CBCS SCHEME

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17ME52

Fifth Semester B.E. Degree Examination, Feb./Mar. 2022
Dynamics of Machinery

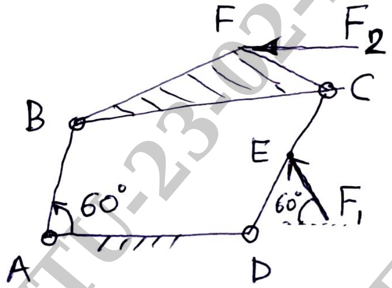
Time: 3 hrs. Max. Marks: 100

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

Module-1

1 a. Explain in brief 'D`Alembert's principle'. **(04 Marks)**

b. For the mechanism shown in Fig. Q1(b), determine the torque on the link AB for the static equilibrium of mechanism, if



AD = 50mm ; AB = 20mm
BC = 60mm ; DC = 35mm
BF = 45mm ; FC = 20mm
DE = 25mm ; F_2 is parallel to AD.

Fig. Q1(b)

i) F_1 = 20N and F_2 = 0 ii) F_1 = 0 and F_2 = 25N iii) F_1 = 20N and F_2 = 25N. **(16 Marks)**

OR

2 The crank and connecting rod of a vertical petrol engine running at 1800 rpm are 60mm and 270mm respectively. The diameter of the piston is 100mm and the mass of reciprocating parts is 1.2kg. During the expansion stroke when the crank has turned 20° from the top dead centre (in CW direction), the gas pressure is 650 kN/m^2. Find

i) The net force on the piston.
ii) Net load on the gudgeon pin.
iii) Thrust on cylinder walls.
iv) Speed at which the gudgeon pin load reverses in direction. **(20 Marks)**

Module-2

3 a. Explain in brief 'Static Balancing'. **(04 Marks)**

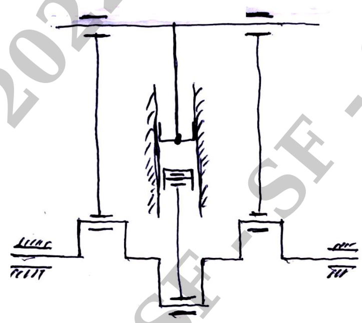
b. A shaft carries four masses in parallel planes A, B, C and D, in the order along it. The masses at B and C are 18 kg and 12.5kg respectively and each has an eccentricity of 6cm. The masses at A and D have an eccentricity of 8cm. The angle between the masses B and C is 100° and that between the masses at B and A is 190° (both angles being measured in the same direction). The axial distance between the planes A and B is 10cm and that between B & C is 20cm. If the shaft is in complete dynamic balance, find

i) the masses at A and D.
ii) the distance between the planes C and D
iii) the angular position of the mass at D. **(16 Marks)**

OR

4 A vertical single cylinder opposed piston engine is shown in Fig. Q4. The lower piston is connected to the centre crank, whereas the upper piston operates the two outer cranks which are at 180° to the centre crank. The stroke of the lower piston is 50cm. The mass of reciprocating parts is 150kg for the lower piston and 225kg for the upper piston. Find the stroke of the upper piston so that the primary force is balanced. If the central connecting rod is 100cm long and each outer connecting rod is 200cm long, determine the maximum value of secondary unbalanced force and the corresponding crank positions. The engine speed is 180 rpm and has a balanced crank. **(20 Marks)**

Fig. Q4



Module-3

5 a. Define Angle of Heel. Derive an expression for angle of heel for a 2 wheeler while negotiating curve. **(10 Marks)**

b. The arms of a Porter governor are 17.8cm long and are hinged at a distance of 3.8cm from the axis of rotation. The mass of each ball is 1.15kg and the mass on the sleeve is 20kg. the Governor sleeve begins to rise at 280 rpm when the links are at an angle of 30° to the vertical. Find the friction force assuming it to be constant. **(10 Marks)**

OR

6 a. Define i) Controlling force ii) Effort iii) Power of a Governor. **(06 Marks)**

b. The rotor of the turbine of a ship has a mass of 2500kg and rotates at 3200 rpm counter clockwise when viewed from stern. The rotor has a radius of gyration of 0.4m. Determine the gyroscopic couple and its effect when

i) The ship steers to left in a curve of 80m radius at a speed of 15 knots (1 knot = 1860m/hr).

ii) The ship pitches 5° above and 5° below the normal position as SHM with a periodic time 40S, and bow is descending with its maximum velocity.

Find the maximum angular acceleration during pitching. **(14 Marks)**

Module-4

7 a. Add the following SHMs analytically and graphically

$x_1(t) = 3\sin(wt + 60°)$; $x_2(t) = 5\cos(wt + 120°)$. **(10 Marks)**

b. Determine an expression for natural frequency of Spring – mass system by energy method, taking mass of spring into account. **(10 Marks)**

OR

8 a. Define i) Degree of freedom ii) Natural frequency iii) Time period iv) Amplitude v) Phase (difference) angle. **(10 Marks)**

b. Determine an expression for the natural frequency of the system shown in Fig. Q8(b). Modulus of rigidity of the material is 'G' and the system undergoes free vibrations (torsional vibrations) of degree of freedom = 1. **(10 Marks)**

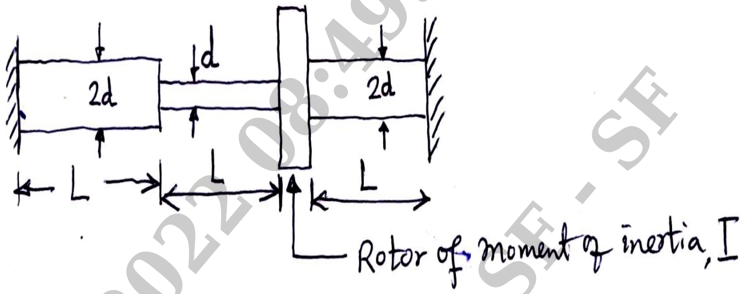


Fig. Q8(b)

Module-5

9 a. State various types of damping and explain in brief. **(06 Marks)**

b. Define Logarithmic decrement and obtain an expression for the same. **(08 Marks)**

c. Obtain differential equation of motion for spring mass dashpot system , clearly showing free body diagrams. **(06 Marks)**

OR

10 a. In a Single – degree undamped free vibrations, a suspended mass of 8kg makes 30 oscillations in 18 seconds. With viscous damping , the amplitude decreases to 0.25 of the initial value after 5 oscillations for the same system. Determine i) Stiffness ii) Logarithmic decrement iii) Damping factor iv) Damping coefficient. **(10 Marks)**

b. A machine part having a mass of 2.5kg vibrated in a viscous medium. A harmonic exciting force of 30N acts on the part and causes a resonant amplitude of 14mm with a period of 0.22S. Find the damping coefficient. **(10 Marks)**

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