COURSE CODE: MCE 202
COURSE TITLE: Engineering Mechanics II
NUMBER OF UNITS: 2 Units
COURSE DURATION: Two hours per week

COURSE DETAILS:

Course Coordinator: Engr. Adekunle, N. Olatunde B.Sc, M.Sc.
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Office Location: Room 4 PG School
Other Lecturers: None

COURSE CONTENT:


COURSE REQUIREMENTS:

This is a compulsory course for all students in engineering. In view of this, students in the college of engineering are strongly advised to attend classes regularly and have a minimum of 75% attendance to be eligible to write the final examination.

READING LIST:

2. Engineering Mechanics by
3. Engineering Mechanics by
NEWTON’S LAW OF MOTION

Newton’s law of motion describe what happens to a body when forces are acting on it.

Dynamics: is the branch of mechanics concerned with the forces that change or produce the motion of bodies.

A car accelerates from rest to 10 mph as a result of force. The engine supplies force through a series of shafts and gears to the tires that pushes backward on the road. Then, the road in turn exerts a force on the car to push it forward.

It is the force that enable us to accelerate the car.

Also, forces respectable for all motions i.e. starting and stopping.

Newton’s 1st law of motion

States that a body at rest, will remain at rest and a body in motion at a constant velocity will continue in motion at that constant velocity, unless acted on by some unbalanced external force.

Force push, pull, drag etc.

Description of the 1st law

i) A book placed on a desk remain in that position

ii) A body moving with constant velocity (speed) on a level road.

Inertia- the resistance of a body to a change in its motion or state of motion

1st law –an inertia coordinate system i.e. a coordinate system in which objects experiencing no unbalanced forces remain at rest or continue in uniform motion. Also, an inertia coordinate system is called an inertia reference system.

Newton’s 1st law is applied in an inertia coordinate system.
Newton’s 2nd law of motion – relate all forces causes acceleration of a body but that acceleration is directly proportional to that force, and in the direction of that force.

Newton’s 3rd law of motion – two bodies A and B and if body A exerts a force on body B, then body B will exert an equal but opposite force on body A. To every action there is equal and opposite reaction \( F_{AB} = -F_{BA} \).

Definition of mass,

Weight,

Momentum,

Force (types of force),

Nature of the force,

Inertia Rigid Body

Simple : Application of Newton’s 2nd law

Determination of the velocity of a body in motion given the force applied

- Determination of the force acting on a moving vehicle
- Effect of retarding force on moving mechanical system

Quantitative description of force and motion of a lift mechanism

D’Alemberts principle

Simple : Application of Newton’s 2nd law

Determination of the velocity of a body in motion given the force applied

Determination of the force acting on a moving vehicle

Effect of retarding force on moving mechanical system

Simple : Application of Newton’s 2nd law

Determination of the velocity of a body in motion given the force applied

Determination of the force acting on a moving vehicle
Effect of retarding force on moving mechanical system
Quantitative description of force and motion of a lift mechanism

WORK ENERGY AND POWER

Definition for work
Mathematic expression for finding work done
Different expression to find work done considering
The direction of force applied and distance moved in the direction of force.
How to obtain work done from force – displacement graph
Standard unit of work done

Definition of Energy and units
Types of Energy
(i) Mechanical Energy = P.E and K.E
(ii) Electrical Energy Solar Energy
(iii) Sound Energy
(iv) Atomic Energy
(v) Heat Energy
Quantitative description of mechanical Energy
Simple illustration of K.E
Simple illustration of P.E

Momentum and collision
Meaning of momentum = mass x velocity

Law of conservation of momentum
Momentum of the bodies before collision =Momentum of bodies after collision
Linear momentum with specific examples
Case 1 Body A moving towards a stationary body B
Case 2. Body A moving towards another body B moving in the same direction
Case 3 Body A moving towards another body B moving in opposite direction
Angular momentum with specific examples

**Types of Collisions**

Direct impact

Indirect (oblique) impact

**Impulse**

**LECTURE FOUR**

**Kinematic of particles**

Brief introduction to kinematic of particle

**Basic definitions of critical terms**

Scalar: a quantity with magnitude only e.g. speed, distance, energy, density, and mass.

Vector: quantity with magnitude and direction: velocity, displacement, acceleration, and momentum.

Rectilinear motion: motion along a straight line

Case 1 Rectilinear motion: a particle moving along a straight line.

1. Determination of instantaneous velocity of particle

2. Determination of Average Acceleration

3. Determination of Instantaneous Acceleration of particle

**Differential equation for rectilinear motion**

Relationship between displacement, velocity, and constant acceleration

Graphical representation

**Derivation of equation of motion**

1. Constant acceleration, \( a = \text{constant} \)

2. Acceleration as a function of time, \( a = f(t) \)

3. Acceleration as a function of displacement, \( a = f(s) \)

4. Acceleration as a function of velocity, \( a = f(v) \)

Rectangular coordinate system
Position vector in rectangular coordinate system
How to obtain velocity from given position vector
How to obtain acceleration from given position vector

**Circular motion of particle**

Determination of Angular velocity
Determination of Angular Acceleration
Determination of Normal Acceleration using formula
Determination of Tangential Acceleration of particle
Application using specific engineering tools

**Plane Motion**

Rectilinear – Curvilinear

Equations of circular motion with constant angular acceleration
Comparison between linear equations of motion with circular motion

**LECTURE FIVE**

**KINEMATICS OF PARTICLES**

Brief introduction to kinematics of particles
Force mass and acceleration
Rectilinear motion
General equation of surface
Vector representation of acceleration
Determination of magnitude acceleration
Vector representation of force

**CURVILINEAR MOTION**

coordinates system.

**Typical Application in Relation to Engineering**

(i) Work Energy-equation
(ii) Application of impulse and momentum formulae

Relative motion equation

Rectangular coordinate system \( F_x, F_y \),

Normal and Tangential Coordinate \( F_n, F_t \)

Polar Coordinates system.

**CURVILINEAR MOTION**

Coordinates system.

**Typical Application in Relation to Engineering**

(i) Work Energy-equation

(ii) Application of impulse and momentum formulae

Relative motion equation

Rectangular coordinate system \( F_x, F_y \),

Normal and Tangential Coordinate \( F_n, F_t \)