Reg. No. : ☐☐☐☐☐☐☐☐☐☐☐☐

L 1481

B.E./B.Tech. DEGREE EXAMINATION, APRIL/MAY 2008.

Fourth Semester

Mechanical Engineering

ME 236 — DYNAMICS OF MACHINES

(Common to Mechatronics Engineering)

Time : Three hours   Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Show the applied force and constraint force in a ball resting on Vee-block.

2. State the purpose of flywheel.

3. Differentiate between the unbalance force caused due to rotating and reciprocating masses.

4. What is meant by Dynamic Balancing?

5. Plot the variation of displacement with respect to time for under damped and over damped systems.

6. Write the expressions for Damping Factor and Damped Frequency.

7. Define the term 'Transmissibility'.

8. What is meant by Support motion?

9. When is a Governor said to be sensitive?

10. What is the gyroscopic effect on stability of two wheeler when it takes a turn?

PART B — (5 × 16 = 80 marks)

11. (a) The Piston diameter of an I.C. engine is 125 mm and the stroke is 220 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. Determine the magnitude and direction of the Inertia force and the corresponding torque on the crank shaft when the angle turned by the crank is 140° from the Inner Dead Centre.

Or

(b) The torque delivered by a two-stroke engine is represented by,

$$T = (1000 + 300 \sin 2\theta - 500 \cos 2\theta) \text{N.m}$$

where θ is the angle turned by the crank from the inner dead centre. The mass of the flywheel is 400 kg and radius of gyration 400 mm.

Determine

(i) The power developed when the engine speed is 250 rpm and

(ii) The maximum fluctuation of speed in terms of percentage.

12. (a) A rotating shaft carries four unbalance masses A, B, C and D as shown below :

	A	B	C	D
Mass (kg)	18	14	16	12
Radius (mm)	50	60	70	60

The masses B, C and D revolve in the planes 80 mm, 160 mm and 280 mm respectively from the plane of mass A and are angularly located at 60°, 135° and 270° respectively measured clockwise from the mass A located at the end of the shaft. The shaft is dynamically balanced by two masses which are located at 50 mm radii and revolving in planes mid way between those of masses A and B and masses C and D respectively. Determine the magnitude and position of balancing masses.

Or

(b) A twin cylinder locomotive has its cylinder centre lines 0.7 m apart and has a stroke of 0.6 m. The rotating masses per cylinder are equivalent to 150 kg at the crank pin and the reciprocating masses per cylinder to 180 kg. The wheel centre lines are 1.5 m apart. The cranks are at right angles. The whole of the rotating and 2/3rd of the reciprocating masses are to be balanced by masses placed at a radius of 0.6 m. Find the magnitude and direction of the balancing masses. Find the fluctuation in rail pressure under one wheel, variation of tractive effort and the magnitude of swaying couple at a crank speed of 300 rpm.

13. (a) A vibrating system consists of a 5 kg mass, a spring with constant of 3.5 N/mm and a dashpot with damping coefficient of 100 N.sec/m. Determine,

   (i) Damping factor

   (ii) Damped Natural frequency

   (iii) Logarithmic decrement

   (iv) Ratio of two successive amplitudes.

Or

(b) The following data refer to a shaft mounted in long bearings :

   Length of the shaft $=$ 1.2 m

   Diameter of the shaft $=$ 14 mm

   Mass of a rotor at mid point of the shaft $=$ 16 kg

   Eccentricity of the centre of mass

   of rotor from the centre of rotor $=$ 0.4 mm

   Modulus of elasticity of shaft material $=$ 200 GN/m^2

   Permissible stress value of shaft material $=$ 70 × 10^6 N/m^2

   Determine the critical speed of the shaft and the range of speed over which it is unsafe to run the shaft. Assume the shaft to be mass less.

14. (a) A machine part having a mass of 2.5 kg vibrates in a viscous medium. A harmonic exciting force of 30 N acts on the part and causes resonant amplitude of 14 mm with a period of 0.22 sec. Find the damping coefficient. If the frequency of the exciting force is changed to 4 Hz, determine the increase in the amplitude of the forced vibrations upon the removal of damper.

Or

(b) The following data relate to a machine supported on four springs.

Mass of machine	=	120 kg
Stroke length	=	90 mm
Mass of reciprocating parts	=	2.5 kg
Speed	=	750 rpm

Springs are symmetrically placed with respect to the centre of mass of the machine. Neglecting damping, find the combined stiffness of springs so that the force transmitted to the foundation is 1/22 of the impressed force. If under actual working conditions, the damping reduces the amplitude of the successive vibrations by 25%, determine the forces transmitted to the foundation at 750 rpm and at resonance. Also find the amplitude of vibrations at resonance.

15. (a) Calculate the range of speed of a Porter governor which has equal arms of each 200 mm long and pivoted on the axis of rotation. The mass of each ball is 4 kg and the central mass of the sleeve is 20 kg. The radius of rotation of the ball is 100 mm when the governor begins to lift and 130 mm when the governor is at maximum speed.

Or

(b) Determine the angle of inclination with respect to the vertical for a two-wheeler having the following details while negotiating a curve of radius 50 m.

Combined mass of vehicle with rider =		260 kg
C.G. with rider in vertical position	=	0.6 m
Moment of Inertia of each road wheel =		1 kg.m^2
Moment of Inertia of flywheel	=	0.3 kg.m^2
Speed of the vehicle	=	90 km/h
Diameter of wheel	=	0.6 m

Speed of engine is 5 times that of road wheels and in same direction.

———————————