Printed Pages : 7   TME503

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

PAPER ID : 4076   Roll No.

B.Tech

(SEM V) ODD SEMESTER THEORY EXAMINATION 2009-10
DYNAMICS OF MACHINES

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

Note :   (i)   *All questions should be attempted.*

(ii)   *Marks are shown against each question.*

1   Answer any **two** of the following :   10×2=20

(i)   (a)   Derive an expression for the angular   4
acceleration of the connecting-rod in
a slider-crank mechanism.

(b)   A vertical petrol engine 150 mm   6
diameter and 200 mm stroke has a
connecting rod 350 mm long. Mass
of piston is 1.6 kg and engine speed
is 1800 RPM. On the expansion stroke,
with crank angle 30° from top dead
centre, the gas pressure is 750 k.N/m^2.
Determine the net thrurst on the engine.

(ii)   (a)   Why are large flywheels required for   3
shearing/punching processes ?

(b) A twin-cylinder engine is single acting with its cranks set at right angles and it runs at 1500 RPM. The torque angle diagram is practically a triangle for the power stroke with a maximum torque of 120 kgt-m at 60° after dead centre of the corresponding crank. The torque on the return stroke is negligible. Find the horse power developed and the moment of inertia of the flywheel, if the speed is to be kept within ± 3% of mean speed.   **7**

(iii) A connecting rod 220 mm long has a mass of 2 kg and moment of inertia of 2×10^4 kg-mm^2 about its C.G. The C.G. is located at a distance of 150 mm from the small end centre. Determine the dynamically equivalent two mass system, when one mass is located at the small end.   **10**

If the connecting rod is replaced by two masses each located at the small and big end, find the correcting couple that must be applied for complete dynamic equivalence of the system, when the angular acceleration of the connecting rod is 20000 radians/sec^2 clockwise. Also indicate the sense of the correction couple.

2   Attempt any **two** of the following :   **10×2=20**

(i) A shaft carries four rotating masses A, B, C and D in this order along its axis. Masses B, C and D are 30 kg, 50 kg and 40 kg respectively and are assumed to be concentrated at radii of 18 cm, 24 cm, 12 cm and 15 cm for A, B, C and D. Planes containing B and C are 30 cm apart. The angular spacing of the planes containing C and D are 90° and 210° respectively relative to B measured in the same plane. If the shaft and masses are to be in complete dynamic balance, find :

(a) the mass and angular position of A

(b) the position of planes A and D.

(ii) Explain Primary and Secondary disturbing forces.

A four cylinder vertical engine has cranks 300 mm long. The planes of rotation of the first, third and fourth cranks are 750 mm, 1050 mm and 1650 mm respectively from that of the second crank and their reciprocating masses are 150 kg, 400 kg and 250 kg respectively. Find the mass of the reciprocating parts of the second cylinder and the relative angular positions of the cranks so that the engine may be in complete primary balance.

(iii) The cranks of a two cylinder uncoupled Inside Cylinder locomotive are at right angles and are 300 mm long. The distance between the centre lines of the two cylinders is 650 mm.

Wheel centre lines are 1.6 metres apart. Reciprocating mass per cylinder is 300 kg. Driving wheel diameter is 1.8 metres. If the hammer blow is not to exceed 45 kN at 100 km/hour, determine :

(a) Fraction of reciprocating masses to be balanced.

(b) Variation in tractive effort, and

(c) Maximum swaying couple.

3 Attempt any **two** of the following : 10×2=20

(i) (a) Describe the operation of a multiplate clutch with the help of a suitable sketch. 5

(b) Derive an expression for the braking torque in an internal expanding shoe-brake. 5

(ii) (a) Differentiate between transmission and absorption types of dynamometers. 3

(b) Describe one dynamometer each of the above two types. 7

(iii) (a) Differentiate between Open and Cross belt drives. In these drives on which pulley will the belt start shipping first, if belt tension is progressively increased ? 3

(b) A belt embraces the shorter pulley by an angle of 165° and runs at 1700 metres/minute. The width, thickness and density of the belt are 20 cm, 8 mm amd 1 gm/cm^3. Determine the maximum power which can be transmitted, if maximum permissible stress in belt is limited to 250 N/cm^2. Assume μ to be 0.25. 7

4 Answer any two of the following : 10×2=20

(i) A Proell governor has all four arms of length 300 mm. Upper arms are pivoted on the axis of rotation and lower arms are attached to a sleeve weighing 40 kg at a distance of 40 mm from the axis of rotation. The extension of lower arms to which balls of weight 3.75 kg are attached are 100 mm in length. These extensions are parallel to governor axis at the minimum radius. Minimum and maximum radii are 180 and 240 mm. Find the range of governor-speed. 10

(ii) Mass of each ball in a Wilson-Hartnell governor is 2.5 kg. Length of ball arm is 100 mm whereas the sleeve arm is 80 mm long. Minimum equilibrium speed is 200 RPM; when radius of rotation is 100 mm. When the sleeve is lifted by 8 mm, equilibrium speed is 212 rpm. 10

The stiffness of each of the springs connected to the balls is 200 N/m. The lever for the auxiliary spring is pivoted at mid point. Determine the stiffness of auxillary spring.

(iii) Explain the terms stability, hunting, isochronism and effort of governor. **10**

5 Attempt any **two** of the following : **10×2=20**

  (i) (a) Explain the difference between Gyroscopic Couple and Reaction Couple. **3**

     (b) A ship has a propeller of mass moment of inertia 2000 kg-m^2. It rotates at 360 rpm in clockwise sense looking from stern. Determine the gyroscopic couple and its effect when ship moves at 30 km/hr and steers to left with a radius of 200 m. **7**

  (ii) (a) Differentiate between Free and Forced vibration. What happens when free vibrations are dampled ? **3**

     (b) A flywheel of mass 750 kg is mounted on a vertical shaft of diameter 50 mm. Both ends of the shaft are fixed as shown in the sketch. L_1 = 1350 mm, **7**

L_2 = 900 mm. If E = 200 GN/m^2, find natural frequency of longitudinal vibration. Neglect the weight of shaft.

Fly Wheel, Shaft, L_1, L_2
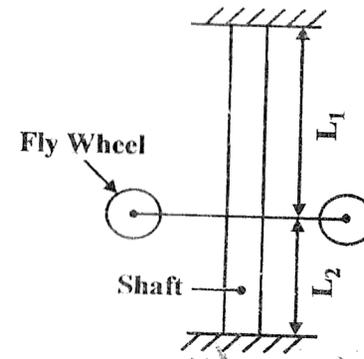
(iii) Find the logarithmic decrement and the ratio of two consecutive amplitudes of a vibrating system which consists of a mass of 3.5 kg, a spring stiffness of 25 N/mm and a damper with a damping coefficient of 0.018 N/mm/s. **10**