Hall Ticket No | | | | | | | | | | | Question Paper Code:AMEC18

# INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)
(Dundigal-500043, Hyderabad)

**B.Tech V SEMESTER END EXAMINATIONS (REGULAR) - DECEMBER 2022**
**Regulation:UG20**
**DYNAMICS OF MACHINERY**
**(MECHANICAL ENGINEERING)**

**Time: 3 Hours** **Max Marks: 70**

**Answer ALL questions in Module I and II**
**Answer ONE out of two questions in Modules III, IV and V**
**All Questions Carry Equal Marks**
**All parts of the question must be answered in one place only**

## MODULE – I

1. (a) Write about the magnitude of gyroscopic couple in an automobile. Explain the effect of the gyroscopic couple on naval ship with a neat sketch. [BL: Understand| CO: 1|Marks: 7]

   (b) A turbine rotor of a ship has a mass of 3500 kg and rotates at a speed of 2000 rpm. The rotor has a radius of gyration of 0.5 m and rotates in clockwise direction when viewed from the stern (rear) end. Determine the magnitude of gyroscopic couple and its direction when the ship runs at a speed of 12 knots and steers to the left in a curve of 70 m radius. [BL: Apply| CO: 1|Marks: 7]

## MODULE – II

2. (a) Differentiate between brake and clutch. Explain the working of internal expanding brake with a neat diagram. [BL: Understand| CO: 2|Marks: 7]

   (b) An engine developing 45 kW at 1000 r.p.m. is fitted with a cone clutch built inside the flywheel. The cone has a face angle of $12.5^o$ and a maximum mean diameter of 500 mm. The coefficient of friction is 0.2. The normal pressure on the clutch face is not to exceed 0.1 $N/mm^2$. Determine: i) The axial spring force necessary to engage to clutch ii) The face width required. [BL: Apply| CO: 2|Marks: 7]

## MODULE – III

3. (a) Describe watts governor with help of neat sketch. Explain precisely the uses of turning moment diagram of reciprocating engines. [BL: Understand| CO: 3|Marks: 7]

   (b) Single cylinder, single acting, four stroke gas engine develops 20 kW at 300 r.p.m. The work done by the gases during the expansion stroke is three times the work done on the gases during the compression stroke, the work done during the suction and exhaust strokes being negligible. If the total fluctuation of speed is not to exceed ± 2 per cent of the mean speed and the turning moment diagram during compression and expansion is assumed to be triangular in shape, find the moment of inertia of the flywheel. [BL: Apply| CO: 3|Marks: 7]

4. (a) Demonstrate the expression for the friction torque for conical collar bearing considering uniform pressure. [BL: Understand| CO: 4|Marks: 7]

(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 governor begins to lift and 200 mm when the governor is at maximum speed. Find the minimum and maximum speeds and range of speed of the governor.

[BL: Apply| CO: 4|Marks: 7]

## MODULE – IV

5. (a) What is balancing of reciprocating masses? Explain static and dynamic balancing.

[BL: Understand| CO: 5|Marks: 7]

(b) A shaft carries four masses in parallel planes A, B, C and D in this order along its length. The masses at B and C are 18 kg and 12.5 kg respectively, and each has an eccentricity of 60 mm. The masses at A and D have an eccentricity of 80 mm. The angle between the masses at B and C is 100° and that between the masses at B and A is 190°, both being measured in the same direction. The axial distance between the planes A and B is 100 mm and that between B and C is 200 mm. If the shaft is in complete dynamic balance, determine :

i) The magnitude of the masses at A and D;

ii) The distance between planes A and D;

iii) The angular position of the mass at D. [BL: Apply| CO: 5|Marks: 7]

6. (a) Discuss about balancing of coupled locomotives. Derive the expression for swaying couple in locomotive balancing. [BL: Understand| CO: 5|Marks: 7]

(b) Four masses $m_1, m_2, m_3$ *and* $m_4$ are 200 kg, 300 kg, 240 kg and 260 kg respectively. The corresponding radii of rotation are 0.2 m, 0.15 m, 0.25 m and 0.3 m respectively and the angles between successive masses are 45°, 75° and 135°. Find the position and magnitude of the balance mass required, if its radius of rotation is 0.2 m. [BL: Apply| CO: 5|Marks: 7]

## MODULE – V

7. (a) Mention the effects of vibrations in simple vibrating system. Elucidate the natural frequency of free longitudinal vibration by equilibrium method. [BL: Understand| CO: 6|Marks: 7]

(b) Cantilever shaft 50 mm diameter and 300 mm long has a disc of mass 100 kg at its free end. The Young's modulus for the shaft material is 200 GN/$m^2$. Determine the frequency of longitudinal and transverse vibrations of the shaft. [BL: Apply| CO: 6|Marks: 7]

8. (a) Write about the the term overdamping of vibrating system. Explain vibration isolation and transmissibility. [BL: Understand| CO: 6|Marks: 7]

(b) A mass of 10 kg is suspended from one end of a helical spring, the other end being fixed. The stiffness of the spring is 10 N/mm. The viscous damping causes the amplitude to decrease to one-tenth of the initial value in four complete oscillations. If a periodic force of 150 cos 50 t N is applied at the mass in the vertical direction, find the amplitude of the forced vibrations. What is its value of resonance? [BL: Apply| CO: 6|Marks: 7]