<table>
<tr><td colspan="6">Department of Mathematics Dibrugarh University</td></tr>
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<tr><td colspan="2">Title of the Course:</td><td colspan="2">Tensor and Classical Mechanics</td><td>Paper Number</td><td>MTHD1</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>1</td><td rowspan="2">Credit</td><td rowspan="2">4</td><td>Course Code</td><td></td></tr>
<tr><td>Semester</td><td>I</td><td></td><td></td></tr>
<tr><td colspan="2" rowspan="2">Instruction Hours (Per week)</td><td colspan="2">Lecture</td><td>Tutorial</td><td>Lab Practical</td><td>Total</td></tr>
<tr><td colspan="2">4</td><td>2</td><td>0</td><td>6</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="4">On completion of the course, the students will be able to
• build a strong foundation for Tensor Analysis for its application in Continuum Mechanics, Fluid Dynamics, MHD, Classical Mechanics etc.
• learn the mathematical formulations of various mechanical problems</td></tr>
<tr><td colspan="2">Course outline</td><td colspan="4">UNIT –1 : Cartesian, Rectilinear and Curvilinear coordinate Systems: Marks-10
Scalars, vectors and Tensors, Index Notations, Kronecker delta, Permutation symbols, Cartesian coordinate system, Rectlinear coordinate systems, Fundamental and reciprocal basis, derivation of formula for determining reciprocal basis, curvilinear coordinate systems, basis and reciprocal basis in curvilinear coordinate systems, Examples and Exercise.

UNIT–2 : General Tensors and the metric tensor: Marks-10
General tensor, the metric tensor, the permutation tensor, Tensor algebra, the quotient rule, physical components of a tensor, scalar product, vector product and scalar triple product in various forms. Examples and Exercise.

UNIT: 3 Christoffel symbols and Covariant differentiation: Marks 10

Partial derivative of a vector, Christoffel symbols, Christoffel symbols in terms of derivative of the metric tensors, Christoffel symbols in orthogonal coordinate systems, covariant derivative of covariant and contravariant components of vectors and second order tensors, covariant derivative of scalars, laws of covariant differentiation, Ricci's theorem, Gradient of a scalar, divergence and curl of vector, Laplacian of a scalar, Examples and Exercise.

Unit 4: Lagrangian approach in Mechanics: Marks 10

Constrained motion and classifications of constrains of motion, degrees of freedom, generalized coordinates, generalized velocities, total Kinetic energy of a system of particles in terms of generalized velocity, generalized momenta and generalized force. Lagrange's equation of motion using D'Alemberts principle.

Unit 5: Hamilton's Principle Marks 10
Euler's Lagrange differential equation and Brachistochrone problem, problem of shortest distance between two points on plane.

Introduction of Hamilton's Principle of least action, Derivation of Lagrange's form of equation of motion using Hamilton's principle of least action, conservation principles and</td></tr>
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	symmetry properties. **Unit-6: Hamiltonian Formulation** **Marks 10** Hamilton's canonical equation of motion, canonical variables, cyclic co-ordinates, Canonical transformations and generating functions. Introduction of Lagrangian bracket and Poissons's bracket and their properties and applications, Introduction to Hamilton-Jacobi theory and applications.
Recommended Text	1. 1. Young, E. C. (2017). Vector and tensor analysis. CRC Press. 2. Aris, R. (2012). Vectors, tensors and the basic equations of fluid mechanics. Courier Corporation. 3. H. Goldstein, Classical Mechanics, Addision Wesley Publishing Company, INC. USA. 4. Lagrangian and Hamiltonian Mechanics by M.G. Calkin, World Scientific, Singapore. 1996
Reference Books	1. 1. Sharma, B. R. (2017). Tensor Analysis: A Primer. Mahaveer publications 2.Calkin, M. G., Lagrangian and Hamiltonian Mechanics, World Scientific, Singapore. 1996 3.Lebedev and Cloud, Tensor Analysis, World Scientific Publishing Co Pte Ltd 4.Gupta, kumar and Sharma, Classical Mechanics, Pragati Prakashan
Website and E-learning Source	http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org,