Unit 105: Scientific Basis of Engineering: Basic Mechanics

Level:	**4**
Unit type:	**Optional (Equipment Management and Clinical Engineering)**
Credit value:	**15**
Guided learning hours:	**120**

Unit summary

In this unit, you will gain a working knowledge of essential engineering mechanics as applied to the field of clinical engineering. You will be expected to apply and contextualise your knowledge and skills, performing routine technical procedures and developing and building your professional practice in accordance with Good Scientific Practice.

Unit assessment requirements

There are no specific assessment requirements for this unit. Please refer to the assessment strategy in *Annexe B*.

Additional information

AC1.1 includes:

- fundamental concepts; units of measurements; International System of Units (SI); numerical calculations
- force, mass and acceleration
- work, energy and power.

AC1.2 includes:

- effects of force on materials
- moments:
    - equilibrium of a particle
    - free body diagram
    - force system resultants
    - principle of moments
    - moment of a force
    - moment of a couple
    - resultant forces and couples

    - equilibrium of planar system of forces
    - graphical and analytical method
- internal forces:
    - shear and moments
    - relation between distributed load
    - shear and moment
    - stress and strain
    - tensile and compressive stress and strain
    - factor of safety
- Hooke's law and elastic constants
- friction:
    - dry friction
    - frictional forces on screws, belts and bearing
    - rolling resistance
    - lubrication
- moment of area:
    - first and second moments
    - polar second moment of area
    - centroids
    - theorem of perpendicular axis
- bending of beams:
    - stresses due to bending
    - neutral axis
    - radius of curvature
    - moment of resistance
    - general bending formula
    - principles of finite element analysis
- torsion of shafts:
    - stresses due to top twisting, angle of twist, general torsion formula, power and work.

AC1.4 includes:

- safe working practice applied to basic mechanical processes
- quality standards
- quality management
- quality assurance
- Standard Operating Procedures (SOPs)
- audit

- service accreditation.

AC1.5 includes:

- areas where clinical engineering could be developed to enhance the care offered to individuals
- how effective patient-healthcare staff operate in clinical engineering.

AC2.2 should include the criteria for selecting tools to perform basic mechanical tasks.

AC5.2 could include volume flow rate, mass flow rate, input and output flow velocities, input and output diameters, continuity of volume and mass for incompressible fluid flow.

AC6.1 includes:

- explanation of the term simple harmonic motion.

AC6.2 includes:

- identification of examples of the application of simple harmonic motion in clinical engineering.

Learning outcomes and assessment criteria

To pass this unit, learners need to demonstrate that they can meet all the learning outcomes for the unit. The assessment criteria outline the requirements that the learner is expected to meet **in own area of work and in accordance with Standard Operating Procedures (SOPs)** to achieve the learning outcomes and the unit.

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
1	Understand the scientific basis of mechanics underpinning clinical engineering	1.1	Explain the fundamental principles of applied mechanics			
		1.2	Explain how a range of simple machines use a single applied force to do work against a single load force			
		1.3	Evaluate the mechanisms that underpin the delivery of a safe, quality-assured clinical engineering service			
		1.4	Evaluate the impact of Clinical Engineering services on patients and patient care pathways			
		1.5	Analyse critical incidents that impact on patient care and where actions have resulted in safer care			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Be able to perform basic mechanical tasks	2.1	Solve basic mechanical problems using the application of force			
		2.2	Select appropriate tools to perform basic mechanical tasks			
3	Be able to determine the operating characteristics of lifting machines	3.1	Explain various types of lifting machines and their characteristics			
		3.2	Explain parameters of lifting machines like kinetic parameters, dynamic parameters			
		3.3	Identify types of lifting machines used in a healthcare environment and discuss their characteristics			
4	Understand how to determine the stress in structural members and joints	4.1	Explain structural members and joints in relation to medical equipment			
		4.2	Explain single and double shear joints, fastening and joint parameters			
5	Understand how to determine the parameters of fluid systems	5.1	Explain various types of fluid systems used in healthcare			
		5.2	Explain flow characteristics of a gradually tapering pipe			
		5.3	Discuss effects of fluid dynamics and fluid characteristics on medical devices like infusion pumps, dialysis equipment etc.			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
6	Understand how to determine the characteristics of simple harmonic motion in engineering systems	6.1	Explain simple harmonic motion in terms of the action of forces			
		6.2	Explain vibrating mechanical systems and use medical devices as examples			
		6.3	Explain the generation of simple harmonic motion and application to mechanical systems			

Learner name: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

Internal verifier signature: _____ Date: _____
(*if sampled*)