COURSE COMPACT

Course.

Course code: MCE 214
Course title: Applied Mechanics-Statics (2 UNITS)
Course status: Core

Course Duration.

Two hours per week for 15 weeks. (30hours)

Lecturer Data.

1. Name of the lecturer: Professor J.S.O. Adeniyi

   College: College of Science and Engineering.

   Department: Mechanical Engineering.

   E-mail:adeniyi.jones@lmu.edu.ng

   Office Location: Engineering Building, Room

2. Name of the lecturer: Engr. IKUBANNI, P.P.

   Qualifications obtained: B.Eng. (Hons.), M.Eng, MNSE, R.Engr, PhD (In view)

   College: College of Science and Engineering.

   Department: Mechanical Engineering.

   E-mail: ikubanni.peter@lmu.edu.ng

   Office Location: Engineering Building, Outer room A024.

3. Name of the lecturer: Engr. Agboola, O.O.

   Qualifications obtained: B.Eng. (Hons.), M.Eng, MNSE, R.Engr

   College: College of Science and Engineering.

   Department: Mechanical Engineering.

   E-mail: agboola.olayinka@lmu.edu.ng

   Office Location: Engineering Building, Outer room A024.

   Consultation Hours: Tuesday: 10.00am- 2.00pm.

   Thursday – Friday: 10.00am – 2.00pm.

Course Content

Statics is the branch of engineering mechanics that deals with the study of forces and their effects while acting on a body at rest. The various topic to be treated include introduction, statics of particles and rigid bodies; Centroids of lines, areas and volumes. Representation and resolution of Two- and Three-dimensional vector of forces, moments and couples. Free body diagram. Equilibrium of forces. Distributed

forces; centres of gravity and mass. Moments of inertia. Analysis of trusses, frames and machines. Friction, and virtual work.

Course Description

This course introduces Engineering students to mechanics fundamental concepts and principles, force and equilibrium of particles, resultant and resolution of forces, Newton first law of motion, Free body diagram. forces of particles in space, equilibrium of particle in space. Force defined by its magnitude and two points on its line of action. Rigid bodies, principle of transmissibility, moment of force, moment of couple, equivalent systems of forces, equilibrium of 2-dimensional rigid bodies, equilibrium of 3-dimensional rigid bodies, distributed forces such as centroids and centre of gravity, areas and lines and volumes. Analysis of trusses, frames and machines, force in beams and cables, friction, moment of inertia of area, moment of inertia of mass and virtual work.

Course Justification

The understanding of the fundamental concept and principles in mechanics will help the students to be able to analyze engineering problems in simple and logical manner.

Course objectives

At the end of the course students would be able to:

1. Understand the fundamental concept and principles in mechanics.
2. Analyze the different forces acting on different component parts such as frames, trusses, wedges etc.
3. Acquire the skills and knowledge in determining the moment of inertia, moment of force, moment of couple, equilibrium of 2- force body and 3-force body.
4. Explain the laws of dry friction and the importance of friction to engineering as well as machine.

Course Requirement

Students should have intensive knowledge on Newton's law of motions, Vectors, Trigonometry and moment before they can embark on this course.

Method of Grading

S/N	Grading	Score (%)
1.	Assignment	10
2.	Test	10
3	Term paper	10
4	Final Examination	70
	Total	**100**

Course Delivery Strategies

1. Provision of detailed explanation in class on the topic.
2. Provision of adequate illustration on the board.
3. Making lecturing periods interactive.
4. Giving the students class work during the lecture period.
5. Giving take-home assignments at the end of each lecture.

COURSE OUTLINES

Module 1

Week 1: Introduction: What is mechanics? Fundamental concepts and principles, system of units

Week 2: Statics of particles (forces in a plane): Force and equilibrium of a particle, resultant of two forces, vectors addition, force resolution, concurrent forces, Newton first law of motion. Free body diagram

Week 3: Statics of particles (forces in space): Rectangular component of a force, concurrent force addition, equilibrium of particle in space. Force defined by its magnitude and two points on its line of action

Module 2

Week 4: Rigid bodies: external and internal forces; principle of transmissibility, moment of force, moment of couple, equivalent systems of forces.

Week 5: Equilibrium of 2-dimensional rigid bodies: Reactions at supports and connections, statically indeterminate reactions, equilibrium of 2-force body.

Week 6: Equilibrium of 3-dimensional rigid bodies: Reactions at supports and connections, statically indeterminate reactions, equilibrium of 3-force body.

Module 3

Week 7: Distributed forces: Centroids and centers of gravity; areas and lines and volumes

Week 8: Analysis of trusses: Definition, simple trusses, analysis of trusses by method of joints and sections

Week 9: Frames and machines: Multiforce members of structures, analysis of frame, machines.

Module 4

Week 10: Force in beams and cables: Introduction, types of loading and support, shear and bending moment.

Week 11: Friction: Introduction, laws of dry friction, angles of friction. Wedges, threaded screws, axle friction, disk friction, rolling resistance and belt friction.

Week 12: Moment of inertia of areas: Determination, Second moment of area, radius of gyration, parallel-Axis theorem.

Module 5

Week 13: Moment of inertia of mass: Determination for 3-dimensional bodies, Parallel-Axis theorem, moment of inertia of thin plates.

Week 14: Virtual work: Introduction, concept of virtual work, principle of virtual work and its application, mechanical efficiency, potential energy and equilibrium, stability of equilibrium.

Week 15: Revision.

Tutorials: Questions will be given to the student at the end of each lecture.

STRUCTURE OF PROGRAMME/METHOD OF GRADING: Regular assignment constitutes a part of the continuous assessment (10%), mid semester examination (10%), test (10%) and semester examination (70%).

RECOMMENDED BOOKS

Vector Mechanics for Engineers: Statics (3 Ed) by Ferdinand P. Bear and Russell Johnston, Jr

Applied Mechanics (3rd Edition) by J. Hannah and M.J. Hillier

Solution Manual to accompany Beer-Johnston: Vector Mechanics for Engineers: Statics (2 Ed)

A textbook of Engineering Mechanics by R.S. Khurm

COURSE CONTENT

Week 1: Introduction: What is mechanics? Fundamental concepts and principles, system of units.

Objective:

The Students should be able to understand the fundamental concepts and principles involved in mechanics and also the system of units.

Description:

First Hour: Introduce the Students to the meaning of mechanics, its fundamental concepts and principles.

Second Hour: The system of units.

Study Question

1. What are the basic concepts and principles involved in mechanics?

Week 2: Statics of particles (forces in a plane): Force and equilibrium of a particle, resultant of two forces, vectors addition, force resolution, concurrent forces, Newton's first law of motion, free body diagram.

Objectives:

At the end of the class students should be able to

1. Find the resultant of two forces, add vectors and find the resultant of several concurrent forces.
2. Determine the resolution of a force into components, do the addition of forces by summing X and Y components.
3. Apply the Newton's first law of motion to solve problems.
4. Solve problems involving equilibrium and free body diagrams and tp do the addition of concurrent forces in space.

Description:

First Hour: Forces and equilibrium of a particle, resultant of two forces, vectors addition.

Second Hour: Force resolution, concurrent forces, Newton's first law of motion, free body diagrams.

Assignments:

1. Find the magnitude and direction of the resultant of the two forces shown knowing that P= 300N and Q= 400N.

Week 3: Statics of particles (forces in space): Rectangular component of a force, concurrent force addition, equilibrium of particle in space, Force defined by its magnitude and two points in its line of actions.

Objectives:

The Students should be able to:

1. Draw a free-body diagram of the particle and resolve each of the forces into rectangular components.
2. Apply vectors in the addition of concurrent forces in space.

Description:

First Hour: Students are taught rectangular components of a force, concurrent force addition.

Second Hour: Equilibrium of particles in space, force defined by its magnitude and two points on its line of action.

Study Questions:

Week 4: Rigid bodies: External and internal forces; principle of transmissibility, moment of force, moment of couple, equivalent systems of forces.

Objective:

Students at the end of the lecture should be able to:

1. Differentiate between external and internal forces and to explain the principle of transmissibility.
2. Apply the principle of moment to real life engineering problems.
3. Determine the moment of couple.

Description:

First hour: Explanation of external and internal forces, principle of transmissibility and moment of force.

Second Hour: Moment of couple and equivalent systems of forces

Study Questions:

Week 5: Equilibrium of 2-Dimensional rigid bodies: Reactions at supports and connections, statically indeterminate reactions, equilibrium of 2-force body.

Objectives:

At the end of the lecture students should to:

1. Apply the principle of moment to solve real life engineering problems in 2-dimensional rigid bodies.
2. Understand the basis of statically indeterminate reactions and using it to solve problems.
3. Explain the equilibrium of a two-force body

Description:

First Hour: Equilibrium of 2-dimensional rigid bodies: Reactions at supports and connections.

Second Hour: Statically indeterminate reactions, equilibrium of 2-force body.

Study Question:

Week 6: Equilibrium of 3-dimensional rigid bodies: Reactions at supports and connections, statically indeterminate reactions, equilibrium of 3-force body.

Objectives:

At the end of the lecture, students should be able to:

1. Apply the principle of moment to solve real life engineering problems in 3-dimensional rigid bodies.
2. Understand the basis of statically indeterminate reactions and using it to solve problems.
3. Explain the equilibrium of a three-force body

Description:

Fist Hour: Equilibrium of 3-dimensional rigid bodies: Reactions at supports and connections.

Second Hour: Statically indeterminate reactions, equilibrium of 3-force body.

Study Question

Week 7: Distributed forces: Centroids and centre of gravity; areas and lines and volumes.

Objective: To expose the students to how to determine the centre of gravity of a two-dimensional body and to find the centroids of areas and lines and volumes.

Description:

First Hour: Centre of gravity, centroids of areas and lines are taught.

Second Hour: Centroids of a volume are taught.

Week 8: Analysis of Trusses: Definition, simple trusses, analysis of Trusses by the method of joints.

Objective:

The Students should be able to explain the importance of trusses in engineering and be able to analyse Trusses by the method of joints.

Description:

First Hour: Definition of trusses, simple trusses

Second Hour: analysis of trusses by method of joints.

Study Question:

Week 9: Frames and Machines: Multiforce members of structures, analysis of frames, machines.

Objectives:

At the end of the lecture Students should understand

1. How to analyse forces in frames.
2. How to analyse forces in machine

Description:

First Hour: Analysis of frames with worked examples.

Second Hour: Analysis of machines with worked examples.

Assignment:

Week 10: Forces in beams and cables: Introduction, types of loading and support, shear and bending moment.

Objectives:

At the end of the lecture students should be able to:

1. Analyze the internal forces in beams and cables.

2. List the various types of loading and support.

3. Determine the shear and bending moment in a beam and also be able to draw the shear and bending moment diagrams.

Description:

First Hour: Forces in beams and cables, Introduction to loading and support

Second Hour: Shear and bending moment.

Week 11: Friction: Introduction, laws of dry friction, angles of friction, Wedges, threaded screws, axle friction, disk friction, rolling resistance and belt friction.

Objectives:

At the end of the lecture, students should understand:

1. The concept of friction

2. The analysis of wedges, threaded screws, axle friction, disk friction, rollinr resistance and belt friction.

Description:

First Hour: Introduction to friction, laws of dry friction, angles of friction, wedges.

Second Hour: Threaded screws, axle friction, disk friction, rolling resistance and belt friction.

Week 12: Moment of inertia of areas: Determination, second moment of area, radius of gyration, parallel axis theorem.

Objectives:

The students should be able to:

1. Compute the moment of inertia of various areas with respect to x and y axes.

2. Determine the second moment of area.

3. Analyze the radius of gyration and parallel axis theorem.

Description:

First Hour: Moment of inertia of areas, determination of the moment of inertia of an area by intergration.

Second Hour: Radius of gyration and parallel axis theorem.

Week 13: Moment of inertia of mass: Determination for 3-dimensional bodies, parallel axis theorem, and moment of inertia of thin plates.

Objectives:

The students should be able to:

1. Compute moment of inertia of mass.
2. Use the parallel axis theorem to solve problems
3. Use the moment of inertia to solve thin plates problems.

Description:

First Hour: Moment of inertia of mass, determination of moment of inertia for 3-dimensional bodies.

Second Hour: Parallel-axis theorem, Moment of inertia for thin plates.

Week 14: Virtual work: Introduction, concept of virtual work, principle of virtual work and its application, mechanical efficiency, potential energy and equilibrium and stability of equilibrium.

Objectives:

The students should be able to:

1. Explain the principle of virtual work as applied to machines.
2. Describe the method of virtual work and to apply it as an alternative to the concept of potential energy.
3. Evaluate the mechanical efficiency of a machine and to determine whether a given position of equilibrium is stable, unstable or neutral.

Description:

First Hour: Introduction to virtual work, concept and principle of virtual work and its application.

Second Hour: Mechanical efficiency, potential energy and equilibrium and stability of equilibrium.

Week 15: Revision.

Objectives:

To revise with the students on all that has been taught during the semester.