



# TECHNICAL UNIVERSITY OF MOMBASA

*Faculty of Engineering and Technology*

## DEPARTMENT OF MECHANICAL AND AUTOMOTIVE ENGINEERING

DIPLOMA IN MARINE ENGINEERING (DMAE 6)

### EMR 2318 APPLIED MECHANICS III

END OF SEMESTER EXAMINATIONS

**SERIES:** DECEMBER, 2013

**TIME:** 2 HOURS

#### INSTRUCTIONS TO CANDIDATES:

1. You should have the following for this examination:
  - Answer Booklet
  - Non-programmable Scientific Calculator
2. This paper consists of **FIVE** Questions.
3. Answer Question **ONE (Compulsory)**, **ONE** Question from Section **B** and **ONE** Question from Section **C**.
4. **This paper consists of THREE printed pages.**  
SECTION A : (Compulsory)

### Question ONE

- (a) Using sketches, explain the principle of superposition for the slope and deflection of a beam loaded simultaneously with a point load at its center and a uniformly distributed load along its length. (Assume the beam is simply supported at the free ends and is of uniform cross-section). **(10 marks)**
- (b) (i) List any **FOUR** classes of gear drives based on the position of their axes.
- (ii) State the **FOUR** design consideration for a gear drive. **(6 marks)**
- (c) With the aid of sketches explain the meaning of the following terms:
- (i) Helix angle
- (ii) Axial pitch
- (iii) Normal pitch **(4 marks)**

### SECTION B : (Answer only ONE Question)

### Question TWO

- (a) A 4m long cantilever beam has a point load of 5KN at the free end and with UDL of 1KN/m 1m from the free end a flexural stiffness of 53.3MNm<sup>2</sup>. Calculate the slope and deflection at the free end. **(10 marks)**
- (b) A 8m long simply supported beam with a uniformly distributed load of 10KN/m has a 4mm deflection at its midpoint. Calculate the gradient at its free ends. **(10 marks)**

### Question THREE

- (a) A simply supported beam of rectangular cross-section has a length of 4m and a depth of 150mm. It carries a 10KN point load at its midpoint and a uniformly distributed load of 10KN/m extending 1m from left end has a second moment of Area of  $2.8 \times 10^{-5} \text{m}^4$ . Assuming the weight of the beam is negligible; calculate the maximum stresses the beam can bear. **(14 marks)**
- (b) Explain **THREE** factors that determine the amount of bending of a beam. **(6 marks)**

### SECTION C - (Answer ONE Question from this Section)

#### Question FOUR

In the epicyclic train shown in Figure 1(c), wheel S is supplied with 3.5kW at 1450r.p.m. P and P<sub>2</sub> is one cast. The number of teeth in the gear wheels are: S, 16; A<sub>1</sub>, 102; P<sub>2</sub>, 44 and A<sub>2</sub>, 103. Determine:

- (a) Speed and direction of rotation of A<sub>2</sub> with A<sub>1</sub> fixed
- (b) Fixing torque required at A<sub>1</sub>

(20 marks)

#### Question FIVE

Two parallel shaft X and Y are to be connected by footed wheels, wheels A and B form a compound pair which can slide along, but rotate with, shaft X; wheels C and D are rigidly attached to shaft Y, and the compound pair may be moved so that A engages with C, or B engages with D.

Shaft X rotates at 640rev/min and the speeds of shaft Y are to be 340 rev/min exactly, and 240 rev/min as nearly as possible. Using a module of 12 for all wheels, determine:

- (a) The minimum distance between the shaft axes
- (b) The suitable tooth numbers for the wheels
- (c) The lower speed of Y

(20 marks)