TECHNICAL UNIVERSITY OF MOMBASA

DEPARTMENT OF MECHANICAL AND AUTOMOTIVE ENGINEERING

UNIVERSITY EXAMINATIONS 2015/2016

THIRD YEAR SECOND SEMESTER UNIVERSITY EXAMINATION FOR THE DEGREE IN BACHELOR OF SCIENCE IN MECHANICAL ENGINEERING (BSME)

EMG 2310: GEAR MECHANISM

SERIES: MAY 2016

TIME: 2 HOURS

INSTRUCTION TO CANDIDATES:

1. You should have the following for this examination:-
    - Answer Booklet
    - Scientific Calculator
2. This paper consists of FIVE Questions
3. Question ONE is COMPULSORY
4. Attempt any other TWO Questions
5. Question ONE carries 30 Marks and the other FOUR questions carry 20 Marks each
6. All symbols have their usual meaning unless specified otherwise

QUESTION ONE: (COMPULSORY: 30 Marks)

a) With the aid of a sketch, formulate the condition for constant velocity of toothed wheels. (12 Marks)

b) Gear Mechanism is the most versatile and widely accepted means of power transmission in machines and mechanisms. Give FIVE advantages and THREE disadvantages of toothed wheels. (8 Marks)

c) State the FIVE (5) general rules that can be used to simplify design of gears (10 Marks)

QUESTION TWO: (20 Marks)

a) With the aid of sketch, describe the following terms as used in relation to gearing:
   I. Dedendum (2 Marks)
   II. Addendum (2 Marks)
   III. Module (2 Marks)
   IV. Circular pitch (2 Marks)
   V. Working depth (2 Marks)

b) Two (2) spur gears have a velocity ratio of 1/4. The driven gear has 72 teeth and the module is 8 mm and rotates at 400 rpm. Calculate:
   I. Number of teeth (2 Marks)
   II. Speed of driver (2 Marks)
   III. Pitch line velocity (2 Marks)

c) The number of teeth of a spur gear are 40 and it rotates at 200 rpm. Determine its circular pitch and pitch line velocity if it has a module of 2 mm. (4 Marks)

QUESTION THREE: (20 Marks)

A pair of gears having 60 and 30 teeth respectively are rotating in mesh and a speed of the smaller being 3000 rpm.

i) Determine velocity of sliding between the gear teeth faces at the point of engagement, pitch point and point of disengagement if the smaller gear is the driver.

Assume that the gear teeth $30°$ involute form, addendum = 5 mm and module = 5 mm.

ii) Find angle through which the pinion turns while any pairs of teeth are in contact.

QUESTION FOUR: (20 Marks)

A pair of single helical gears is required to give a speed reduction of 4.2:1. The gears are to have a normal module of 3 mm, a pressure angle of $20°$ and a helix angle of $30°$. If the shaft centre-lines are to be approximately 400 mm apart, determine the number of teeth on each wheel and the exact centre distance. (This should be given to the nearest 0.01 mm.)

The pinion is supported in bearings equally spaced on either side of the centre line of the gear. If the speed of the pinion is 1000 rev/min and 75 kW is being transmitted, find the end-thrust on the pinion shaft and the load on each bearing. Assume that the end-thrust is carried by a separate thrust bearing.

QUESTION FIVE: (20 Marks)

Two gear wheel mesh externally and are to give a velocity ratio of 4:1. The teeth are of involute form.

Module = 6 mm, Addendum = 1 module, $30°$ involute form. The pinion rotates at 90 rpm. Determine:

i) The number of teeth on pinion to avoid interference and corresponding number of teeth on wheel. (5 Marks)
ii) The length of path and arc of contact. (9 Marks)
iii) Number of pairs of teeth in contact. (3 Marks)
iv) The maximum velocity of sliding. (3 Marks)