(BM-404) - Biomechanics

Course Outline:

Theory:

1. **Introduction**
    1. Definition and perspective
    2. Review of statics
    3. Review of Dynamics
    4. Review of deformable body mechanics
    5. Viscoelasticity, material properties
2. **Anthropometry**
    1. Density, mass and inertial properties
    2. Direct measurement of anthropometric parameters
    3. Muscle anthropometry
    4. Mechanical advantage of muscle
    5. Multipoint muscles,
3. **Kinematics of Human Movement**
    1. Forms of motion
    2. Standard reference systems and joint movement terminology
    3. Spatial reference systems
    4. qualitative vs. quantitative analysis of human movement
    5. limb-segment angles, joint angle, linear and angular velocities and acceleration
    6. tools for direct/indirect measurement of kinematic quantities
4. **The biomechanics of Human Bone Growth and Development**
    1. Composition and Structure of Bone Tissue
    2. Material Constituents
    3. Structural Organization
    4. Types of Bones
    5. Bone Growth and Development
    6. Longitudinal Growth
    7. Circumferential Growth
    8. Adult Bone Development
    9. Bone Response to Stress
    10. Bone Modeling and Remodeling
    11. Bone Hypertrophy
    12. Bone Atrophy
    13. Osteoporosis
5. **Kinetics of Human Movement**
    1. Link segment models
    2. Joint reaction forces
    3. Direct Force measurements
6. **Biomechanics of upper & lower extremity**
    1. Loading and injuries to the shoulder, elbow, wrist joints.
    2. Loading and injuries to the Hip, knee and ankle joints
7. **Gait Biomechanics**
    1. Methods of gait analysis
    2. Gait cycle
    3. Temporal-spatial parameters
    4. Hip, knee and ankle joint kinematics and kinetics
    5. Interpretation of gait data

List of Practicals:

1. To determine the coordinates of the centre of gravity (COG) of a body using segmentation method.
2. To determine the centre of Gravity Measurement using Reaction Board
3. Volumetric analysis of irregular shaped body segments
4. To determine the muscle force required by the biceps while holding a known weight in hand for a range of elbow joint angles using the mechanical arm model
5. To determine the muscle force using an analytical model comprising two muscles at the elbow joint and compare the results with the previous one.
6. Design and develop a goniometer for upper limb.
7. Design and develop a goniometer for lower limb.
8. Design and develop a dynamometer for wrist.
9. Gait analysis among healthy individuals.
10. Dynamometry of human foot by virtue of body weight
11. Volumetric analysis of irregular shaped body segments
12. Analysis of human motion using Movement Velocity counter
13. Development of static human model using Visual 3D
14. Study of blood flow using blood vessel models
15. To design the human limbs on Solid works.
16. To analyse the human limbs on ANSYS.

Suggested Teaching Methodology:

- Lecturing
- Written Assignments Report Writing

Suggested Assessment:

Theory (100%)

- Sessional (20%)
- Quiz (12%)
- Assignment (8%)
- Midterm (30%)
- Final Term (50%)

Laboratory (100%)

- Labs
- Open-Ended Labs

Recommended Text and Reference Books:

1. Susan J. Hall, Basic Bio-Mechanics, 6th Ed, 2011.
2. Margareta Nordin, Victor H. Frankel, Basic Biomechanics of the Musculoskeletal System
3. NihatÖzkaya, et al, Fundamentals of Biomechanics: Equilibrium, Motion, and Deformation
4. David A. Winter, Biomechanics and Motor Control of Human Movement