ATME College of Engineering

COURSE MODULES OF THE SUBJECT TAUGHT FOR THE SESSION MARCH-JUNE(2024)

Course Syllabi with CO's

Faculty Name :				**Academic Year**: 2023-2024 (EVEN SEMESTER)			
Department: Mathematics							
Course Code	**Course Title**	**Core/ Elective**	**Prerequisite**	**Contact Hours**			**Total Hrs/ Sessions**
				L	T	P	
BMATC201	**Mathematics –II for Civil Engineering Stream**	**Core**	Partial Differentiation, Integration, Vectors, Trigonometric, Differentiation	**2**	**2**	**2**	**40**
Course Objectives	The goal of the course **Mathematics –II for Civil Engineering Stream** (**BMATC201**) is to • **Familiarize** the importance of Integral calculus and Vector calculus essential for civil engineering. • **Analyse** Civil engineering problems applying Partial Differential Equations. • **Develop** the knowledge of solving civil engineering problems numerically						
Topics Covered as per Syllabus							

Module-1: Integral Calculus

Introduction to Integral Calculus in Civil Engineering applications.

Multiple Integrals: Evaluation of double and triple integrals, evaluation of double integrals by change of order of integration, changing into polar coordinates. Applications to find: Area and Volume by double integral. Problems.

Beta and Gamma functions: Definitions, properties, relation between Beta and Gamma functions. Problems.

Self-Study: Volume by triple integration, Centre of gravity.

Applications: Applications to mathematical quantities (Area, Surface area, Volume), analysis of probabilistic models. **(RBT Levels: L1, L2 and L3)**

Module-2 : Vector Calculus

Vector Differentiation: Scalar and vector fields. Gradient, directional derivative, curl and divergence - physical interpretation, solenoidal and irrotational vector fields. Problems.

Vector Integration: Line integrals, Surface integrals. Applications to work done by a force and flux. Statement of Green′s theorem and Stoke′s theorem. Problems.

Self-Study: Volume integral and Gauss divergence theorem.

Applications: Heat and mass transfer, oil refinery problems, environmental engineering. Analysis of stream lines, velocity and acceleration of a moving particle.

(RBT Levels: L1, L2 and L3)

Module-3: Partial Differential Equations (PDE's)

Importance of partial differential equations for Civil Engineering application.

Formation of PDE's by elimination of arbitrary constants and functions. Solution of nonhomogeneous PDE by direct integration. Homogeneous PDEs involving derivative with respect to one independent variable only. Solution of Lagrange's linear PDE.

Derivation of one-dimensional heat equation and wave equation.

Self-Study: Solution of one-dimensional heat equation and wave equation by the method of separation of variables.

Applications: Design of structures (vibration of rod/membrane).

(RBT Levels: L1, L2 and L3)

Module-4: Numerical methods -1

Importance of numerical methods for discrete data in the field of Civil Engineering.

Solution of algebraic and transcendental equations: Regula-Falsi and Newton-Raphson methods (only formulae). Problems. Finite differences, Interpolation using Newton′s forward and backward difference formulae, Newton′s divided difference formula and Lagrange′s interpolation formula (All formulae without proof). Problems.

N**umerical integration**: Trapezoidal, Simpson's $(1/3)_{rd}$ and $(3/8)_{th}$ rules (without proof). Problems.

Self-Study: Bisection method, Lagrange′s inverse Interpolation**.**

Applications: Estimating the approximate roots, extremum values, Area, volume, surface area. Finding approximate solutions to civil engineering problems..

(RBT Levels: L1, L2 and L3)

Module-5: Numerical methods -2

Introduction to various numerical techniques for handling Civil Engineering applications. Numerical Solution of Ordinary Differential Equations (ODE's):

Numerical solution of ordinary differential equations of first order and first degree - Taylor′s series method, Modified Euler′s method, Runge-Kutta method of fourth order and Milne′s predictor-corrector formula (No derivations of formulae). Problems.

Self-Study: Adam-Bashforth method.

Applications: Finding approximate solutions to ODE related to civil engineering fields.

(RBT Levels: L1, L2 and L3)

List of Laboratory experiments (2 hours/week per batch/ batch strength 15)

10 lab sessions + 1 repetition class + 1 Lab Assessment

1. Program to compute surface area, volume and centre of gravity
2. Evaluation of improper integrals
3. Finding gradient, divergent, curl and their geometrical interpretation
4. Verification of Green's theorem

5 Solution of one-dimensional heat equation and wave equation

6 Solution of algebraic and transcendental equations by Regula-Falsi and Newton-Raphson method

7 Interpolation/Extrapolation using Newton's forward and backward difference formula

8 Computation of area under the curve using Trapezoidal, Simpson's $(1/3)_{rd}$ and (3/8)th rule

9 Solution of ODE of first order and first degree by Taylor's series and Modified Euler's method

10 Solution of ODE of first order and first degree by Runge-Kutta 4_{th} order and Milne's predictor-corrector method

Suggested software's : Mathematica/MatLab/Python/Scilab

List of Text Books

1. B. S. Grewal: "Higher Engineering Mathematics", Khanna publishers, 44th Ed.2021
2. E. Kreyszig: "Advanced Engineering Mathematics", John Wiley & Sons, 10th Ed.,2018.

List of Reference Books

1. **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.Newyork, 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, 7th Ed., 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.

List of URLs, Text Books, Notes, Multimedia Content, etc

- http://.ac.in/courses.php?disciplineID=111
- http://www.class-central.com/subject/math(MOOCs)
- http://academicearth.org/
- VTU e-Shikshana Program
- VTU EDUSAT Program

Course Outcomes	**Course Outcomes:** At the end of the course the student will be able to: **CO1:** Apply the knowledge of multiple integrals to compute area and volume. **CO2:** Understand the applications of vector calculus refer to solenoidal, irrotational vectors, line integral and surface integral. **CO3:** Demonstrate partial differential equations and their solutions for physical interpretations. **CO4:** Apply the knowledge numerical methods in solving physical and engineering phenomena. **CO5:** Get familiarize with modern mathematical tools namely Mathematica/MatLab/Python/Scilab

Internal Assessment Marks: 50 (Two Unit Tests each of 20 Marks and two assignments of 10Marks each. Total 60M is scaled down to 30Marks and Practical component 20Marks).

The Correlation of Course Outcomes (CO's) and Program Outcomes (PO's)

List of Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO-1	2	2	0	0	-	0	0	0	0	0	0	2
CO-2	3	3	0	0	-	0	0	0	0	0	0	2
CO-3	3	3	0	0	-	0	0	0	0	0	0	-
CO-4	3	3	0	0	-	0	0	0	0	0	0	3
CO-5	-	-	0	0	3	0	0	0	0	0	0	2

Note: Level 3- Highly Mapped, Level 2-Moderately Mapped, Level 1-Low Mapped, Level 0- Not Mapped