First Semester B.E.
Mathematics-I for Civil Engineering Stream(22MATC11)
(Effective from the academic year 2022-23)

Topics	Topics To Be Covered	Hours
Module–I: Calculus		
Polar coordinates, Polar curves - angle between the radius vector and the tangent, angle between two curves, pedal equations.	Discussion restricted to derivation and problems as suggested in articles no.4.7(1, 2) and 4.8 (for Polar Curves only) of Textbook 1	**2L**
Curvature and Radius of Curvature-Cartesian, parametric, polar and pedal forms. Problems.	Discussion restricted to problems as suggested in articles no.4.10, 4.11 (1, 2, 4) (proof for Cartesian and polar only) of Textbook 1	**2L**
Tutorials	i) Involvement of faculty and students in identifying the problems & solutions. ii) **PPT presentations by the faculty about the applications of the module-Structural designs and paths, Strength of Materials, and Elasticity.** iii) Guidance to the students for self-study topics through illustrative examples.	**4T**
Self-study: Centre and Circle of curvature, Evolutes and Involutes	**Article No. 4.10 (3)(4), 4.12 of textbook 1.** 1. **No Question is to be set for SEE** 2. **20% weightage shall be given to CIE from self-study topics**	
(RBT Levels: L1, L2 & L3) Total		**8**
Module–II: Series Expansion and Multivariable Calculus		
Taylor's and Maclaurin's series expansion for one variable (Statement only) – problems. Indeterminate forms - L'Hospital's rule, Problems.	(i) Discussion restricted to problems on article no.4.4 of textbook 1 (*No question to be set on Taylor's series*) (ii) Discussion restricted to 0^0, ∞^0, 0∞ & 1^∞ only, article no. 4.5 of textbook 1	**2L**
Partial differentiation, Total derivative, differentiation of composite functions. Jacobian and problems. Maxima and minima for a function of two variables. Problems.	(i) Discussion and coverage of contents as suggested in articles 5.1, 5.2, 5.5(1) and 5.11 of textbook 1. (ii) Discussion and problems restricted to article no.5.7 (1) of textbook 1.	**2L**
Tutorials	i) Involvement of faculty and students in identifying the problems & solutions. ii) **PPT presentations by the faculty about the applications of the module-Computation of stress and strain, Errors and approximations, Estimating the critical points.** iii) Guidance to the students for self-study topics through illustrative examples.	**4T**
Self-Study: Euler's Theorem, Method of Lagrange's undetermined multipliers with single constraint.	**Article No. 5.4 and 5.12 of textbook 1** 1. **No Question is to be set for SEE.** 2. **20% weightage shall be given to CIE from self-study topics**	
(RBT Levels: L1, L2 & L3) Total		**8**

Module-III: Ordinary Differential Equations of First Order		
Linear and Bernoulli's differential equations, Exact and reducible to exact differential equations-Integrating factors on $\frac{1}{M}\left(\frac{\partial M}{\partial y}-\frac{\partial N}{\partial x}\right)$ & $\frac{1}{N}\left(\frac{\partial N}{\partial x}-\frac{\partial M}{\partial y}\right)$. Orthogonal trajectories, Newton's law of cooling.	(i) Discussion and problems restricted to article no.11.9 (only for introduction No questions to be set for SEE) and 11.10 of textbook 1. (ii) In the case of reducible to exact equations, I.F. is restricted to $\frac{1}{M}\left(\frac{\partial M}{\partial Y}-\frac{\partial N}{\partial X}\right)$ & $\frac{1}{N}\left(\frac{\partial N}{\partial x}-\frac{\partial M}{\partial Y}\right)$ only. article no.11.11, 11.12(4) of text Book 1. (iii) Application-oriented problems are restricted to articles no.12.3 (1, 2 & 3) & 12.6 of textbook 1.	**3L**
Nonlinear differential equations: Introduction to general and singular solutions, Solvable for p only, Clairaut's equations, reducible to Clairaut's equations. Problems.	Discussion and problems restricted to article no. 11.13(case I only) and 11.14 of textbook 1.	**1L**
Tutorials	i) Involvement of faculty and students in identifying the problems & solutions. ii) **PPT presentations by the faculty about the applications of the module- Rate of Growth or Decay, Conduction of heat.** iii) Guidance to the students for self-study topics through illustrative examples.	**4T**
Self-study: **Nonlinear ODE solvable for x and y. Application of ODE in Civil Engineering-Bending of the beam and Whirling of the shaft.**	**Article no. 11.13 (Case II and Case III), 12.5 of textbook 1** 1. **No Question is to be set for SEE** 2. **20% weightage shall be given to CIE from self-study topics**	
(**RBT Levels: L1, L2 & L3**) **Total**		**8**
Module-IV: Ordinary Differential Equations of Higher-Order		
Higher-order linear ODEs with constant coefficients. Inverse differential operator.	Discussion of problems in article no. 13.4, 13.5, 13.6 and 13.7 of textbook 1. (P.I. restricted to $R(x) = e^{ax}, \sin ax, \cos ax, x^n$ for $f(D)y = R(x)$)	**2L**
Method of variation of parameters, Cauchy's and Legendre's homogeneous differential equations. Problems.	Discussion of problems in article no.13.8 (1) of Textbook 1. Discussion of problems in article no.13.9 of Textbook 1 (*P.I. restricted to $R(x)= e^{ax}$, sin ax, cos ax, x^n & log x in f(D)y = R(x) for Cauchy's and Legendre's equations*)	**2L**
Tutorials	i) Involvement of faculty and students in identifying the problems & solutions. ii) **PPT presentations by the faculty about the applications of the module- oscillations of a spring, Transmission lines and Highway engineering.** iii) Guidance to the students for self-study topics through illustrative examples.	**4T**
Self-study: Finding the solution by the method of undetermined coefficients. Formulation and solutions of cantilever beam.	**Article no. 13.8(2) and 14.4 of Textbook 1** 1. **No Question is to be set for SEE.** 2. **20% weightage shall be given to CIE from self-study topics**	
(**RBT Levels: L1, L2 & L3**) **Total**		**8**
Module-V: Linear Algebra		

Elementary row transformation of a matrix, Rank of a matrix. Consistency and Solution of a system of linear equations. Gauss elimination method, Gauss–Jordan method and approximate solution by the Gauss-Seidel method.	Discussion and problems as suggested in article no. 2.7, 2.10, 28.6(1, 2) and 28.7(2) of Textbook 1.	**3L**
Eigen values and Eigenvectors - Rayleigh's power method to find the dominant eigenvalue and eigenvector.	Discussion and problems as suggested in article no. 4.0, 8.1 and 20.8 of Textbook 2	**1L**
Tutorials	i) Involvement of faculty and students in identifying the problems & solutions. ii) **PPT presentations by the faculty about the applications of the module- Structural Analysis, Balancing equations.** iii) Guidance to the students for self-study topics through illustrative examples.	**4T**
Self-study: Solution of a system of linear equations by Gauss-Jacobi method, Inverse of a square matrix by Cayley-Hamilton theorem.	Article no. 28.7(1), 2.15 of Textbook 1. 1. **No Question is to be set for SEE.** 2. **20% weightage shall be given to CIE from self-study topics.**	
(**RBT Levels: L1, L2 & L3**)	**Total**	**8**

Text Books: -
1. **B. S. Grewal**: "Higher Engineering Mathematics", Khanna Publishers, 44thEd., 2021.
2. **E. Kreyszig**: "Advanced Engineering Mathematics", John Wiley & Sons, 10thEd., 2018.

Reference Books:-

1. **B.V. Ramana:** "Higher Engineering Mathematics" McGraw-Hill Education, 11th Ed., 2017
2. **Srimanta Pal & Subodh C. Bhunia**: "Engineering Mathematics" Oxford University Press, 3rd Ed., 2016.
3. **N.P Bali and Manish Goyal**: "A Textbook of Engineering Mathematics" Laxmi Publications, 10th Ed., 2022.
4. **C. Ray Wylie, Louis C. Barrett:** "Advanced Engineering Mathematics" McGraw – Hill Book Co., New York, 6th Ed., 2017.
5. **Gupta C.B, Sing S.R and Mukesh Kumar:** "Engineering Mathematic for Semester I and II", Mc-Graw Hill Education(India) Pvt. Ltd 2015.
6. **H. K. Dass and Er. Rajnish Verma:** "Higher Engineering Mathematics" S. Chand Publication, 3rd Ed., 2014.
7. **James Stewart: "**Calculus" Cengage Publications, 7thEd., 2019.
8. **David C Lay:** "Linear Algebra and its Applications", Pearson Publishers, 4th Ed., 2018.
9. **Gareth Williams:** "Linear Algebra with applications", Jones Bartlett Publishers Inc., 6th Ed., 2017.
10. **Gilbert Strang:** "Linear Algebra and its Applications", Cengage Publications, 4th Ed., 2022.

Web links and Video Lectures:

1. http://nptel.ac.in/courses.php?disciplineID=111
2. http://www.class-central.com/subject/math(MOOCs)
3. http://academicearth.org/
4. VTU EDUSAT PROGRAMME - 20