[Total No. of Questions - 9] **[Total No. of Printed Pages - 4]**
(2064)

14694

B. Tech 6th Semester Examination

Dynamics of Machines

ME-6001

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 : Candidate are requested to attempt five questions in all selecting one question from each of the section A, B, C, D of the question paper and all the subparts of the questions in section E. Use of non-programmable calculators is allowed. Assume suitable data if required.

SECTION - A

1. (a) Explain the term 'static balancing' and 'dynamic balancing'. State the necessary conditions to achieve them. Also, explain the method of balancing of different masses revolving in the same plane. (10)

   (b) A horizontal steam engine running at 120 rpm has a bore of 250 mm and a stroke of 400 mm. The connecting rod 0.6m and mass of the reciprocating parts is 60kg. When the crank is turned through an angle of 45º from the inner dead centre, the steam pressure on the cover and side is 70 kN/m^2. Considering the diameter of the piston rod equal to 500 mm, determine—

   (i) Turning moment on the crank shaft.

   (ii) Thrust on bearings.

   (iii) Acceleration of the flywheel, if the power of the engine is 20kW.

   Mass of the flywheel 60 kg and radius of gyration 0.6m. (10)

2. (a) Deduce an expression for the inertia force in the reciprocating mass, neglecting the weight of the connecting rod, crank-pin effort as well as the crank effort and piston effort. (10)

   (b) Four masses m_1, m_2, m_3 and m_4 are 200 kg, 300 kg, 240 kg and 260 kg respectively. The correspondinig radii of rotation are 0.2m, 0.15m, 0.25m and 0.3m respectively and the angles between successive masses are 45º, 75º and 135º. Find the position and magnitude of the balancing mass required, if its radius of rotating is 0.2m. (10)

SECTION - B

3. (a) Write a short note on primary and secondary balancing. Explain why only a part of the unbalanced force due to reciprocating masses is balanced by revolving mass. Deduce the expression for resultant unbalanced for in a reciprocating engine. (10)

   (b) Derive the following expression, for an uncoupled two cylinder locomotive engine—

   (i) Sawying couple (ii) Tractive force variation (iii) Hammer blow. (10)

4. (a) An inside cylinder locomotive has its cylinder centre lines 0.7m apart and has a stroke of 0.6m. The rotating masses per cylinder are equivalent to 150 kg at the crank pin, and the reciprocating masses per cylinder to 180 kg. The wheel centre lines are 1.5m apart. The cranks are at right angles.

   The whole of rotating and 2/3 of the reciprocating masses are to be balanced by masses placed at a radius of 0.6m. Find the magnitude and direction of the balancing masses.

   Find the fluctuation in rail pressure under one wheel, variation of tractive effort and magnitude of swaying couple at a crank speed of 300 rpm. (10)

   (b) Discuss the balancing of V-engines and derive the expressions for resultant primary and secondary force acting. (10)

SECTION - C

5. What is the function of a governor? How does it differ from flywheel? Sketch a Hortnell governor. Describe its function and deduce a relation to find the stiffness of the spring. Explain the term 'Hunting' for a Hartnell governor. (20)

6. (a) In a spring-controlled Hartung type of governor, the length of the ball arm is 84mm and the sleeve arm 126mm. When in the mid-position, each spring is compressed by 60mm and the radius of rotation of the mass centres is 160mm. The mass of the sleeve is 18kg and of each ball 4kg. Spring stiffness is 12 kN/m of compression and total lift of the sleeve 24mm. Determine the ratio of the range of speed to the mean speed of the governor. Also, find the speed in the mid position.

   Neglect the moment due to the revolving masses when the arms are inclined. (10)

   (b) Differentiate Proell governor to porter governor. Describe the function of a Proell governor with the help of a neat sketch. (10)

SECTION - D

7. (a) What are torsion dynamometers? Describe with sketches one form of torsion dynamometers and explain the calculations involved in finding the power transmitted in brief. (10)

   (b) Each wheel of a four-wheeled, rear engine automobile has a moment of inertia of 2.4kgm^2 and an effective diameter of 660mm. The rotating parts of the engine has a moment of inertia of 1.2 kgm^2. The gear ratio of engine to the back wheel is 3 to 1. The engine axis is parallel to the

rear axle and crank shaft rotates in the same sense as the road wheel. The mass of vehicle is 2200 kg and the centre of mass is 550mm above the road level. The track width of the vehicle is 1.5m. Determine the limiting speed of the vehicle around a curve with 80m radius so that all the four wheel maintain contact with the road surface.

(10)

8. (a) The essential features of a transmission dynamometer are shown in **figure 1.** A is driving pully which runs at 600 rpm. B and C are jockey pulleys mounted on a horizontal beam pivoted at D, about which point the complete beam is balanced when at rest. E is the driving pulley and all portions of the belt between the pulleys are vertical. A, B and C are each of 300 mm diameter and the thickness and weight of the belt are neglected. The length DF is 750mm. Find—

(i) The value of weight W to mountain the beam in a horizontal position when 4.5 kW is being transmitted.

(ii) The value of the weight W, when the belt just begins to slip on pulley A.

The coefficient of fricton being 0.2 and maximum tension in the belt is 1.5kN

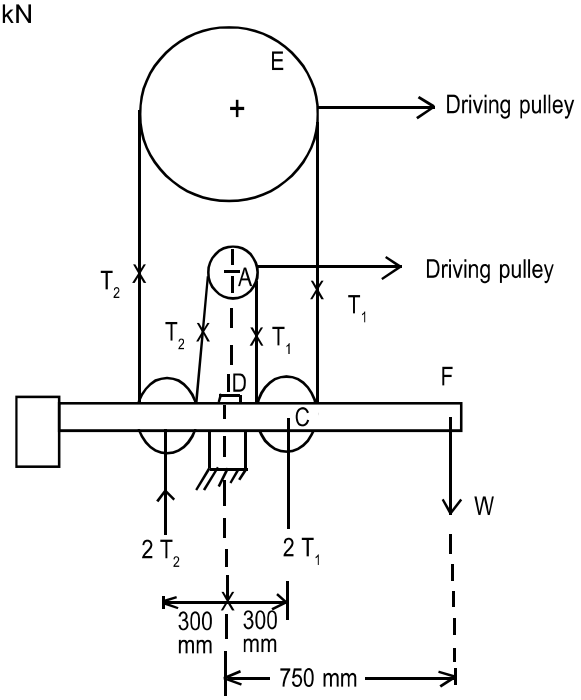

Fig. 1

(10)

(b) Explain the effect of the gyroscopic couple on the reaction of the four wheels of a vehicle negotiating a curve. (10)

[P.T.O.]

SECTION - E

9. Attempt all questions. Marks are written at the right side.

(i) Write a short notes on gyroscope. (2)

(ii) Write the conditions of equilibrium for the two balancing masses placed in two different planes, parallel to the plane of rotation of the disturbing mass. (2)

(iii) Calculate the brake power of the engine for the data recorded with rope brake dynamometer—

Diameter of the flywheel = 1.2 m

Diameter of the rope = 12.5 mm

Speed of the engine = 200 rpm

Dead load on the brake = 600 N

Spring balance reading = 150 N (2)

(iv) What do you mean by the term height of the governor? Write the formula for the height in case of watt governor. (2)

(v) A Turbine rotor of a ship has a mass of 8 tonnes and a radius of gyration 0.6 m. It rotates at 180 rpm clockwise, when looking from the stern. Determine the gyroscopic couple, if the ship travels at 100 km/hr and steers to the left in a curve of 75m radius. (2)

(vi) Which governor is used to drive a gramophone? (1)

(vii) Write the expression for the height ratio for a porter governor to watt's governor, when the length of arms and links are equal. (1)

(viii) Why the balancing of rotating parts is necessary for high speed engine? (1)

(ix) Write the conditions necessary for dynamic balancing of the shaft. (1)

(x) Write the expression for the resultant unbalanced force at a instant in a reciprocating engine. (1)

(xi) Write an example of absorption and transmission dynamometers. (1)

(xii) What will be the effect of sleeve movement in upward direction over the governor speed? (1)

(xiii) Write down the expression for gyroscopic couple by defining all the variables. (1)

(xiv) What will be the effect of gyroscopic couple acting on the ship pitching upwards? (1)

(xv) State the D-Alembert's principle. (1)