

## Syllabus template

<b>Semester: 7</b>	
<b>Programme: Mathematics</b>	
<b>Course: Analysis-3 &amp; Ordinary Differential Equations-2</b>	
<b>Paper code: B4MT230721T</b>	<b>Credits:4</b>
<b>Hours/week: 4</b>	
<b>Category: Core/MDC/SEC/VAC: Minor</b>	
<b>Theory / Practical / Composite: Theory</b>	
<b>No of Modules: Nil</b>	
<b>Course Overview: Analysis-3 &amp; Ordinary Differential Equations-2</b>	
<p>This course develops advanced concepts in real analysis and differential equations, focusing on both theoretical understanding and problem-solving techniques. It begins with mean value theorems, Taylor and Maclaurin expansions, and their applications to indeterminate forms and optimization problems. The course extends to functions of multiple variables, covering limits, continuity, partial derivatives, exact differentials, and optimization methods including Lagrange multipliers. It also introduces multiple integrals, including double and triple integrals, along with change of variables using Jacobians and their applications.</p> <p>Finally, the course addresses second-order linear differential equations, including homogeneous and non-homogeneous cases, Cauchy–Euler equations, and methods such as undetermined coefficients and variation of parameters. Overall, the course provides a strong analytical foundation for multivariable calculus and differential equations with applications in science and engineering.</p>	
<b>Course Outcome:</b> On successful completion of the course a student will be able to do the following:	
<b>Explain and apply</b> Rolle’s, Lagrange’s, and Cauchy’s Mean Value Theorems, and use Taylor and Maclaurin expansions in analyzing functions.	
<b>Apply</b> L’Hospital’s Rule and optimization techniques to solve problems involving indeterminate forms and extrema of functions of one variable.	
<b>Analyze</b> functions of two and three variables with respect to limits, continuity, and partial derivatives, including use of chain rule and exact differentials.	
<b>Apply</b> methods of multivariable optimization, including unconstrained and constrained optimization using Lagrange multipliers.	
<b>Evaluate</b> double and triple integrals and apply change of variables using Jacobians to solve problems in multiple dimensions.	
<b>Solve</b> second-order linear differential equations using appropriate methods such as complementary function, particular integral, undetermined coefficients, and variation of parameters.	
<b>Analyze</b> the structure of differential equations using Wronskian and interpret the nature of solutions for homogeneous and non-homogeneous cases.	

**Prerequisites:****SYLLABUS**

<b>UNIT/Module</b>	<b>CONTENT</b>	<b>NUMBER OF CLASSES</b>	<b>CO Mapping</b>	<b>COGNITIVE LEVEL</b>
<b>I.</b>	<p>Analysis-3: Mean Value Theorems [15]: Statement of Rolle's Theorem - its geometrical interpretation and direct applications. Mean Value Theorems of Lagrange and Cauchy (proof included) and applications (5). Indeterminate Forms: L' Hospital's Rule: statement and problems only (2). Statement of Taylor's and Maclaurin's Theorem with Lagrange's &amp; Cauchy's form of remainders. Taylor's and Maclaurin's infinite series for functions like <math>\exp(x)</math>, <math>\sin(x)</math>, <math>\cos(x)</math>, <math>(1+x)^n</math>, <math>\ln(1+x)</math> (with restrictions wherever necessary) (5). Application of the principle of maximum and minimum for a function of a single variable in geometrical, physical and other problems (3).</p> <p>Functions of two and three variables[14]:Geometrical representations. Limit and continuity (definitions) for functions of two variables, sequential criteria, examples (3). Partial derivative: knowledge and use of chain rule. Exact differentials: definition and examples (emphasis on problem solving only) (3). Successive partial derivatives: statement of Schwarz's theorem on commutativity of mixed partial derivatives (3). Euler's Theorem on homogeneous function of two and three variables (2). Unconstrained optimization of functions of not more than three variables, Lagrange's method of constrained optimization—problems only (using theory of eigen values) (3).</p> <p>Multiple integrals [12]: Evaluation of Double Integrals over rectangular</p>	<b>41 classes</b>	<b>CO1, CO2, CO3, CO4, CO5</b>	<b>K2, K3, K4</b>

	regions and non-rectangular regions [3], Triple Integrals and its applications [5], Change of Variable in Multiple (double & triple) Integrals: general properties of Jacobian [4].			
<b>II.</b>	Ordinary Differential Equations-2 Linear differential equations of second order[11]: solution of homogeneous equation [2], Wronskian and related problems[2].Linear non-homogeneous equations with constant co-efficients; Cauchy Euler equation [3]; Method of undetermined co-efficients, Second order linear differential equations with variable co-efficients; method of variation of parameters [4].	<b>11 classes</b>	<b>CO6, CO7</b>	<b>K3, K4</b>
<b>Text Books</b>				
1. An Introduction to Analysis: Differential Calculus: (Part-I): Ghosh & Maity.				
2. Mathematical Analysis: Malik &Arora.				
3. Real Analysis: S. K. Mapa.				
4. Differential Equations: Chakraborty & Ghosh.				
<b>Suggested readings</b>				
1. Advanced differential Calculus of several variables: Subir Mukherjee.				
2. Differential Equations: Shepley L. Ross.				
<b>Web Resources</b>				
<b>Evaluation:</b> Theory CIA: <b>20+5+5=30</b> Semester Exam: <b>70</b>				
<b>Paper Structure for Theory Semester Exam Module:</b> 7 questions each of <b>10</b> marks out of a set of <b>13</b> questions.				

### Course outcomes (COs) and Cognitive Level Mapping

<b>COs</b>	<b>CO Description</b>	<b>Cognitive levels</b>
<b>CO1</b>	Explain and apply Rolle's, Lagrange's, and Cauchy's Mean Value Theorems, and use Taylor and Maclaurin expansions in analyzing functions.	<b>K2, K3</b>
<b>CO2</b>	Apply L'Hospital's Rule and optimization techniques to solve problems involving indeterminate forms and extrema of functions of one variable.	<b>K3</b>
<b>CO3</b>	Analyze functions of two and three variables with respect to limits, continuity, and partial derivatives, including use of chain rule and exact differentials.	<b>K4</b>
<b>CO4</b>	Apply methods of multivariable optimization, including unconstrained and constrained optimization using Lagrange multipliers.	<b>K3, K4</b>
<b>CO5</b>	Evaluate double and triple integrals and apply change of variables using Jacobians to solve problems in multiple dimensions.	<b>K3, K4</b>
<b>CO6</b>	Solve second-order linear differential equations using appropriate methods such as complementary function, particular integral, undetermined coefficients, and variation of parameters.	<b>K3</b>
<b>CO7</b>	Analyze the structure of differential equations using Wronskian and interpret the nature of solutions for homogeneous and non-homogeneous cases.	<b>K4</b>