SEMESTER III

III.1 Calculus II

Total marks: 100
Theory: 75
Internal Assessment: 25
5 Lectures, 1 Tutorial (per week per student)

Functions of several variables, level curves and surfaces, graphs of functions of two variables, limits and continuity of functions of two and three real variables, partial differentiation (two variables), partial derivative as a slope, partial derivative as a rate, higher order partial derivatives (notion only), equality of mixed partials, tangent planes, approximations and differentiability, sufficient condition for differentiability (statement only), chain rule for one and two independent parameters, illustration of chain rule for a function of three variables with three independent parameters, directional derivatives and the gradient, extrema of functions of two variables, method of Lagrange multipliers, constrained optimization problems, Lagrange multipliers with two parameters.

Reference:
[1]: Chapter 11.

Double integration over rectangular region, double integration over nonrectangular region, double integrals in polar co-ordinates, triple integrals, cylindrical and spherical co-ordinates, change of variables.

Reference:
[1]: Chapter 12.

Divergence and curl, line integrals, The Fundamental Theorem and path independence, Green's Theorem, surface integrals, Stoke's Theorem, The Divergence Theorem.

Reference:
[1]: Chapter 13.

REFERENCE:

1. **M. J. Strauss, G. L. Bradley** and **K. J. Smith,** *Calculus* (3rd Edition), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education), Delhi, 2007.

SUGGESTED READING:

1. **Jerrold E. Marsden, Anthony J. Tromba** and **Alan Weinstein,** *Basic Multivariable Calculus*, Springer-Verlag, 2005.

III.2 Numerical Methods and Programming

Total marks: 150
Theory: 75
Practical: 50
Internal Assessment: 25
5 Lectures, 2 Practicals, 1 Tutorial (per week per student)

Algorithms, Convergence, Bisection method, False position method, Fixed point iteration method, Newton's method, Secant method, LU decomposition, Gauss-Jacobi, Gauss-Siedel and SOR iterative methods.

Reference:

[1]: Chapter 1 (Sections 1.1-1.2), Chapter 2 (Sections 2.1-2.5), Chapter 3 (Section 3.5, 3.8).

Lagrange and Newton interpolation: linear and higher order, finite difference operators.

References:

[1]: Chapter 5 (Sections 5.1, 5.3)

[2]: Chapter 4 (Section 4.3).

Numerical differentiation: forward difference, backward difference and central difference. Integration: trapezoidal rule, Simpson's rule, Euler's method.

Reference:

[1]: Chapter 6 (Sections 6.2, 6.4), Chapter 7 (Section 7.2)

Note: Emphasis is to be laid on the algorithms of the above numerical methods.

Practical / Lab work to be performed on a computer:

Use of computer aided software (CAS), for example *Matlab / Mathematica / Maple / Maxima* etc., for developing the following Numerical programs:

(i) Calculate the sum 1/1 + 1/2 + 1/3 + 1/4 + ----------+ 1/ N.

(ii) To find the absolute value of an integer.

(iii) Enter 100 integers into an array and sort them in an ascending order.

(iv) Any two of the following

(a) Bisection Method

(b) Newton Raphson Method

(c) Secant Method

(d) Regulai Falsi Method

(v) LU decomposition Method

(vi) Gauss-Jacobi Method

(vii) SOR Method or Gauss-Siedel Method

(viii) Lagrange Interpolation or Newton Interpolation

(ix) Simpson's rule.

Note: For any of the CAS *Matlab / Mathematica / Maple / Maxima* etc., Data types-simple data types, floating data types, character data types, arithmetic operators and operator precedence, variables and constant declarations, expressions, input/output, relational operators, logical operators and logical expressions, control statements and loop statements, Arrays should be introduced to the students.

REFERENCES:

1. **B. Bradie,** *A Friendly Introduction to Numerical Analysis*, Pearson Education, India, 2007.
2. **M. K. Jain, S. R. K. Iyengar** and **R. K. Jain,** *Numerical Methods for Scientific and Engineering Computation*, New age International Publisher, India, 5th edition, 2007.

SUGGESTED READING:

1. **C. F. Gerald** and **P. O. Wheatley**, *Applied Numerical Analysis*, Pearson Education, India, 7th edition, 2008

III.3 Algebra II

Total Marks: 100
Theory: 75
Internal Assessment: 25
5 Lectures, 1 Tutorial (per week per student)

Symmetry of a square, dihedral groups, definition and examples of groups including permutation groups and quaternion groups (illustration through matrices), elementary properties of groups, subgroups and examples of subgroups, centralizer, normalizer, center of a group, cyclic groups, generators of cyclic groups, classification of subgroups of cyclic groups.

Reference:

[1]: Chapters 1, Chapter 2, Chapter 3 (including Exercise 20 on page 66 and Exercise 2 on page 86), Chapter 4, Chapter 5 (upto Example 3).

Cycle notation for permutations, properties of permutations, even and odd permutations, alternating group, a Check-Digit Scheme based on the dihedral group D_5, product (HK) of two subgroups, definition and properties of cosets, Lagrange's theorem and consequences including Fermat's Little theorem, an application of cosets to permutation groups, the rotation group of a cube and a soccer ball, definition and examples of the external direct product of a finite number of groups, normal subgroups, factor groups, applications of factor groups to the alternating group A_4, commutator subgroup.

Reference:

[1]: Chapter 5, Chapter 7 (including Exercises 3, 6 and 7 on page 168), Chapter 8 (upto Example 2), Chapter 9 (upto Example 13 and including Exercise 52 on page 188).

Definition and examples of homomorphism, properties of homomorphism, definition and examples of isomorphism, Cayley's theorem, properties of isomorphism, Isomorphism theorems I, II and III, definition and examples of automorphisms, inner automorphisms, automorphisms and inner automorphisms group, automorphism group of finite and infinite cyclic groups, applications of factor groups to automorphisms groups, Cauchy's theorem for finite abelian groups.

Reference:

[1]: Chapter 6, Chapter 9 (Theorems 9.3-9.5), Chapter 10

REFERENCES:

1. **Joseph A. Gallian**, *Contemporary Abstract Algebra* (4th Ed.), Narosa Publishing House, 1999.

SUGGESTED READING:

1. **David S. Dummit** and **Richard M. Foote**, *Abstract Algebra* (2nd Edition), John Wiley and Sons (Asia) Pvt. Ltd, Singapore, 2003.

III.4 Qualifying paper