**COEP Technological University**

**Department of Mathematics**

**( MA- ) Ordinary Differential Equations and Multivariate Calculus**

F.Y. B.Tech. Semester II (MECH, META, MFS, Robotics)

Teaching Scheme Examination Scheme

Lectures: 2 hrs / week Internal Test: 20 marks

Tutorials: 1 hr / week Tutorials: 20 marks

Self-study: 1 hr/week End Sem. Exam: 60 marks

**Unit I:** **Multivatiate Calculus:**

Functions of Several Variables, Partial Derivatives, the Chain Rules, Extreme Values and Saddle Points, Lagrange’s multiplier Method; Double integrals in Cartesian co-ordinates, iterated integrals, change of variables, triple integrals in Cartesian co-ordinates, Applications to Area, Volume, Moments, and Center of Mass.

**S:** Area, Volume, Moments, and Center of Mass. **[8L+4T+4S]**

**Unit II:** **Vector Calculus:**

Vector differentiation, gradient, divergence and curl, line integral and arc length parameterization, surface integrals, path independence, statements, and illustrations of theorems of Green, Stokes and Gauss, applications.

**S:** path independence **[8L+4T+4S]**

**Unit III:** **Ordinary Differential Equations:**

Review of first order differential equations, linear differential equations, homogeneous higher order linear differential equations, non-homogeneous higher order linear differential equations with constant coefficients (method of undetermined coefficients and method of variation of parameters), Euler-Cauchy equations, Numerical methods for Ordinary differential equations: Euler’s and Runge Kutta method.

**S:** Review of first order differential equations, linear differential equations, homogeneous differential equations, method of variation of parameters **[8L+4T+4S]**

**Unit IV: Laplace Transform:**

Laplace Transform of simple functions, Inverse Laplace Transform, Properties and Theorems of Laplace Transforms; Applications to Initial and boundary value problems.

**S:** Properties and Theorems of Laplace Transforms  **[4L+2T+2S]**

**Text Books:**

* Thomas’ Calculus (14th edition) by Maurice D. Weir, Joel Hass, Frank R. Giordano, Pearson Education.
* Advanced Engineering Mathematics (10th edition) by Erwin Kreyszig, Wiley eastern Ltd.

**Reference Books** **:**

* Calculus for Scientists and Engineers by K.D Joshi, CRC Press.
* A course in Multivariate Calculus and Analysis by Sudhir Ghorpade and Balmohan Limaye, Springer Science and Business Media.
* Differential equations with Applications and Historical notes by George Simmons, Tata Mc-Graw Hill Publishing company Ltd, New Delhi.

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**Outcomes:** Students will be able to

1. **identify** first order ordinary differential equations, **recall** double / triple integrals, vector differentiation, vector integration, **define** Laplace transform.
2. **understand** basic concepts of higher order ordinary differential equations, **understand** basic concepts of co-ordinate systems, iterated integrals, **state** the significance of gradient, divergence, and curl, **understand** partial derivatives.
3. **solve** linear differential equations using different methods, **evaluate** directional derivatives and extreme values, **evaluate** multiple integrals, **find** area / mass / volume using multiple integrals, **evaluate** line integrals and surface integrals, **find** Laplace tranform.
4. **prove** theorems, **solve** ordinary differential equations using Laplace transform, **identify** orthogonal trajectories, **apply** Green’s / Stoke’s / Divergence theorem to different type of problems.
5. **apply** concepts of ordinary differential equations and multivariate calculus to various problems including real life problems.

**Note 1:**

* To measure CO1, questions may be of the type- define, identify, state, match, list, name etc.
* To measure CO2, questions may be of the type- explain, describe, illustrate, evaluate, give examples, compute etc.
* To measure CO3, questions will be based on applications of core concepts.
* To measure CO4, questions may be of the type- true/false with justification, theoretical fill in the blanks, theoretical problems, prove implications or corollaries of theorems, etc.
* To measure CO5, some questions may be based on self-study topics and also comprehension of unseen passages.

**Note 2 :**

All the Course outcomes 1 to 3 will be judged by 75% of the questions and outcomes 4 and 5

will be judged by 25 % of questions.