GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Bachelor of Engineering
Level: UG
Subject Code : BE03000211
Course / Subject Name : Mathematics – III

w. e. f. Academic Year:	2024-25
Semester:	3
Category of the Course:	BSC

Prerequisite:	Basic calculus and ODE
Rationale:	The course is designed to meet the requirements of various mathematical concepts for Mechanical and allied branches.

Course Outcome:

After the completion of the course, students will be able to:

No	Course Outcomes
1	Establish the Fourier series expansion of periodic functions and perform its applications
2	Apply suitable methods to solve partial differential equations. Model and solve some engineering problems related to heat and wave equations.
3	Estimate the intermediate values of the function from its tabulated values using appropriate interpolation formulas.
4	Perform numerical differentiation and integration and also solve ODEs using numerical methods.
5	Compute Laplace and inverse Laplace transforms of the various functions using its properties and apply them to solve ordinary differential equations

Teaching and Examination Scheme:

Teaching - Learning Scheme (in Hours per Semester)					Total Credits = TH/30	Assessment Pattern and Marks					Total Marks
						Theory		Tutorial / Practical			
L	T	P	TW/SL	TH		ESE (E)	PA (M)	PA/ (I)	TW/ SL (I)	ESE (V)	
45	0	30	45	120	04	70	30	20	30	50	200

Where L = Lecture, T= Tutorial, P= Practical, TW/SL = Term-Work / Self-Learning, TH = Total Hours, ESE = End-Semester Examination, PA = Progressive Assessment

Course Content:

Unit No.	Content	No. of Hours	% of Weightage
1.	**Fourier Series:** Periodic functions, Fourier series of functions of 2π or any other period, Dirichlet's condition for convergence of Fourier	06	13
	series, Fourier series of even and odd functions, Half-range Fourier series,		
2.	**Partial Differential Equations (PDEs):** Formation of partial differential equations, solution of first order linear and non-linear partial differential equations, Charpit's method. Solution of homogeneous and nonhomogeneous linear partial differential equations of second and higher order by complementary function and particular integral method, classification of second order linear partial differential equations, method of separation of variables, one-dimensional wave equation and heat equation.	15	33
3.	**Finite Differences and Interpolation:** Finite difference operators and their relations, Newton's forward and backward difference methods, Lagrange's interpolation method, Inverse interpolation, Newton's divided difference method.	06	13
4.	**Numerical Differentiation and Integration**: Numerical Differentiation: Derivatives using forward difference and backward difference formulae Numerical Integration: Newton-Cotes quadrature formulae, Trapezoidal rule, Simpson's rules, Gaussian integration, Case studies	06	13
5.	**Numerical Solution of Ordinary Differential Equations**: Picard's method, Euler's method, Runge-Kutta 2nd and 4^{th} order method, Case studies	04	10
6	**Laplace Transforms:** Laplace transform and Inverse Laplace transform, linearity, first shifting theorem (s-shifting), transforms of derivatives and integrals, ODEs, unit step function (Heaviside function), second shifting theorem (t-Shifting), Laplace transform of periodic functions, short impulses, Dirac's delta function, convolution, integral equations, differentiation and integration of transforms, ODEs with variable coefficients, systems of ODEs	08	18
	Total	**45**	**100**

Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks (%)					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
10	**40**	**50**		-	-

Where R: Remember; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create (as per Revised Bloom's Taxonomy)

References/Suggested Learning Resources:

(a) Books:

1. Advanced Engineering Mathematics, Erwin Kreyszig, Herbert Kreyszig, Edward J. Norminton, John Wiley & Sons, Inc
2. Advanced Engineering Mathematics, Dennis G Zill, Warren S. Wright, Jones and Bartlett Publication.
3. Mathematical Methods of Science and Engineering, Kanti B. Datta, Cengage Learning
4. Introductory methods of Numerical analysis, S. S. Sastry, PHI publication
5. Advanced Engineering Mathematics, Peter O'Neill, Cengage Publishers
6. Partial Differential Equations for Scientists and Engineers, S. J. Farlow, Dover Publications

(b) Open-source software and website:

1. http://onlinecourses.nptel.ac.in/noc25_ma45/preview
2. https://onlinecourses.nptel.ac.in/noc21_ma51/preview
3. https://onlinecourses.nptel.ac.in/noc21_ma45/preview
4. https://onlinecourses.nptel.ac.in/noc20_ma43/preview

Suggested Course Practical List:

Assign engineering application problems related to the topics mentioned in the content.

- **Activities suggested under self-learning:**

Activity	No. of Hours	Total Hours Claimed	Evaluation Criteria
Assignments on topics like Fourier Series, Partial Differential Equations (PDEs),Finite Differences and Interpolation, Numerical Differentiation and Integration, Numerical Solution of Ordinary Differential Equations, Laplace Transforms	Completing ten assignments (2h each)	20	Evaluation based on assignment submitted
Online Video based learning	Duration of video = 10h Report preparation = 5h	15	Report or presentation based on learning through video.
Online participation in two Quizzes	4 hours for preparation of each quiz and 1hour for participation in each quiz.	10	Quiz scores
Online Course (MOOC/NPTEL/SWAYAM/edX, etc.) on PDEs/Numerical methods /Laplace transforms	Minimum course duration of 10 hours	10	Assessment through an examination at the end of the course.

			Certificate submission required
Implementing Numerical methods in MS-Excel spreadsheet	Doing Two Spreadsheets based assignments (5 hours each)	10	Review based on the implementation, results, and presentation of results analysis
Modeling and Simulation of Engineering Systems (Developing mathematical models and performing simulations)	Model formulation (5h) + Simulation and result analysis (5h)	10	Evaluation based on model accuracy, computational efficiency, and interpretation of results
Developing Posters, Charts, or PowerPoint Presentations on course related topics	Designing and presenting visual content	15	Assessment based on creativity, clarity, and presentation skills

Note:

1. The activities listed above are suggestive, and faculty members have the flexibility to select and modify them as needed.
2. The total self-learning hours remain fixed at 45 hours, ensuring comprehensive coverage of topics of Mathematics III
3. Faculty can adjust the distribution of hours across different activities while maintaining a balanced learning approach.
4. All records pertaining to the evaluation and assessment of self-learning activities must be properly maintained and preserved at the institute level. These records should be made available to the university upon request.
5. Institutes are encouraged to utilize digital platforms, such as Microsoft Teams, for effective recordkeeping and to ensure transparency in the evaluation and assessment of self-learning activities.

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