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P.E.S. College of Engineering, Mandya - 571 401

(An Autonomous Institution affiliated to VTU, Belagavi)

Fifth Semester, B. E. - Mechanical Engineering

Semester End Examination; Feb. - 2021

Dynamics of Machinery

Time: 3 hrs *Max. Marks: 100*

***Note**: Answer **FIVE** full questions, selecting **ONE** full question from each unit.*

UNIT - I

1 a. With a suitable example, enumerate the concept free body diagram. 4

b. A four link mechanism is acted upon by forces as depicted in Fig. 1(b). Determine the torque 'T_2' to be applied on link 2 to keep the mechanism in static equilibrium for both in magnitude and direction. The dimensions of the various links are AB = 40 mm, BC = 60 mm, CD = 50 mm, DA = 30 mm and DE = 20 mm, P = 100 N. 16

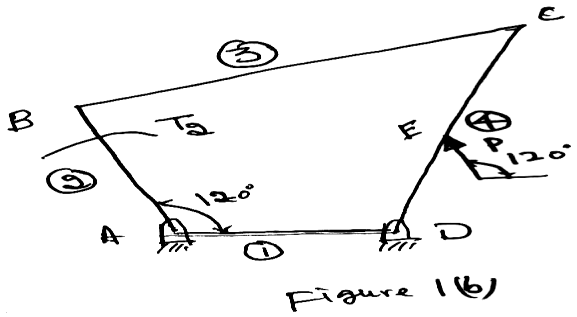

Figure 1(b)

2 a. Explain 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 a torque 6

b. The mechanism is acted upon by forces as shown in Fig. 2(b). The dimensions of various links of the mechanism are O_2A = 100 mm, AB = 250 mm, AE = 50 mm and $\angle AO_2B = 30°$. Determine the magnitude and direction of 'T_2' to keep the system is static equilibrium. 14

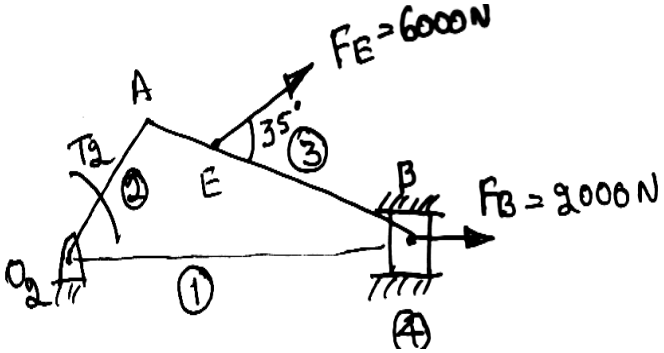

Fig. 2(b)

UNIT - II

3 a. State and explain D'Alembert's principle. 6

Contd…2

b. In a vertical double acting engine, the connecting rod is 4.5 times the crank. Stroke of the piston is 400 mm and mass of reciprocating parts is 100 kg. The engine runs at 250 rpm. If the net load on the piston due to stream pressure is 25 kN, when the crank has turns through an angle 120° from top dead center. Determine;

i) Net force on the piston

ii) Thrust on the connecting rod

iii) Thrust on the sides of the cylinder walls

iv) Crank pin effort

v) Thrust on crank shaft bearing

vi) Turning moment or torque on the crank shaft

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4. A horizontal steam engine running at 120 rpm has a bore of 250 mm and a stroke of 400 mm. The connecting rod is 0.6 and mass of the reciprocating parts is 60 kg. When the crank has turned through an angle of 45° from the inner dead center, the steam pressure on the cover end side is 550 kN/m^2 and that on the crank and side is 70 kN/m^2. Considering the diameter of piston rod as 50 mm, determine; 20

i) Turning moment on the crank shaft

ii) Thrust on the bearings

iii) Acceleration of the fly wheel , if the power of the engine is 20 kW mass of the flywheel 60 kg and radius of gyration is 0.6 m

UNIT - III

5 a. The turning moment diagram for a multi-cylinder engine has been drawn to a scale of 1 mm = 600 N-m vertically and 1 mm = 3° horizontally. The intercepted areas between the output torque curve and mean resistance line, taken in order from one end are as follows: +52, −124, +92, −140, +85, −72 and + 107 mm^2, when the engine is running at a speed of 600 rpm. If the total fluctuation of speed is not to exceed ±1.5% of the mean, find the necessary mass of the flywheel of radius of 0.5 m. 12

b. Sketch and explain the working principle of Parter Governor. 8

6. A shaft fitted with a flywheel rotates at 250 rpm and drives a machine. The torque of machine varies in a cyclic manner over a period of 3 revolutions. The torque raised from 750 N-m to 3000 N-m uniformly during ½ revolution and remains constant for the following revolution. It then falls uniformly to 750 N-m during the next ½ revolution and remains constant for one revolution, the cycle is repeated thereafter. Determine the power required to drive the machine and percentage fluctuation in speed it the driving torque applied to the shaft is constant and mass of flywheel is 500 kg with radius of gyrations of 600 mm. 20

Contd…3

UNIT - IV

7 a. What is static and dynamic balancing? 4

b. *A*, *B*, *C* and *D* are four masses carried by a rotating shaft at a radius 100, 125, 200 and 150 mm respectively. The planes in which the matter revolves are spaced 600 mm apart and the mass *B*, *C* and *D* are 10 kg, 5 kg and 4 kg respectively. Find the required mass *A* and the relative angular setting of the four masses so that the shaft shall be in complete balance. 16

8. A four crank engine has two outer cranks set at 120° to each other and their reciprocating masses are each 400 kg. The distance between the planes of rotation of adjacent cranks are 450 mm, 750 mm and 600 mm. If the engine is to be in complete primary balance, find the reciprocating mass and the relative angular position for each of the inner cranks. If the length of each crank is 300 mm, the length of each connecting rod is 1.2 m and the speed of rotation is 240 rpm, what is the maximum secondary unbalanced force? 20

UNIT - V

9 a. Enumerate on the effect of gyroscopic couple of a ship under steering, pitching and rolling with suitable sketches. 9

b. Analyze the stability of a two wheel vehicle turning right drive the necessary equation. 11

10 a. Explain the stability of a four wheeler automobile negotiating a curve and derive the necessary condition for stability 10

b. A ship is propelled by rotar of mass of 2000 kg rotates at a speed of 2400 rpm. The radius of gyration of rotar is 0.4 m and spins clockwise direction when viewed form bow (front) end. Find the gyroscopic couple and its effect when, 10

i) The ship takes left turn at a radius of 350 m with a speed of 35 kmph

ii) The ship pitches with bow rising at an angular velocity of 1 rad/s

iii) The ship rolls at an angular velocity of 0.15 rad/sec

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