CBCS SCHEME

USN | | | | | | | | | | |

17ME52

Fifth Semester B.E. Degree Examination, Dec.2019/Jan.2020
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. Enumerate the concept of static equilibrium of a body subjected to a system of (i) Two forces (ii) Three forces (iii) Member with two forces and a torque **(06 Marks)**

b. A four bar mechanism is shown in Fig.Q1(b), which is acted upon by a force $P = 100 \angle 120^\circ$ N on link CD. The dimensions of various link 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 static equilibrium of the mechanism.

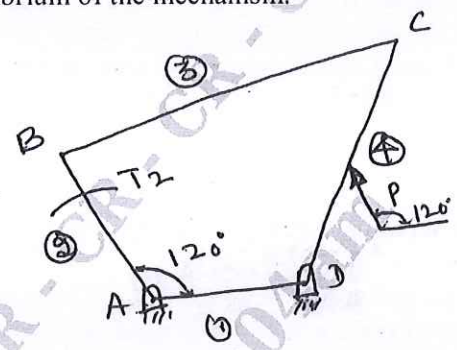

Fig.Q1(b) **(14 Marks)**

OR

2 a. Explain the D'Alembert's principle and discuss on its significance. **(04 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 top dead centre. Determine :

(i) Net force on the piston
(ii) Thrust in the connecting rod along connecting rod
(iii) Thrust on the sides of cylinder walls
(iv) Crank pin effort
(v) Thrust on crank shaft bearing
(vi) Turning moment on the crank shaft **(16 Marks)**

Module-2

3 a. Discuss on the concept of static and dynamic balancing. **(04 Marks)**

b. Four masses A, B, C and D are completely balanced. Masses C and D make angles of 90° and 210° respectively with B in the same sense. The plane containing B and C are 300 mm apart. Masses A, B, C and D can be assumed to be concentrated at radii of 360 mm, 480 mm, 240 mm and 300 mm respectively. The massed B, C and D are 15 kg, 25 kg and 20 kg respectively. Determine:

(i) Mass A and its angular position
(ii) Position of planes A and D. **(16 Marks)**

OR

4 A four crank engine has two outer cranks set at 120° to each other and their reciprocating masses are 400 kg each. The distance between the planes of rotation of adjacent cranks are 450 mm, 750 mm and 600 mm. If the engine is to be incomplete 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, 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 Marks)**

Module-3

5 a. Explain the following term relative governors:
(i) Stability
(ii) Sensitiveness
(iii) Isochromism
(iv) Hunting **(04 Marks)**

b. The arms of a porter governor are each 250 mm long and pivoted on the governor axis. The mass of each ball is 5 kg and the mass of central sleeve is 30 kg. The radius of rotation of the balls is 150 mm, when the sleeve begins to rise and reaches a value of 200 mm for maximum speed. Determine the range of the Governor. If the friction at the sleeve is equivalent of 20 N of load at the Sleeve. Determine how the speed range is modified. **(16 Marks)**

OR

6 a. With neat sketches, enumerate on the effect of Gyroscopic couple on the steering, pitching and rolling of a ship. **(09 Marks)**

b. A ship is propelled by a rotor of mass of 2000 kg rotates at a speed of 2400 rpm. The radius of gyration of rotor is 0.4 m and spins clockwise direction, when viewed from bow (Front) end. Find the gyroscopic couple and its effect when
(i) The ship takes left turn at a radius of 350 m with a speed of 35 kmph.
(ii) The ship pitches with the bow rising at angular velocity of 1 rad/sec.
(iii) The ship rolls at an angular velocity of 0.15 rad/sec. **(11 Marks)**

Module-4

7 a. Define the following terms:
(i) Simple Harmonic Motion
(ii) Resonance
(iii) Natural frequency
(iv) Phase difference **(08 Marks)**

b. Add the following harmonic motions analytically and check the solution graphically:
$x_1 = 4\cos(\omega t + 10°)$ and $x_2 = 6\sin(\omega t + 60°)$ **(12 Marks)**

OR

8 a. Explain the energy method of finding natural frequency of spring-mass system. **(10 Marks)**

b. Find the natural frequency of the system shown in Fig.Q8(b).

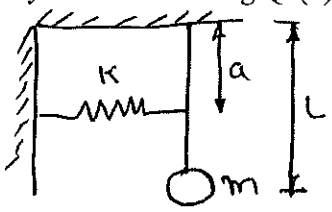

Fig.Q8(b) **(10 Marks)**

Module-5

9 a. Set up a differential equation for a spring mass damper system and obtain complete solution for a under damped system. (10 Marks)

b. The measurement on a mechanical vibrating system shows that the mass of 10 kg and that the spring can be combined to give an equal spring stiffness of 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 two consecutive amplitude (10 Marks)

OR

10 a. Derive an expression for magnification factor or amplitude ratio for spring mass system with viscous damping subjected to Harmonic force. (10 Marks)

b. A mass of 100 kg has been mounted on a spring dash pot system having stiffness of 19,600 N/m and damping coefficient 100 N-S/m. The mass acted upon by a harmonic force of 39 N at the undamped natural frequency of the system. Find:
   (i) Amplitude of vibration of the mass
   (ii) Phase difference between the force and displacement
   (iii) Force transmissibility ratio (10 Marks)

* * * * *