Register Number.....

B.E. DEGREE EXAMINATIONS: NOVEMBER 2009

Fourth Semester

MECHATRONICS ENGINEERING

U07MH402: Dynamics of Machinery

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

Answer ALL the Questions:-

PART A (10 x 1 = 10 Marks)

1. The D-Alembert's principle is used to reduce a dynamic problem into an _____
   A. Equivalent static problem B. Equivalent dynamic problem
   C. Static problem D. None of the above
2. The smallest circle that can be drawn to the cam profile is_____
   A. Base circle B. Pitch circle C. Pitch curve D. Prime circle
3. The balancing of rotating and reciprocating parts is necessary when it runs at_____
   A. Slow speed B. medium speed C. high speed D. very slow speed
4. For dynamic balancing of a shaft, _____
   A. The net dynamic force acting on the shaft is zero
   B. The net couple due to the dynamic forces acting on the shaft is zero
   C. Both (A) and (B)
   D. None of the above
5. The following is a type of free vibration:_____
   A. Longitudinal vibrations B. Transverse vibrations
   C. Torsional vibrations D. All the above
6. When a body is subject to transverse vibrations, the stress induced in the body will be _____
   A. Tensile stress B. compressive stress C. no stress D. zero stress
7. The ratio of force transmitted to the force applied is_____
   A. Isolation factor B. Transmissibility ratio
   C. both (A) and (B) D. None of the above
8. In vibration isolation system, if $\omega/\omega_n>1$, then the phase difference between the transmitted force and the distributed force is_____
   A. 0 B. 90 C. 180° D. 270°
9. A hartnell governor is_____
   A. Pendulum type governor B. spring loaded governor
   C. dead weight governor D. inertia governor

ship is upward, the effect of gyroscopic couple acting on it be _____

A. to move the ship towards portside B. to move the ship towards starboard
C. All the above D. none of the above

PART B (10 x 2 = 20 Marks)

10. State D-Alembert's principle.
11. Give the various types of motion of the follower.
12. Give the two conditions to be satisfied, in order to have a complete balance of several revolving masses in different planes.
13. State the condition for static balancing of a shaft.
14. Define logarithmic decrement.
15. What is isolation factor?
16. What is viscous damping?
17. Define forced vibrations.
18. Classify spring controlled governor.
19. What is height of a governor?

PART C (5 x 14 = 70 Marks)

20. (a) The crank pin circle radius of a horizontal engine is 300mm. The mass of the reciprocating parts is 250kg. When the crank has traveled 60° from I.D.C., the difference between driving and back pressures is0.35 N/mm^2. The connecting rod length between centers is 1.2m and the cylinder bore is 0.5m. If the engine runs at 250rpm and if the effect of the piston rod diameter is neglected, calculate: a) pressure on slide bars. b) thrust in the connecting rod. c) tangential force in the crank pin. d) turning moment on the crank shaft.

(OR)

(b) The following data refer to a steam engine: Diameter of the piston=240mm, stroke=600mm, length of the connecting rod=1.5m, mass of the reciprocating parts=300kg, mass of the connecting rod=250kg, speed=125rpm, centre of gravity of connecting rod from crankpin=500mm, radius of gyration of the connecting rod about an axis through the centre of gravity=650mm.Determine the magnitude and direction of the torque exerted on the crank shaft when the crank has turned through 30° from the inner dead centre.

22. (a) Four masses m_1, m_2, m_3 and m_4 are 200kg, 300kg, 240kg and 260kg respectively. The corresponding radii of rotation are 0.2m, 0.15m, 0.25m and 0.3m respectively and the angles between successive masses are 45°, 75° and 135°. Find the position and magnitude of the balanced mass required by analytical method, if its radius of rotation is 0.2m.

(OR)

(b) A shaft carries four masses A, B, C and D of magnitude 200kg, 300kg, 400kg and 200kg respectively and revolving at radii 80mm, 70mm, 60mm and 80mm in planes measured from A at 300mm, 400mm and 700mm. The angles between the cranks measured clockwise 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 100mm, between X and Y is 400mm and between Y and D is 200mm. If the balancing masses revolve at a radius of 100mm, find their magnitudes and angular positions.

23. (a) The mass of a single degree damped vibration system is 7.5kg and makes 24 free oscillations in 14 seconds while disturbed from its equilibrium position. The Amplitude of vibration reduces to 0.25 of its initial value after five oscillations. Determine: 1) stiffness of the spring, 2) logarithmic increment and 3) damping factor.

(OR)

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

24. (a) A coil of spring stiffness 4 N/mm supports vertically a mass of 20kg at the free end. The motion is resisted by the oil dashpot. It is found that the amplitude of the at the beginning of the fourth cycle is 0.8 times the amplitude of the vibration. Determine the damping force per unit velocity. Also find the frequency of damped and undamped vibrations.

(OR)

(b) A single cylinder vertical petrol engine of total mass 300kg is mounted upon a steel chassis frame and causes a vertical static deflection of 2mm. The reciprocating parts of the engine have a mass of 20kg and move through a vertical stroke of 150mm with simple harmonic motion. A dashpot is provided whose damping resistance is directly proportional to the velocity and amounts to 1.5kN per meter per second. Considering that the steady state of vibration is reached, determine: 1) Amplitude of forced vibrations, when the driving shaft of the engine rotates at 480rpm and 2) Speed of the driving shaft at which resonance will occur.

25. (a) The arms of a Porter governor are 300mm long. The upper arms are pivoted on axis of rotation. The lower arms are attached to a sleeve at a distance of 40mm from the axis of rotation. The mass of the load on the sleeve is 70kg and the mass of each ball is 10kg. Determine the equilibrium speed when the radius of rotation of the balls is 200mm. If the friction is equivalent to a load of 20N at the sleeve, what will be the range of speed for this position?

(OR)

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

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

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

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