

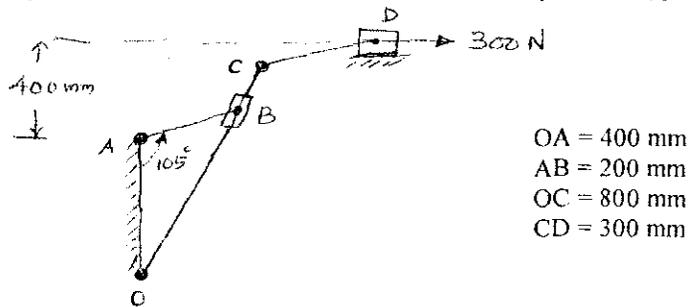
B. Tech Degree V Semester Examination in Marine Engineering, November 2009

MRE 501 DYNAMICS OF MACHINERY

Time : 3 Hours

Maximum Marks : 100

- I. (a) Explain the principle of superposition. (5)
 (b) For the static equilibrium of the mechanism shown, find the torque to be applied on link AB. (15)



OR

- II. (a) What do you understand by shaking forces and shaking moments? (5)
 (b) The effective steam pressure on the piston of a vertical steam engine is 200 kN/m^2 when the crank is 40° from the inner dead centre on the down stroke. The crank is 300 mm and connecting rod is 1200 mm in length. The diameter of the cylinder is 800 mm. What will be the torque on the crank shaft if the engine speed is 300 rpm and the mass of the reciprocating parts 250 Kg? (15)

- III. (a) Define the terms : (i) Coefficient of fluctuation of energy (5)
 (ii) Coefficient of fluctuation of speed.
 (b) The turning moment diagram of a 4 – stroke engine is assumed to be represented by four triangles, the areas of which from the line of zero pressure are
- | | |
|--------------------|-----------------------|
| Suction stroke | = 440 mm^2 |
| Compression stroke | = 1600 mm^2 |
| Expansion stroke | = 7200 mm^2 |
| Exhaust stroke | = 660 mm^2 |
- Each mm^2 of area represents 3 N.m of energy. If the resisting torque is uniform, determine the mass of the rim of a flywheel to keep the speed between 218 and 222 rpm when the mean radius of the rim is to be 1.25 m. (15)

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
- (i) the ship steers to the left in a curve of 60 m radius at a speed of 18 knots.
 - (ii) The ship pitches $\pm 7.5^\circ$ about the normal position and the bow is descending with its maximum velocity; the pitching motion is simple harmonic with a period of 18 seconds.
 - (iii) the ship rolls and at the instant, its angular velocity is 0.035 rad/s counter clockwise when viewed from the stern.
- Also, find the maximum angular acceleration during pitching. (20)

(Turn Over)

- V. (a) What is meant by static and dynamic balancing? (5)
 (b) Four masses A, B, C and D are completely balanced. Masses C and D make angles of 90° and 210° respectively with B in the same sense. The planes containing B and C are 300 mm apart. Masses A, B, C and D can be 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 (i) Mass A and its angular position (15)
 (ii) Positions of planes A and D. (15)

OR

- VI. Each crank of a 4 – cylinder vertical engine is 225 mm. The reciprocating masses of the first, second and fourth cranks are 450, 750 and 600 mm respectively. Determine the reciprocating mass and the relative angular position of each of the inner cranks if the engine is to be in complete primary balance. Also, determine the maximum secondary unbalanced force if the length of the crank and the connecting rod are 300 mm and 1200 mm respectively and the speed is 240 rpm. (20)
- VII. (a) Derive an expression for the logarithmic decrement for a viscously damped single degree of freedom spring – mass – damper system. (5)
 (b) An under damped shock absorber is to be designed for a motor cycle of mass 200 Kg. Find the necessary stiffness and damping constant of the shock absorber if the damped period of vibration is to be 2 sec and the amplitude x_1 is to be reduced to $\frac{1}{4}$ th in one half cycle. (15)

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 cm. 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 cm. Find – (15)
 (i) the damping constant of the foundation
 (ii) the dynamic force amplitude on the base
 (iii) the amplitude of the displacement of the machine relative to the base.

- IX. Find the natural frequency and mode shapes of the 2 – degree of freedom system shown. (20)



OR

- X. (a) Explain 'principal co – ordinates' and 'normal modes' of vibration. (5)
 (b) Determine the fundamental frequency of the system shown by Dunkerley's method. (15)

