Department of Liberal Education
Era University, Lucknow
Course Outline
Effective From: 2023-24

Name of the Program	**B.A. / B.Sc. (LIBERAL EDUCATION)**			**Year/ Semester:**	**3rd / 5th**
Course Name	**Tensor Analysis**	**Course Code:**	**MT302**	**Type:**	**Theory**
Credits	**04**			**Total Sessions Hours:**	**60 Hours**
Evaluation Spread	**Internal Continuous Assessment:**	**50 Marks**		**End Term Exam:**	**50 Marks**
Type of Course	○ Compulsory	◉ Core		○ Creative	○ Life Skill
Course Objectives	The objective of tensor analysis is to investigate the relations which remain valid when we change from one coordinate system to another coordinate system.				

Course Outcomes (CO): *After the successful course completion, learners will develop following attributes:*

Course Outcome (CO)	**Attributes**
CO1	The objective of this course is to familiarize the students subscript and superscript and Kronecker delta.
CO2	Student doing this course is able to know transformation of co-ordinates.
CO3	Explain the concept of covariant derivative of covariant vector and contravariant vectors..
CO4	On successful completion of the course students have to gained knowledge about covariant differentiation second order as well as mixed tensor.
Pedagogy	Interactive, discussion-bases, student-centered, presentation.
Internal Evaluation Mode	Mid-term Examination: 20 Marks Activity: 10 Marks Class test: 05 Marks Online Test/Objective Test: 05 Marks Assignments/Presentation: 05 Marks Attendance: 05 Marks

Session Details	**Topic**	**Hours**	**Mapped CO**
Unit 1	Introduction, Subscripts and superscripts, Summation convention, Free and Dummy indices, Kronecker delta. **Activity:** Draw on chart about Subscript ans Superscript.	15	CO1
Unit 2	Transformation of co-ordinates, Invariants, Contravariant vectors, Covariant vectors, Mixed tensors of second order, Tensors of higher order, Addition and multiplication of tensors, Contraction, Composition of tensors. **Activity:** To demonstrate a function which is not a one -one but onto. To demonstrate a function which is an one -one but not onto.	15	CO2

Unit 3	Fundamental tensors or metric tensors, Raising and lowering of indicies, Christoffel symbols, Covariant differentiation, Covariant derivative of a covariant vector, Covariant derivative of a contravariant vector. **Activity:** To very that amongst all the rectangle of same perimeter, the square have maximum area.	15	CO3
Unit 4	Covariant derivative of a covariant tensor of the second order, Covariant derivative of a contravariant tensor of the second order, Covariant derivative of a mixed tensor of the second order. Riemann curvature tensor, Properties of curvature tensor, Ricci tensor, Scalar curvature, Einstein tensor. **Activity:** Assignment based activity on mixed tensor.	15	CO4

CO-PO and PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	2				1				1		1	1		
CO2	2				1				1		1			
CO3	2				1				1		1	1		
CO4	2				1				1		1			

Strong contribution-3, Average contribution-2 , Low contribution-1,

Suggested Readings:

Text- Books	Kumar, Vinod, Tensor Analysis.
Reference Books	1. Ahsan, Z., (2008). Tensor Analysis with Applications. Ahsan Publication Tunbridge Wells, U. K. 2. Block, H.D., (1977). Introduction to tensor Analysis. U. S.: Charles E. Merrill Books, Inc.
Para Text	**Unit 1:** 1. https://www.youtube.com/watch?v=CLrTj7D2fLM **2.** https://www.youtube.com/watch?v=LS1GzGGpc1s **Unit 2:** 1. https://www.youtube.com/watch?v=D5cDPYVQMkA 2. https://www.youtube.com/watch?v=5uWsroxq_cI **3.** https://www.youtube.com/watch?v=3l1t5wkulT8 **Unit 3:** 1. https://www.youtube.com/watch?v=-7mJWY58vVE **2.** https://www.youtube.com/watch?v=MZqiIA3zuZo **Unit 4:** 1. https://www.youtube.com/watch?v=7dideLU49ac 2. https://www.youtube.com/watch?v=8iocWnnp0Kc

Recapitulation & Examination Pattern		
Internal Continuous Assessment:		
Component	**Marks**	**Pattern**
Mid Semester	20	**Section A:** Contains **10** MCQs/Fill in the blanks/One Word Answer/ True-False type of questions. Each question carries **0.5 mark.** **Section B:** Contains **07** descriptive questions out of which **05** questions are to be attempted. Each question carries **03 marks**.
Activity	10	Will be decided by subject teacher
Class Test	05	Contains **05 descriptive questions.** Each question carries **01** mark.
Online Test/ Objective Test	05	Contains **10 multiple choice questions.** Each question carries **0.5** mark.
Assignment/ Presentation	05	Assignment to be made on topics and instruction given by subject teacher.
Attendance	05	As per policy.
Total Marks	**50**	

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Signature:

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Signature: