Register Number .....

B.E. DEGREE EXAMINATIONS NOVEMBER 2009

Fifth Semester

MECHANICAL ENGINEERING

U07ME501 Dynamics of Machinery

Time: Three hours **Maximum Marks: 100**

Answer ALL the Questions:-

PART A (10 x 1 = 10 Marks)

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

(a) positive (b) zero (c) negative (d) fluctuating

2. In a turning moment diagram, the variations of energy above and below the mean resisting torque line is called

(a) Fluctuation of energy (b) maximum fluctuation of energy

(c) Coefficient of fluctuation of energy (d) Coefficient of fluctuation of speed

3. In order to have a complete balance of the several revolving masses in different planes

(a) the resultant force must be zero

(b) the resultant couple must be zero

(c) both the resultant force and couple must be zero

(d) the resultant force must be more than zero

4. Multi cylinder engines are desirable

(a) only balancing problems are reduced (b) only flywheel size is reduced

(c) both (a) & (b) (d) increasing the speed

5. A hartnell governor is a

(a) pendulum type governor (b) spring loaded governor

(c) dead weight governor (d) Inertia governor

6. In an automobile, if the vehicle makes a left turn, the gyroscopic torque

(a) increases the forces on the outer wheels

(b) decreases the forces on the outer wheels

(c) does not affect the forces on the outer wheels

(d) keep the constant force on the outer wheels

7. The factor which affects the critical speed of a shaft is

(a) diameter of the disc (b) span of the shaft

(c) eccentricity (d) all of the above

8. When a body is subjected to transverse vibrations, the stress induced in a body is

(a) Shear stress (b) tensile stress

(c) Compressive stress (d) Crushing stress

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

(a) 0° (b) 90° (c) 180° (d) 270°

10. At a nodal point in a shaft, the amplitude of torsional vibration is

(a) zero (b) minimum (c) maximum (d) Negativ

PART B (10 x 2 = 20 Marks)

11. State D'Alembert's principle.
12. Define 'Coefficient of Fluctuation of Energy'.
13. What do you understand by the term *partial balacing?*
14. What is the difference between balancing of rotating & reciprocating masses.
15. Differentiate between governor and flywheel?
16. When the aeroplane in the above case turns right, with other conditions kept same what is the effect of reactive gyroscopic couple?
17. Write the importance of whirling speed of a shaft.
18. Define the terms. Damping factor and Resonance.
19. How torsional equivalent shaft can be defined?
20. What do you is mean by transmissibility ratio or isolation factor.

PART C (5 x 14 = 70 Marks)

21. (a) A single cylinder double acting steam engine develops 150 kW at a mean spe 80 r.p.m. The coefficient of fluctuation of energy is 0.1 and the fluctuation of s is ± 2% of mean speed. If the mean diameter of the flywheel rim is 2 metre an hub and spokes provide 5% of the rotational inertia of the flywheel, find the and cross-sectional area of the flywheel rim. Assume the density of the fly material (which is cast iron) as 7200 kg/m^3.

(OR)

(b) The crank and connecting rod of a petrol engine, running at 1800 r.p.m. are 5 and 200 mm respectively. The diameter of the piston is 80 mm and the mass reciprocating parts is 1 kg. At a point during the power stroke, the pressure piston is 0.7 N/mm^2, when it has moved 10 mm from the inner dead c Determine : 1. Net load on the gudgeon pin, 2. Thrust in the connecting r Reaction between the piston and cylinder, and 4. The engine speed at whic above values become zero.

shaft carries four masses A, B, C and D of magnitude 200 kg, 300 kg, 400 kg and 0 kg respectively and revolving at radii 80 mm, 70 mm, 60 mm and 80 mm in planes measured from A at 300 mm, 400 mm and 700 mm. The angles between the cranks measured anticlockwise are A to B 45°, B to C 70° and C to D 120°. The balancing masses are to be placed in planes X and Y. the distance between the planes A and X is 100 mm, between X and Y is 400 mm and between Y and D is 200 mm. If the balancing masses revolve at a radius of 100 mm, find their magnitude and angular positions.

(OR)

(b) A four crank engine has the two outer cranks set at 120° to each other, and their reciprocating masses are each 400 kg. The distance between the planes of rotation of adjacent cranks are 450 mm, 750 mm and 600 mm. If the engine is to be in complete primary balance, find the reciprocating mass and the relative angular position for each of the inner cranks. If the length of each crank is 300 mm, the length of each connecting rod is 1.2 m and the speed of rotation is 240 r.p.m., what is the maximum secondary unbalanced force?

23. (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 ship propelled by a turbine rotor which has a mass of 5 tonnes and a speed of 2100 r.p.m. The rotor has a radius of gyration of 0.5 m and rotates in a clockwise direction when viewed from the stern. Find the gyroscopic effects in the following conditions:

1. The ship sails at a speed of 30 km/h and steers to the left in a curve having 60 m radius.
2. The ship pitches 6 degree above and 6 degree below the horizontal position. The bow is descending with its maximum velocity. The motion due to pitching is simple harmonic and the periodic time is 20 seconds.
3. The ship rolls and at a certain instant it has an angular velocity of 0.03 rad/s clockwise when viewed from stern.

Determine also the maximum angular acceleration during pitching. Explain how the direction of motion due to gyroscopic effect is determined in each case.

24. (a) A body of mass 20 kg is suspended from a spring which deflects 15 mm under the load. Calculate the frequency of free vibrations and verify that a viscous damping force amounting to approximately 1000 N at a speed of 1 m/s is just-sufficient to make the motion aperiodic. If when damped to this extend, the body is subjected to a disturbing force with a maximum value of 125 N making 8 cycles/s, find the amplitude of the ultimate motion.

(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 shaft 1.5 m long, supported in flexible bearings at the ends carries two wheels each of 50 kg mass. One wheel is situated at the centre of the shaft and the other at a distance of 375 mm from the centre towards left. The shaft is hollow of external diameter 75 mm and internal diameter 40 mm. The density of the shaft material is 7700 kg/m^3 and its modulus of elasticity is 200 GN/m^2. Find the lowest whirling speed of the shaft, taking into account the mass of the shaft.

(OR)

(b) A motor drives a centrifugal pump through gearing, the pump speed being one-third that of the motor. The shaft from the motor to the pinion is 60 mm diameter and 300 mm long. The moment of inertia of the motor is 400 kg-m^2. The impeller shaft is 100 mm diameter and 600 mm long. The moment of inertia of the impeller is 1500 kg-m^2. Neglecting inertia of the gears and the shaft, determine the frequency of torsional vibration of the system. The modulus of rigidity of the shaft material is 80 GN/m^2.

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