

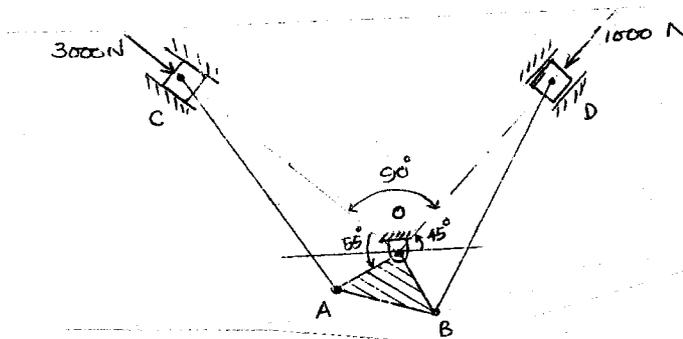
B. Tech Degree V Semester Examination in Marine Engineering January 2011

MRE 501 DYNAMICS OF MACHINERY

Time : 3 Hours

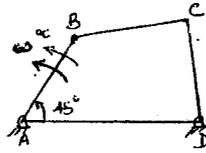
Maximum Marks : 100

- I. A two - cylinder engine develops pressure forces in cylinders as shown. Determine the torque that must be applied to crank OA for the static equilibrium of the system. Given $OA = OB = 50$ cm, $AC = BD = 250$ cm, $\angle AOB = 90^\circ$. (20)



OR

- II. In a four bar mechanism shown, the input crank revolves with an angular velocity of 10 rad/s and angular acceleration of 25 rad/s² at the instant when it makes an angle 45° . The mass of the links is 4 Kg/m length. Determine the torque required to overcome the inertia forces, neglecting the gravitational effects. Assume all links are to be of uniform cross section $AB = CD = 800$ mm, $BC = 1000$ mm, $AD = 1500$ mm. (20)



- III. A shearing machine is used to cut flat strips and each operation requires 37.5 kNm of energy. The machine has a flywheel with radius of gyration of 900 mm. The speed at the start of each operation is 1300 rpm. Determine the mass of the flywheel assuming that the energy required for cutting is fully supplied by the flywheel and the speed reduction is not more than 15% of the maximum. Also find the torque supplied to the flywheel so that it regains its full speed in 3.3 sec. (20)

OR

- IV. A ship is propelled by a turbine rotor having a mass of 6 tonnes and a speed of 2400 rpm. The direction of rotation of the rotor is clockwise when viewed from the stern. The radius of gyration of the rotor is 450 mm. Determine the gyroscopic effect when the
- (i) ship steers to the left in a curve of 60 m radius at a speed of 18 knots
 - (ii) ship pitches with an amplitude of 7.5° and the bow is descending with its maximum velocity. The pitching motion is simple harmonic with a period of 18 seconds.
 - (iii) ship rolls with an angular velocity 0.035 rad/s counter clockwise when viewed from the stern.
- (20)

- V. (a) Distinguish between static balancing and dynamic balancing. (5)
- (b) Four masses A, B, C and D are completely balanced. Masses C and D makes angles of 90° and 120° respectively with B in the same sense. The planes containing B and C are 300 mm apart. Masses A, B, C, D are assumed to be concentrated at radii of $360, 480, 240$ and 300 mm respectively. The masses B, C and D are 15 Kg, 25 Kg and 20 Kg respectively. Determine :

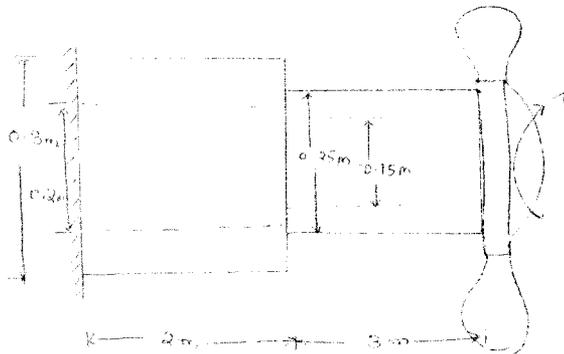
(P.T.O.)

- (i) the mass A and its angular position
- (ii) the positions of masses A & D. (15)

OR

VI. The firing order of a six-cylinder vertical four stroke in-line engine is 1-4-2-6-3-5. The piston stroke is 80 mm and the length of each connecting rod is 180 mm. The pitch distance between the cylinders are 80, 80, 120, 80, 80 mm respectively. The reciprocating mass per cylinder is 1.2 Kg and the engine speed is 2400 rpm. Determine the out of balance primary and secondary forces and couples on the engine taking a plane midway between the cylinder 3 and 4 as the reference plane. (20)

VII. (a) Determine the torsional spring constant (equivalent stiffness) of the steel propeller shaft shown. Take $G = 80 \text{ GPa}$. (8)



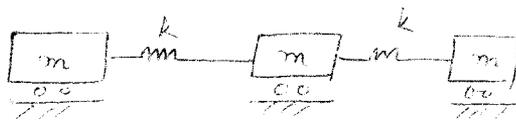
(b) An under damped shock absorber is to be designed for a motorcycle of mass 200 Kg. When the shock absorber is subjected to an initial vertical velocity due to a road bump, the amplitude of vibration is to be reduced to one-fourth in one half cycle. The damped period of vibration is 2 sec. Find the necessary stiffness and damping for the shock absorber. (12)

OR

VIII (a) Explain the working of an accelerometer. (5)
 (b) A heavy machine, weighing 3000 N is supported on a resilient foundation. The static deflection of the foundation due to the weight of the machine is found to be 7.5 mm. It is observed that the machine vibrates with an amplitude of 1 cm when the base of the foundation is subjected to harmonic oscillation at the undamped natural frequency of the system with an amplitude of 0.25 mm. Find : (15)

- (i) the damping constant of the foundation
- (ii) dynamic force amplitude on the base
- (iii) the amplitude of displacement of the machine relative to the base.

IX. Determine the natural frequencies and mode shapes of the 3 degree-of-freedom system shown. (20)



OR

X. (a) Explain static coupling and dynamic coupling by taking suitable examples. (10)
 (b) Find the fundamental frequency of vibration for the system shown using Dunkerley's method. (10)

