Real Analysis and Calculus

1.1 Course Number: MA 111

1.2 Contact Hours: 3-1-0 Credits: 11

1.3 Semester-offered: 1st Year-Odd

1.4 Prerequisite: None

1.5 Syllabus Committee Member: Dr. C. Kundu (Convener), Dr. M.K. Rajpoot & Dr. A. Kumar

2. **Objective:** The key objectives of the course are:

- ☞ To set forth the process of thinking by which the concepts and methods of real analysis and calculus are developed.
- ☞ This novel course is designed to cater to the needs of foundation in modern technology.
- ☞ This course stands on the boarder-line between Elementary Mathematics (algebra, plain geometry, etc.) and the more advance abstract analysis.

3. **Course Content:**

Unit-wise distribution of content and number of lectures

Unit	Topics	Sub-topic	Lectures
1	**Real Analysis and Single-Variable Calculus**	Sequence, series and convergence tests. Limit, continuity, differentiability/successive differentiation and Leibnitz theorem. Rolle's theorem, Lagrange and Cauchy's mean value theorems, Taylor's and Maclaurin's expansion. Indeterminate forms and L' Hospital's rule. Curvature, asymptotes, concavity, convexity and point of inflexion. Riemann integration, Fundamental theorem of calculus, Differentiation under integral sign: Leibnitz rule. Improper integrals and their convergence. Beta-Gamma functions and properties.	19
2	**Multi-Variable Calculus**	Functions of several variables, Limit, continuity and differentiability. Partial derivatives and total derivatives. Homogeneous function and Euler's theorem. Taylor's and Maclaurin's expansion. Jacobian. Maxima/Minima, Lagrange's method of multipliers.	5
3	**Multiple Integrals**	Evaluation of double integrals, polar coordinates, change of order of integration and application, Evaluation of triple integrals, change of coordinates, evaluation of volumes of solids and curved surfaces. Applications: Mass, center of gravity and moment of inertia of two and three dimensional structures.	8

4	**Vector Calculus**	Directional derivative, tangent plane, normal line. Differentiation and integration of vector valued functions: line, surface and volume integrals, application to work done/circulation, outward flux; gradient, divergence, curl. Green's, Gauss' and Stoke's theorems (without proof).	7
		Total	**39**

4. Readings

4.1 Textbook:

- *Thomas' Calculus* by Thomas, Hass, Heil and Weir. Pearson Education.
- *Real Analysis* by Bartle and Sherbert. Wiley.

4.2 Reference books:

- ✓ *Basic Multivariable Calculus* by Marsden, Tromba & Weistein. Springer, India, Pvt. Ltd.
- ✓ *Vector Calculus* by S.J. Colley. Pearson Education.
- ✓ *Theory and Problems of Advanced Calculus* by M.R. Spiegel (Schaum Series)
- ✓ *Advanced Engineering Mathematics* by E. Kreyszig, Wiley-India Ed.
- ✓ *Advanced Engineering Mathematics* by H.K. Dass.
- ✓ *Higher Engineering Mathematics* by B.S. Grewal.

5 Outcome of the Course:

Every student in Engineering & Technology will be able to understand the contents of topics being covered in his branch. The students will also enlarge their mathematical concepts and operations and become familiar with the new mode of approach to a problem.