VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI

B.E. SYLLABUS FOR 2018-2022

Advanced Calculus and Numerical Methods

(Common to all branches)
[As per Choice Based Credit System (CBCS) scheme]
(Effective from the academic year 2018-19)

Course Code : 18MAT21
Contact Hours/Week : 05(3L+2T)
Total Hours:50 (8L+2T per module)
Semester : II

CIE Marks : 40
SEE Marks: 60
Exam Hours:03
Credits: 04 (3:2:0)

Course Learning Objectives: This course viz., Advanced Calculus and Numerical Methods (**18MAT21**) aims to prepare the students:

- To familiarize the important tools of vector calculus, ordinary/partial differential equations and power series required to analyze the engineering problems.
- To apply the knowledge of interpolation/extrapolation and numerical integration technique whenever analytical methods fail or very complicated, to offer solutions.

MODULE-I

Vector Calculus:-
Vector Differentiation: Scalar and vector fields. Gradient, directional derivative; curl and divergence-physical interpretation; solenoidal and irrotational vector fields- Illustrative problems.
Vector Integration: Line integrals, Theorems of Green, Gauss and Stokes (without proof). Applications to work done by a force and flux.
(RBT Levels: L1 & L2)

MODULE-II

Differential Equations of higher order:-Second order linear ODE's with constant coefficients-Inverse differential operators, method of variation of parameters; Cauchy's and Legendre homogeneous equations. Applications to oscillations of a spring and L-C-R circuits.
(RBT Levels: L1 ,L2 and L3)

MODULE-III

Partial Differential Equations(PDE's):-
Formation of PDE's by elimination of arbitrary constants and functions. Solution of non-homogeneous PDE by direct integration. Homogeneous PDEs involving derivative with respect to one independent variable only. Solution of Lagrange's linear PDE. Derivation of one dimensional heat and wave equations and solutions by the method of separation of variables.
(RBT Levels: L1, L2 & L3)

MODULE-IV

Infinite Series: Series of positive terms- convergence and divergence. Cauchy's root test and D'Alembert's ratio test(without proof)- Illustrative examples.

Power Series solutions-Series solution of Bessel's differential equation leading to $J_n(x)$-Bessel's function of first kind-orthogonality. Series solution of Legendre's differential equation leading to $P_n(x)$-Legendre polynomials. Rodrigue's formula (without proof), problems.

(RBT Levels: L1 & L2)

MODULE-V

Numerical Methods:
Finite differences. Interpolation/extrapolation using Newton's forward and backward difference formulae, Newton's divided difference and Lagrange's formulae (All formulae without proof). Solution of polynomial and transcendental equations – Newton-Raphson and Regula-Falsi methods(only formulae)- Illustrative examples.

Numerical integration: Simpson's (1/3)th and (3/8)th rules, Weddle's rule (without proof) – Problems.

(RBT Levels: L1, L2 & L3)

Text Books:

1. **B.S. Grewal**: Higher Engineering Mathematics, Khanna Publishers, 43rd Ed., 2015.
2. **E. Kreyszig**: Advanced Engineering Mathematics, John Wiley & Sons, 10th Ed.(Reprint), 2016.

Reference books:

1. **C.Ray Wylie, Louis C.Barrett** : "Advanced Engineering Mathematics", 6th Edition, 2. McGraw-Hill Book Co., New York, 1995.
2. **James Stewart** : "Calculus –Early Transcendentals", Cengage Learning India Private Ltd., 2017.
3. **B.V.Ramana**: "Higher Engineering Mathematics" 11th Edition, Tata McGraw-Hill, 2010.
4. **Srimanta Pal & Subodh C. Bhunia:** "Engineering Mathematics",Oxford University Press,3rd Reprint,2016.
5. **Gupta C.B., Singh S.R. and Mukesh Kumar**: "Engineering Mathematics for Semester I & II", Mc-Graw Hill Education (India) Pvt.Ltd., 2015.

Web links and Video Lectures:

1. http://nptel.ac.in/courses.php?disciplineID=111
2. http://www.class-central.com/subject/math(MOOCs)
3. http://academicearth.org/
4. VTU EDUSAT PROGRAMME – 20

Course Outcomes: On completion of this course, students are able to:

CO1: Illustrate the applications of multivariate calculus to understand the solenoidal and irrotational vectors and also exhibit the inter dependence of line, surface and volume integrals.

CO2: Demonstrate various physical models through higher order differential equations and solve such linear ordinary differential equations.

CO3: Construct a variety of partial differential equations and solution by exact methods/method of separation of variables.

CO4: Explain the applications of infinite series and obtain series solution of ordinary differential equations.

CO5: Apply the knowledge of numerical methods in the modeling of various physical and engineering phenomena.

Question Paper Pattern:

- **The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.**
- The question paper will have ten full questions carrying equal marks.
- Each full question carries 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

H. O. D.
Dept. Of Chemistry
Alva's Institute of Engg. & Technology
Mijar, MOODBIDRI - 574 225