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

PAPER ID : 4016 Roll No.

B. Tech.

(SEM. V) EXAMINATION, 2007-08

DYNAMICS OF MACHINES

Time : 3 Hours] *[Total Marks : 100*

Note : *(1) Attempt **all** questions.*
*(2) All questions carry **equal** marks.*
(3) Assume missing data suitably, if any.

1 Attempt any **two** parts of the following :

(a) Derive the expression for angular velocity and angular acceleration of the connecting rod in slider-crank mechanism. **10**

(b) What do you understand by dynamically equivalent system? Explain! Also explain the connection couple. **10**

(c) A certain machine requires a torque of $(5000+500 \sin\theta)$ N-m to drive it. The machine is directly coupled to an engine which produces a torque of $(5000 + 600 \sin 2\theta)$ N-m. The flywheel and other rotating parts attached to the engine has a mass of 500 kg at a radius of gyration of 0.4 m. If the mean speed is 150 rpm find : **10**

(i) the fluctuation of energy

(ii) the total percentage fluctuation of speed

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(iii) the maximum angular acceleration of the flywheel and the corresponding shaft position.

2 Attempt any **two** parts of the following :

(a) (i) Explain why only a part of the unbalanced force due to reciprocating masses is balanced by revolving masses. **10**

(ii) How the different mass rotating in different planes are balanced?

(b) Explain the various effects of partial balancing of locomotives. **10**

(c) The following data refer to two cylinder locomotive with cranks at 90^{o} **10**

Reciprocating mass per cylinder = 300 kg

Crank radius = 0.3 m

Driving wheel diameter = 1.8 m

Distance between cylinder centre lines = 0.65 m

Distance between the driving wheel central planes = 1.55 m

Determine :

(i) the fraction of the reciprocting masses to be balanced, if the hammer blow is not to exceed 46 kN at 96.5 km/hr.

(ii) the variation in tractive effort.

(iii) the maximum swaying couple.

3 Attempt any **four** parts of the following :

(a) Derive the expression for total frictional torque for a conical pivot bearing. Consider uniform wear. **5**

(b) A single plate clutch, effective on both sides, is required to transmit 25 kW at 3000 rpm. Determine the outer and inner radii of frictional surface if the coefficient of friction is 0.255, the ratio of radii is 1.25 and the maximum pressure is not to exceed 0.1 N/mm^2. Assume the theory of uniform wear. **5**

(c) Derive the expression for centrifugal tension in a belt. Does it affect the power transmitted? 5

(d) For a flat belt prove that $\frac{T_1}{T_2} = e^{\mu\theta}$, where symbols have their usual meanings. 5

(e) With the help of neat sketch explain the working of Internal expanding brake. 5

(f) Describe the construction and operation of a proxy brake absorption dynamometer. 5

4 Attempt any **two** parts of the following :

(a) Differentiate between the functions of a governor and a flywheel. With the help of neat sketch explain Wilson-Hartnell governor and derive the expression for equilibrium speed. 10

(b) In a spring loaded governor of the Hartnell type, the mass of each ball is 1kg, length of vertical arm of the bell crank lever is 100 mm and that of the horizontal arm is 50 mm. The distance of fulcrum of each bell crank lever is 80 mm from the axis of rotation of the governor. The extreme radii of rotation of the balls are 75 mm and 112.5 mm. The maximum equilibrium speed is 5 per cent greater than the minimum equilibrium speed which is 360 rpm. Find, neglecting obliquity of arms, initial compression of the spring and equilibrium speed corresponding to the radius of rotation of 100 mm. 10

(c) Explain the terms and derive expressions for effort and power of a porter governor. 10

5 Attempt any **two** parts :

(a) Discuss the effect of the gyroscopic couple on a two wheeled vehicle when taking a turn. **10**

(b) A rear engine automobile is travelling along a track of 100 m mean radius. Each of the four wheels has a moment of inertia of 2.5 kg-m^2 and an effective diameter of 0.6m. The rotating parts of the engine have a moment of inertia of 1.2 kg-m^2. The engine axis is parallel to the rear axle and the crank shaft rotates in the same sense as the road wheels. The ratio of engine speed to back axle speed is 3:1. The automobile has a mass of 1600 kg and has its centre of gravity 0.5 m above road level. The width of the track of the vehicle is 1.5m. **10**

Determine the limiting speed of the vehicle around the curve for all four wheels to maintain contact with the road surface. Assume that road surface is not cambered and C.G. of the automobiles lies centrally w.r.t. the four wheels.

(c) (i) In a single degree damped vibrating system, a suspended mass of 8 kg makes 30 oscillations in 18 s. The amplitude decreases to 0.25 of the initial value after 5 oscillations. Determine : **10**

(a) the stiffness of the spring
(b) the logarithmic decrement
(c) the damping factor
(d) the damping coefficient.

(ii) Explain the energy method for finding out the natural frequency of a conservative system.
