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(Following Paper ID and Roll No. to be filled in your Answer Book)

PAPER ID : 4076   Roll No.

B.Tech.

FIFTH SEMESTER EXAMINATION, 2006-07

DYNAMICS OF MACHINES

Time : 3 Hours   Total Marks : 100

Note : (i) Attempt ALL questions.

(ii) All questions carry equal marks.

(iii) In case of numerical problems assume data wherever not provided.

(iv) Be precise in your answer.

1. Attempt *any two* parts of the following :   (10x2=20)

(a) Show diagrammatically various forces acting on the reciprocating part of a steam engine. Define Piston effort. Indicate the manner in which this can be determined for a given point on the stroke for double acting horizontal and vertical steam engine.

(b) Determine the driving torque available on crank 2 (Fig. 1) if a force P of 200 kg is applied on link 4 of slider crank mechanism. Also determine the forces acting on the crank pin, piston pin and the main bearing. Given $O_2A = 10$ cm, $AB = 30$ cm

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(Fig. 1)
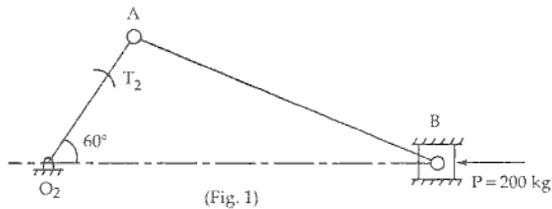
(c) Explain the function of a flywheel from a crank effort diagram. The equation of torque on the crankshaft of an engine is given by the equation.

$T = 10000 + 4750 \sin 2\theta - 2850 \cos 2\theta$ Nm

Where θ is the crank angle. The resisting torque is uniform

Find :

(i) Power developed

(ii) moment of inertia of flywheel if the variation of speed is not to exceed $\pm 2\%$ of the mean speed which is 240 rpm.

(iii) angular acceleration of flywheel when $\theta = \pi/4$ radian from IDC.

2. Attempt *any two* parts of the following :   (10x2=20)

(a) Why is the need of balancing increasing these days ? Explain in a comprehensive manner the method of balancing a number of rotating masses in one plane, by a single mass in the same plane.

(b) Explain the terms

(i) Variations in tractive effort

(ii) Swaying couple and

(iii) hammer blow as applied to locomotive balancing. Derive expression for these for a two cylinder locomotive having cranks 90° apart.

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(c) Four masses A, B, C and D i.e, 40 kg, 50 kg, 60 kg and M kg, respectively are rigidly connected to a shaft at 30 cm, 24 cm, 28 cm and 24 cm respectively from the axis of the shaft. The shaft revolves about its axis and the planes of revolution of masses are at equal intervals apart. Determine M and the angular positions of B, C and D in relation to that of A in order that masses may completely balance one another.

3. Attempt *any two* parts of the following :   (10x2=20)

(a) What are different types of friction ? Explain with suitable examples. Deduce an expression for the radius of friction circle in terms of the radius of the journal and the angle of friction.

(b) Describe with a neat sketch the working of a single plate friction clutch. Establish a formula for the maximum torque transmitted by a single plate clutch. Assume that the pressure intensity on the contact faces is uniform.

(c) A rough rule for leather belting is that the difference between the tight side and slack side tensions should not exceed 100 N/cm of width for a belt of 5 mm thickness. If this rule is applied under the following conditions, what is the maximum stress on the tight side of the belt ? $\theta = 170°$, $\mu = 0.3$, $\vartheta = 240$ m/min, $\rho = 0.15$ N/cm^3.

4. Attempt *any two* parts of the following :   (10x2=20)

(a) Define the following terms as applied to governors.

(i) Controlling force   (ii) Governor Power

(iii) Sensitiveness   (iv) Stability

(v) Hunting

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(b) State the essential difference between a Porter and a Hartnell governor. Derive the relation between the height of the governor (h) and the angular speed of the balls (ω) for a Porter governor.

(c) In a spring loaded governor of the Hartnell type, the weight of each ball is 5 kg and the lift of the sleev is 5 cm. The speed at which the governor begins to float is 240 rpm and at this speed the radius of rotation of balls is 11 cm. The mean working speed of the governor is 20 times the range of speed when friction is neglected. If the lengths of balls and roller arms are 12 cm and 10 cm respectively and if the distance between the centre of pivot of bell crank liver and axis of governor spindle is 14 cm. Determine the initial compression of the spring taking into account obliquity of arms.

If friction is equivalent to a force of 3 kg at the sleev, find the total alteration in speed before the sleev begin to move from mid position.

5. Attempt *any two* parts of the following : (10x2=20)

(a) What do you understand by gyroscopic couple ? Derive a formula for its magnitude. Explain the effect of the gyroscopic couple on the reaction of the four wheels of a vehicle negotiating a curve.

(b) The engine and the propeller of an aeroplane weighs 5 kN and the radius of gyration is 50 cm. The propeller rotates at 3000 rpm in clockwise direction looking from the rear. If the aeroplane makes quarter of a circle of radius 100 m towards left hand side while flying at 240 km/hr, what gyroscopic couple will act on the aeroplane frame and what will be its effect ?

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(c)　The measurements on a mechanical vibrating system show that it has a mass of a 8 kg and that the springs can be combined to give an equivalent stiffness 5.4 N/mm. If the vibrating system has a dashpot attached which exerts a force of 60 N when the mass has a velocity of 1 m/sec. Find

(i)　Critical damping coefficient

(ii)　Damping factor

(iii)　Logarithmic decrement, and

(iv)　Ratio of two consecutive amplitudes.

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