourier Transform:** Periodic function; Fourier series; Half-range Expansion; Fourier Transform **Laplace Transform:** Definition; Inverse Laplace Transform; Properties: Linearity, Shifting Theorems, Transform of Derivatives and Integrals, Convolution and Integral Equations; Solving ODE using Laplace Transform: Partial Fraction method	10	17
3	**Partial Differential Equations:** Formation; Solution of PDE f(x,y,z,p,q) = 0; First order: Linear equations by Lagrange's method; Some standard forms of Non Linear equations; Charpit's method; Second order: Classification of PDE's; Method of Separation of Variables	10	17

4	**Probability and Statistics:** Probability; Sample Space; Events; Conditional Probability; Baye's Theorem; Random Variable; Mathematical Expectation; Generating Function and Law of Large Numbers; Probability Distribution: Discrete and Continuous - Binomial, Poisson & Normal; Central Limit Theorem; Elementary Theory of Sampling; Standard Error or Means and Variance	12	19

Reference Books:
1. Advanced Engineering Mathematics (8th Edition), by E. Kreyszig, Wiley-India (2007).
2. Engineering Mathematics Vol 2, by Baburam, Pearson
3. Elementary Differential Equations by W. E. Boyce and R. DiPrima, (8th Edition), John Wiley (2005)
4. Fourier series and Boundary Value Problems by R. V. Churchill and J. W. Brown, (7th Edition), McGraw-Hill (2006).
5. Calculus by T. M. Apostol, Volume-2 (2nd Edition), Wiley Eastern , 1980
6. Statistical Methods I and II by N. G. Das, McGraw-Hill Education
7. Applied Statistics & Probability for Engineers by Sharma, Willey
8. Fundamentals of Mathematical Statistics by S.C. Gupta and V. K. Kapoor, Sultan Chand & Sons.

Course Outcome:
After learning the course the students should be able to
1. Ordinary Differential Equations and Their Applications
   - Determine the order of an ordinary differential equation. Classify an ordinary differential equation as linear or nonlinear.
   - Identify whether or not a differential equation is exact.
   - Solve second order linear differential equations with constant coefficients that have a characteristic equation with real and distinct roots.
   - Evaluate the Wronskian of two functions.
   - Apply the method of undetermined coefficients to solve non-homogeneous second order linear differential equations.
   - Use the method of variation of parameters to solve non-homogeneous higher order linear differential equations
2. Fourier Series and Fourier Transform
   - Identify periodic functions, determine their periods & find the Fourier series for them.
   - Find the Fourier sine and cosine series for the function defined on [0, L].
   - Evaluate Fourier transforms from the definition.
3. Laplace Transform
   - Evaluate Laplace transforms from the definition.
   - Evaluate inverse Laplace transforms.
   - Apply the shifting theorems to evaluate Laplace transforms and inverse Laplace transforms.
   - Use Laplace transforms to solve differential equations.
   - Evaluate the Laplace transform of a convolution of functions.
4. Partial Differential Equations
   - Determine the order of a partial differential equation.
   - Classify a partial differential equation as linear or nonlinear and find its solutions.
5. Probability and Statistics
   - Use probability as a tool for statistical analysis.
   - Apply statistical tests.

List of Open Source Software/learning website:

1. NPTEL
   http://www.cdeep.iitb.ac.in/nptel/Electrical%20&%20Comm%20Engg/Signals%20and%20System/Course_home
   https://www.youtube.com/watch?v=DPg5T-YBQjU
   https://www.youtube.com/watch?v=7fJeo1fylKI
   https://www.youtube.com/watch?v=1FnBPmEWpus
   https://www.youtube.com/watch?v=dgDIQ0VA0pA
   https://www.youtube.com/watch?v=SoBs-YGQUdc
   https://www.youtube.com/watch?v=Fh8m6Z
   https://www.youtube.com/watch?v=GmIcbqdvIgcdFaqU

2. **Instructor(s):** Prof. Haynes Miller, Prof. Arthur Mattuck
   http://ocw.mit.edu/courses/mathematics/18-03-differential-equations-spring-2010/video-lectures/

3. **Instructor:** Prof. Haynes Miller, Prof. Arthur Mattuck, Dr. John Lewis
   http://ocw.mit.edu/courses/mathematics/18-03sc-differential-equations-fall-2011/

ACTIVE LEARNING ASSIGNMENTS: Preparation of power-point slides, which include videos, animations, pictures, graphics for better understanding theory and practical work – The faculty will allocate chapters/ parts of chapters to groups of students so that the entire syllabus to be covered. The power-point slides should be put up on the web-site of the College/ Institute, along with the names of the students of the group, the name of the faculty, Department and College on the first slide. The best three works should submit to GTU.