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

PAPER ID : 4016 Roll No.

B.Tech

FIFTH SEMESTER EXAMINATION, 2005-2006

DYNAMICS OF MACHINES

Time : 3 Hours *Total Marks : 100*

Note : *(i) Attempt **ALL** the 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*** of the following : **(10x2=20)**

(a) For the reciprocating engine mechanism in figure 1 the following data is given : Length of crank is 7.5 cm, Length of connecting rod is 28 cm, Distance of centre of gravity (C.G.) of link 2 from main bearing is 5 cm, Distance of C.G. of link 3 from crank pin is 12 cm, Crank angle from line of stroke is 60°, Crank speed is 2000 rpm counter clockwise, Mass of link 2 is 2.5 kg, Mass of link 3 is 4 kg, Mass of link 4 is 3 kg, Mass moment of intertia of link 2 is 60 kg cm^2 and mass moment of intertia of link 3 is 500 kg cm^2, Make a complete inertia force analysis.

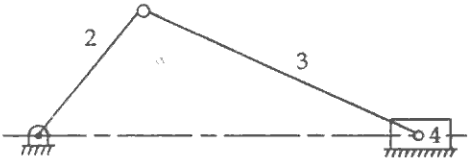

Figure 1

(b) The equation of a turning moment curve of an IC engine running at 300 rpm is given by $T = 25000 + 8500 \sin 3\theta$ Nm. A flywheel coupled to the crankshaft has a mass moment of inertia 452 kg m^2 about its axis of rotation. Determine the horse power of the engine, total fluctuation of speed and maximum angle by which the flywheel leads or lags an imaginary flywheel running at a constant speed.

(c) Distinguish clearly between the terms 'Crank pin effort' and 'Crank effort'. Derive expression for these. State how the size of a flywheel is calculated.

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

(a) (i) Compare the functions of a flywheel and a governor.

(ii) Describe the effect of friction on the sensitiveness of a governor.

(iii) Define the terms : stability, effort and power of a governor.

(b) In a porter governor the arms and links are each 20 cm long and are hinged on the main axis. Each ball weighs 2.5 kg and the central weight is 2.5 kg. The force of friction of mechanism at the sleeve is 25 N. The inclination of the arms to the vertical is 30° and 45° in the lowest and highest position respectively. Calculate :

(i) the travel of the sleeve

(ii) the speeds at the bottom, middle and the top of the travel of the sleeve, neglecting friction

(iii) same as (ii) but during upward travel taking friction into account

(iv) same as (iii) but during downward travel.

(c) In a Hartnell type governor, the length of ball and sleeve arms of a bell crank lever are 150 mm and 130 mm respectively. The distance of the fulcrum of the bell crank lever from the governor axis is 14 cm. The mass of each governor ball is 5 kg. The governor runs at a mean speed 310 rpm with the ball arms vertical and sleeve arms horizontal. For an increase of speed of 4%, the sleeve moves 10 mm upwards. Assume sleeve mass to be 50 kg. Find :

(i) the minimum equilibrium speed if the total sleeve increment is limited to 20 mm

(ii) the spring stiffness and sensitivity of the governor

(iii) when the governor is isochronous at 300 rpm what is the stiffness of the spring.

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

(a) What are in-line engines ? State, clearly how in-line four stroke and two stroke engines are balanced.

(b) Determine the bearing reactions for a system of four unbalance masses, shown in figure 2. The rotor speed is 600 rpm.

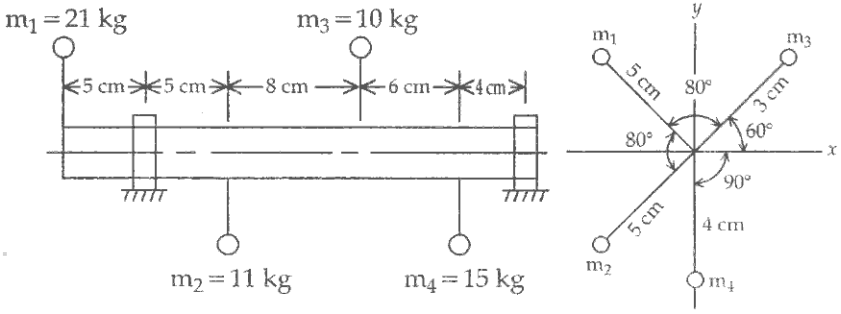

figure 2

(c) The firing order in a six cylinder vertical four stroke in-line engine is 1-4-2-6-3-5. The piston stroke is 100 mm and the length of each connecting rod is 200 mm. The pitch distances between the cylinder centre lines are 100 mm, 100 mm, 150 mm, 100 mm and 100 mm respectively. The reciprocating mass per cylinder is 1 kg and the engine runs at 2500 rpm. Determine the out-of-balance primary and secondary forces and couples on this engine, taking a plane midway between cylinders 3 and 4 as the reference plane.

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

(a) How are the dynamometers classified ? What is the difference between absorption and transmission type of dynamometers ? Explain, with the help of diagram, any one absorption type of dynamometer.

(b) An internal expanding shoe brake actuated mechanically by cam and lever arrangement, has the following dimensions : Diameter of drum = 27 cm, distance between the fulcrum centres = 7.5 cm, distance of fulcrum centres and that of cam axis, both from the drum centre = 11.5 cm distance of the line of action of braking force from the cam axis = 10 cm, distance between the points where the cam acts on the two brake shoes = 3.2 cm. Each shoe subtends an angle of 90° at the drum centre. If the braking force is 500 N and co-efficient of friction is 0.3, find the braking torque on the drum. Assume that the reactions between the brake shoes and the drum pass through the point bisecting the contact angle. Also assume that forces exerted by the cam ends on the two shoes are equal.

(c) Determine for an open belt drive the width of a 9.5 mm thick leather belt required to transmit 15 HP from a motor running at 750 rpm. Diameter of the driving pulley of the motor is 30 cm. The driven pulley runs at 250 rpm and the distance between the centres of the two pulleys is 3 m. Neglect the sag of the belt and assume no slip.

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

(a) How is the stability of moving vehicles, which is taking a turn, ascertained ? What are the various factors affecting the stability ?

(b) A motor cycle along with the rider has a mass 310 kg and the system centre of gravity is 60 cm above the ground level. Each wheel of the machine has a mass 10 kg, radius 30 cm and radius of gyration 25 cm. The rotating parts of the engine have equivalent mass 15 kg and radius of gyration 8 cm and they rotate in the same direction as the road wheels. The gear ratio from wheel to engine is 1:8. Calculate the angle of banking necessary for the machine to ride normal to the banked track on a bend of 80 m radius at a speed 150 kmph.

(c) (i) Explain with the help of graphs, the variation in amplitude of forced undamped vibrations, with change in angular velocity when periodic force is constant in magnitude.

(ii) The static deflection of an automobile on its springs is 10 cm. Find the critical speed when the automobile is travelling on a road. Figure 3, which can be approximated by a sine wave 8 cm amplitude and wave length 15 m. Assume the damping ratio to be 0.05. Also determine the amplitude of vibration at 75 kmph.

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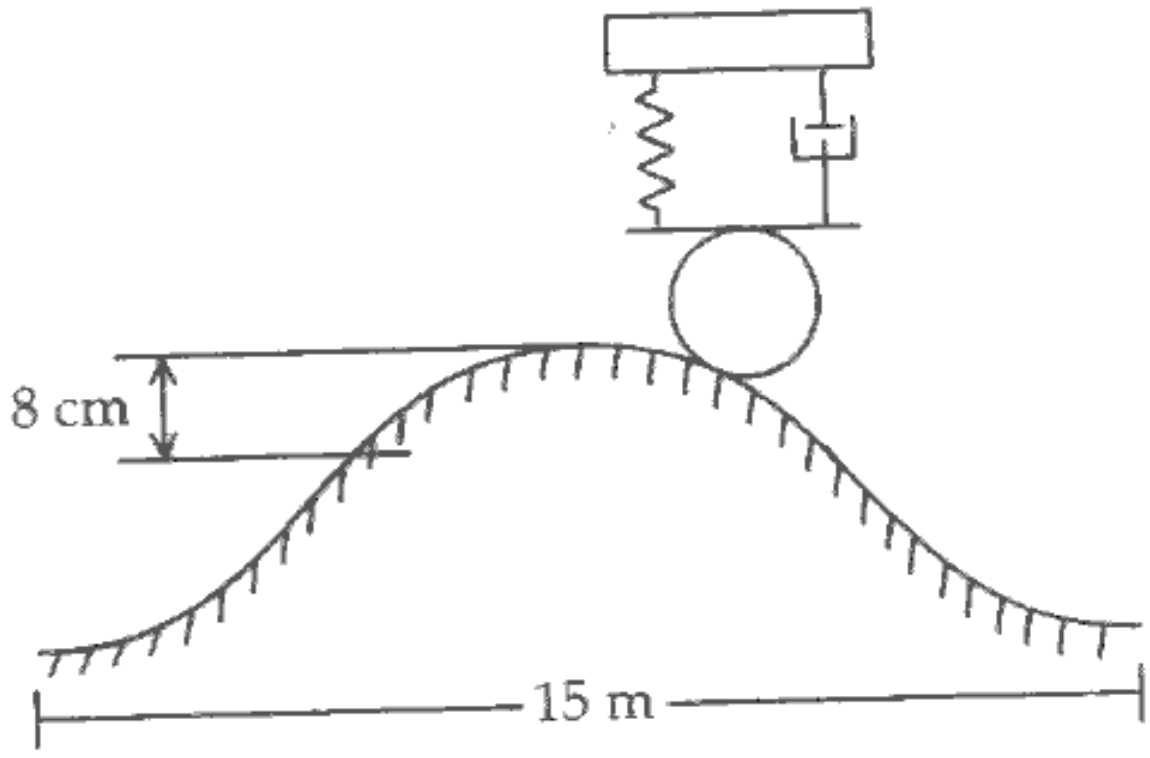

figure 3

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