Faculty of Engineering and Technology
Department of Mechanical & Automotive Engineering
SPECIAL/SUPPLEMENTARY EXAMINATION FOR:
BSc. Mechanical Engineering
EMG 2310 : GEAR MECHANISM
END OF SEMESTER EXAMINATION (SCHOOL BASED)
SERIES: AUGUST2017
TIME: 2 HOURS
DATE: Pick Date**Dec2017**

Instruction to Candidates:

You should have the following for this examination
- *Answer booklet*
- *Non-Programmable scientific calculator*

This paper consists of **FIVE** questions.

Question **ONE** is **COMPULSORY**

Attempt any other **TWO** questions.

Maximum marks for each part of a question are as shown.

Do not write on the question paper.

Mobile phones are not allowed in the examination room.

Question ONE (COMPULSORY: 30 Marks)

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

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

c) 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)

Question TWO (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 THREE (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. Working depth   (2 Marks)

b) A pinion has 21 involute teeth of module 5 mm, a pressure angle of $20°$ and an addendum of 6 mm. It drives an internally toothed wheel having 80 teeth and an addendum of 5 mm. Calculate the arc of approach and arc of recess. What would be the maximum possible addendum for the internally toothed wheel if interference is to be avoided?   (12 Marks)

Question FOUR (20 Marks)

a) 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)

b) 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)

c) Two spiral gear wheels A and B have 45 and 15 teeth at spiral angles $20°$ and $50°$ respectively. Both wheels are of the same hand. A is 150 mm diameter. Find the distance between the shafts and the angle between the shafts.

If the teeth are of $20°$ involute form and the coefficient of friction is 0.08, find the efficiency of the gears (i) if A is the driver, (ii) if B is the driver.   (10 Marks)

Question FIVE (20 Marks)

a) Two gear wheel mesh externally and are to give a velocity ratio of 3:1. The teeth are of involute form.
   Module = 6 mm, Addendum = 1 module, $20°$ involute form. Determine:
   i) The number of teeth on pinion to avoid interference and corresponding number of teeth on wheel.   (4 Marks)
   ii) The length of path and arc of contact.   (6 Marks)

b) A pair of spiral gears, of equal pitch diameter with their axis at right angles, are to have a speed ratio of 4 to 1. The center distance is to be between 100 mm and 105 mm. If these gears are to be cut with a 2.5 module milling cutter, determine:
   i)   The exact helical angles;
   ii)   The exact center distance;
   iii)   The blank diameters;
   iv)   The virtual number of teeth in each gear.   (10 Marks)