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B.Tech. Degree V Semester Examination in Marine Engineering December 2017

MRE 1501 DYNAMICS OF MACHINERY

(*2013 Scheme*)

Time: 3 Hours Maximum Marks: 100

(5 × 20 = 100)

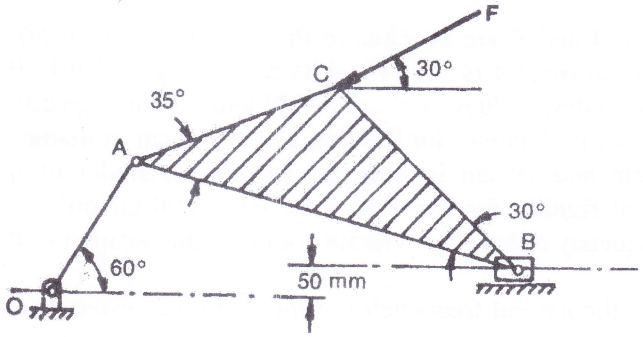
I. (a) What is meant by inertia force? Explain. (5)

(b) The length of the connecting rod of a gas engine is 500 mm and its centre of gravity lies at 165 mm from the crank pin centre. The rod has a mass of 80 kg and a radius of gyration of 182 mm about an axis through the centre of mass. The stroke of the piston is 225 mm and the crank speed is 300 rpm. Determine the inertia force on the crankshaft when the crank has turned (i) 30° and (ii) 135° from the inner dead centre. (15)

OR

II. (a) What is meant by shaking force in dynamic force analysis? Explain. (5)

(b) For the mechanism shown in figure, find the required input torque for static equilibrium. The lengths OA and AB are 250 mm and 650 mm respectively. $F = 500$ N. (15)



III. A machine is coupled to a two stroke engine which produces a torque of $(800 + 180.\sin 3\theta)$ Nm, where θ is the crank angle. The mean engine speed is 400 rpm. The flywheel and the other rotating parts attached to the engine have a mass of 350 kg at a radius of gyration of 200 mm. Calculate (a) the power of the engine (b) the total fluctuation of speed of the flywheel when (i) the resisting torque is constant (ii) the resisting torque is $(800 + 80.\sin\theta)$ Nm. (20)

OR

IV. The rotor of a marine turbine has a moment of inertia of 750 kgm^2 and rotates at 3000 rpm clockwise when viewed from aft. If the ship pitches with angular simple harmonic motion having a periodic time of 16 seconds and amplitude of 0.1 radian, find (i) the maximum angular velocity of the rotor axis (ii) the maximum value of the gyroscopic couple (iii) the gyroscopic effect as the bow dips. (20)

V. A radial engine has three cylinders whose axes are spaced at angular interval of 120°. The three connecting rods are coupled directly to a single crank. The stroke is 120 mm and the length of each connecting rod is 180 mm. The mass of reciprocating parts per cylinder is 2 kg. Determine the resultant primary and secondary forces acting on the frame of the engine when running at 2100 rpm. (20)

OR

(P.T.O.)

VI. (a) What are the effects of partial balancing of locomotives? (5)

(b) A shaft carries four rotating masses *A, B, C* and *D* which are completely balanced. The masses *B, C* and *D* are 50 kg, 80 kg and 70 kg respectively. The masses *C* and *D* make angles of 90° and 195° respectively with mass *B* in the same sense. The masses *A, B, C* and *D* are concentrated at radii 75 mm, 100 mm, 50 mm and 90 mm respectively. The plane of rotation of masses *B* and *C* are 250 mm apart. Determine (i) mass *A* and its angular position (ii) the position of planes of masses *A* and *D*. (15)

VII. (a) What is meant by Coulomb damping? Explain. (5)

(b) A mass of 1 kg is attached to a spring having a stiffness of 3920 N/m. The mass slides on a horizontal surface, the coefficient of friction between mass and surface being 0.1 (Coulomb damping). Determine the frequency of vibrations of the system and the amplitude after one cycle if the initial amplitude is 0.25 cm. (15)

OR

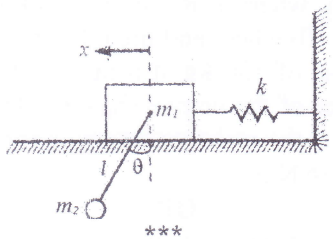
VIII. (a) What is meant by logarithmic decrement? Explain. (5)

(b) In a large cannon, the gun barrel and the recoil mechanism (critically damped system) have a mass of 500 kg with a recoil spring stiffness of 10,000 N/m. The gun recoils 0.4 m upon firing. Determine (i) the critical damping coefficient of the damper (ii) the initial recoil velocity of the gun. (15)

IX. Two rotors *A* and *B* are attached to the end of a shaft of 50 cm long. Weight of the rotor *A* is 300 N and its radius of gyration is 30 cm and the corresponding values of *B* are 500 N and 45 cm respectively. The shaft is 7 cm in diameter for the first 25 cm, 12 cm in diameter for the next 10 cm and 10 cm in diameter for the remainder of its length. Modulus of rigidity for the shaft material is 800 GN/m^2. Determine (i) the frequency of torsional vibration and (ii) the position of the node. (20)

OR

X. Determine the natural frequencies of the vibrating system shown in the following figure. Take $k = 90$ N/m, $l = 0.25$ m, $m_1 = 2$ kg and $m_2 = 0.5$ kg. (20)



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