CBCS SCHEME

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17ME52

# Fifth Semester B.E. Degree Examination, Jan./Feb. 2023
## 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. State the condition for static equilibrium of a body subjected to a system for (i) Two forces (ii) Three forces (iii) Member with two force and torque. **(08 Marks)**

b. For the 4 bar mechanism shown in Fig. Q1 (b), find the required torque $T_2$ and various P in forces on the links for the equilibrium of the system.

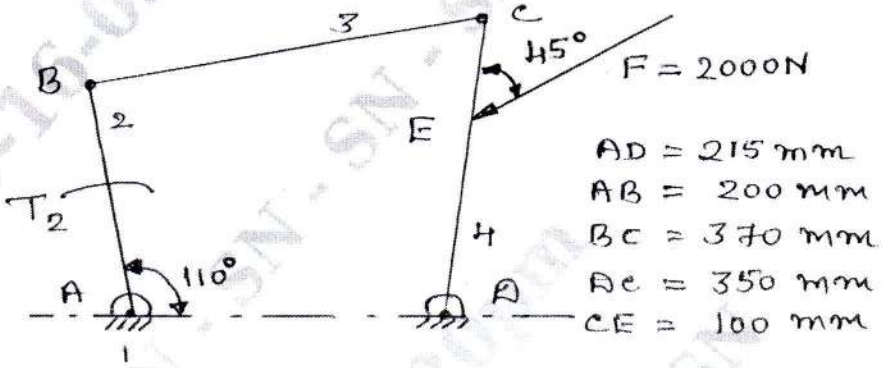


Fig. Q1 (b) **(12 Marks)**

**OR**

2 a. Explain D'Alembert's principle and discuss on its significance. **(06 Marks)**

b. The crank and the connecting rod of a vertical single cylinder gas engine running at 1800 rpm are 60 and 240 mm respectively. The diameter of the piston is 80 mm and the mass of reciprocating parts is 1.2 kg. At a point during the power stroke when the piston has moved 20 mm from the top dead center position, the pressure on the piston is 800 kN/m$^2$, determine the

(i) Net force on the piston
(ii) Thrust in the connecting rod.
(iii) Thrust on the sides of cylinder walls
(iv) Engine speed at which the above values are zero. **(14 Marks)**

### Module-2

3 a. Briefly explain the static and dynamic balancing. **(04 Marks)**

b. A shaft carries 4 rotating masses A, B, C and D in this order along the axis. The mass A may be assumed to be concentrated at 160 mm radius, B at 180 mm, C at 200 mm and D at 120 mm radius. The masses B, C and D are 40, 30 and 50 kg respectively. The planes containing B and C are 300 mm apart. The angular spacings of C and D are 90° and 210° respectively with respect to B measured in the same direction. If the shaft and masses are to be in complete dynamic balance determine (i) Mass and angular position of A (ii) Position of planes A and D. **(16 Marks)**

**OR**

4 a. What do you mean by primary and secondary unbalance in reciprocating engines? **(04 Marks)**

b. The cranks and connecting rod of a 4 cylinder in Line engine running at 1800 rpm and are 50 mm, 250 mm each respectively and the cylinder are spaced 150 mm apart. If the cylinders are numbered 1 to 4 in sequence from one end and the cranks appear at intervals of 90° in an end view in the order 1 – 4 – 2 – 3. The reciprocating mass corresponding to each cylinder is 1.5 kg. Determine

(i) Unbalanced primary and secondary forces if any.

(ii) Unbalanced primary and secondary couples.

with reference to central plane of engine. **(16 Marks)**

## Module-3

5 a. Derive the expression for speed of a porter governor with usual notations taking friction into account. **(08 Marks)**

b. A Porter governor has equal arms each 250 mm long and pivoted on the axis of rotation. Each ball has a mass of 5 kg and the mass of the central load on the sleeve is 25 kg. The radius of rotation of the ball is 150 mm when the governer begins to lift and 200 mm when the governor is at maximum speed. Find the range of speed, sleeve lift, governor effort and power of the governor in the following cases :

(i) When the friction at the sleeve is neglected.

(ii) When the friction at the sleeve is equivalent to 10 N. **(12 Marks)**

**OR**

6 a. Explain the effect of Gyroscopic couple of a ship under, (i) Steering (ii) Pitching (iii) Rolling. **(08 Marks)**

b. An aeroplane make a complete half circle of 40 m radius towards left when flying at 175 km/hr. The mass of the rotary engine and propeller is 400 kg with the radius of gyration 300 mm. The engine runs at 2500 rpm clockwise when viewed from rear. Find the gyroscopic couple on the aircraft. What will be the effect if the aeroplane turn towards right instead of left. **(12 Marks)**

## Module-4

7 a. Define the following terms :

(i) Periodic motion.

(ii) Amplitude

(iii) Natural frequency

(iv) Resonance

(v) Degrees of freedom. **(10 Marks)**

b. Add the following harmonic motions analytically and check the solution graphically,

$X_1 = 2\cos(\omega t + 0.5)$

$X_2 = 5\sin(\omega t + 1.0)$ **(10 Marks)**

**OR**

8 a. Explain the energy method and Rayleigh's method of finding natural frequency of spring mass system. **(12 Marks)**

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

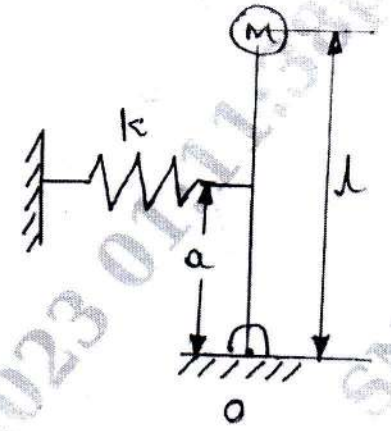


Fig. Q8 (b)

**(08 Marks)**

## Module-5

9 a. Set up a differential equation for a spring mass damper system and obtain complete solution for a over damped system. **(12 Marks)**

b. The mass of a single degree damped vibrating is 7.5 kg makes 24 free oscillation in 14 secs, when distributed from its equilibrium position. The amplitude of vibration reduces 0.25 of its initial value after 5 oscillations. Determine :
(i) Stiffness of spring (ii) Logarithmic decrement (iii) Damping factor. **(08 Marks)**

**OR**

10 a. Define Magnification factor and explain its significance. **(10 Marks)**

b. A machine of total mass 17 kg is mounted on springs having stiffness K = 11000 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) Transmitting.
(iii) Force transmitted to the ground or foundation,
Take $\xi = 0.2$. **(10 Marks)**

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