15172

B. Tech 5th Semester Examination

Dynamics of Machines (NS)

ME-315

Time : 3 Hours   **Max. Marks : 100**

The candidates shall limit their answers precisely within the answer-book (40 pages) issued to them and no supplementary/continuation sheet will be issued.

Note :   (i)   All question carry equal marks.

(ii)   Section E is compulsory. Attempt at-least one question each from other section.

(iii)   Assume missing data if any.

SECTION - A

1.   (a)   With the help of suitable mechanism discuss the Principle of virtual work applied to static force analysis.

(b)   Determine the torque required to be applied at the crank shaft of a slider crank mechanism to bring it in equilibrium. The slider is subjected to horizontal force of 6000 N and a force of magnitude 1000 N is applied on the connecting rod as shown in Figure 1. The dimensions of the link are as under:
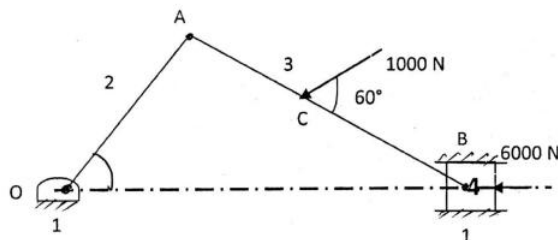
OA=250 mm, AB=750 mm, AC=250 mm, Angle BOA =40°

(5+15=20)

Figure 1

2.   A shaft rotating at uniform speed carries two discs A and B of mass 6 kg and 5 kg respectively. The center of gravity of each disc is 2.5 mm away from the axis of rotation and the angle between them is 90°. The shaft has bearings C and D, between A and B such that AC=250 mm, AD=500 mm. AB=1000 mm. It is desired to make the dynamic forces on the bearings equal and opposite and to have a minimum value for given speed by means of a mass in plane E at a radius of 20 mm. Determine:

(i)   The magnitude of masses to be attached at E and its angular position with respect to A.

(ii)   The distance of plane E from A   (20)

SECTION - B

3.   The following data relate to a connecting rod of a petrol engine:

Mass	70kg
Distance between bearings	850mm
Diameter of small end bearing	75mm
Diameter of big end bearing	100mm
Time of oscillation when the connection rod is suspended from small end	1.83s
Time of oscillation when the connection rod is suspended from big end	1.68s

Determine:

(i)   Radius of gyration of the connecting rod

(ii)   Moment of Inertia of the connecting rod

(iii)   Mass of dynamic equivalent link   (20)

4.   In a four cylinder in-line IC engine, the mass of the reciprocating parts of cylinder number 1 and 4 are 120 kg each and that of the cylinder number 2 and 3 are 175 kg each. If the crank radius is 150 mm, length of the connecting rod is 450 mm and engine speed is 1300 rpm, determine the primary and secondary forces and couples. The cylinders are placed 600 mm apart. (Figure 2).   (20)
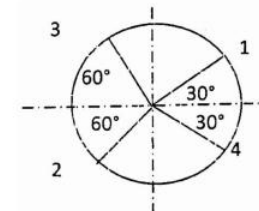

Figure 2

SECTION - C

5. (a) With help of a suitable sketch deduce the relation for height of Proell governor.

    (b) In a spring controlled gravity governor, the mass of each ball is 1.8 kg and the distance of fulcrum from the axis of rotation is 65 mm. The bell crank lever has a vertical arm of 120 mm long and horizontal arm of length 50 mm. The mass of the sleeve is 6 kg. The sleeve begins to rise at 200 rpm and the rise of sleeve for 5% increase is 9 mm. Determine the initial thrust in the spring and the stiffness of the spring.   (10+10=20)

6. (a) What is function of a flywheel and how its size is determined?

    (b) The effective turning moment exerted at the crank shaft of a double acting engine is represented by :
    $T = 1490 + 236 \sin 2\theta = 198 \cos 2\theta$ kg m; where θ is the crank angle displacement from the inner dead center. Assuming the resisting torque to be constant determine:

    (i)   Power of the engine when the speed is 150 rpm.

    (ii) Moment of inertia of the flywheel if the speed variation is not to exceed ±0.5% of the mean speed.

    (iii) The angular acceleration of the flywheel when the crank has turned through 30° from inner dead centre.

    (iv) Maximum angular retardation.   (6+14=20)

SECTION - D

7. (a) Discuss the use and application of transmission dynamometer.

    (b) The essential features of a belt transmission dynamometer are shown in Figure 3. A is the driving pulley which runs at 600 rpm. B and C are jockey pulleys mounted on a horizontal beam PQ pivoted at D about which the complete beam is balanced when at rest. E is the driven pulley (not shown). Pulleys A, B, and C are of diameter 300 mm each. And the portion of belt between pulleys are vertical. Find the under mentioned values if the coefficient of friction is 0.2 and maximum tension in the belt is 1.5 kN

    (i)   Weight W to maintain the beam horizontally when 4.5 kW power is being transmitted.

    (ii) The value of weight when the belt just begins to slip on pulley A.   (8+12=20)
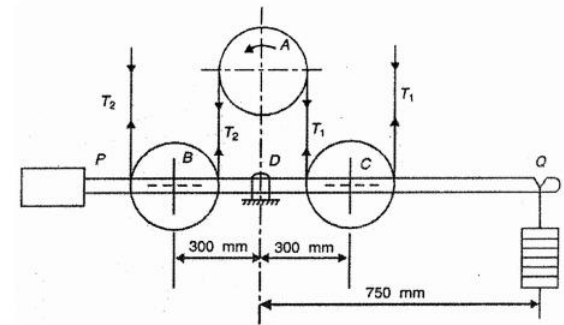
[P.T.O.]

Figure 3

8. (a) Discuss all the cases related to stability of a four wheeler ship through proper sketches.

    (b) Rotor of a ship has a mass of 2500 kg and its radius of gyration is 0.45 m. The rotor rotates at 2600 rpm in counter clockwise direction when viewed from rear end. Determine the gyroscopic couple and its effect when:

    (i)   The ship takes a left turn at a radius of 340 m with a speed of 30 kmph.

    (ii) The ship pitches with bow rising at an angular velocity of 1 rad/s.

    (iii) The ship rolls at an angular velocity of 0.15 rad/s.
                                                        (12+8=20)

SECTION - E

9. (a) Why rotating masses are to be dynamically balanced?

    (b) What is gyroscopic couple?

    (c) What are primary disturbing and secondary disturbing forces?

    (d) What is the significance of controlling force in governors?.

    (e) Explain the term spin and precession, how do these differ from each other?

    (f) Why complete balancing of reciprocating engines is not possible in certain cases?

    (g) How static force analysis is performed?

    (h) Derive the expression for height of sleeve in a watt governor.

    (i) How dynamometers are classified? What is their application?

    (j) Explain the function of flywheel with reference to turning moment diagram.   (2×10=20)