(Following Paper ID and Roll No. to be filled in your Answer Book)

PAPER ID : 2537 Roll No. | | | | | | | | | | |

B.Tech.

(SEM. VI) THEORY EXAMINATION 2010-11

THEORY OF MACHINES-II

Time : 2 Hours *Total Marks : 50*

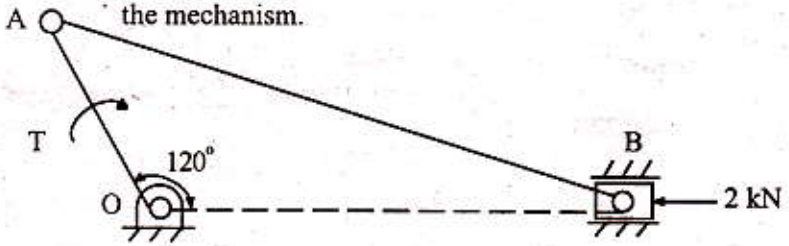
Note : Attempt **all** questions. All questions carry equal marks. Assume missing data and make necessary assumptions.

1. Attempt any **two** parts :– **(7×2=14)**

(a) (i) State and explain D'Alembert's principle.

(ii) Define the terms turning moment, coefficient of fluctuation of speed and coefficient of fluctuation of energy.

(b) A slider crank mechanism is acted upon by a force **F** = 2 kN at B as shown in the Fig. 1. The lengths of link OA and AB are 100 mm and 450 mm respectively. Determine the input torque T on the link OA for the static equilibrium of the mechanism.



(c) The effective steam pressure on the piston of a vertical steam engine is 220 kN/m² when the crank is 40° from the inner dead centre on the down stroke. The crank length is 300 mm and the connecting rod length is 1200 mm. The diameter of the cylinder is 800 mm. What will be the torque on the crankshaft if the engine speed is 300 rpm and the mass of the reciprocating parts 250 kg ?

2. Attempt any **two** parts :– **(6×2=12)**

(a) What do you understand by primary and secondary unbalance in reciprocating engines ? Why it is not possible to balance reciprocating engine completely ? Explain.

(b) Four masses A, B, C and D are completely balanced. Masses C and D make angles of 90° and 190° respectively with that of mass B in the counterclockwise direction. The rotating masses have the following properties :

$m_b = 30$ kg, $m_c = 40$ kg, $m_d = 35$ kg, and

$r_a = 150$ mm, $r_b = 200$ mm, $r_c = 100$ mm, $r_d = 180$ mm.

Planes B and C are 250 mm apart. Determine the mass A and its angular position with that of mass B.

(c) Each crank and the connecting rod of a four-crank inline engine are 200 mm and 800 mm respectively. The outer cranks are set at 120° to each other and each has a reciprocating mass of 200 kg. The spacing between adjacent planes of cranks is 400 mm, 600 mm and 500 mm. If the engine is in complete primary balance, determine the

reciprocating masses of inner cranks and their relative angular positions. Also find the secondary unbalanced force if the engine speed is 210 rpm.

3. Attempt any **two** parts :– **(6×2=12)**

(a) Describe the function of a Porter governor with the help of a neat sketch. Derive the expression for speed of the proell governor, considering the force of friction also.

(b) In a Hartnell governor, the radius of balls is 60 mm at the minimum speed of 300 rpm. The length of the ball arm is 140 mm and the sleeve arm is 90 mm. The mass of each ball is 5 kg and the sleeve is 8 kg. The stiffness of the spring is 20 N/mm. Determine (i) Speed when the sleeve is lifted by 50 mm, (ii) Initial compression of the spring, (iii) Governor effort and (iv) Power.

(c) In a Proell governor the mass of each ball is 8 kg and the mass of sleeve is 120 kg. Each arm is 180 mm long. The length of extension of lower arms to which the balls are attached is 80 mm. The distance of pivots of arms from axis of rotation is 30 mm and the radius of rotation of the balls is 160 mm when the arms are inclined at 40° to the axis of rotation. Determine (i) equilibrium speed, (ii) coefficient of insensitiveness if the friction of the mechanism is equivalent to 30 N and (iii) range of speed when the governor is inoperative.

4. Attempt any **two** parts :– **(6×2=12)**

(a) (i) Explain in what way the gyroscopic couple affects the motion of an aircraft while taking a turn.

(ii) Derive the expression for natural frequency of a vibratory system having a mass suspended from the free end of a massless spring.

(b) The turbine rotor of a sea vessel having a mass of 1050 kg rotates at 1200 rpm clockwise while looking from the stern. The vessel pitches with an angular velocity of 1.2 rad/s. What will be the gyroscopic couple transmitted to the hull when the bow rises ? The radius of gyration of the rotor is 300 mm.

(c) In a singe degree damped vibrating system; the suspended mass of 4 kg makes 24 oscillations in 20 sec. The amplitude decreases to 0.3 of the initial value after 4 oscillations. Find the stiffness of the spring, the logarithmic decrement, the damping factor and damping coefficient.