CBCS SCHEME

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18SM54

Fifth Semester B.Tech. Degree Examination, Jan./Feb. 2023
Computer Aided Design and Manufacturing

Time: 3 hrs. Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. State the condition for static equilibrium of a body subjected to a system of:
(i) Two forces
(ii) Three forces
(iii) Member with two forces and torque **(06 Marks)**

b. A slider crank mechanism is shown in Fig.Q1(b). The force applied to the piston is 1000 N when the crank is at 60° from IDC. Calculate the driving torque T_2.

AB = 100 mm
BC = 300 mm

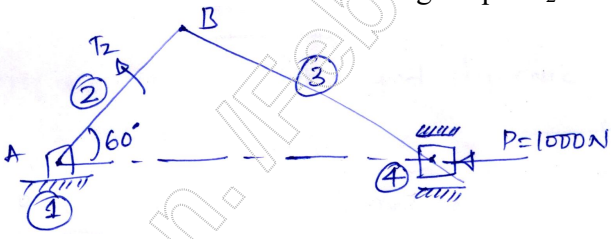

Fig.Q1(b) **(14 Marks)**

OR

2 a. Explain in brief D′ Alembert's principle. **(06 Marks)**

b. In a vertical double acting engine, the connecting rod is 4.5 times the crank. Stroke of the piston is 400 mm and the mass of the reciprocating parts is 100 kg. The engine runs at 250 rpm. If the net load on the piston due to steam pressure is 25 kN, when the crank has turned through an angle of 120° from the top dead centre, determine :
(i) Net force on the piston or piston effort
(ii) Thrust in the connecting rod
(iii) Thrust on the sides of cylinder walls.
(iv) Crank pin effort
(v) Thrust on crankshaft bearing
(vi) Turning moment **(14 Marks)**

Module-2

3 a. Briefly explain static and dynamic balancing. **(06 Marks)**

b. A, B, C and D are 4 masses carried by a rotating shaft at radius of 100, 125, 200 and 150 mm respectively. The planes in which the masses revolve are spaced 600 mm apart and the masses of B, C and D are 10, 5, 4 kg respectively. Find the required mass 'A' and the relative angular positions of the 4 masses to keep the shaft in balance. **(14 Marks)**

OR

4 The pistons of a 4 cylinder vertical inline engine reach their uppermost position at 90° interval inorder of their axial position. Pitch of cylinder = 0.35 m, crank radius = 0.12 m, length of connecting rod = 0.42 m. The engine runs at 600 rpm. If the reciprocating parts of each engine has of mass of 2.5 kg. Find the unbalanced primary and secondary forces and couples. Take central plane of engine as reference plane. **(20 Marks)**

Module-3

5 a. Derive an expression for speed of a porter governor with usual notations taking friction into account. **(10 Marks)**

b. The mass of each ball of a spring controlled governor is 1.4 kg. The bell crank level has its vertical arm 90 mm and horizontal arm 40 mm. The distance of fulcrum from the axis of rotation is 45 mm. The sleeve has a mass of 7.5 kg. The sleeve begins to rise at 220 rpm. The rise of the sleeve for 6% rise in speed is 8 mm. Find the initial thrust on the spring and its stiffness. **(10 Marks)**

OR

6 a. Define gyroscopic effect. With usual notations and diagram, derive an expression for the gyroscopic couple produced by a rotating disc. **(08 Marks)**

b. The motor of a marine having a mass of 1 ton and radius of gyration 300 mm rotates at 1550 rpm clockwise when looking from the bow. Determine the gyroscopic couple and its effect on the ship in the following cases.

(i) When the ship pitches with an angular velocity of 1 rad/sec when the bow (1) Rising (2) Falling.

(ii) When the ship is speeding at 40 km/hr and takes a right turn in a circular path of 200 m radius.

(iii) When the ship rolls at certain instant, it has an angular velocity of 0.5 rad/sec when viewed from the stern. **(12 Marks)**

Module-4

7 a. Derive the equation for natural frequency of the spring mass system considering the mass of the spring into account. **(10 Marks)**

b. Add the following harmonic motions analytically and check the solutions graphically:

$x_1 = 3\sin(\omega t + 30^o)$ $x_2 = 4\cos(\omega t + 10^o)$ **(10 Marks)**

OR

8 a. Define logarithmic decrement and derive the equation for same. **(10 Marks)**

b. The mass of a single degree damped vibrating system is 7.5 kg makes 24 free oscillations in 14 secs, when disturbed from its equilibrium position. The amplitude of vibration reduced to 0.25 of its initial value after 5 oscillations. Determine: (i) Stiffness of spring (ii) Logarithmic decrement (iii) Damping factor **(10 Marks)**

Module-5

9 a. Derive an expression for magnification factor for a spring mass system with viscous damping subjected to harmonic force. **(10 Marks)**

b. A machine of total mass of 17 kg is mounted on springs having stiffness, K = 11,000 N/cm. A piston within the machine has a mass of 2 kg has a reciprocating motion with stroke 7.5 cm and speed 6000 rpm. Assuming the motion to be S.H.M. Determine:
(i) Amplitude of machine (ii) Transmissibility (iii) Force transmitted to the ground or foundation. Take $\xi = 0.2$ **(10 Marks)**

OR

10 a. Define transmissibility and derive an expression for the transmissibility ratio and the phase angle for the transmitted force. **(10 Marks)**

b. A mass of 100 kg been mounted on a spring dashpot system having spring stiffness of 19,600 N/m and damping coefficient of 100 N-sec/m. The mass is acted upon by a harmonic force of 39 N at the undamped natural frequency of the system. Determine:

(i) Amplitude of vibration of the mass

(ii) Phase difference between force and displacement

(iii) Force transmissibility ratio **(10 Marks)**

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