

UNIVERSITY OF MADRAS
M.Sc. DEGREE PROGRAMME IN MATHEMATICS
 SYLLABUS WITH EFFECT FROM 2023-2024

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| Title of the Course | | TENSOR ANALYSIS AND RELATIVITY | | | | | |
| Paper Number | | | | | | | |
| Category | Elective | Year | II | Credits | 3 | Course Code | 528E4B |
| | - | Semester | IV | | | | |
| Pre-requisite | | Vector Calculus and Mechanics | | | | | |
| Course Outline | | <p>UNIT-I : Tensor Algebra : Systems of Different orders – Summation Convention – Kronecker Symbols - Transformation of coordinates in S_n - Invariants – Covariant and Contravariant vectors - Tensors of Second Order – Mixed Tensors – Zero Tensor – Tensor Field – Algebra of Tensors</p> <p>– Equality of Tensors – Symmetric and Skew-symmetric tensors - Outer multiplication, Contraction and Inner Multiplication – Quotient Law of Tensors – Reciprocal Tensor – Relative Tensor – Cross Product of Vectors.</p> <p>Chapter I : I.1 – I.3,I.7 and I.8 and Chapter II : II.1 – II.19</p> | | | | | |
| | | <p>UNIT-II : Tensor Calculus : Riemannian Space – Christoffel Symbols and their properties.</p> <p>Chapter III: III.1 and III.2</p> | | | | | |
| | | <p>UNIT-III : Tensor Calculus(contd) : Covariant Differentiation of Tensors – Riemann–Christoffel Curvature Tensor – Intrinsic Differentiation</p> <p>Chapter III: III.3 – III.5</p> | | | | | |
| | | <p>UNIT-IV : Special Theory of Relativity : Galilean Transformations – Maxwell’s equations – The ether Theory – The Principle of Relativity.</p> <p>Relativistic Kinematics : Lorentz Transformation equations – Events and simultaneity – Example – Einstein Train – Time dilation – Longitudinal Contraction - Invariant Interval - Proper time and Proper distance - Worldline - Example – twin paradox – addition of velocities – Relativistic Doppler effect.</p> <p>Chapter 7 : Sections 7.1 and 7.2</p> | | | | | |
| | | <p>UNIT-V : Relativistic Dynamics : Momentum – Energy – Momentum – energy four vector – Force - Conservation of Energy – Mass and energy – Example – inelastic collision – Principle of equivalence – Lagrangian and Hamiltonian formulations.</p> <p>Accelerated Systems : Rocket with constant acceleration – example – Rocket with constant thrust.</p> <p>Chapter 7 : Sections 7.3 and 7.4</p> | | | | | |

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| Recommended Text For Units I,II and III | U.C. De, Absos Ali Shaikh and Joydeep Sengupta, Tensor Calculus, Narosa Publishing House, New Delhi, 2004. |
| For Units IV and V | D.Greenwood, Classical Dynamics, Prentice Hall of India, New Delhi, 1985. |
| Reference Books | <ol style="list-style-type: none">1. J.L.Synge and A.Schild, Tensor Calculus, Toronto, 1949.2. A.S.Eddington. The Mathematical Theory of Relativity, Cambridge University Press, 1930.3. P.G.Bergman, An Introduction to Theory of Relativity, Newyor, 1942.4. C.E.Weatherburn, Riemannian Geometry and the Tensor Calculus, Cambridge, 1938. |