

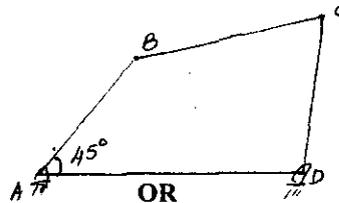
B.Tech Degree V Semester Examination in Marine Engineering, March 2008

MRE 501 DYNAMICS OF MACHINERY

Time : 3 Hours

Maximum Marks : 100

- I. (a) Explain the following :
 (i) Super position principle (ii) Shaking forces (5)
- (b) In a four bar linkage ABCD shown in figure, the link AB revolves with angular velocity of 20 rad/sec and angular acceleration of 100 rad/sec² both in clockwise direction when it makes an angle 45° with AD. Neglecting gravitational effects, find the torque necessary to overcome inertia forces. The lengths of various links are :
 AB = CD = 40 cm, BC = 50 cm and AD = 75cm. The mass of links is 15 Kg/m. (15)



- II. (a) Explain the following :
 (i) Equivalent system (ii) Correction couple (6)
- (b) The following data relate to a connecting rod of a reciprocating engine :
 Mass = 55Kg; Distance between bearing centers = 850 mm; diameter of small end bearing = 75 mm; diameter of big end bearing = 100 mm; time of oscillation when the connecting rod is suspended from small end = 1.83 sec; time of oscillation when the connecting rod is suspended from big end = 1.68 sec. Determine
 (i) the radius of gyration of the rod about an axis passing through the centre of gravity and perpendicular to the plane of oscillation
 (ii) the moment of inertia of the rod about the same axis
 (iii) the dynamically equivalent system for the connecting rod, constituted of two masses, one of which is situated at the small end centre. (14)
- III. (a) Explain the effect of centrifugal tension on fly wheel. (6)
- (b) A punching press pierces 35 holes per minute in a plate using 10 kN-m of energy per hole during each revolution. Each piercing takes 40% of the time needed to make one revolution. A cast iron fly wheel used with the punching machine is driven by a constant torque electric motor. The flywheel rotates at a mean speed of 210 rpm and the fluctuation of speed is not to exceed $\pm 1\%$ of the mean speed. Find
 (i) Power of the electric motor
 (ii) Mass of flywheel
 (iii) Cross-sectional dimensions of the rim when the width is twice its thickness.
 Take hoop stress for cast/iron = 4MPa and density of cast iron = 7200 Kg/m³. (14)
- OR**
- IV. (a) Describe the gyroscopic effect on sea going vessels during steering and rolling. (6)
- (b) The turbine rotor of a ship has a mass of 20 tonnes and a radius of gyration of 0.75 m. Its speed is 2000 rpm. The ship pitches 6° above and below the horizontal position. One complete oscillation takes 18 seconds and the motion is simple harmonic, calculate :

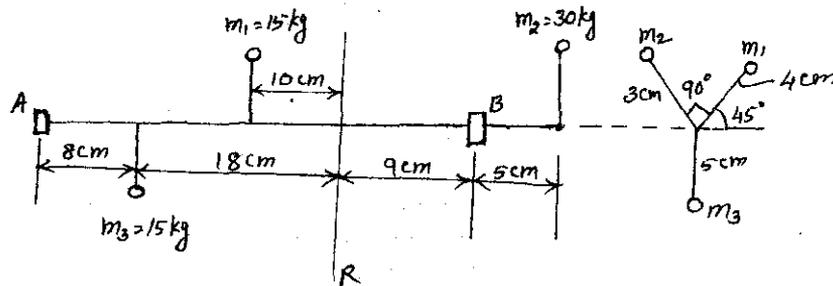
(Turn Over)

- (i) the maximum couple tending to shear the holding down bolts of the machine
 (ii) the maximum angular acceleration of the ship during pitching
 (iii) the direction in which the bow will tend to turn while rising, if the rotation of the rotor is clockwise when looking from rear

(14)

- V. (a) Explain the conditions required to complete balancing of the several revolving masses in different planes. (4)
 (b) Three masses m_1, m_2 and m_3 located in the plane 1, 2 and 3 are to be balanced by correcting masses in planes 3 and R are shown in the figure.

Determine the balancing masses while balancing this rotor on a machine, if the maximum error in determining the magnitudes of correcting masses is +5%, determine the bearing reactions left on the supports on a percentage of the original reactions. Take radius of correcting mass in plane R as $r = 10$ cm. (16)



A & B are bearings

OR

- VI. (a) Explain the following: (i) hammer blow (4)
 (ii) swaying couple (16)
 (b) The cranks and connecting rods of a 4-cylinder in-line engine running at 1800 rpm are 60mm and 240 mm each respectively and the cylinders are spaced 150 mm apart. If the cylinders are numbered 1 to 4 in sequence from one end, the cranks appear at intervals of 90° in an end view in the order 1-4-2-3. The reciprocating mass corresponding to each cylinder is 1.5Kg. Determine
 (i) Unbalanced primary and secondary forces, if any
 (ii) Unbalanced primary and secondary couples with reference to Central plane of the engine.

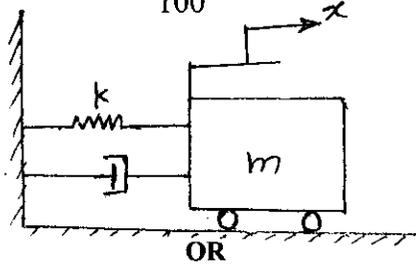
- VII. (a) Explain the terms 'under damping', 'critical damping' and 'over damping'. (6)
 (b) The system shown in the figure is displaced from its static equilibrium position to the right a distance of 0.01 m. An impulsive force acts towards the left on the mass at the instant of its release to give it an initial velocity V_0 in that direction. If the system has the following parameters.

$K = 15700$ N/m, $C = 1570$ N-sec/m, $m = 9.8$ Kg

- (i) Derive the expression for the displacement from the equilibrium position in terms of time 't' and initial velocity V_0

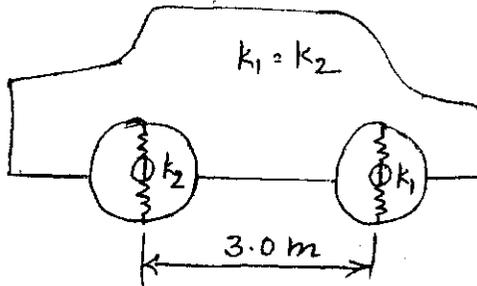
(Contd...3)

- (ii) What value V_0 would be required to make the mass pass the position of the static equilibrium $\frac{1}{100}$ sec after it is applied. (14)



OR

- VIII. (a) Explain (i) Vibration exciters (6)
(ii) Accelerometers
- (b) A shaft 1.5cm diameter and 1m long is held in long bearings. The weight of the disc at the centre of the shaft is 15 Kg. The eccentricity of the centre of gravity of the disc from centre of rotor is 0.03 cm. The modulus of elasticity of the material of shaft is 2×10^6 Kg/cm². The permissible stress in the shaft material is 700 Kg/cm². Find (i) The critical speed of the shaft (ii) The range of speed over which it is unsafe to run the shaft. Neglect the weight of the shaft. (14)
- IX. (a) Explain the Matrix formulation for solution of multi degree freedom vibrating system. (5)
(b) Find the natural frequencies of car with the following conditions shown in the figure.
Total mass of car = 300 Kg
Wheel base = 3.0 m
C.G is 1.50 from front axle
Radius of gyration is 1.0 m.
Spring constants of front and rear springs are 70×10^3 N/m each. (15)



OR

- X. Determine the natural frequency of oscillation of the double pendulum as shown in the figure. Find its value when $m_1 = m_2 = 5$ Kg, $l_1 = l_2 = 25$ cm. (20)

