Code No:R2022032 | R20 | SET - 1

II B. Tech II Semester Supplementary Examinations, December - 2023

DYNAMICS OF MACHINERY

(Mechanical Engineering)

Time: 3 hours **Max. Marks: 70**

Answer any **FIVE** Questions each Question from each unit
All Questions carry **Equal** Marks

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UNIT-I

1 a) Discuss briefly the various types of friction experienced by a body. [7M]

b) A centrifugal friction clutch has a driving member consisting of a spider carrying four shoes which are kept from contact with the clutch case by means of flat springs until increase of centrifugal force overcomes the resistance of the springs and the power is transmitted by friction between the shoes and the case. Determine the necessary mass of each shoe if 22.5 kW is to be transmitted at 750 r.p.m. with engagement beginning at 75% of the running speed. The inside diameter of the drum is 300 mm and the radial distance of the center of gravity of each shoe from the shaft axis is 125 mm. Assume $\mu = 0.25$. [7M]

Or

2 a) Explain the following : [7M]
(i) Limiting friction, (ii) Angle of friction, and (iii) Coefficient of friction.

b) A vehicle moving on a rough plane inclined at 10° with the horizontal at a speed of 36 km/h has a wheel base 1.8 meters. The center of gravity of the vehicle is 0.8 meter from the rear wheels and 0.9 meter above the inclined plane. Find the distance travelled by the vehicle before coming to rest and the time taken to do so when 1. The vehicle moves up the plane, and 2. The vehicle moves down the plane. The brakes are applied to all the four wheels and the coefficient of friction is 0.5 [7M]

UNIT-II

3 a) Explain the terms 'fluctuation of energy' and 'fluctuation of speed' as applied to fly wheels. [7M]

b) Synthesize a four-bar mechanism to generate a function $y = \sin x$ for $0 \leq x \leq 90°$. The range of the output crank may be chosen as 60° while that of input crank be 120°. Assume three precision points which are to be obtained from Chebyshev spacing. Assume fixed link to be 52.5 mm long and $\theta_1 = 105°$ and $\varphi_1 = 66°$. [7M]

Or

4 a) A single cylinder, single acting, four stroke cycle gas engine develops 20 kW at 250 r.p.m. The work done by the gases during the expansion stroke is 3 times the work done on the gases during the compression stroke. The work done on the suction and exhaust strokes may be neglected. If the fly wheel has a mass of 1.5 tones and has a radius of gyration of 0.6m, find the cyclic fluctuation of energy and the coefficient of fluctuation of speed. [7M]

b) Describe the method of designing a four-bar mechanism as a function generation. [7M]

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UNIT-III

5 a) 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]

b) An aero plane runs at 600 km / h. The rotor of the engine weighs 4000 N with radius of gyration of1 meter. The speed of rotor is 3000 r.p.m. in anticlockwise direction when seen from rear side of the aero plane. If the plane takes a loop upwards in a curve of 100 meters radius, find: i) gyroscopic couple developed and ii) effect of reaction gyroscopic couple developed on the body of aero plane. [7M]

Or

6 a) Explain the effect of the gyroscopic couple on the reaction of the four wheels of a vehicle negotiating a curve. [7M]

b) Each paddle wheel of a steamer have a mass of 1600 kg and a radius of gyration of 1.2 m. The steamer turns to port in a circle of 160 m radius at 24 km / h, the speed of the paddles being 90 r.p.m. Find the magnitude and effect of the gyroscopic couple acting on the steamer. [7M]

UNIT-IV

7 a) Explain clearly the terms ‘static balancing’ and ‘dynamic balancing’. State the necessary conditions to achieve them. [7M]

b) A 3.6 m long shaft carries three pulleys, two at its two ends and third at the mid-point. The two end pulleys has mass of 79 kg and 40 kg and their centre of gravity are 3 mm and 5 mm respectively from the axis of the shaft. The middle pulley mass is 50 kg and its centre of gravity is 8 mm from the shaft axis. The pulleys are so keyed to the shaft that the assembly is in static balance. The shaft rotates at 300 r.p.m. in two bearings 2.4m apart with equal overhang on either side. Determine: i) the relative angular positions of the pulleys, and ii) dynamic reactions at the two bearings. [7M]

Or

8 a) Why is balancing of rotating parts necessary for high speed engines? [7M]

b) A shaft has three eccentrics, each 75 mm diameter and 25 mm thick, machined in one piece with the shaft. The central planes of the eccentric are 60 mm apart. The distance of the centres from the axis of rotation are 12 mm, 18 mm and 12 mm and their angular positions are 120° apart. The density of metal is 7000 kg/m^3. Find the amount of out-of-balance force and couple at 600 r.p.m. If the shaft is balanced by adding two masses at a radius 75 mm and at distances of 100 mm from the central plane of the middle eccentric, find the amount of the masses and their angular positions. [7M]

UNIT-V

9 a) Derive the differential equation characterising the motion of an oscillation system subject to viscous damping and no periodic external force. Assuming the solution to the equation, find the frequency of oscillation of the system. [7M]

b) A shaft 1.5 m long, supported in flexible bearings at the ends carries two wheels each of 50 kg mass. One wheel is situated at the centre of the shaft and the other at a distance of 375 mm from the centre towards left. The shaft is hollow of external diameter 75 mm and internal diameter 40 mm. The density of the shaft material is 7700 kg/m^3 and its modulus of elasticity is 200 GN/m^2. Find the lowest whirling speed of the shaft, taking into account the mass of the shaft. [7M]

Or

10 a) Establish an expression for the natural frequency of free transverse vibrations for a simply supported beam carrying a number of point loads, by (i) Raleigh's method and (ii) Dunkerley's method [7M]

b) A machine of mass 75 kg is mounted on springs and is fitted with adashpot to damp out vibrations. There are three springs each of stiffness 10 N/mm and it is found that the amplitude of vibration diminishes from 38.4 mm to 6.4 mm in two complete oscillations. Assuming that the damping force varies as the velocity, determine: i) the resistance of the dashpot at unit velocity; ii) the ratio of the frequency of the damped vibration to the frequency of the undamped vibration; and iii) the periodic time of the damped vibration. [7M]