Hall Ticket No | | | | | | | | | | | Question Paper Code: AME011

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Four Year B.Tech V Semester End Examinations (Supplementary) - January, 2019

Regulation: IARE – R16

DYNAMICS OF MACHINERY

Time: 3 Hours **(ME)** **Max Marks: 70**

Answer ONE Question from each Unit
All Questions Carry Equal Marks
All parts of the question must be answered in one place only

UNIT – I

1. (a) Derive a formula to determine the magnitude and direction of gyroscopic couple. **[7M]**

   (b) A four-wheeled motor car of mass 2000 kg has a wheel base of 2.5 m, trackwidth of 1.5 m and its centre of gravity 500 mm above the ground level. Weight on both front wheels put together is 11770N and that on the rear wheels is 7874N.Each wheel has an effective diameter of 0.8 m and a moment of inertia of 0.8 kg-m^2.The drive shaft, engine flywheel and transmission are rotating at four times the speed of road wheel, in anticlockwise direction when viewed from the rear, and are equivalent to a mass of 75 kg having a radius of gyration of 100 mm. If the car is taking a right turn of 60 m radius at 60 km/h, find the load on each wheel. **[7M]**

2. (a) Explain the effect of gyroscopic couple on a ship pitching upward. With a neat sketch explain gyroscopic effect in a four wheeler. **[7M]**

   (b) The dimensions of 4 link mechanism are AB = 500 mm, BC = 660 mm, CD= 560 mm and AD= 1000 mm. The link AB has an angular velocity of 10.5 rad/sec counter clock wise and an angular retardation of 26 rad/sec^2 at the instant when it makes an angle of 60^0 with AD, the fixed link. The mass of the link BC and CD is 4.2 kg/m length. The link AB has a mass of 3.54 kg the center of which lies at 200 mm from A and a moment of inertia of 88550 kg.mm^2. Neglecting gravity and friction effects determine instantaneous value of the drive torque required to be applied on AB to overcome the inertia forces. **[7M]**

UNIT – II

3. (a) Describe with a neat sketch a centrifugal clutch and deduce an equation for the total torque transmitted. **[7M]**

   (b) A single block brake is shown in Figure 1. The diameter of the drum is 250 mm and the angle of contact is 90^0. If the operating force of 700 N is applied at the end of a lever and the coefficient of friction between the drum and the lining is 0.35, determine the torque that may be transmitted by the block brake. **[7M]**

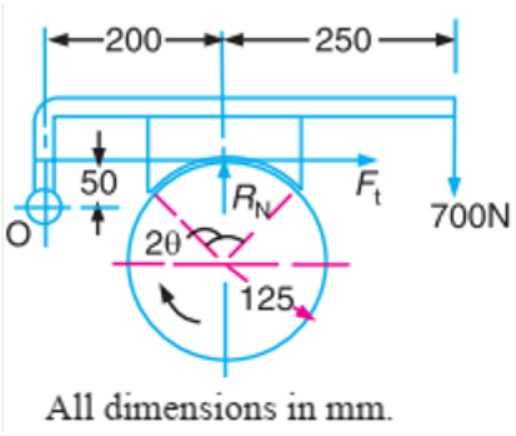

Figure 1

4. (a) Describe the construction and functioning of a transmission type dynamometer. **[7M]**

   (b) Figure 2 shows a winch stopping a weight 'W' with a differential band brake acting on a drum 800 mm diameter. The two ends of the bands are attached to pins on opposite sides of the fulcrum of the brake lever and at distances of 25 mm and 100 mm from the fulcrum. The angle of lap of the brakeband is 250^0 and the coefficient of friction is 0.25. Determine the braking torque when a force of 750 N is applied to the lever at a distance of 3000 mm from the fulcrum. **[7M]**

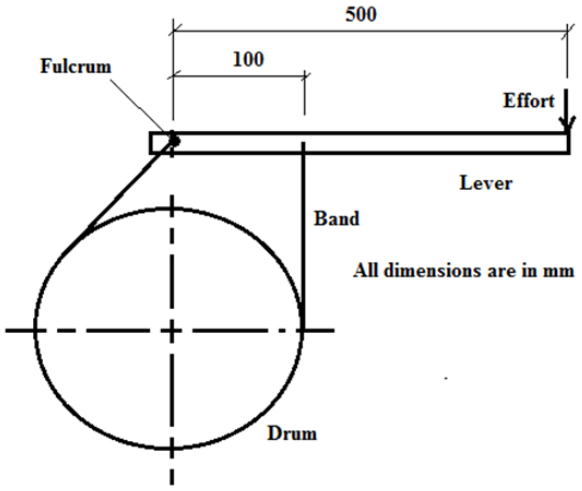

Figure 2

UNIT – III

5. (a) Define the terms coefficient of fluctuation of energy and coefficient of fluctuation of speed. Derive the relation for the coefficient of fluctuation of speed in terms of maximum fluctuation of energy and the kinetic energy of the flywheel at mean speed. **[7M]**

   (b) The turning moment diagram for a four stroke gas engine may be assumed for simplicity to be represented by four triangles, the areas of which from the line of zero pressure are as follows: Suction stroke = $0.45 \times 10^{-3} m^2$; Compression stroke = $1.7 \times 10^{-3}\ m^2$; Expansion stroke = $6.8 \times 10^{-3}\ m^2$; Exhaust stroke = $0.65 \times 10^{-3} m^2$. Each m^2 of area represents 3 MN-m of energy.

Assuming the resisting torque to be uniform, find the mass of the rim of a flywheel required to keep the speed between 202 and 198 r.p.m. The mean radius of the rim is 1.2 m. **[7M]**

6. (a) What are centrifugal governors? How do they differ from inertia governors? Describe the function of a Proell governor with a neat sketch. **[7M]**

   (b) Each arm of a porter governor is 250 mm long. The upper and lower arms are pivoted to links of 40 mm and 50 mm respectively from the axis of rotation. Each ball has mass of 5 kg and the sleeve mass is 50 kg. The force of friction on the sleeve of the mechanism is 40 N. Determine the range of speed of the governor for extreme radii of rotation of 125 mm and 150 mm. **[7M]**

UNIT – IV

7. (a) Write a short note on primary and secondary balancing. **[7M]**

   (b) Four masses A, B, C and D are completely balanced. Masses C and D makes an angle of 90^0 and 195^0 respectively with B in the same sense. The rotating masses have the following properties. M_b= 25Kg, r_a=150 mm, m_c=40 kg, r_b=200 mm, m_d=35 kg, r_c= 100mm, r_d=180 mm planes B and C are 250 mm apart. Determine **[7M]**

   i) The mass A and its angular position

   ii) The position of planes A and D

8. (a) Explain balancing of radial engines using direct and reverse crank methods. **[7M]**

   (b) A four cylinder vertical engine has cranks 150 mm long. The planes of rotation of the first, second and fourth cranks are 400 mm, 200 mm and 200 mm respectively from the third crank and their reciprocating masses are 50 kg, 60 kg and 50 kg respectively. Find the mass of the reciprocating parts for the third cylinder and the relative angular positions of the cranks in order that the engine may be in complete primary balance. **[7M]**

UNIT – V

9. (a) Explain Dunkerley's method to determine the natural frequency of a shaft carrying a number of point loads and a uniformly distributed load along its entire span. **[7M]**

   (b) A cantilever shaft 50 mm diameter and 300 mm long has a disc of mass100 kg at its free end. Young's modulus for the shaft material is 200 GN/m^2. Determine the frequency of longitudinal and transverse vibrations of the shaft. **[7M]**

10. (a) Explain the following: **[7M]**

    i. Forced vibration

    ii. Vibration isolation

    iii. Vibration transmissibility.

    (b) A mechanical vibrating system has amass of 8 kg and a spring whose stiffness is 5.4 N/mm. If the vibrating system has a dashpot exerting a force of 40 N when the mass moves at a velocity of 1 m/s, find:

    i. Critical damping coefficient **[7M]**

    ii. Damping factor

    iii. Logarithmic decrement.

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