B.Tech. Degree V Semester Examination in Marine Engineering December 2016

MRE 1501 DYNAMICS OF MACHINERY
(2013 Scheme)

Time : 3 Hours

Maximum Marks : 100

$(5 \times 20 = 100)$

I. (a) Explain the equilibrium of a member with two forces and a torque.   (4)

   (b) In a four link mechanism shown in the fig., torque T_3 and T_4 have magnitudes of 30 N.m and 20 N.m respectively. The link lengths are AD = 800 mm, AB = 300 mm, BC = 700 mm and CD = 400 mm. Determine the input torque T_2 required for the static equilibrium of the mechanism.   (16)
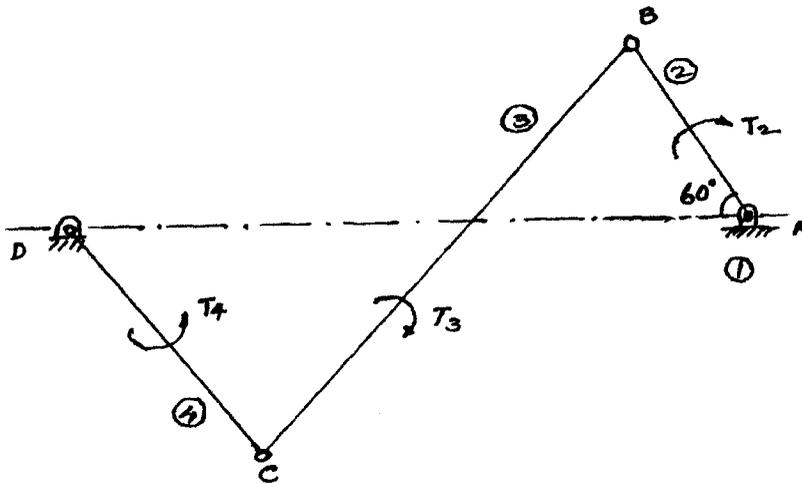
OR

II. (a) Derive an expression for the acceleration of the piston of a slider-crank mechanism.   (8)

   (b) A horizontal gas engine running at 210 rpm has a bore of 220 mm and a stroke of 440 mm. The connecting rod is 924 mm long and the reciprocating parts weigh 20 kg. When the crank has turned through an angle of 30° from the inner dead centre, the gas pressure on the cover and the crank sides are 500 kN/m² and 60 kN/m² respectively. Diameter of the piston rod is 40 mm. Determine : (i) turning moment on the crank shaft (ii) thrust on the bearings (iii) acceleration of the fly wheel which has a mass of 8 kg. and radius of gyration of 600 mm while the power of the engine is 22 kW.   (12)

III. (a) Explain with neat sketch the turning moment diagram of a four stroke IC engine. (6)

(b) A three cylinder single acting engine has its cranks at 120°. The turning moment diagram for each cycle is a triangle for the power stroke with a maximum of 60 N.m. at 60° after the dead centre of the corresponding crank. There is no torque on the return stoke. The engine runs at 400 rpm Determine (i) the power developed (ii) the coefficient of fluctuation of speed if the mass of the flywheel is 10 kg and radius of gyration 88 mm (iii) the coefficient of fluctuation of energy and (iv) the maximum angular acceleration of the fly wheel. (14)

OR

IV. A car is of total mass 3000 kg. It has a wheel base equal to 2.5 m and track width equal to 1.5 m. The effective diameter of each wheel is 80 cm and moment of inertia of each wheel is 1.0 kgm². The rear axle ratio is 4. The mass moment of inertia of engine rotating parts is 3 kgm² and spin axis of the engine parts is perpendicular to the spin axis of wheels. Determine the reaction at each wheel if car takes right turn of 100 m at 108 km/hr speed. The height of C.G. is 0.5 m from ground and it is placed on the vertical line through geometric centre of wheels. (20)

V. Four masses A, B, C and D are completely balanced. Masses C and D makes angle 90° and 200° respectively with that of mass B in the counter clockwise direction. The rotating masses have the following properties :
mb = 25 kg, mc = 40 kg, md = 35 kg, ra = 150 mm, rb = 200 mm, rc = 100 mm, rd = 180 mm. The planes B and C are 250 mm apart. Determine (i) the mass A and its angular position with B (ii) the positions of all the planes relative to the plane of mass A. (20)

OR

VI. (a) Derive an expression for the maximum swaying couple. (6)

(b) The cranks of a two cylinder uncoupled inside cylinder locomotive are at right angles and are 325 mm long. The cylinders are 675 mm apart. The rotating masses per cylinder are 200 kg at the crank pin and the reciprocating parts per cylinder is 240 kg. The wheel centre lines are 1.5 m apart. The whole of rotating and 2/3 rd of reciprocating masses are to be balanced and the balance masses are to be placed in planes of the rotation of the driving wheels at radius of 800 mm. Find (i) the magnitude and direction of balancing masses (ii) the magnitude of hammer blow (iii) variation of the tractive force (iv) maximum swaying couple at a crank speed of 240 rpm. (14)

VII. (a) Derive an expression for the time period of free vibration. (5)

(b) In a single degree damped vibration system a suspended mass of 8 kg makes 30 oscillations in 18 seconds. The amplitude decreases to 0.25 of the initial value after 5 oscillations. Determine (i) the stiffness of the spring (ii) logarithmic decrement (iii) the damping factor (iv) the damping coefficient. (15)

OR

VIII. (a) A rotor has a mass of 12 kg and is mounted mid way on a 24 mm diameter horizontal shaft supported at its ends by bearings. The bearings are 1 m apart. The shaft rotates at 2400 rpm. If the centre of the mass of the rotor is 0.11 mm away from the geometric centre of the rotor due to manufacturing defect, find the amplitude of the steady state vibration and the dynamic force transmitted to the bearing. $E = 200 \text{ GN/m}^2$. (10)

(b) Explain with neat sketch the working of vibrometer. (10)

IX. (a) Determine the natural frequencies of the system shown in the figure. Given : $K_1 = k_2 = 40 \text{ N/m}$ $k = 60 \text{ N/m}$ $m_1 = m_2 = 10 \text{ kg}$. (14)
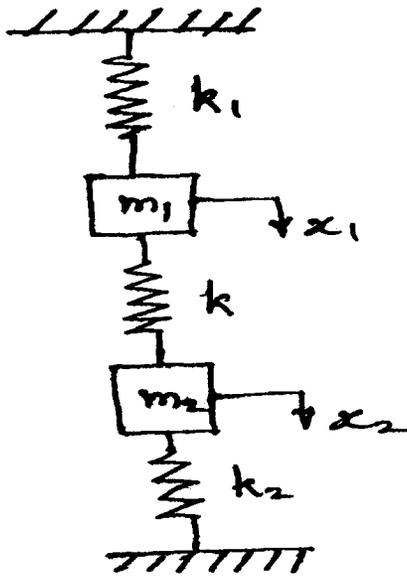
(b) Explain Dunkerley's method. (6)

OR

X. Determine the natural frequency of oscillation of the double pendulum as shown in figure. Find its value when $m_1 = m_2 = 5 \text{ kg}$ $l_1 = l_2 = 25 \text{ cm}$. (20)

***