Register Number: …………………..

B.E. DEGREE EXAMINATIONS: NOV/DEC 2012

Fifth Semester

MECHANICAL ENGINEERING

MEC113: Dynamics of Machinery

Time: Three Hours **Maximum Marks: 100**

Answer ALL Questions:-

PART A (10 x 1 = 10 Marks)

1. In an engine, the work done by inertia force in a cycle is

    A) positive   B) zero   C) negative   D) infinite

2. The maximum fluctuation of energy is the

    A) sum of maximum and minimum energies

    B) difference between maximum and minimum energies

    C) ratio of the maximum and minimum energies

    D) ratio of the mean resisting torque to the work done per cycle

3. In order to have complete balance of the several revolving masses in different planes, both the resultant force and couple must be

    A) positive   B) zero   C) negative   D) infinite

4. The swaying couple is due to the

    A. primary unbalanced force   B) secondary unbalanced force

    C) two cylinders of locomotive   D) partial balancing

5. Longitudinal vibrations are said to occur when the particles of the body moves

    A) perpendicular to its axis   B) parallel to its axis

    C) in a circle about its axis   D) in an angle from its axis

6. When a body is subjected to transverse vibrations, the stree induced in a body will be

    A) shear stress   B) tensile stress   C) compressive stress   D) Both A & C

7. The ratio of maximum displacement of the forced vibration to the deflection due to the static force, is known as

    A) damping factor   B) damping coefficient

    C) logarithmic decrement   D) magnification factor

8. In a vibration isolation system, if $\omega/\omega_n > 1$, then the phase difference between the transmitted force and the disturbing force is

    A) 0°   B) 90°   C) 180°   D) 270°

9. Which of the following governor is used to drive a gramophone?

    A) Watt   B) Porter   C) Pickering   D) Hartnell

10. A disc spinning on its axis at 20 rad/s undergo precession when a torque 100 N-m is applied about an axis normal to it an angular speed, if mass moment of inertia of the disc is the 1 kg-m^2

   A) 2 rad/s   B) 5 rad/s   C) 10 rad/s   D) 20 rad/s

PART B (10 x 2 = 20 Marks)

11. State D'Alembert's principle.

12. Define inertia force.

13. What do you understand by balancing of rotating masses?

14. Write a short note on inside cylinder locomotive and outside cylinder locomotive.

15. Draw a simply supported beam with an eccentric load W and give its static deflection expression.

16. Write a short note on a) frequency and b) period of vibration.

17. Explain critical damping and large damping in short.

18. What is viscous damping?

19. What is the function of a governor?

20. Explain active and reactive gyroscopic couple?

PART C (5 x 14 = 70 Marks)

21. a) The connecting rod of an IC engine is 225 mm long and has a mass 1.6 kg. The mass of the piston and gudgeon pin is 2.4 kg and stroke is 150 mm. The cylinder bore is 112.5 mm. the centre of gravity of the connecting rod is 150 mm from the small end. Its radius of gyration about the centre of gravity for oscillations in the plane of swing of the connecting rod is 87.5 mm. Determine the magnitude and direction of the resultant force on the crank pin when the crank is at 40° and the piston is moving away from inner dead centre under an effective gas pressure of 1.8 MN/m^2. The engine speed is 1200 r.p.m.

(OR)

b) The turning moment diagram of a four stroke engine may be assumed for the stroke of simplicity to be represented by four triangles in each stroke. The areas of these triangles are as follows:

Suction stroke = 5 x 10^{-5} m^2; Compressive stroke = 21 x 10^{-5} m^2; Expansion stroke = 85 x 10^{-5} m^2; Exhaust stroke = 8 x 10^{-5} m^2. All the areas expecting expansion stroke are negative. Each m^2 of area represents 14 MN-m of work.

Assuming the resisting torque to be constant, determine the moment of inertia of the flywheel to keep the speed between 98 r.p.m and 102 r.p.m. Also find the size of a

rim-type flywheel based on the minimum material criterion, given that density of flywheel material is 8150kg/m^3; the allowable tensile stress of the flywheel is 7.5 MPa. The rim cross-section is rectangular; one side being four times the length of the other.

22.a) Four masses A, B, C and D as shown below are to be completely balanced.

	A	B	C	D
Mass (kg)	-	30	50	40
Radius (mm)	180	240	120	150

The planes containing masses B and C are 300 mm apart. The angle between planes containing B and C is 90°. B and C makes angle of 210° and 120° respectively with D in the same sense. Find: 1. The magnitude and the angular position of mass A; and 2. The position of planes A and D.

(OR)

b) In an in-line six cylinder engine working on two stroke cycle, the cylinder centre lines are spaced at 600 mm. In the end view, the cranks are 60° apart and in the order 1-4-5-2-3-6. The stroke of each piston is 400 mm and the connecting rod is 1 m. The mass of the reciprocating parts is 200 kg per cylinder and that of rotating parts 100 kg per crank. The engine rotates at 300 r.p.m. Examine the engine for the balance of primary and secondary forces and couples. Find the maximum unbalanced forces and couples.

23. a) Derive the natural frequency of free vibrations using Equilibrium method and Energy method.

(OR)

b) A machine of mass 75 kg is mounted on springs and is fitted with a dashpot to damp out vibrations. There are three springs each of stiffness 10 N/mm and it is found that the amplitude of vibration diminishes from 38.4 mm to 6.4 mm in two complete oscillations. Assuming that the damping force varies as the velocity, determine : 1. The resistance of the dashpot at unit velocity; 2. The ratio of the frequency of the damped vibraton to the frequency of the undamped vibration; and 3. The periodic time of the damped vibration.

24. a) Explain in detail about Logarithmic decrement and vibration Isolation.

(OR)

b) The mass of an electric motor is 120 kg and it runs at 1500 r.p.m. The armature mass is 35 kg and its C.G. lies 0.5 mm from the axis of rotation. The motor is mounted on five springs of negligible damping so that the force transmitted is one- eleventh of the impressed force. Assume that the mass of the motor is equally distributed among the five springs.

Determine: 1. Stiffness of each spring; 2. Dynamic force transmitted to the base at the operating speed; and 3. Natural frequency of the system.

25. a) A Porter governor has equal arms each 250 mm long and pivoted on the axis of rotation. Each ball has a mass of 5 kg and the mass of the central load on the sleeve is 25 kg. The radius of rotation of the ball is 150 mm when the governor begins to lift and 200 mm when the governor is at maximum speed. Find the range of speed, sleeve lift, governor effort and power of the governor in the following cases: 1. When the friction at the sleeve is neglected, and 2. When the friction at the sleeve is equivalent to 10N.

(OR)

b) A four wheeled motor car of mass 2000 kg has a wheel base 2.5 m, track width 1.5m and height of centre of gravity 500 m above the ground level and lies at 1m from the front axle. Each value has an effective diameter of 0.8 m and a moment of inertia of 0.8 kg-m^2. The drive shaft, engine flywheel and transmission are rotating at 4 times the speed of road wheel, in a clockwise direction when viewed from the front and is equivalent to a mass of 75 kg having a radius of gyration of 100 mm. if the car is taking a right turn of 60 m radius at 60 km/h, find the load on each wheel.

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