

BT MRE - V - 09 - 11

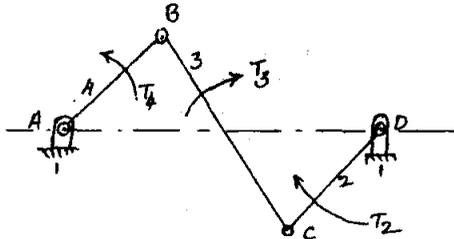
B.Tech Degree V Semester Examination in Marine Engineering, June 2009

MRE 501 DYNAMICS OF MACHINERY

Time : 3 Hours

Maximum Marks : 100

- I. (a) What are the conditions of static equilibrium of a three-force member and a member with two forces and a torque? (5)
- (b) In the four-bar mechanism shown in the figure below, torque T_3 and T_4 are 50 N-m and 60 N-m respectively. For the static equilibrium of the system. Find the required input torque T_2 . $BC = 80$ cm, $AB = 35$ cm, $AD = 109$ cm, $CD = 38$ cm. (15)



OR

- II. (a) Explain Correction Couple. (5)
- (b) A single - cylinder vertical engine has a bore of 30 cm, a stroke 40 cm, and a connecting rod 80 cm long. The weight of the reciprocating parts is 1350 N. When the piston is at quarter - stroke and is moving downwards, the net pressure on it is 0.64MPa. If the speed of the engine is 300 rpm, find the approximate turning moment on the crank shaft at the instant described above. In the above problem if the C.G of the connecting rod be 50 cm from the small end, the radius of gyration about the centroidal axis 30cm, the weight of the reciprocating part 900 N and that of the connecting rod 1200 N, determine the corrected turning moment for the instant described in the problem. (7 + 8=15)

- III. (a) What is the function of a flywheel? How does it differ from that of a Governor? (5)
- (b) A certain machine requires a torque of $(5000 + 500 \sin \theta)$ N-m to drive it, where ' θ ' is the angle of rotation of the shaft measured from certain datum. The machine is directly coupled to an engine which produces a torque of $(5000 + 600 \sin 2\theta)$ N-m. The fly wheel and other rotating parts attached to the engine has a mass of 500 Kg and a radius of gyration of 40cm. If the mean speed of the engine is 150 rpm, determine
- (i) the maximum fluctuation of energy
 - (ii) the percentage fluctuation of speed and
 - (iii) the maximum and minimum angular acceleration of the flywheel and corresponding shaft positions. (15)

OR

- IV. (a) Describe the gyroscopic effect on sea going vessels. (8)
- (b) The mass of the turbine rotor of a ship is 20 tonnes and has a radius of gyration of 0.6m. Its speed is 2000 rpm. The ship pitches 6° above and 6° below the horizontal position. A complete oscillation takes 30 seconds and the motion is simple harmonic. Determine the following
1. Maximum gyroscopic couple
 2. Maximum angular acceleration of the ship during pitching
 3. The direction in which the bow will tend to turn when rising, if the rotation of the rotor is clockwise when looking from the left. (12)

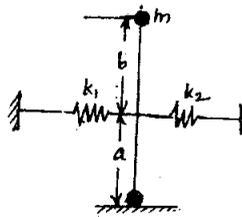
- V. (a) Discuss how a single revolving mass is balanced by two masses revolving in different planes. (5)
- (b) A shaft with 3 meters span between two bearings carries two masses of 10 Kg and 20 Kg acting at the extremities of the arms 0.45m and 0.6m long respectively. The planes in which these masses rotate are 1.2m and 2.4m respectively from the left end bearing supporting the shaft. The angle between the arms is 60° . The speed of rotation

(Turn Over)

of the shaft is 200 rpm. If the masses are balanced by two counter masses rotating with the shaft acting at radii of 0.3m and placed at 0.3m from each bearing centers, estimate the magnitude of the two balance masses and their orientation with respect to the X-axis, ie. mass of 10 Kg. (15)

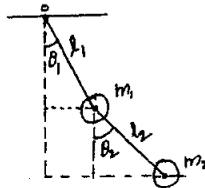
OR

- VI. (a) Prove that the resultant unbalanced force is minimum when half of the reciprocating masses are balanced by rotating masses. (6)
- (b) The bearings of a shaft at A and B are 5m apart. The shaft carries three eccentric masses C,D and E which are 160Kg, 170Kg and 85Kg respectively. The respective eccentricity of each mass measured from the axis of rotation is 0.5cm, 0.3 cm and 0.6 cm and the distance from A is 1.3m, 3m and 4 m respectively. Determine the angular position of each mass with respect to C, so that no dynamic force is exerted at B, and also find the dynamic force at A for this arrangement when the shaft runs at 100 rpm. (14)
- VII. (a) Discuss the effect of inertia of the shaft in longitudinal vibration. (5)
- (b) Find the natural frequency of vibration of the system for small amplitudes. If ' K_1 ', ' K_2 ', 'a' and 'b' are fixed, determine the value of b for which the system will not vibrate. Find maximum acceleration of the mass. The system is shown in the figure below. (15)



OR

- VIII. (a) Explain with sketch the working of vibrometer. (6)
- (b) A vehicle weighs 490 Kg and total spring constant of its suspension system is 60 Kg/cm. The profile of the road may be approximated to a line curve of amplitude 4.0 cm and wave length of 4.0 metres. Determine : (14)
- the critical speed of the vehicle
 - the amplitude of the steady state motion of the mass when the vehicle is driven at critical speed and the damping factor is 0.5
 - the amplitude of the steady state motion of mass when the vehicle is driven at 57 Km/hr and the damping factor is same as (ii)
- IX. (a) Explain the Matrix method of formulation for vibrations. (5)
- (b) Determine the natural frequency of oscillation of the double pendulum shown in the figure. Find its value when $m_1 = m_2 = 5$ Kg, $l_1 = l_2 = 25$ cm. (15)



OR

- X. (a) Explain Dunkerby's method for vibration. (5)
- (b) A steel shaft of diameter 10 cm is carrying three masses 5 Kg, 7.5Kg and 14 Kg respectively as shown in the figure below. The distance between the rotors are 0.7m. Determine the natural frequencies of torsional vibrations. The radii of gyration of three rotors are 0.20, 0.30 and 0.40 m respectively. Take $G = 9 \times 10^8$ N/m². (15)

