UNIVERSITY OF LAGOS
DEPARTMENT OF MECHANICAL ENGINEERING
FIRST SEMESTER 2022/2023 SESSION

MEG 805: CONTINUUM MECHANICS

Lecturers	
Dr. Olayinka O. Adewumi	Rm. 051 oadewunmi@unilag.edu.ng
Teaching Assistant	
TBD	
Prerequisites	Vector Algebra and Calculus
Lectures:	Date: Monday, 12 noon to 2 pm, Wednesday 9am to 11 am (Zoom Virtual Classes)
Learning resources	1. Lecture Course Material Continuum Mechanics for Modeling , Simulation & Design by OA Fakinlede on https://lms.s2pafrica.com/ 2. Download Mathematica Software (Compulsory)
Supplementary Texts	Weekly lecture and tutorial recordings will be posted on https://lms.s2pafrica.com/
Online Self Tests	Self-testing will be done after each chapter is covered

GRADING

Quizzes: Six online self-tests will be held in Weeks 3, 6, 9, 13 and 14 after each chapter covered

Attendance: The university policy states that students must have a minimum of 65% attendance to sit for the final examinations. This will be strictly adhered to.

Tutorials: There will be 6 tutorial sessions during the semester to further strengthen students understanding of the course and Mathematica Programming

Self-Tests, and Final Exams will be graded as follows,

GRADING	
Self-Tests (Chap1to3)	20%
Self-Tests (Chap4to6)	30%
Final Exam	50%

COURSE OBJECTIVES

The focus of this course is getting students to understand the fundamental concepts of tensor and tensor analysis used to describe the mechanics of a material modeled as a continuum. Towards the end of the course, you will apply the

concepts learnt in the science of kinematics and the conservation laws. By the end of this course (MEG 805), students will develop competence in reading and understanding current textbooks written in tensor notation in preparation for engineering design and simulation projects.

Course learning outcomes

- Describe what a vector basis is and understand how to write in index notation
- Describe how to carry out a coordinate transformation from one coordinate system to another and its interpretation
- Identify what a tensor is, its components, invariants and decomposition of tensors
- Applying and extending the concepts of vector calculus to tensors
- Analyzing and solving problems written in tensor notation using Mathematica codes
- Understand why strain is the choice in quantifying deformation
- Understand the conservation principles from the continuum mechanics perspective

ACADEMIC INTEGRITY

You are encouraged to have group discussions with other students but you also have a responsibility to be honest with yourself, your colleagues and the staff of the faculty on all tasks carried out during the course. The following constitute a breach of academic integrity,

- Submitting homework copied from another source as your own.
- Submitting another student's work as your own
- Bringing prohibited materials into an exam

Lecture Schedule

		Vectors: A review of elementary principles & an extension to abstract concepts	
Week 1		**Introduction and The Summation Convention**	
R1	03/04/23	Introduction, Vectors and Linear Independence, Orthonormal basis, Kronecker Delta, Substitution symbol, Component form – Product of vectors, Tensor Product	
Week2		**Coordinate Transformation for Euclidean Space, Basis Vectors, Euclidean Point & Vector Spaces**	
R2	10/04/23	Axes Rotation, Geometry of Transformation, Cartesian and other coordinate systems, Vector spaces	
Week3		**Tutorial and Coding Session**	**OST1 Opens**
R3	17/04/23	**Worked Examples**	
		Tensor Algebra	
Week 4		**Tensor: A Linear Transformation and Euclidean Vector Space**	
R4	24/04/23	Definition of a Tensor, Linear Transformations, Simple Tensors, Properties of Tensors, Tensor Magnitude & Direction, Axioms for Second-Order Tensors, Decomposing Tensors, Transformation of Line Elements	
Week 5		**The Eigen-value Problem**	
R5	01/05/23	Determinant & Transformation of Volumes, Characteristic Equation, Spectral Decomposition	
Week 6		**Tutorials and Coding Session**	**OST2 Opens**
R6	08/05/23	Worked Examples	
		Tensor Calculus	
Week 7		**Differential & Integral Calculus with Tensors, Gradient, Divergence & Curl of Vectors**	

R7	15/05/23	Differentiation & Large Objects, Scalar, Vector & Tensor Arguments, The Gateaux Differential, Review of Limit & Continuity for Real Scalar Domains, The Directional Derivative, Limit & Continuity for Normed Vector Spaces, Real Functions in Real Domains, Frechet Derivatives	
Week 8		**Green, Stokes & Gauss Integrals**	
R8	22/05/23	Integral Field Theorems	
Week 9		**Tutorials and Coding Session**	**OST3**
R9	29/05/23	Worked Examples	
		Kinematics	
Week 10		**Introduction, Deformation Gradient and Configurations**	
L1 L2	05/06/23 07/06/23	Referential and Spatial Configurations, Simple Deformation & Motions, Polar Decomposition Theorem, Strain Tensors	
Week 11		**Tutorials and Coding Session**	**OST4 Opens**
L3 L4	12/06/23 14/06/23	Worked Examples on Kinematics	
Week 12		**Stress and Heat Flux**	
L5 L6	19/06/23 21/06/23	Introduction, Cauchy's Stress Theorem, Stress Invariants and Decompositions	
Week 13		Tutorials and Coding Session	**OST5 Opens**
L7 L8	26/06/23 28/06/23	Worked Examples on Stress & Heat Flux	
Week 14		**Natural Balance Principles**: Mass, Momentum & Energy Balances	
L9 L10	03/07/23 05/07/23	Introduction, Balance of Mass, Balance of Linear Momentum, Balance of Angular Momentum, Energy Balance, Second Law of Thermodynamics	
L11	08/07/23	Tutorials and Coding Session	**OST6 Opens**
Exam Week		**FINAL EXAMS**	