TECHNICAL UNIVERSITY OF MOMBASA

FACULTY OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF MECHANICAL & AUTOMOTIVE ENGINEERING

BACHELOR OF SCIENCE IN MECHANICAL ENGINEERING

EMG 2208: MECHANICS OF MACHINES I

END OF SEMESTER II YEAR II EXAMINATION

SERIES: APRIL2016

TIME: 2HOURS

DATE: Pick DateSelect MonthPick Year

TIME: 2 HOURS

INSTRUCTIONS TO CANDIDATES

1. You are required to have the following for this examination:
    - Examination Booklet, Examination pass and student ID.
    - Drawing instruments
    - Scientific calculator
2. This paper consists of **FIVE** Questions.
3. Answer **ANY THREE** Questions.
4. Maximum marks for each part of a question are shown.
5. Take gravitational acceleration, $g = 9.81 m/s^2$ where applicable.
6. Show all your working on the answer booklet
7. **Do not write on the question paper**

QUESTION ONE

Figure Q1 shows the link mechanism of a quick return mechanism of the slotted lever type, the various dimensions of which are: OA=400mm, OP=200mm, AR=700mm and RS=300mm. The crank OP rotates at 210rpm.For the configuration shown, draw the velocity and acceleration diagrams and hence determine the acceleration of the cutting tool at S and the angular acceleration of the link RS.

(20 Marks

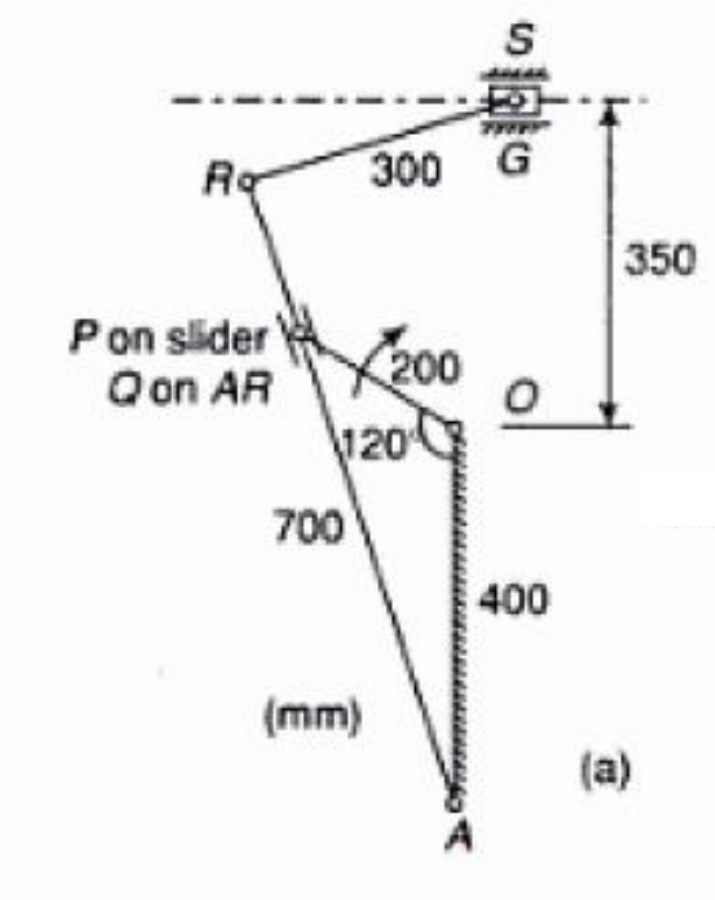

Figure Q1

QUESTION TWO

In an epicyclic gear of sun and planet type shown in Figure Q2, the pitch diameter of the annular is 224mm and module 4mm. When the annular ring is stationary, the spider that carries three planet wheels P of equal size makes one revolution for every five revolutions of the driving spindle carrying the sun wheel. Determine:

(a) The number of teeth for all the wheels

(b) The torque required to fix the annular if an input torque of 20Nm is applied to the spindle carrying the sun wheel.

(20 Marks)

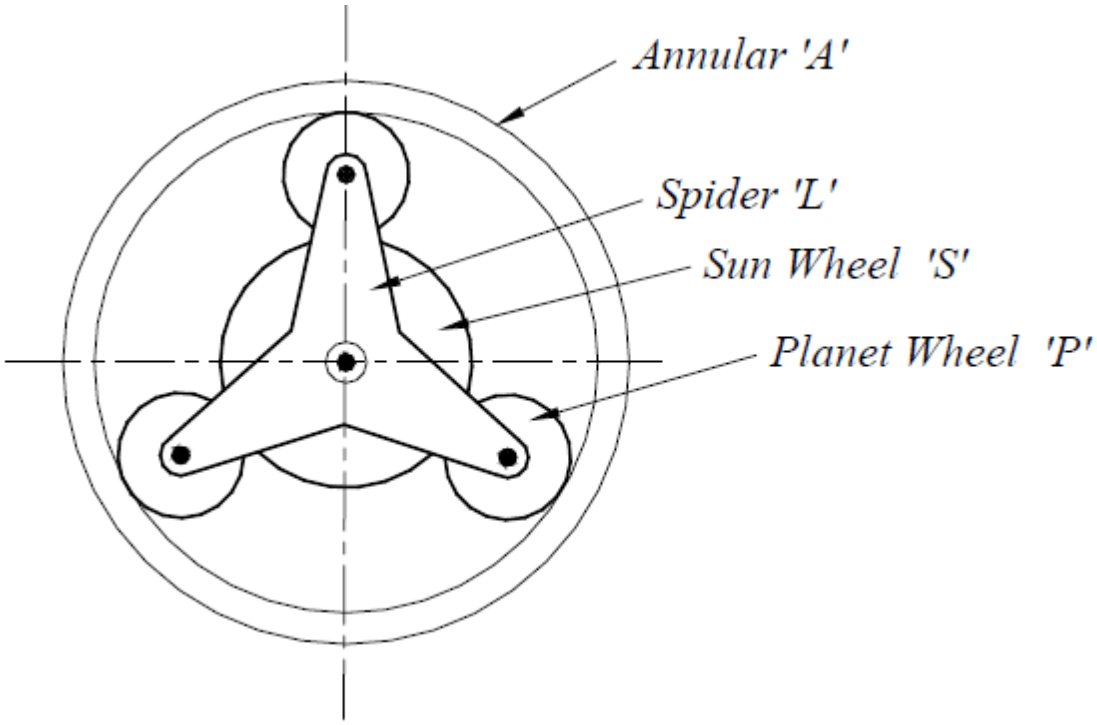

Figure Q2:

QUESTION THREE

(a) A cone clutch is to be designed in order to have inner and outer radii of r_1 and r_2 respectively. If W is the axial load to be transmitted to the clutch and β is the semi-angle of the cone, show that the frictional torque transmitted by the clutch, assuming uniform wear, will be given by:

$$\mu W\left[\frac{r_2 + r_1}{2}\right]\cos ec\beta$$

Where, μ is the coefficient of friction between the contact surfaces (6 Marks)

(b) A cone clutch is required to transmit 200Nm of torque at 1250rev/min. The large diameter of the clutch is 350mm and the cone has a face angle of 6.25° with a conical surface width of 65mm. The coefficient of friction of the contact surfaces is 0.2. Assuming uniform wear, determine:

i) The axial force required to transmit the torque

ii) The least axial force necessary to hold the clutch in engagement

iii) The maximum normal pressure

(7 Marks)

(c) Considering the same clutch in part (b) above, with the same specifications but assuming uniform pressure, determine:

i) The axial force required to transmit the torque

ii) The maximum power transmitted

iii) The average normal pressure on the contact surfaces

(7 Marks)

QUESTION FOUR

(a) A compressor requires 90KW in order to run at 250rev/min. The drive is by V-belt from an electric motor running at 750rev/min. The diameter of the pulley on the compressor shaft is 1m and the centre distance between the pulleys is 1.75m and the belt speed is 1600m/min. The cross-sectional area of each belt is 375mm^2, the density of the belt material is 1000Kg/m^3 and the allowable tensile stress in the material is 2.5MN/m^2. The

groove angle of the pulley is 35° and the coefficient of friction between the belt and the pulley is 0.25. Determine the number of V-belts required to transmit the power.

(10 Marks)

(b) A belt drive consists of two V-belts in parallel, on grooved pulleys of the same size. The angle of the groove is 30°. The cross-sectional area of each belt is 750mm^2 and the coefficient of friction between the belt and the pulley is 0.15. The density of the belt material is 1.5Mg/m^3 and the maximum safe stress in the material is 7MN/m^2. If the diameter of the pulleys is 300mm, calculate:

i) The power that can be transmitted between the pulleys

ii) The shaft speed in rev/min at which the power transmitted would be a maximum.

(10 Marks)

QUESTION FIVE

(a) Show that the torque (T) required to raise a given load and also to overcome any frictional forces using a power screw is given by:

$$T = Fd_m\left[\frac{\Pi\mu d_m + l}{\Pi d_m - \mu l}\right] + \mu_c F\frac{d_c}{2}$$

Where:

d_m – mean thread diameter

l – lead of the screw

μ – coefficient of friction between screw and nut thread

μ_c – coefficient of friction at collar

d_c – effective friction diameter of collar (7 Marks)

(b) The C-clamp shown in Figure Q5 uses a 10mm screw with a pitch of 2mm. the coefficient of friction is 0.15 for both the threads and the collar. The collar has a frictional diameter of 16mm. The capacity of the clamp is 700N. Determine:

i) The torque required to tighten the clamp to full capacity

ii) The length of the handle if the operator is to exert a force of 15N at the end of the handle.

(7 Marks)

(c) A single square thread power screw is to raise a load of 50KN. A screw thread of major diameter 34mm and a pitch of 6mm is used. The coefficient of friction at the thread and collar is 0.15 and 0.1 respectively. If the collar frictional diameter is 100mm and the screw turns at a speed of 1rev/min, determine:

i) The power input to the screw

ii) The combined efficiency of the screw and collar

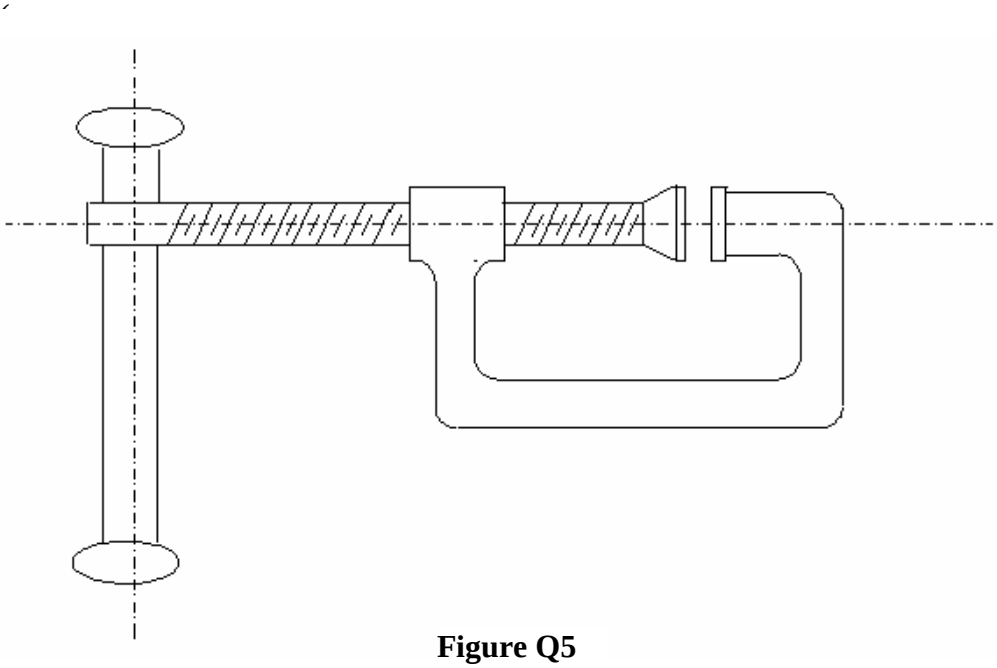

Figure Q5