4. The cylinders of a V-engine are set at an angle of 40º with both cylinders connected to a common crank. The connecting rod is 300 mm long and the crank radius is 60 mm. The reciprocating mass is 1 kg per cylinder whereas the rotating mass at the crank pin is 1.5 kg. A balance mass equivalent to 1.8 kg is also fitted opposite to the crank at a radius of 80 mm. Determine the maximum and the minimum values of the primary and secondary forces due to inertia of the reciprocating and rotating masses if the engine rotates at 900 rpm. **15**

Section C

5. A shearing machine is used to cut flat strips and each operation requires 37.5 kN/m of energy. The machine has a flywheel with radius of gyration of 900 mm. The speed at the start of each operation is 130 rpm. Determine the mass of the flywheel assuming that the energy required for cutting is fully supplied by the flywheel and the speed reduction is not more than 15% of the maximum. Also find the torque supplied to the flywheel so that it regains its full speed in 3.3 seconds. **15**

Roll No. ..... **Total Pages : 07**

J-21-0066

B. Tech. EXAMINATION, 2021

Semester VI (CBCS)

DYNAMICS OF MACHINERY

ME-606

Time : 2 *Hours* *Maximum Marks :* 60

The candidates shall limit their answers precisely within 20 pages only (A4 size sheets/assignment sheets), no extra sheet allowed. The candidates should write only on one side of the page and the back side of the page should remain blank. Only blue ball pen is admissible.

Note : Attempt *Four* questions in all, selecting *one* question from any of the Sections A, B, C and D. Q. No. **9** is compulsory. Use of scientific calculator is permitted during the examination.

Section A

1. Find the torque required to be applied to the link AB of the linkage shown in Figure 1 to maintain the static equilibrium. **15**

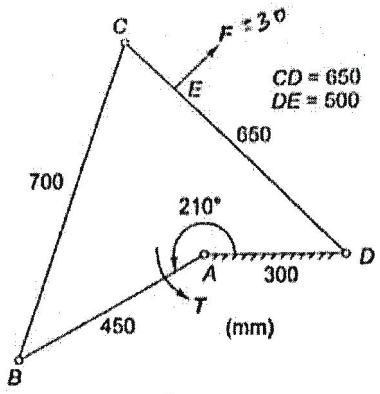
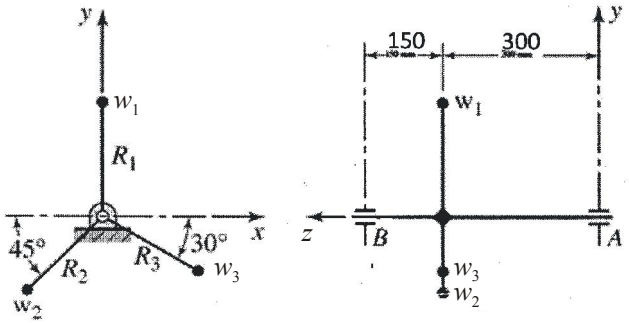


Figure 1

2. Figure 2 illustrates three weights connected to a shaft that rotates in bearings A and B. Determine the magnitude of the bearing reactions if the shaft speed is 350 rev/min. A counterweight is to be located at a radius of 250 mm. Find the value of the weight and its angular orientation



R_1 = 200 mm, R_2 = 300 mm, R_3 = 150 mm, w_1 = 0.556 N, w_2 = 0.417 N, w_3 = 0.834 N. **15**

Section B

3. The following data apply to a four-bar linkage shown in Figure 3 :

R_{AO2} = 0.3 m, R_{O4O2} = 0.9 m, R_{BA} = 1.5 m, R_{BO4} = 0.8 m, R_{CA} = 0.85 m, R_{DO4} = 0.4 m, R_{G202} = 0, R_{G3A} = 0.65 m, R_{G4O4} = 0.45 m, θ_c = 33°, θ_D = 53°, α = 16°, β = 17°, m_2 = 5.2 kg, m_3 = 65.8 kg, m_4 = 21.8 kg, I_{G2} = 2.3 kg m^2, I_{G3} = 4.2 kg-m^2, I_{G4} = 0.51 kg-m^2. A kinematic analysis at θ_2 = 60°, ω_2 = 12 $\hat{k}$ rad/s ccw, α_2 = 0, gives θ_3 = 0.7°, θ_4 = 20.4°, α_3 = 85.6 rad/s^2 cw, α_4 = 172 rad/s^2 cw, A_{G3} = 96.4 m/s^2 ∠259°, A_{G4} = 97.8 m/s^2 ∠270°. Find all the pin reactions and the torque applied to link 2. **15**

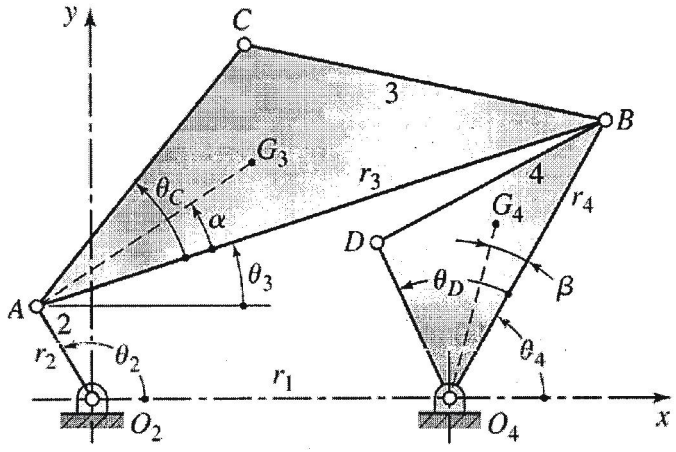


Figure 3

6. A Hartnell governor has two rotating balls, of mass 2.7 kg each. The ball radius is 125 mm in the mean position when the ball arms are vertical and the speed is 150 r.p.m. with the sleeve rising. The length of the ball arms is 140 mm and the length of the sleeve arms is 90 mm. The stiffness of the spring is 7 kN/m and the total sleeve movement is 12 mm from the mean position. Allowing for a constant friction force of 14 N acting at the sleeve, determine the speed range of the governor in the lowest and highest sleeve positions. Neglect the obliquity of the ball arms. **15**

Section D

7. The rotor of a marine turbine has a moment of inertia of 750 kg/m^2 and rotates at 3000 rpm clockwise when viewed from aft. If the ship pitches with angular simple harmonic motion having a periodic time of 16 seconds and an amplitude of 0.1 radian, find the :

(i) Maximum angular velocity of the rotor axis

(ii) Maximum value of the gyroscopic couple

(iii) gyroscopic effect as the bow dips. **15**

8. A machine mounted on springs and fitted with a dashpot has a mass of 60 kg. There are three springs, each of stiffness 12 N/mm. The amplitude of vibrations reduces from 45 to 8 mm in two complete oscillations. Assuming that the damping force varies as the velocity, find :

(i) Damping coefficient

(ii) Ratio of frequencies of damped and undamped vibrations

(iii) Periodic time of damped vibrations. **15**

(Compulsory Question)

9. (a) What are the basic elements of a vibratory system ? What is the degree of freedom ?

(b) What is logarithmic decrement ? Derive the relation for the same.

(c) Explain the following terms in relation to gyroscope :

(i) Precession

(ii) Spin

(iii) Gyroscopic planes.

(d) Explain the following terms in relation to governors :

(i) Sensitiveness

(ii) Hunting

(iii) Stability.

(e) What is the condition of isochronism in governors ? Find the required condition of isochronism in case of Hartnell governor.

(f) Explain the working of a torsion dynamometer with the help of diagram.

(g) Differentiate between primary and secondary unbalance in reciprocating engines.

(h) Explain the term "equivalent offset inertia force".

(i) What are turning moment diagrams ? Why are they drawn ?

(j) What do you mean by applied and constraint forces ? Explain. **1½×10=15**