III SEMESTER (Civil Engineering)

Course Title	NUMERICAL TECHNIQUES, STATISTICS AND PROBABILITY DISTRIBUTIONS.		
Course Code	22MATC31	CIE Marks	50
Course Type	Theory	SEE Marks	50
Teaching Hours/Week (L: T: P: S)	2:2:0:0	Total Marks	100
Total Hours of Pedagogy	40 hours	Exam Hours	03
		Credits	03

Course objectives:

The goal of the course **Numerical Techniques, Statistics and Probability Distributions** for civil engineering is to

- Have an insight into Statistical methods, Correlation and regression analysis.
- Learn the concept of solving the ordinary differential equations arising in engineering applications, using numerical methods.
- Develop the probability distribution of discrete and continuous random variables, Markov chain, Joint probability distribution occurs in civil engineering.
- Provide the principles of statistical inferences and the basics of hypothesis testing with emphasis on some commonly encountered hypotheses.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. In addition to the traditional lecture method, different types of innovative teaching methods may be adopted so that the delivered lessons shall develop students theoretical and applied mathematical skills.
2. State the need for Mathematics with Engineering Studies and Provide real-life examples.
3. Support and guide the students for self–study.
4. You will also be responsible for assigning homework, grading assignments and quizzes, and documenting students' progress.
5. Encourage the students for group learning to improve their creative and analytical skills.
6. Show short related video lectures in the following ways:
   - As an introduction to new topics (pre-lecture activity).
   - As a revision of topics (post-lecture activity).
   - As additional examples (post-lecture activity).
   - As an additional material of challenging topics (pre-and post-lecture activity).
   - As a model solution of some exercises (post-lecture activity).

Module-1

Curve Fitting and Statistical Methods.:

Curve Fitting**:** Curve fitting by the method of least squares, fitting the curves of the forms $y = ax + b$, $y = ax^2 + bx$ + c and $y = ax^b$

Statistical Methods**:** Correlation and regression-Karl Pearson's coefficient of correlation and rank correlation, problems. Regression analysis, lines of regression, problems. **(8 Hours)**

[Text 1: 24.1, 24.4, 24.5, 24.6, 25.12, 25.13, 25.14, 25.16]

Self-Study: Fitting of the curves y = ab^x and y = ae^{bx}. Angle between two regression lines, problems.
(RBT Levels: L1, L2 and L3)

Module-2

Numerical Solution of Simultaneous and Second order Ordinary Differential Equations:

Numerical solutions of simultaneous first order differential equations-Picard's method, Taylor's series method and Runge-Kutta method (No derivations of formulae). Second-order differential equations - Runge-Kutta method and Milne's predictor and corrector method (No derivations of formulae). **(8 Hours)**

Self-study: Solution of Laplace's equation using standard five-point formula.
(RBT Levels: L1, L2 and L3)

Module-3

Probability Distributions:

Review of basic probability theory. Random variables (discrete and continuous), probability mass and density functions. Mathematical expectation, mean and variance. Binomial, Poisson and normal distributions - problems (derivations for mean and standard deviation for Binomial and Poisson distributions only)-Illustrative examples. **(8 Hours)**

[Text 1: 26.1, 26.2, 26.7, 26.8, 26.9, 26.10, 26.13, 26.14, 26.15, 26.16]

Self-study: Exponential distribution**.**
(RBT Levels: L1, L2 and L3)

Module-4

Joint probability distribution & Markov Chain:

Joint probability distribution: Joint Probability distribution for two discrete random variables, expectation, covariance and correlation.

Markov Chain: Introduction to Stochastic Process, Probability Vectors, Stochastic matrices, Regular stochastic matrices, Markov chains, Higher transition probabilities, Stationary distribution of Regular Markov chains and absorbing states. **(8 Hours)**

[Text 3: 8.1, 8.2, 8.3, 8.4, 8.5, 8.6, 5.6, 5.7]

Self-Study: Joint Probability distribution for two continuous random variables.
(RBT Levels: L1, L2 and L3)

Module-5

Sampling Theory:

Introduction to sampling distributions, standard error, Type-I and Type-II errors. Test of hypothesis for means, student's t-distribution, Chi-square distribution as a test of goodness of fit. (**8 Hours)**

[Text 1: 27.1, 27.2, 27.3, 27.4 27.5, 27.7, 27.9, 27.10, 27.11, 27.12, 27.13, 27.14, 27.15, 27.16, 27.17, 27.18]

Self-Study: Point estimation and interval estimation.
(RBT Levels: L1, L2 and L3)

Teaching-Learning Process for all modules	**Chalk and Talk/PowerPoint presentation/YouTube videos.**

Course Outcomes (Course Skill Set):

After successfully completing the course, the students will be able:

1. Make use of the correlation and regression analysis to fit a suitable mathematical model for the statistical data.
2. To solve mathematical models represented by initial or boundary value problems involving ordinary differential equations.
3. Apply discrete and continuous probability distributions in analyzing the probability models arising in the civil engineering field.
4. Use Markov's chains in analyzing the probability models arising in civil engineering field and construct joint probability distributions.
5. Demonstrate the validity of testing the hypothesis.

Evaluation Details:

Evaluation Type		Component	Max Marks	Marks Reduced to	Min. Marks	Evaluation Details
Theory Component	Internal Assessment Tests (IAT)	IAT-1	25	25	20	Average of two IATs, Scaled down to 25 marks
		IAT-2	25			
	Comprehensive Continuous Evaluations (CCE)	CCE-1	25	25		Any two Assessment methods as per 22OB4.2 of regulations. Average of two CCEs, scaled down to 25 marks
		CCE-2	25			
	Total CIE -Theory			**50**	**20**	
SEE			100	**50**	**18**	Conducted for 100 marks And scaled down to 50.
CIE + SEE				**100**	**40**	

Suggested Learning Resources:

Text Books:

1. **B. S. Grewal**: "Higher Engineering Mathematics", Khanna publishers, 44th Ed.2018.
2. **E. Kreyszig**: "Advanced Engineering Mathematics", John Wiley & Sons, 10th Ed. (Reprint), 2016.
3. **Seymour Lipschutz and Marc Lars Lipson:** "Probability", (Chapters: 5 and 8), McGraw Hill Education (India) Private Limited, Chennai, Special Indian Edition, 2010.

Reference Books:

1. **B.V. Ramana:** "Higher Engineering Mathematics" McGraw-Hill Education, 11th Ed.
2. **Srimanta Pal & Subodh C.** Bhunia: "Engineering Mathematics" Oxford University Press, 3rd reprint, 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 edition, 4th Reprint 2019.

E-Resources:

- 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

Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning

- Quizzes
- Assignments
- Seminars

CO- PO Mapping:

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
22MATC31.1	3	3	1									
22MATC31.2	3	3	2									
22MATC31.3	3	3										
22MATC31.4	3	3										
22MATC31.5	2	3	1									
Level 3- Highly Mapped, Level 2-Moderately Mapped, Level 1-Low Mapped, Level 0- Not Mapped												