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B.E / B.Tech (Full Time) DEGREE END SEMESTER EXAMINATIONS, MAY 2012

MECHANICAL ENGINEERING

FOURTH SEMESTER

ME 9253 DYNAMICS OF MACHINES

(REGULATION 2008)

Time : 3 hr. Max. Mark :100

Answer ALL Questions

Part A (10 x 2 = 20 Marks)

1 What is free body diagram? How is it helpful in finding the various forces acting on members of a mechanism?

2 State and explain D'Alembert's principle.

3 Give reasons why it is very essential that all the rotating and reciprocating parts should be completely balanced as far as possible.

4 What is meant by dynamic balancing and state the necessary condition to achieve them.

5 Draw neat sketches of the longitudinal, transverse and torsional vibration.

6 Draw neat sketches of the under damping, critical damping and over damping with regard to free vibration.

7 Sketch the turning moment diagram of a four stroke cycle internal combustion engine.

8 What is the basic functional difference between a flywheel and a governor?

9 What is an Isochronous governor? State its specific use, if any?

10 State the effect of gyroscopic couple on a naval ship during rolling.

PART B (5 x 16 = 80 Marks)

11 A connecting rod 220 mm long between centres, has a mass of 2 kg and moment of inertia of $2x10^4$ kg mm^2 about its centre of gravity. Centre of gravity 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 centre. If the connecting rod is replaced by two masses located at the two centres, find the correction couple that must be applied for complete dynamical equivalence of the system, when the angular acceleration of the connecting rod is 20000rad/s^2 clockwise. (16)

12a A rotating shaft carries four unbalanced mass 18kg, 14kg, 16kg and 12kg at radii 5cm, 6cm, 7cm and 6 cm respectively. The 2^{nd} , 3^{rd} and 4^{th} masses revolve in planes 8 cm, 16 cm, and 28 cm respectively measured from the plane of the first mass and are angularly located at 60°, 135° and 270° respectively measured anticlockwise from the first mass looking from this mass end of the shaft. The shaft is dynamically balanced by two masses, both located at 5 cm radii and revolving in planes mid way between those of 1^{st} and 2^{nd} masses and midway between those of 3^{rd} and 4^{th} masses. Determine graphically or otherwise, the magnitude of the masses and their respective angular positions.

(16)

[OR]

12b The following data apply to two cylinder locomotive with cranks at right angles:

Reciprocating mass per cylinder = 300 kg

Crank radius = 0.3 m

Driving wheel diameter = 1.8 m

Distance between cylinder centers = 0.65 m

Distance between driving wheel centers = 1.6 m

Determine :

(i) The fraction of reciprocating masses to be balanced if the hammer blow is not to exceed 45kN at 100 km/hr.
(ii) The variation in tractive effort
(iii) The maximum swaying couple

(16)

13a Find the logarithmic decrement and the ratio of any two consecutive amplitude of a vibrating system, which consists of a mass of 3.5 kg, a spring of stiffness 2.5 N/mm and a damper of damping coefficient 0.018 N/mm/S. (16)

[OR]

13b Find the frequency of the transverse vibration of a shaft which is simply supported at the ends and is of 40 mm in diameter and 2.5 m in length. The shaft carries three point loads of masses 30 kg, 70kg and 45 kg at 0.5m, 1m, and 1.7m respectively from the left support. The Young's modulus for the material of the shaft is 200 GN/m^2. Neglect the weight of the shaft. (16)

14a The static deflection of an electric motor of mass 400 kg supported by a system of four parallel springs and static deflection is found to be 50 mm. If the electric motor has a rotating unbalance of 0.20 kg m, determine the amplitude of vibration at 2000 rpm, the force transmitted to the ground. (16)

[OR]

14b Write short notes on the following:

(i) Dynamic magnifier & Transmissibility

(ii) Critical speed of shaft (16)

15a A Porter governor has equal arms each 25 cm long and pivoted on the axis of rotation. Each ball has a mass of 4 kg and mass of central load is 24 kg. The radius of rotation is 15 cm when the sleeve begins to lift and 20 cm when the governor is at its maximum speed. Find the range of speed, and sleeve lift of the governor. (16)

[OR]

15b A car is of total mass 3000kg. It has wheel base equal to 2.5m and track width equal to 1.5m. The effective diameter of each wheel is 80 cm and moment of inertia

of each wheel is 1.0 kg m^2. The rear axle ratio is 4. The mass moment of inertial of engine rotating parts is 3kg m^2 and spin axis of engine parts is perpendicular to the spin axis of the wheels. Determine the reaction at each wheel if car takes right turn of 100 m radius at 108 km/hr speed. The height of C.G is 0.5 m from ground and it is placed on the vertical line through geometric centre of wheels.

(16)