Roll No. ....

24257

B. Tech. (5th Semester) (Mechanical Engg.) Examination – December, 2011

DYNAMICS OF MACHINES

Paper : ME - 301 - F

Time : Three hours]   _[Maximum Marks : 100_

Before answering the question, candidates should ensure that they have been supplied the correct and complete question paper. No complaint in this regard, will be entertained after examination.

Note : Attempt _five_ questions in all, selecting at least one question form each Section. Question No. 1 is **compulsory**. All questions carry equal marks.

1. (i) Two masses in different planes are necessary to rectify the dynamic unbalance. Comment.

   (ii) What do you mean by force balancing of linkages ? How is it achieved ? Explain.

   (iii) In what way is the inertia of the connecting rod of a reciprocal engine taken into account ?

(iv) What is the difference between a brake and a clutch ?

(v) What is meant by self-locking and a self-energized brake.

(vi) Explain in what way the gyroscopic couple affects the motion of an aircraft while taking a turn.

(vii) What do you mean by spin, procession and gyroscopic planes ?

(viii) Explain the terms sensitiveness, hunting and stability relating to governors.

(ix) Why are the inertia governors quicker in action as compared to centrifugal governors ? Explain.

(x) Why are the inertia governors quicker in action as compared to centrifugal governors ? Explain.

$$2 \times 10 = 20$$

SECTION – A

2. The piston diameter of an internal combustion engine is 125 mm. The connecting rod is 4.5 times the crank length and has a mass of 50 kg. The mass of the reciprocating parts is 30 kg. The centre of mass of the connecting rod is 170 mm from the crank-pin centre

and the radius of gyration about an axis through the centre of mass is 148 mm. The engine runs at 320 rpm. Find the magnitude and the direction of inertia force and the corresponding torque on the crankshaft when the angle turned by the crank is 140° from the inner dead centre.

20

3. (a) What are the conditions for a body to be in equilibrium under the action of two forces, three forces and two forces and a torque ?   6

(b) What do you mean by dynamical equivalent system ? Explain.   4

(c) Derive a relation for the turning moment at the crankshaft in terms of piston effort and the angle turned by the crank.   10

SECTION – B

4. The following data refer to a four-coupled wheel locomotive with two inside cylinders :

Pitch of cylinders = 600 mm
Reciprocating mass/cylinder. = 315 kg
Revolving mass/cylinder. = 260 kg
Distance between driving wheels. = 1.6 m
Distance between coupling rods. = 2 m

Diameter of driving wheels.   =   1.9 m

Revolving parts for each Coupling
rod crank   =   130 kg

Engine crank radius.   =   300 mm

Coupling rods crank radius.   =   240 mm

Distance of centre of balance mass
in planes of driving wheels from
axle center.   =   750 mm

Angle between engine cranks.   =   90°

Angle between coupling rod Crank
with adjacent engine crank   =   180°

The balanced mass required for the reciprocating parts is equally divided between each pair of coupled wheels. Determine the :

(i) magnitude and position of the balance mass required to balance two-third of reciprocating and whole of revolving parts.

(ii) hammer-blow and the maximum variation of tractive force when the locomotive speed is 80 km/h.   20

5. (a) Find the magnitudes of the unbalanced primary and secondary forces in V-engines. Deduce the expression when the lines of stroke of the two cylinders are at 60° and 90° to each other. 8

   (b) Explain the method of direct and reverse cranks to determine the unbalance forces in radial in engines. 12

SECTION – C

6. The length of the ball and sleeve arms of the bell crank lever of a Hartnell governor is 140 and 120 mm respectively. The mass of each governor ball is 5 kg. The fulcrum of the bell-crank lever is at a distance of 160 mm. At the mean speed of the governor which is 270 rpm, the ball arms are vertical and the sleeve arms are horizontal. The sleeve moves up by 12mm for an increase of speed of 4%. Neglecting friction, determine the :

   (i) Spring Stiffness.

   (ii) Minimum equilibrium speed when the sleeve move by 24 mm.

   (iii) Sensitiveness of the Governor

(iv) Spring stiffness for the governor to be isochronous at the mean speed. 20

7. (a) What is the advantage of a self-expanding shoe brake ? Derive the relation for the friction torque for such a brake. 10

(b) Write a short note on Rope Brake Dynamometer. 10

SECTION – D

8. A four-wheeled trolley car has a total mass of 3000 kg. Each axle with its two wheels and gears has a total moment of inertia of 32 kg.m². Each wheel is of 450 mm radius. The centre distance between two wheels on an axle is 1.4 m. Each axle is driven by a motor with a speed ratio of 1 : 3. Each motor along with its gear has a moment of inertia of 16 kg. m² and rotates in the opposite direction to that of the axle. The centre of mass of the car is 1m above the rails. Calculate the limiting speed of the car when it has to travel around a curve of 250 m radius without the wheels leaving the rails. 20

9. (a) What is the effect of the gyroscopic couple on the stability of a four wheeler while negotiating a curve ? In what way does this affect along with that of the centrifugal force limit the speed of the vehicle ?   10

(b) Discuss the gyroscopic effect on the vessels.

10