**Course: Discipline Specific Core [Semester-5]**

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| Semester | 5 |
| Paper Number | Paper no:12 [HMTCR5121T] |
| Paper Title | **Vector Calculus and Ring theory II** |
| No. of Credits | 6 |
| Theory/ Composite | Theory |
| No of periods assigned | Th:6 |
| Name of Faculty Member(s) | Prof. Anindya Dey  Prof. Gaurab Tripathi |
| Course Description/ Objective | * Polynomial rings and their basic properties. * Concept of factorization in rings with study of ID, UFD, PID and ED and their inter-relations * Application of ring theory in Number Theory. * Vector calculus course designed to visualise the interrelationship between vector, linear algebra and functions of several variables by defining differentiability of vector functions. * Arc length parameterisation & orientability of curves studied as it is basic to study of line & surface integrals. * Distinction between irrotational and conservative vector fields and connection with exact & non exact linear odes to be explored. * Application oriented treatment of classical integral theorems of vector calculus, including Fundamental Theorem, Green’s theorem, Stokes’ theorem & divergence theorem to promote problem solving ability. |
| Syllabus | **Vector Calculus:**  Differentiation of vector valued functions of one scalar variable, velocity, speed, acceleration. Parametrized curve, unit speed curve, reparametrization, length of a piecewise smooth curve (5). Implication of the results and (1).  Concepts of scalar and vector fields, physical significance. Gradient. Divergence and curl, Laplacian , Statement and proofs of related vector idetities(4).  Vector integration: Line integrals of vector fields along piecewise smooth curve, Application of line integrals: Mass and Work. Fundamental Theorem for line integrals, Conservative vector fields, examples: Gravitational and Electromagnetic fields, Independence of path .Circulation, Irrotational vector fields , Conservative vector fields are irrrotational, In star-like /simply connected domain irrotational vector fields are conservative. (8)  Double integration over rectangular region, double integration over non-rectangular region,  Double integrals in polar co-ordinates, Surface area and volume ,Green’s Theorem , area of a plane region bounded by a parametric curve. Integration of a vector filed over a plane region. (8) Integration of vector fields over a surfaces of various form, Stokes theorem and their applications (7). Triple integrals, Triple integral over a parallelepiped and  solid regions. Volume by triple integrals, cylindrical and spherical co-ordinates.  Change of variables in double integrals and triple integrals. The Gauss’s divergence theorem (6)  **Ring Theory II**  Polynomial rings over commutative rings, division algorithm and consequences **[4]**, principal ideal domains [**3**], factorization of polynomials, reducibility tests, irreducibility tests, Eisenstein criterion **[5]**, and unique factorization in Z [x]. Divisibility in integral domains, irreducible, primes **[5]**, GCD, unique factorization domains, Euclidean domains **[5]**. 2-square theorem and properties of and [3].  Every ED is a PID **(2)** Every PID is a UFD **(2)**. Examples and problems **(3)** R is an I D implies R[x] is an I D, R is a field implies R[x] is an ED, D is a UFD implies D[x] is a UFD **(4)** |
| Texts | Calculus, Vol. II-T. M. Apostol  Topics in Abstract Algebra—M. K. Sen, S. Ghosh, P. Mukhopadhyay |
| Reading/Reference Lists | 1. Basic Multivariate Calculus: A. Weinstein, J. Marsden, A. Tromba 2. Vector Calculus: J. Marsden, A. Tromba 3. Multivariate Calculus and Geometry: Sean Dineen. 4. Abstract Algebra: Dummit and Foote 5. Algebra: M.Artin 6. Topics in Algebra: I.N.Herstein 7. Elementary Linear Algebra—Howard Anton, Chris Rorres |
| Evaluation | CIA: 20  End-Sem: 80[ 40 +40] |