ENGINEERING MATHEMATICS II
SH 151

Lecture : 3 **Year : I**
Tutorial : 1 **Part : II**
Practical : 0

Course Objectives:
Course objective: After completion of the course students will be able to apply knowledge of partial differentiation, multiple integrals, vector calculus, optimization, matrices and infinite series in their corresponding study area.

1 Calculus of two and more variables (6 hours)

1.1 Partial differentiation
- 1.1.1 Partial derivatives of first and higher order
- 1.1.2 Homogeneous function: Euler's theorem for two and three variables Total derivatives and differentials, differentiation of composite and implicit functions
- 1.1.3 Jacobians and their properties
- 1.1.4 Extreme values of two and three variables. Lagrange's multiplier
- 1.1.5 Application in optimization of function of two variables in one Constraint

2 Multiple integrals (7 hours)

2.1 Double integrals in Cartesian and Polar form. Change of order of integration
2.2 Triple integrals in Cartesian, cylindrical and spherical coordinates
2.3 Area, volume, moment of inertia, mass and centroid by double and triple integrals

3 Vector calculus (12 hours)

3.1 Review of scalar and vector products , scalar and vector triple product, scalar and vector product of four vectors
3.2 Vector differentiation and integration, their geometrical meaning, velocity and acceleration
3.3 Vector differential operators : Gradient , directional derivatives, divergence and curl
3.4 Line integrals , independent of path, conservative and irrotational vector fields, scalar potential
3.5 Introduction to Green's theorem and its application
3.6 Surface integrals, calculation of Flux
3.7 Volume integrals , Gauss Divergence theorem(without proof) and its application in evaluation of surface integrals
3.8 Introduction to Stoke's theorem and its application

4 Laplace Transform (7 hours)

4.1 Definition of Laplace transform, condition for existence, Laplace transforms of some elementary functions , properties of Laplace transform, shifting and change of scale properties
4.2 Inverse Laplace transform, uniqueness of inverse Laplace transform, properties of inverse Laplace transform
4.3 Laplace transform of derivatives and integral , multiplication by t^n and division by t , the convolution theorem
4.4 Laplace transform of Heaviside's unit function, Dirac-delta function and periodic functions
4.5 Application of Laplace transform to ordinary differential equations

5 Matrices (8 hours)

5.1 Review of algebra of real and complex matrices
5.2 Rank of matrices and its application in system of linear equations
5.3 Vector space, linear dependence and independence
5.4 Eigen values: Cayley Hamilton theorem and its applications
5.5 Eigen vectors, diagonalization of matrices
5.6 Reduction of quadratic forms into canonical forms (three variables only)

6 Solution of differential equation in series and special functions (5 hours)

6.1 Power series method
6.2 Bessel's functions: Introduction, properties and application
6.3 Legendre's function: Introduction, properties and application

Tutorial

There shall be related tutorials exercised in class and given as regular homework exercise. Tutorial can be as following for each specified chapters

1. Techniques of partial differentiation , differentiation of composite and implicit functions , total derivatives, and related exercises
2. Exercises related to Euler's theorem
3. Exercises related to extreme values of two and three variables
4. Change of order of integration in multiple integrals
5. Exercises related to application of double and triple integrals in finding area, volume, moment of inertia, mass and centroid
6. Examples related to revision of scalar and vector product of two and three vactors
7. Problems on gradient , directional derivatives, divergence and curl
8. Exercises on line integrals, independent of path
9. Exercises on surface integrals
10. Exercises on Green's theorem, verification and application in calculating line integrals
11. Verification of Stoke's theorem, application
12. Verification of Gauss' Divergence theorem , and application in calculating surface integrals
13. Exercises related to Laplace transforms
14. Exercises inverse Laplace transforms
15. Exercises related to application of Laplace transform to ordinary differential equations
16. Exercises related to Laplace transform of Heaviside's unit function, Dirac-delta function and periodic functions
17. Rank and solution of simultaneous equations
18. Eigen values and eigen vectors, diagonalization problems
19. Exercises related to reduction of quadratic forms into canonical forms
20. Exercises relate to Bessel's function and Legendre's polynomial

Final Exam

The questions will cover all the chapters in the syllabus. The evaluation scheme will be as indicated in the table below:

Chapter	Hours	Mark distribution*
1	6	8
2	7	8
3	12	18
4	**7**	**8**
5	**8**	**12**
6	**5**	**6**
Total	**45**	**60**

* There may be minor deviation in marks distribution.

References

1. Jeffery A. , (2002). Advanced Engineering Mathematics Academic Press.
2. O'Neill, P.V., (1983). Advanced Engineering Mathematics, Wadsworth Publishing Company
3. Kreyszig , A. ,(2010). Advanced engineering Mathematics ,John Wiley & Sons
4. Sastry S.S. , (2008). Engineering Mathematics vol I and II, PHI Learning Private Limited, New Delhi.
5. Wylie C. , Barrett L.(1995) . Advanced Engineering Mathematics, McGraw-Hill
6. Dutta , Debashis , (2005).Engineering Mathematics Vol I and II, New Age International (p) Limited.