

I Semester

CALCULUS AND DIFFERENTIAL EQUATIONS			
Course Code	21MAT11	CIE Marks	50
Teaching Hours/Week (L:T:P:S)	2:2:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03
<p>Course objectives: The goal of the course Calculus and Differential Equations - 21MAT11 is</p> <ul style="list-style-type: none"> To facilitate the students with a concrete foundation of differential calculus To solve the first and higher-order ordinary differential equations enabling them to acquire the knowledge of these mathematical tools. To develop the knowledge of matrices and linear algebra in a comprehensive manner. 			
<p>Teaching-Learning Process (General Instructions): These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.</p> <ol style="list-style-type: none"> 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. State the need for Mathematics with Engineering Studies and Provide real-life examples. Support and guide the students for self-study. You will also be responsible for assigning homework, grading assignments and quizzes, and documenting students' progress. Encourage the students for group learning to improve their creative and analytical skills. Show short related video lectures in the following ways: <ul style="list-style-type: none"> 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: Differential Calculus - 1			
<p>Polar curves, angle between the radius vector and the tangent, angle between two curves. Pedal equations. Curvature and Radius of curvature - Cartesian, Parametric, Polar and Pedal forms. Problems.</p> <p>Self-study: Center and circle of curvature, evolutes and involutes. (RBT Levels: L1, L2 and L3)</p>			
Teaching-Learning Process	Chalk and talk method / Power Point Presentation		
Module-2: Differential Calculus - 2			
<p>Taylor's and Maclaurin's series expansion for one variable (Statement only) – problems. Indeterminate forms-L'Hospital's rule. Partial differentiation, total derivative-differentiation of composite functions. Jacobian and problems. Maxima and minima for a function of two variables. Problems.</p> <p>Self-study: Euler's Theorem and problems. Method of Lagrange undetermined multipliers with single constraint. (RBT Levels: L1, L2 and L3)</p>			
Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation		

Module-3: Ordinary Differential Equations (ODE's) of first order	
<p>Linear and Bernoulli's differential equations. Exact and reducible to exact differential equations. Applications of ODE's-Orthogonal trajectories, Newton's law of cooling.</p> <p>Nonlinear differential equations: Introduction to general and singular solutions; Solvable for p only; Clairaut's equations, reducible to Clairaut's equations. Problems.</p> <p>Self-Study: Applications of ODE's: L-R circuits. Solvable for x and y.</p> <p>(RBT Levels: L1, L2 and L3)</p>	
Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation
Module-4: Ordinary Differential Equations of higher order	
<p>Higher-order linear ODE's with constant coefficients - Inverse differential operator, method of variation of parameters, Cauchy's and Legendre homogeneous differential equations. Problems.</p> <p>Self-Study: Applications to oscillations of a spring and L-C-R circuits.</p> <p>(RBT Levels: L1, L2 and L3)</p>	
Teaching-Learning Process	Chalk and talk method / Power Point Presentation
Module-5: Linear Algebra	
<p>Elementary row transformation of a matrix, Rank of a matrix. Consistency and Solution of system of linear equations; Gauss-elimination method, Gauss-Jordan method and Approximate solution by Gauss-Seidel method. Eigenvalues and Eigenvectors-Rayleigh's power method to find the dominant Eigenvalue and Eigenvector.</p> <p>Self-Study: Solution of system of equations by Gauss-Jacobi iterative method. Inverse of a square matrix by Cayley- Hamilton theorem.</p> <p>(RBT Levels: L1, L2 and L3).</p>	
Teaching-Learning Process	Chalk and talk method / Power Point Presentation
Course outcomes (Course Skills Set)	
<p>After successfully completing the course, the student will be able to understand the topics.</p> <ul style="list-style-type: none"> • Apply the knowledge of calculus to solve problems related to polar curves and its applications in determining the bentness of a curve. • Learn the notion of partial differentiation to calculate rate of change of multivariate functions and solve problems related to composite functions and Jacobian. • Solve first-order linear/nonlinear ordinary differential equations analytically using standard methods. • Demonstrate various models through higher order differential equations and solve such linear ordinary differential equations. • Test the consistency of a system of linear equations and to solve them by direct and iterative methods. 	

Assessment Details (both CIE and SEE)**Continuous Internal Evaluation:**

10 marks weightage has to be given for the **Self-Study component** (Via assignment/seminar/test).

Semester End Examination:

3.

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.

Reference Books

1. **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, Latest edition.
4. **C. Ray Wylie, Louis C. Barrett:** "Advanced Engineering Mathematics" McGraw – Hill Book Co.Newyork, Latest ed.
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 (2014).
7. **James Stewart:** "Calculus" Cengage publications, 7th edition, 4th Reprint 2019.

Web links and Video Lectures (e-Resources):

- <http://.ac.in/courses.php?disciplineID=111>
- [http://www.class-central.com/subject/math\(MOOCs\)](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

II Semester

ADVANCED CALCULUS AND NUMERICAL METHODS			
Course Code	21MAT21	CIE Marks	50
Teaching Hours/Week (L:T:P:S)	2:2:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03
<p>Course objectives: The goal of the course Advanced Calculus and Numerical Methods - 21MAT21 is,</p> <ul style="list-style-type: none"> • To facilitate the students with a concrete foundation of integral calculus. • To facilitate the students with a concrete foundation of vector calculus, partial differential equations, and numerical methods enabling them to acquire the knowledge of these mathematical tools. 			
<p>Teaching-Learning Process (General Instructions): These are sample Strategies; which teachers can use to accelerate the attainment of the various course outcomes.</p> <ol style="list-style-type: none"> 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: <ul style="list-style-type: none"> ● 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: Integral Calculus			
<p>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 a double integral. Problems.</p> <p>Beta and Gamma functions: Definitions, properties, the relation between Beta and Gamma functions. Problems.</p> <p>Self-Study: Centre of gravity.</p>			
Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation		
Module-2: Vector Calculus			
<p>Vector Differentiation: Scalar and vector fields. Gradient, directional derivative, curl and divergence - physical interpretation, solenoidal and irrotational vector fields. Problems.</p> <p>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.</p> <p>Self-Study: Volume integral and Gauss divergence theorem.</p>			
Teaching-Learning Process	Chalk and talk method / Power Point Presentation		
Module-3: Partial Differential Equations (PDE's)			

<p>Formation of PDE's by elimination of arbitrary constants and functions. Solution of non-homogeneous 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.</p> <p>Self-Study: Solution of one-dimensional heat equation and wave equation by the method of separation of variables.</p>	
Teaching-Learning Process	Chalk and talk method / Power Point Presentation
Module-4: Numerical methods -1	
<p>Solution of polynomial and transcendental equations: Regula-Falsi and Newton-Raphson methods (only formulae). Problems.</p> <p>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.</p> <p>Numerical integration: Simpson's (1/3)rd and (3/8)th rules(without proof). Problems.</p> <p>Self-Study: Bisection method, Lagrange's inverse Interpolation, Weddle's rule</p>	
Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation
Module-5: Numerical methods -2	
<p>Numerical Solution of Ordinary Differential Equations (ODE's):</p> <p>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, Milne's predictor-corrector formula (No derivations of formulae). Problems.</p> <p>Self-Study: Adam-Bashforth method.</p>	
Teaching-Learning Process	Chalk and talk method/PowerPoint Presentation
<p>Course outcomes (Course Skills Set)</p> <p>After successfully completing the course, the student will be able to understand the topics:</p> <ul style="list-style-type: none"> • Apply the concept of change of order of integration and change of variables to evaluate multiple integrals and their usage in computing the area and volume. • Illustrate the applications of multivariate calculus to understand the solenoidal and irrotational vectors and also exhibit the interdependence of line, surface, and volume integrals. • Formulate physical problems to partial differential equations and to obtain solutions for standard practical PDE's. • Apply the knowledge of numerical methods in modeling various physical and engineering phenomena. • Solve first-order ordinary differential equations arising in engineering problems. 	

Assessment Details (both CIE and SEE)

Continuous Internal Evaluation(CIE):

Semester End Examination(SEE):

3.

Suggested Learning Resources:

Text Books

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- VTU e-Shikshana Program
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