Course Code	EM 217
Course Title	Advanced Calculus
No. of Credits	3
Pre-requisites	None
Compulsory/Optional	Compulsory for Mechanical Engineering Specialization

Aim(s): To introduce calculus of functions of several variables,vector valued functionsandcomplex line integrals, and the use ofintegral theorems in any orthogonal curvilinear coordinates to solve calculus related problems.

Intended Learning Outcomes:
On successful completion of the course, the students should be able to;

- Sketch level curves and level surfaces of functions of two and three variables, and sketch their surfaces and solids, and then compute their Taylor series expansions and their maximums and minimums.
- Compute double and triple integrals of scalar functions over any given 2D and 3D regions.
- Compute gradient, divergence and curl of given functions, and Laplace operator using orthogonal curvilinear coordinates and to evaluate line integrals of vector valued functions and complex valued functions.
- Evaluate surface and volume integrals of continuous vector fields over a given domain and apply integral theorems in terms of orthogonal curvilinear coordinates.

Time Allocation (Hours): Lectures 36 Tutorials 5 Practical Assignments 8 **(Notional Hours 150)**

Course content/Course description:

- **Functions of several variables:** Reviewofpartial derivatives,geometric interpretation,total differentials, and chain rules;Sketching level curves and level surfaces of functions of two and three variables;Sketching surfaces and solids;Limit, and continuity of functions of two and three variables; tangent planes and linear approximation; directional derivative and gradient vector

- **Maximum and Minimum Values:** Mean value theorem, Taylor's theorem;Extreme value theorem and second derivative test; Lagrange multipliers;Scalar line integrals

- **Double and Triple Integration:** Definitions of double and triple integrals;Double and triple integrals over rectangular domains;Double and triple integrals over any general domains;Cylindrical and Spherical polar coordinates;Jacobian and its properties;Applications of double and triple integrals(change of coordinates)

- **Vector Fields and Vector Operators:** Scalar fields and vector fields;Gradient, Divergence and Curl and theirgeometrical and physical interpretations

- **Vector and complex line integral:** Line integrals of vector valued functions and path independency of line integrals;Simply connected domains and conservative vector fields;Cauchy-Riemann equations and Line integrals of complex valued functions;Complex line integrals over simply connected domains and Cauchy's Theorem; Applications of harmonic functions

- **Orthogonal curvilinear coordinates, Surface integrals and Integral Theorems:** Greens Theorem on the plane;Surface integrals of scalar fields and vector fields;Stokes' theorem and divergence theorem;Area and volume elements in terms of orthogonal curvilinear coordinates;Surface integrals with orthogonal curvilinear coordinates;Applications of integral theorems in terms of orthogonal curvilinear coordinates

Recommended Texts :

- James Stewart,Calculus, Fifth Edition(2006)., Thomson Books/Cole
- Watson FulksAdvanced Calculus an Introduction to Analysis3rd Edition(1978), John Wiley & sons, Inc.
- E. B. Saff and A. D. SinderFundamentals of Complex Analysis with Applications to Engineering, Science, and Mathematics,Third Edition,(2014). Pearson Education Ltd.

Assessment	**Percentage Mark**
In-course	
Tutorials/Quizzes	10
Mid Semester Examination	30
End-semester	60