LANDMARK UNIVERSITY, OMU-ARAN

COURSE COMPACT FOR STRENGTH OF MATERIALS (MCE 316).

COLLEGE: College of Science and Engineering,
DEPARTMENT: Mechanical Engineering,

Course

Course code: MCE 316
Course title: STRENGTH OF MATERIALS
Credit unit: 2
Course status: COMPULSORY

Lecturer's Data

Name of the lecturer: ENGR. IBIKUNKE 'ROTIMI ADEDAYO
Qualifications obtained: M Eng. COREN Reg.

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Consultation Hours: Monday: 2.00-4.00pm
Wednesday: 3.00-5.00pm

INTRODUCTION TO THE COURSE

Course Description: Strength of materials is a course that introduces the engineering students to the study of the effect of external forces on engineering materials and the ability of the materials to resist failure. The fundamental knowledge in elementary applied mechanics and calculus is required for quick and better understanding of the course. The course will introduce materials classification, types of stress and the stress strain relationship. Effect of shearing forces and bending moments on beams will be considered. The pure bending and deflection of different classes of beams shall be considered. The causes of failure, types of failure and failure analysis will be considered as well.

Course Justification: Knowledge of strength of materials is greatly required in engineering projects, design of bridges, girders, structures, buildings and machine developments. The course will give students a clear understanding of the principles underlying engineering design and guide them in the design procedures and processes that will ensure safe designs that could stand the test of time.

Course Objectives:

(a) Review of the previous studies in Physics and mathematics which includes: System of Units, resolution of forces, moment, trigonometric relations, algebra, and calculus (differential and integral).
(b) Understanding the conditions of equilibrium between the external forces and reactions on a member.
(c) Understanding the relationships between strains (deformation) in a member and stresses (internal forces) producing them.
(d) Understanding the conditions that can lead to failure in structural members and machine elements.
(e) Analysis to determine the limiting loads that a member can stand before failure or excessive deformation occurs.

Course Content: The topics to be treated in the course content include: Advance topics in bending moments and shear force in beams. Theory of bending of beams. Deflection of beams. Unsymmetrical bending and shear centre, and applications Strain energy. Biaxial and tri-axial state of stress. Transformation of stress. Mohr circle. Failure theories. Springs. Creep, fatigue, fracture and stress concentration.

Course Expectations:

S/N	GRADING	SCORE (%)
1.	Continuous Assessments • C.AI • C.AII (Mid-Semester Test) • C.AIII	 7% 15% 8%
2.	Assignment	
3.	Practical (Laboratory work)/ Case Studies	10%
4.	Final Examination	60%
5.	Total	100

Course Delivery Strategies:

- Provision of detailed explanation in class on each topic.
- Provision of adequate illustration on the board.
- Making lecturing periods interactive.
- Giving the students class work during the lecture period.
- Giving take-home assignments at the end of each lecture.
- Solving practical questions,

Course Duration: Two hours per week for 15 weeks (30hours)

LECTURE CONTENT

Module 1

- **Week 1:** (a) Review of fundamental mechanics and calculus, and
  (b) Introduction to strength of materials
- **Week 2:** (a) Determination of stress on inclined plane,
  (b) Stress transformation
- **Week 3:** (a) Biaxial, and
  (b) Tri-axial stresses

Objectives of module 1: The students at the end of the lectures for the week should be able to:

(a) Apply the basic fundamental principles of mechanics and calculus to approach problems in strength of materials.
(b) Understand the classification of materials based on ductility or brittleness,
(c) Explain different types of strains and stresses and their relations,
(d) Resolve stress and strains on inclined planes and when rotated.
(e) Understand the concept of biaxial and tri-axial stresses; also the relationship between the shear and normal stresses in these state of stresses.

- **Description**

  First hour: Review of topics such as units and conversion of units, Trigonometry, differential and integral calculus.
  Second hour: Definition of strength of materials in engineering concept, Classification of materials in terms of their elastic strength, explaining the terms Stress and Strain and the various types.
  Third hour: Considering stresses in a plane and the corresponding vertical and horizontal components, pure normal stresses on given planes.
  Fourth hour: Stress transformation in an element or a body when rotated through an angle. Determination of transformation equations for planes.
  Fifth hour: Considering biaxial stress case, General two dimensional stress system, and Tri-axial stress. Determination of Principal stresses from principal strains.

Module 2

- **Week 4:** (a) Classification of beams, explanation of the impact of shearing force and bending moment on beams,
  (b) Determining the relationship between load, shear force and bending moment.

- **Week 5:** (a) Calculation of shear force and bending moment, drawing of shear force and bending moment diagrams of a cantilever loaded at a point.

(b) Calculation of shear force and bending moment, drawing of shear force and bending moment diagrams of a cantilever with distributed load.

- **Week 6:** (a) Analysis of a simply supported beams with concentrated loads,
  (b) Analysis of a simply supported beams with distributed loads.

Objectives of module 2: The students at the end of the lectures for the week should be able to:

(a) Describe types of beams in their loading conditions,
(b) Calculate the shear force required in causing a failure of a loaded beam,
(c) Determine the location for bending and the maximum bending moment possible in a particular loading condition, and
(d) Analysis any form of loaded beams and draw the shear and bending diagrams,

- **Description**

First hour: (a) Classification of beams into cantilever, simply supported beam, overhanging beam, popped cantilever,
(b) Explaining types of loading: Concentrated load on beams, beams with distributed load, varying load, gradually varying load, and continuous load.

Second hour: Mathematical derivation of the relationship between load (w), shear force (F), and bending moment (M). Showing that $w = -\frac{\delta F}{\delta x}$ and showing that $\frac{\delta M}{\delta x} = F = 0$.

Third hour: (a) Solving problems that involve a loaded cantilever: determination of the required shear force, bending moment.

Fourth hour: (b) diagrammatical representation of the shear force and the bending moment involved.

Fifth hour: (a) Analysing simply supported beams that bear pointed loads for the shear force and bending moment.

Sixth hour: (b) drawing of the shear force and bending moment diagrams.

Module 3

- **Week 7:** Practical

Experiments:

i. Determination of shear force and bending moment on a cantilever with concentrated loads,
ii. Determination of shear force and bending moment on a pivoted beam.

- **Week 8:** Tutorials
- **Week 9:** Pure bending
- **Week 10:** Torsion of shafts

Objectives of module 3: The students at the end of the lectures for the week should be able to:

(a) The students will carry out experiment in the strength of material Laboratory to determine shear force and bending moment of loaded beams.
(b) Practical oriented questions will be solved as tutorials in the classroom.
(c) State the assumptions in the theory of bending,
(d) Establish a relationship between a radius of curvature of a beam, bending moment, bending stress, and the cross-sectional dimensions of a beam.
(e) Establish the effect of torque on a rotating shaft.

- **Description**

First two hours: Experiments will be performed in the Laboratory under the instruction of the Technologist to determine the effect of loads on beams to determine the shear force resulted and the bending moment.
Third hour: Problems involving stresses on inclined planes shall be solved.
Fourth hour: Problems on biaxial and tri-axial stresses will be solved.
Fifth hour: Statements and assumptions about theory of bending shall be explained.
Sixth hour: Derivation of bending moment equation, when considering a beam bent through the neutral axis: $M/I = \sigma/y = E/R$.
Seventh hour: (a) Explanation of what Torsion means,
(b) Explanation of assumptions made about torsional stress and strain in circular shafts
Eight hour: Derivation of torsion equation in a rotating circular shaft.

Module 4

- **Week 11:** Deflection of beams

- **Week 12:** Practicals

Experiments:

i. Determination of slope and deflection of a centrally loaded simply supported beam and of a cantilever with concentrated load at its free end.
ii. Determination of the relationship between torsional moment and angle of twist of a shaft and the relationship between clamping length and the angle of twist.

- **Week 13:** Springs

- **Week 14:** Failure in structure members and machine elements

- **Week 15:** Revision/Tutorials

Objectives of module 4: The students at the end of the lectures for the week should be able to:

(a) Understand the methods for determining the deflection in different forms of beams,
(b) Understand the double integration method,
(c) Solve problems of beams deflection using double integration method'
(d) Understand the principle of energy absorbent using spring device,
(e) Solve problems involving leaf spring.
(f) Understand the ways by which failure of structure and machine members occur.
(g) Ask questions concerning their doubts in any part of the course.

- **Study Questions: Study questions shall be prepared in different topics after each lecture and uploaded to the students' portals.**

- **Reading List –** (a) STRENGHT OF MATERIALS by G.H. RYDER ,
  (b) MECHANICAL SCIENCE IV by M.A. RIX
  (c) STRENGHT OF MATERIALS by M. CHAKRABORTI
  (D) STRENGHT OF MATERIALS (MECHANICS OF SOLID) by R.S. KURMI

HOD's COMMENTS: _____
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Name: _____ Signature _____ Date: _____