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

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Four Year B.Tech V Semester End Examinations (Regular) - November, 2018

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) Explain the effects of gyroscopic couple on the reaction of the wheels of a four-wheeler negotiating a curve. **[7M]**

   (b) The rotor in a ship has a mass of 3500 kg and a radius of gyration of 0.45 m. It rotates at a speed of 3000 rpm anticlockwise when looking from the bow. Find the gyroscopic couple and its effect upon the ship:

   i. when the ship is steering to the left on a curve of 100 m radius at a speed of 36 km/h.

   ii. when the ship is pitching in simple harmonic motion, the bow falls with maximum velocity. The period of pitching is 40 seconds and the total angular displacement between the two extreme positions of pitching is 12 degrees. **[7M]**

2. (a) State D'Alembert's principle and explain how it simplifies a dynamic problem into an equivalent static one. **[7M]**

   (b) The crank-pin circle radius of a horizontal engine is 300 mm. The mass of the reciprocating parts is 250 kg. When the crank has moved 60^0 from the inner dead center, load on the piston is 68730N. The connecting rod length between centers is 1.2m and the cylinder bore is 0.5 m. If the engine runs at 250 rpm and the effect of piston rod diameter is neglected, Find: **[7M]**

   i. Pressure on slide bars
   ii. Tangential force on the crank-pin
   iii. Turning moment on the crank shaft.

UNIT – II

3. (a) With the help of a neat sketch, describe the construction and working of a centrifugal clutch. **[7M]**

   (b) A single plate clutch, both sides effective, has outer and inner diameters 300 mm and 200 mm respectively. The maximum intensity of pressure at any point on the contact surface should not exceed 0.1 N/mm^2. Take the coefficient of friction as 0.3, and find the power transmitted by the clutch at a speed of 2500 rpm. **[7M]**

4. (a) With a neat sketch, explain the working of an internal expanding brake. **[7M]**

(b) A band brake shown in Figure 1 laps around 270^0 of a drum of 450 mm diameter which is keyed to the shaft. The brake provides a braking torque of 225 N-m. One end of the band is fixed to a fulcrum pin of the lever and the other end to a pin 100 mm from the fulcrum. An operating force is applied at 500 mm from the fulcrum and the coefficient of friction is 0.25. Find the operating force when the drum rotates in the

i. Clockwise direction **[7M]**

ii. Anticlockwise direction.

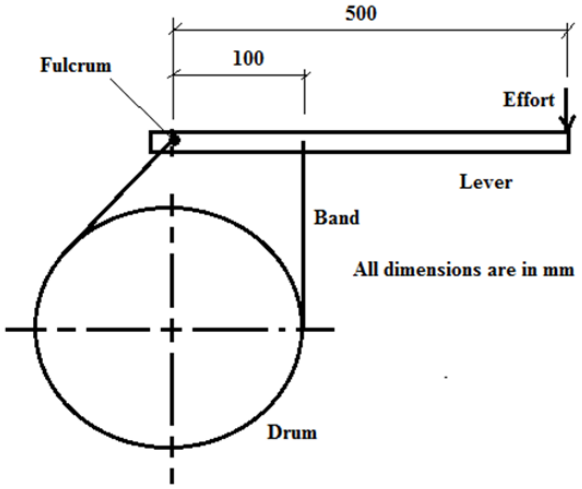

Figure 1

UNIT – III

5. (a) Draw a turning moment diagram for a four-stroke compression ignition internal combustion engine and explain it. **[7M]**

(b) The turning moment diagram shown in Figure 2 for a multi-cylinder engine has been drawn to a scale 1 mm = 600 N-m vertically and 1 mm = 3^0 horizontally. The intercepted areas between the output torque curve and the mean resistance line, taken in order from one end, are as follows: + 52, – 124, + 92, – 140, + 85, – 72 and + 107 mm^2, when the engine runs at a speed of 600 rpm. If the total fluctuation of speed is not to exceed ± 1.5% of the mean, find the mass of the flywheel whose radius of gyration is0.5 m. **[7M]**

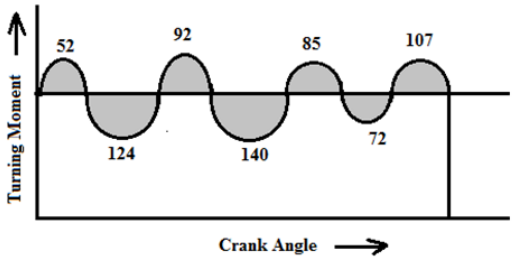

Figure 2

6. (a) With the help of a neat sketch, explain the construction and working of a Hartnell governor. **[7M]**

   (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. **[7M]**

UNIT – IV

7. (a) Explain the 'direct and reverse crank' method for determining unbalanced forces in radial engines. **[7M]**

   (b) Four masses m1, m2, m3 and m4 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 45^0, 75^0 and 135^0. Find the position and magnitude of the balance mass required, if its radius of rotation is 0.2 m. **[7M]**

8. (a) Explain the method of balancing of different masses revolving in the same plane. **[7M]**

   (b) The cranks of a four-cylinder marine oil engine are arranged at angular intervals of 90^0. The engine speed 70 rpm and the reciprocating mass per cylinder is 800 kg. the inner cranks are 1 m apart and are symmetrically arranged between the outer cranks which are 2.6 m apart. Each crank is 400 mm long. Determine the firing order of the cylinders for the best balance of reciprocating masses and also the magnitude of the unbalanced primary couple for that arrangement. **[7M]**

UNIT – V

9. (a) Discuss briefly with neat sketches the longitudinal, transverse and torsional free vibrations **[7M]**

   (b) An instrument vibrates with a frequency of 1 Hz when there is no damping. When the damping is provided, the frequency of damped vibrations was observed to be 0.9 Hz. Find the damping factor and logarithmic decrement. **[7M]**

10. (a) Derive the equation for natural frequency of free torsional vibration of three rotor systems **[7M]**

    (b) Calculate the whirling speed of a shaft 20 mm diameter and 0.6 m long carrying a mass of 1 kg at its mid-point. The density of the shaft material is 40 Mg/m^3, and Young's modulus is 200 GN/m^2. Assume the shaft to be freely supported. **[7M]**

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