- COURSE NAME :BIOMECHANICS AND APPILED KINESOLOGY
- SUBJECT CODE: 6277
- ACADEIMIC YEAR :2
- TOPIC NAME: MOTIONS AND FORCES

MOTION & FORCES IN HUMAN BIOMECHANICS

Understanding Kinematics & Kinetics in Human Movement

"Every movement has a science, every action has a force."

DESIGN THINKING ROADMAP

- Empathize → Define → Ideate → Prototype → Test

- We will explore biomechanics using this design thinking framework.

EMPATHIZE: WHY STUDY MOTION?

- - Motion is the foundation of human movement
- - Patients struggle with mobility; rehab requires understanding motion
- - Relevance: physiotherapy, sports science, rehabilitation

DEFINE: WHAT IS MOTION?

- - Motion = change in position over time
- - Kinematics: describes displacement
- - Kinetics: explains forces causing motion
- - Motion variables: type, location, direction, magnitude, rate

TYPES OF MOTION

- - Translatory (linear): e.g., anterior drawer test
- - Rotary (angular): e.g., elbow flexion
- - General/Curvilinear: e.g., walking
- - Reciprocal: alternating movement (e.g., gait cycle)

PLANES OF MOTION

- - Sagittal plane: flexion/extension (e.g., squat)
- - Frontal plane: abduction/adduction (e.g., side leg raise)
- - Transverse plane: rotation (e.g., trunk rotation)

DIRECTION OF MOTION

- - Flexion vs Extension
- - Abduction vs Adduction
- - Internal vs External Rotation
- - Foot/Ankle: dorsiflexion, plantarflexion, inversion, eversion
- - Forearm: pronation, supination

QUANTITY OF MOTION

- - Displacement (ROM): degrees/meters
- - Velocity: rate of displacement
- - Acceleration: rate of velocity change
- - Momentum: mass × velocity

DEFINE: WHAT IS FORCE?

- - Force = push or pull (unit: Newton)
- - Vector quantity: magnitude + direction
- - Sources:
- * Internal: muscles, ligaments
- * External: gravity, contact

TYPES OF FORCES

- - Compression: joint surfaces pushed together
- - Tensile/Distraction: surfaces pulled apart
- - Shear: parallel force, sliding
- - Friction: resists sliding

FORCE SYSTEMS

- - Linear: forces along same line
- - Parallel: parallel forces cause turning/rotation
- - Concurrent: forces meet at a point but in different directions
- - Example: anterior & posterior deltoid fibers pull → resultant vector

REAL-LIFE EXAMPLE: KNEE EXTENSION

- - Quadriceps contraction during knee extension with weight boot
- - Lever system: Third-class lever
- - Fulcrum = knee joint
- - Effort = quadriceps force
- - Load = leg + boot weight

TORQUE & MOMENT ARM IN KNEE EXTENSION

- - Torque = Force × Moment Arm
- - Quadriceps generates extension torque against external flexion torque
- - Effort arm < resistance arm = mechanical disadvantage
- - Advantage: large ROM and speed at distal end

MUSCLE CONTRACTIONS IN ACTION

- - Concentric: lifting weight (shortening)
- - Isometric: holding weight (stabilizing)
- - Eccentric: lowering weight (controlled lengthening)
- - Tension: eccentric > isometric > concentric

CONCLUSION & THANK YOU

- - Motion & forces are inseparable
- - Clinical rehab depends on biomechanics
- - Physiotherapists = 'engineers of the human body'

- Roadmap Recap:
- Empathize → Define → Ideate → Prototype → Test