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15ME52

Fifth Semester B.E. Degree Examination, Dec.2019/Jan.2020
Dynamics of Machines

Time: 3 hrs. Max. Marks: 80

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

Module-1

1 a. Considering slider crank mechanism, state and explain principle of virtual work. **(06 Marks)**

b. A four bar mechanism shown in Fig.Q1(b) is acted by a force P = 100, ∠120°N on link CD. The dimensions of the various links are AB = 40 mm, BC = 60 mm, CD = 50 mm, DA = 30 mm and DE = 20 mm. Determine the magnitude and direction of input torque T_2 on link AB for the static equilibrium of the mechanism.

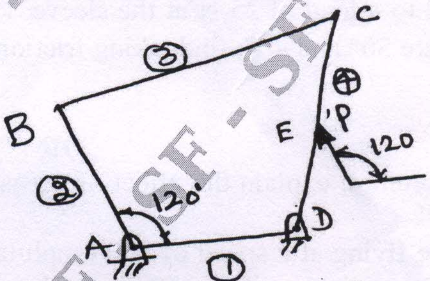

Fig.Q1(b) **(10 Marks)**

OR

2 a. Explain in brief D'Alembert's principle and state why it is used. **(06 Marks)**

b. A horizontal gas engine running at 240 rpm has a bore of 500 mm and stroke of 600 mm. The length of connecting rod is 1.2 m and mass of reciprocating parts is 200 kg. The difference between driving and back pressure is 0.4 N/mm², when the crank has turned an angle of 60° from inner dead center. Neglecting the affect of piston rod, determine:

(i) Net force on the piston or piston effort.
(ii) Thrust in the connecting rod
(iii) Pressure in the slide bars
(iv) Tangential force on the crank pin
(v) Thrust on the bearings
(vi) Turning movement on the crank shaft
(vii) Acceleration of the flywheel which has mass of 100 kg and radius of gyration of 500 mm, while the power of the engine is 100 KW. **(10 Marks)**

Module-2

3 A rotor has the following properties.

Mass	Magnitude (kg)	Radius (mm)	Angle (degrees)	Axial distances from 1st mass (mm)
1	9 kg	100 mm	0°	-
2	7 kg	120 mm	60°	160 mm
3	8 kg	140 mm	135°	320 mm
4	6 kg	120 mm	270°	560 mm

If the shaft is balanced by two counter masses located at 100 mm radius r and revolving in planes midway of planes 1 and 2 and midway of 3 and 4, determine the magnitude of the masses and their respective angular position. **(16 Marks)**

OR

4 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 planes of rotation of adjacent cranks are 450 mm, 750 mm and 600 mm. If the engine is to be in complete 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, find maximum secondary unbalanced force. **(16 Marks)**

Module-3

5 a. Define the term stability and sensitivity of a governor. **(06 Marks)**

b. In an engine governor of the porter type, the upper and lower arms are 200 mm and 250 mm respectively and pivoted on the axis of rotation. The mass of the center load is 15 kg, the mass of each ball is 2 kg and friction of sleeve together with a resistance of the operating gear is equal to a load of 25 N at the sleeve. If the limiting inclination of the upper arms to the vertical are 30° and 40°, find taking friction into account, range of speed of the governor. **(10 Marks)**

OR

6 a. With neat sketches, explain the affect of gyroscopic couple on steering, pitching and rolling of a ship. **(08 Marks)**

b. An aeroplane flying at a speed of 300 kmph takes right turn with a radius of 50 meter. The mass of engine and propeller is 500 kg and radius of gyration is 400 mm. If the engine runs at 1800 rpm in clockwise direction, when viewed from tail end, determine the gyroscopic couple and state its effect on the aeroplane. What will be the effect, if the aeroplane turns to left instead of right? **(08 Marks)**

Module-4

7 a. Define the following terms:

(i) Harmonic motion (ii) Natural frequency
(iii) Amplitude (iv) Damping **(08 Marks)**

b. Add the following harmonic motions and check the solution graphically:

$x_1 = 2\cos(\omega t + 0.5)$ $x_2 = 5\sin(\omega t + 1.0)$ **(08 Marks)**

OR

8 a. Find the natural frequency of spring-mass system considering inertia effect of the mass of the spring. **(08 Marks)**

b. Find the natural frequency of the Fig.Q8(b).

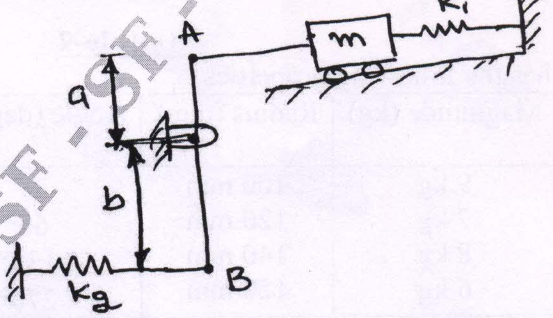

Fig.Q8(b) **(08 Marks)**

Module-5

9 a. Define logarithmic decrement and prove that logarithmic decrement $'\delta' = \frac{2\pi\xi}{\sqrt{1-\xi^2}}$ where ξ is damping ratio. **(07 Marks)**

b. The measurement on a mechanical vibrating system shows that the mass of 10 kg and that the springs can be combined to give an equal spring stiffness 5 N/mm. If the vibrating system have a dashpot attached which exerts a force of 40 N, when the mass have a unit velocity of 1 m/sec. Determine:
(i) Critical damping coefficient
(ii) Damping factor
(iii) Logarithmic decrement
(iv) Ratio of any consecutive amplitudes. **(09 Marks)**

OR

10 a. Write short notes on the following:
(i) Magnification factor
(ii) Transmissibility. **(06 Marks)**

b. A single cylinder vertical diesel engine has a total mass of 100 kg is mounted on a steel chassis frame. The static deflection owing to the weight of the chassis is 3 mm. The reciprocating masses of the engine amounts to 10 kg and the stroke of the engine 80 mm. A dashpot with a damping coefficient of 2 N/mm/sec is used to dampen the vibration. Determine:
(i) amplitude of the vibration, if the driving shaft rotates at 1000 rpm,
(ii) speed of the driving shaft, when resonance occurs. **(10 Marks)**

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