THE OPEN UNIVERSITY OF SRI LANKA
FACULTY OF ENGINEERING TECHNOLOGY
DIPLOMA IN TECHNOLOGY – LEVEL 03
FINAL EXAMINATION 2007/2008
MEX 3230/MED1201– MECHANICS OF MACHINES
DATE :25th APRIL 2008
TIME :0930 HRS - 1230 HRS
DURATION :03 HOURS

WRITE YOUR INDEX NUMBER CLEARLY

WRITE YOUR REGISTRATION NUMBER

READ THE FOLLOWING INSTRUCTIONS CAREFULY BEFORE ANSWERING THE QUESTION PAPER

PART – B

1. *Part – B consists of **eight** questions. Answer **only five** questions.*
2. *All questions carry equal marks.*
3. *Time allocation for Part B is **2 hrs and 15 minutes.***
4. *Do not spend more than **20 – 25 minutes** for each question.*
5. *Hand over **PART- B** separately.*

PART- B

QUESTION 01

a) Derive from first principles an expression for the effort required to raise a load with a screw jack taking friction into consideration. Define all parameters you consider.

b) A power screw driven by an electric motor causes to move a nut in a horizontal plane against a force of 75 kN at a speed of 300 mm/min. The screw has a single square thread of 6 mm pitch on a major diameter of 40 mm. The coefficient of friction at the screw threads is 0.1. Estimate power of the motor that drives the screw.

QUESTION 02

Dimensions of the mechanism, shown in Fig.Q2, are as follows:
$AB = 0.45$m ; $BD = 1.5$ m; $BC = CE = 0.9$ m

The crank AB turns uniformly at 180 rpm. in the clockwise direction and the blocks at D and E are working in frictionless guides.
Draw the velocity diagram for the mechanism and find the velocities of the sliders D and E in their guides. Also determine the turning moment at A if a force of 500N acts on D in the direction of arrow X and a force of 750 N acts on E in the direction of arrow Y.

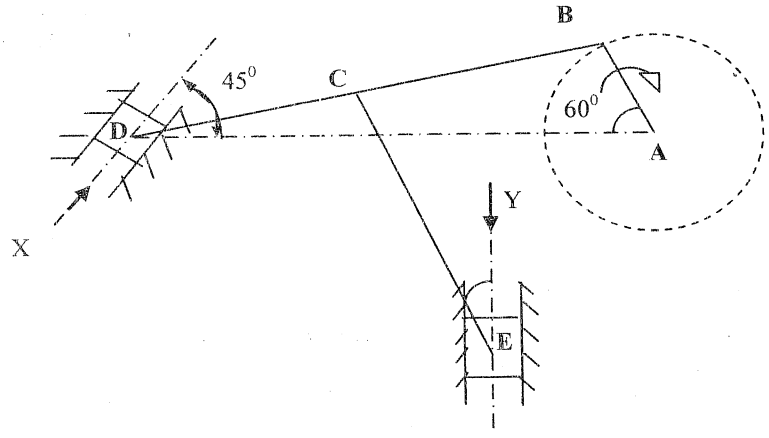

Fig.Q2

QUESTION 03

a) For a flat belt drive system, prove that $\frac{T_1}{T_2} = e^{\mu\theta}$,

Where T_1 = Tension in the tight side of the belt,
T_2 = Tension in the slack side of the belt
μ = Coefficient of friction between the belt and the pulley, and
θ = Angle of contact between the belt and the pulley (in radians)

b) A flat belt drive that transmits power the initial tension is 2000 N. The coefficient of friction between the belt and the pulley is 0.3 and the angle of lap on the smaller pulley is 150^0. The smaller pulley has a radius of 200 mm and rotates at 500 rpm. Find the power in kW transmitted by the belt.

QUESTION 04

a) Derive an expression for the length of the arc of contact in a pair of spur gears in mesh.

b) The number of teeth on each of the two identical spur gears in mesh is 40. The teeth have 20^0 involute profile and the module is 6 mm. If the arc of contact is 1.75 times the circular pitch, find the addendum.

QUESTION 05

A loaded Porter governor has four links each 250 mm long, two resolving masses each of 3 kg and a central dead weight of mass 20 kg. All links are attached to respective sleeves at radial distances of 40 mm from the axis of rotation. The masses revolve at a radius of 150 mm at minimum speed and at a radius of 200 mm at maximum speed. Determine the speed range within which the governor operates.

QUESTION 06

The turning moment diagram shown in Fig.Q6 has following scales:
Turning moment 1mm ≡ 6 Nm; ***Crank angle 1 mm ≡ 1^0***

The turning moment diagram repeats in every half revolution of the engine and the areas above and below the mean turning moment line taking in order, are +285, -685, +50, -340, +960, -270 mm^2.
The rotating parts are equivalent to a mass of 40 kg at a radius of gyration of 150mm. Determine the coefficient of fluctuation of speed when the engine runs at 1,200 rpm.

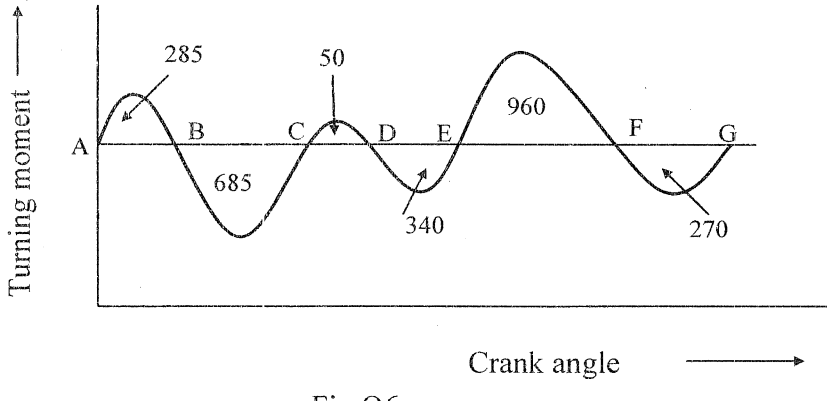

Fig.Q6

QUESTION 07

Fig.Q7 shows a compound epicyclic gear train, gears S_1 and S_2 being rigidly attached to the shaft Q. If the shaft P rotates at 1000rev/min clockwise, while the annulus A_2 is driven in the opposite direction at 500 rev/min, determine the speed and direction of rotation of the shaft Q. The numbers of the teeth in the wheels are S_1, 24: S_2 , 40: A_1, 100: A_2, 120.

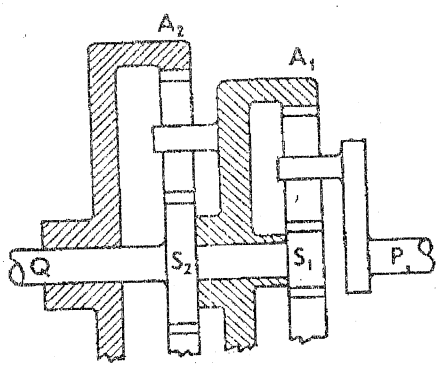

Fig.Q7

QUESTION 08

Find the mass and the angle at which this mass should be positioned in each plane A and D at a radius of 60 mm in order to produce a complete balance of the rotating system of masses shown in Fig.Q8.
Radius B is 75 mm
Radius C is 50 mm
Mass of B is 5 kg
Mass of C is 2 kg

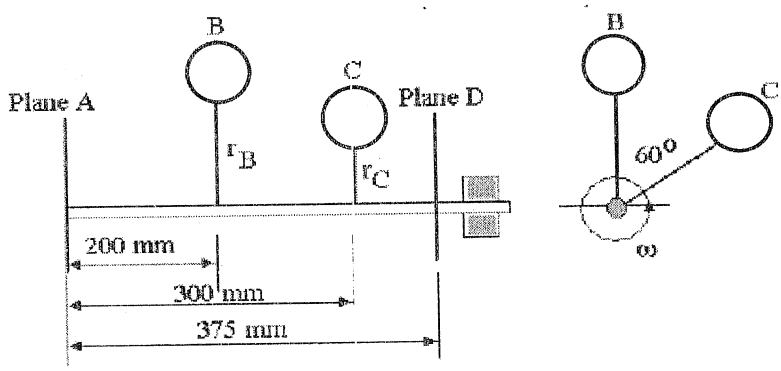

Fig.Q8