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INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Four Year B.Tech V Semester End Examinations (Regular) - November, 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) Explain the effect of the gyroscopic couple on an aeroplane. [7M]
(b) The turbine rotor of a ship has a mass of 8 tonnes and a radius of gyration 0.6 m. It rotates at 1800 RPM clockwise, when looking from the stern. Determine the gyroscopic couple, if the ship travels at 100 km/hr and steer to the left in a curve of 75 m radius. [7M]
2. (a) How are free body diagrams helpful in finding the various forces acting on different members of the mechanism? [7M]
(b) Determine the required input torque on the crank of a slider crank mechanism for static equilibrium when the applied piston load is 1500N. The length of the crank and connecting rod are 40 mm and 100 mm respectively and the crank has turned through 45° from the inner dead center. [7M]

UNIT – II

3. (a) Define a clutch used in an automobile. Describe the working of a multi plate clutch. [7M]
(b) A conical friction clutch is used to transmit 90 kW at 1500 RPM. The semicone angle is 20° and the coefficient of friction is 0.2. If the mean diameter of the bearing surface is 375 mm and the intensity of normal pressure is not to exceed 0.25 N/mm^2 , find the dimensions of the conical bearing surface and the axial load required. [7M]
4. (a) Describe a transmission type dynamometer. How transmission dynamometers are classified? [7M]
(b) In a winch, the rope supports a load W and is wound round a barrel 450 mm diameter. A differential band brake acts on a drum 800 mm diameter which is keyed to the same shaft as the barrel. 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 brake band is 250° and the coefficient of friction is 0.25. What is the maximum load W which can be supported by the brake when a force of 750 N is applied to the lever at a distance of 3000 mm from the fulcrum? [7M]

UNIT – III

5. (a) Explain the turning moment diagram of a four stroke cycle internal combustion engine.. [7M]
(b) The turning moment diagram for a multicylinder engine has been drawn to a scale 1 mm = 600 N-m vertically and 1 mm = 3° 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 is running at a speed of 600 RPM. If the total fluctuation of speed is not to exceed $\pm 1.5\%$ of the mean, find the necessary mass of the flywheel of radius 0.5 m. [7M]
6. (a) Define the terms coefficient of fluctuation of energy and coefficient of fluctuation of speed. What is the function of a flywheel in a punching press? [7M]
(b) The arms of a Porter governor are each 250 mm long and pivoted on the governor axis. The mass of each ball is 5 kg and the mass of the central sleeve is 30 kg. The radius of rotation of the balls is 150 mm when the sleeve begins to rise and reaches a value of 200 mm for maximum speed. Determine the speed range of the governor. If the friction at the sleeve is equivalent of 20 N of load at the sleeve, determine how the speed range is modified. [7M]

UNIT – IV

7. (a) Explain the effect of partial balancing of reciprocating parts of two cylinder locomotives. [7M]
(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. [7M]
8. (a) Explain the method of direct and reverse cranks to determine the unbalance in radial engines. [7M]
(b) The three cranks of a three cylinder locomotive are all on the same axle and are set at 120° . The pitch of the cylinders is 1 meter and the stroke of each piston is 0.6 m. The reciprocating masses are 300 kg for inside cylinder and 260 kg for each outside cylinder and the planes of rotation of the balance masses are 0.8 m from the inside crank. If 40% of the reciprocating parts are to be balanced, find i) the magnitude and the position of the balancing masses required at a radius of 0.6 m ii) the hammer blow per wheel when the axle makes 6 r.p.s. [7M]

UNIT – V

9. (a) Describe longitudinal free vibrations and transverse free vibrations with neat sketch. [7M]
(b) A shaft 50 mm diameter and 3 meters long is simply supported at the ends and carries three loads of 1000 N, 1500 N and 750 N at 1 m, 2 m and 2.5 m from the left support. The Young's modulus for shaft material is 200 GN/m^2 . Find the frequency of transverse vibration. [7M]
10. (a) Obtain the equation for natural frequency of free torsional vibration of three rotor systems. [7M]
(b) A shaft of 100 mm diameter and 1 metre long has one of its end fixed and the other end carries a disc of mass 500 kg at a radius of gyration of 450 mm. The modulus of rigidity for the shaft material is 80 GN/m^2 . Determine the frequency of torsional vibrations. [7M]

