CBCS SCHEME

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

17ME52

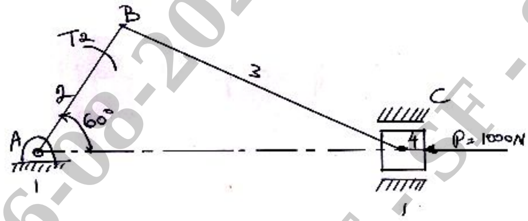
Fifth Semester B.E. Degree Examination, July/August 2021
Dynamics of Machinery

Time: 3 hrs. Max. Marks: 100

Note: ***Answer any FIVE full questions.***

1 a. State 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. **(06 Marks)**

b. Determine the required input torque on the crank of a slider crank mechanism shown in Fig. Q1 (b) for static equilibrium. **(14 Marks)**



AB = 100 mm,
BC = 300 mm

Fig. Q1 (b)

2 a. State and explain D'Alembert's principle. **(06 Marks)**

b. A horizontal gas engine running at 240 rpm has a bore of 500 mm and a stroke of 600 mm. The length of connecting rod is 1.2 m and the mass of the reciprocating parts is 200 kg. The difference between driving and back pressure is 0.4 N/mm^2 when the crank has turned through an angle of 60° from the inner dead centre. Neglecting the effect 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 moment on the crank shaft.
(vii) Acceleration of the flywheel which has a mass of 100 kg and radius of gyration of 500 mm while the power of the engine is 100 kW. **(14 Marks)**

3 a. Briefly explain the static and dynamic balancing. **(06 Marks)**

b. Two masses m_1, m_2, m_3, m_4 and m_5 revolve in the same plane. Magnitudes of m_1, m_2 and m_3 are 5, 2.5 and 4 kg respectively. Angular positions of m_2, m_3, m_4 and m_5 are 60°, 135°, 210° and 270° from m_1. Determine the masses m_4 and m_5. **(14 Marks)**

4 In a four cylinder engine the two outer cranks are at 120° to each other and their reciprocating masses are each 100 kg. The distance between the planes of rotation of adjacent cranks are 450 mm, 750 mm and 450 mm. Length of each crank is 300 mm and length of each connecting rod is 1200 mm. Speed of engine is 240 rpm. Find

(i) The reciprocating masses and relative angular positions for each of the inner cranks.
(ii) The unbalanced secondary forces and couples if any, measured about the central plane for this arrangement arrived at for primary balancing. **(20 Marks)**

5 a. Define the following with respect to the working of Governors:

(i) Sensitiveness
(ii) Isochronism
(iii) Hunting of governor
(iv) Effort of a governor
(v) Stability of a governor **(10 Marks)**

b. Each ball of a Governor has a mass of 1.5 kg attached to one arm of a bell crank lever. The other arms of bell crank lever. The other arms of bell crank lever lift the sleeve against the force exerted by the spring under compression which surrounds the governor spindle. Length of ball and sleeve arms are 125 and 75 mm. Fulcrum is 90 mm from the axis. Maximum and minimum radii are 115 and 75 mm. The sleeve begins to lift at a speed of 300 rpm. Maximum speed is 6% greater. Find the rate of spring or stiffness and equilibrium speed for the radius 90 mm. **(10 Marks)**

6 a. Analyze the stability of a two wheel vehicle taking left turn. Derive the necessary equations. **(10 Marks)**

b. An aeroplane makes a complete half circle of 50 m radius towards left when flying at 200 km/hr. The mass of the rotary engine and propeller is 400 kg with radius of gyration 300 mm. The engine runs at 3000 rpm counter clockwise when viewed from the rear. Determine the gyroscopic couple and its effect on the air craft. **(10 Marks)**

7 a. Define the following with respect to vibration:
(i) Simple Harmonic Motion (SHM).
(ii) Degrees of freedom.
(iii) Phase difference.
(iv) Resonance.
(v) Damping. **(10 Marks)**

b. Add the following harmonic motions and check the solution graphically,
$x_1 = 2\cos(\omega t + 0.5)$
$x_2 = 5\sin(\omega t + 1.0)$ **(10 Marks)**

8 a. Determine the natural frequency of a spring mass system where the mass of the spring is also to be taken into account. **(06 Marks)**

b. An oscillating system with a natural frequency of 3.98 Hz starts with an initial displacement of $x_0 = 10$ mm and an initial velocity of $\dot{x}_0 = 125$ mm/sec. Calculate all the vibratory parameters involved and the time taken to reach the first peak. **(14 Marks)**

9 a. State the types of damping and explain the differential equation of viscous damping. **(08 Marks)**

b. Large guns are designed so that on firing the bavel records against a spring. At the end of the record a dash pot is engaged that allows the bavel to return to its initial position in the minimum time without oscillation. Determine the proper spring constant and the dashpot damping co-efficient for a bavel having a mass of 900 kg. Initial recorded velocity at the instant of firing is 25 m/sec and the distance recorded is 1.5 m. Also find the time required for the bavel to return to a position 0.15 m from the initial position if the time for recorded is $\frac{1}{4}$ of time period. **(12 Marks)**

10 a. Show that providing damping in vibration isolation is not useful when the frequency ratio is more than 1.414 or $\sqrt{2}$. **(08 Marks)**

b. A machine of total mass 68 kg mounted on springs of stiffness $k = 11{,}000$ N/cm. With an assumed damping factor $\xi = 0.2$. A piston within the machine has a mass of 2 kg has a reciprocating motion with stroke 7.5 cm and a speed of 3,000 rpm. Assuming the motion of piston to be S.H.M. Determine
(i) Amplitude of machine
(ii) Phase angle with respect to exciting force.
(iii) Transmissibility and force transmitted to foundation.
(iv) Phase angle of transmitted force with respect to exciting force. **(12 Marks)**