BT-MRE-V/12.15.1088 Reg. No. | | | | | | | | | A

B.Tech. Degree V Semester Examination in Marine Engineering December 2015

MRE 1501 DYNAMICS OF MACHINERY

Time: 3 Hours Maximum Marks: 100

(5 × 20 = 100)

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

(b) A four-link mechanism with the following dimensions is acted upon by a force 80 N at an angle 150° on link DC as shown in fig.1. AD = 50 mm, AB = 40 mm, BC = 100 mm, DC = 75 mm, DE = 35 mm. Determine the input torque T on link AB for the static equilibrium of the mechanism for the given configuration. (16)

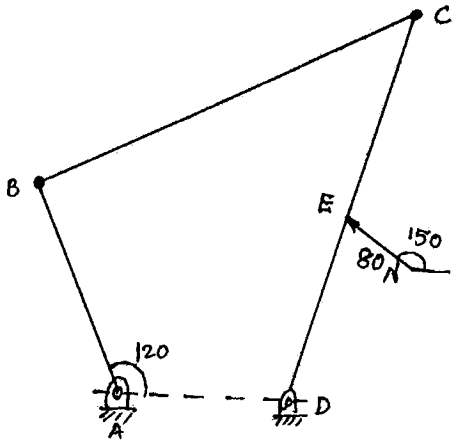


Fig 1

OR

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

(b) The crank and connecting rod of a vertical petrol engine running at 1800 rpm are 60 cm and 270 cm respectively. The diameter of the piston is 100 mm and the mass of the reciprocating parts is 3 kg. During the expansion stroke when the crank has turned 20° from the top dead centre, the gas pressure is 650 kN/m^2. Determine (i) the net force on the piston (ii) the net load on the gudgeon pin (iii) the thrust on the cylinder walls (iv) the speed at which the load on the gudgeon pin is reversed. (12)

III. (a) Explain the terms coefficient of fluctuation of energy and coefficient of fluctuation of speed. (6)

(b) The turning moment diagram of a petrol engine is drawn to a vertical scale of 1 mm = 500 N.m and the horizontal scale of 1 mm = 3°. The turning moment diagram repeats after every half revolution of the crankshaft. The areas above and below the mean torque line are 260, -600, 100, -420, 920 and –250 mm^2. The rotating parts have a mass of 60 kg and radius of gyration 2.5 m. If the engine speed is 1800 rpm, determine the coefficient of fluctuation of speed. (14)

OR

IV. The turbine rotor of a ship has a mass of 3 tonnes and rotates at 2000 rpm clockwise when viewed from aft. The radius of gyration of the rotor is 350 mm. Determine the gyroscopic couple and its effect when (i) the ship turns right at a radius of 250 m with a speed of 24 km/h. (ii) the ship pitches with the bow rising at an angular velocity of 0.8 rad/s (iii) the ship rolls at an angular velocity of 0.1 rad/s. (20)

V. (a) Explain static and dynamic balancing. (8)

(b) A shaft carries four rotating masses A, B, C and D of masses 200 kg, 300 kg, 240 kg and 260 kg revolving at radii 270 mm, 210 mm, 300 mm and 360 mm respectively. The distances of planes of rotation of B, C and D measured from A are 270 mm, 420 mm and 720 mm respectively. The angular positions of B, C and D referred to A are 45°, 120° and 255° measured in the anticlockwise direction. The balancing masses must be on planes 120 mm away from A and 100 mm from D in between A and D. The balancing masses revolves at a radii of 72 mm. Determine the balancing masses and the angular positions with respect to the mass A. (12)

OR

VI. Each crank and the connecting rod of a four-crank inline engine are 200 mm and 800 mm respectively. The outer cranks are set 120° to each other and has a reciprocating mass of 200 kg. The spacing between adjacent planes of cranks are 400 mm, 600 mm and 500 mm. If the engine is in complete primary blance, determine the reciprocating masses of inner cranks and their relative angular positions. Also find the unbalanced secondary force if the engine speed is 210 rpm. (20)

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

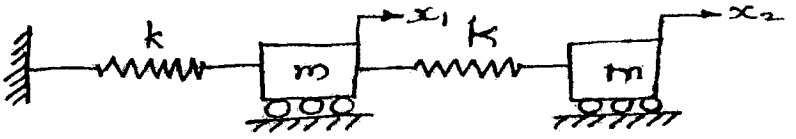
(b) A vibrating system consists of, a mass of 50 kg, a spring of stiffness 30 kN/m and a damper. The damping provided is only 20% of the critical value. Determine (i) the damping factor (ii) the critical damping coefficient (iii) the natural frequency of damped vibrations (iv) the logarithmic decrement (v) the ratio of two consecutive amplitudes. (15)

OR

VIII. (a) Derive an expression for the critical speed of a rotating shaft mounted with a rotor having an eccentricity of mass centre. (10)

(b) Explain the working of a seismometer. (10)

IX. Find the natural frequency and mode shapes of the system shown. (20)



OR

X. The moment of inertia of three rotors A, B and C are respectively 0.3, 0.6 and 0.18 $kg.m^2$. The distances between A and B is 1.5 m and between B and C is 1 m. The shaft is 70 mm in diameter and the modulus of rigidity of shaft material is 84×10^9 N/m^2. Find (i) the frequency of torsional vibration (ii) position of nodes (iii) amplitude of vibrations. (20)

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