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P.E.S. College of Engineering, Mandya - 571 401

(An Autonomous Institution affiliated to VTU, Belagavi)

Fourth Semester, B.E. - Industrial and Production Engineering

Semester End Examination; May/June - 2018

Theory of Machines

Time: 3 hrs *Max. Marks: 100*

***Note**: Answer **FIVE** full questions, selecting **ONE** full question from each unit.*

UNIT - I

1 a. Explain the following with suitable example :

i) Kinematic link ii) Kinematic pair iii) Kinematic chain

iv) Mechanism v) Degrees of Freedom 10

b. What is Inversions? With a neat sketch, explain first and second Inversion of Slider crank chain. 10

2 a. Explain with a neat sketch, crank and slotted lever mechanism. 10

b. With a neat diagram, explain Whitworth Quick return motion mechanism. 10

UNIT - II

3 a. Explain the following technologies :

i) Pitch Circle diameter ii) Pitch point iii) Addendum iv) Dedendum v) Backlash 5

b. Explain with a neat sketch, law of Gearing (or) Conditions of correct Gearing. 7

c. A pinion having 25 teeth drives a gear having 60 teeth. The tooth profile is involute with pressure angle of 20º, module 8 mm and addendum equal to 1 module. Determine; 8

i) Length of path of contact ii) Arc of Contact iii) The contact ratio

4 a. With a neat sketch, explain Reverted and epicyclic Gear trains. 8

b. A compound epicyclic gear train is shown in Fig. 4(b), the gears, A, D and E are free to rorate on the axis P. Compound gear B and C rotate together on the axis Q at the end of arm 'F'. All the gears have equal pitch. Number of external teeth on the gear A, B, C are 18, 45 and 21 respectively. The gears D and E are annular gears. Gear A rotates at 90 rpm, CCW, gear D rotates at 450 rpm C.W. Find the speed and the direction of rotation of arm and gear E.

(Tabular Column method). 12

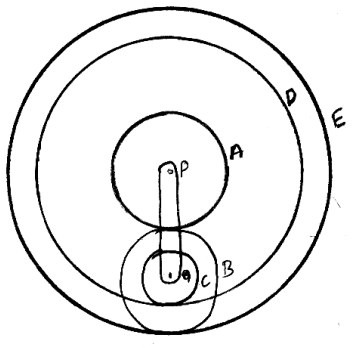

Fig. 4(b)

Contd…2

UNIT - III

5 a. State the laws of solid friction. 5

b. Deduce an expression for ratio of Belt tension on Flat belt drive. 7

c. A line shaft is driven by an electric motor through an open belt drive. The speed of motor is 1500 rpm and the line shaft should rorate at 600 rpm. The maximum linear speed at which the belt should run is 1200 m/min. Determine the diameter of the pulleys when, 8

i) Thickness of belt is neglected

ii) Thickness of Belt is 12mm

iii) 5% total slip is taken by considering thickness of belt

6 a. With neat sketch, deduce an expression for ratio of Belt tension on V-belt drive. 10

b. A belt drive is required to transmit 10 kW from a motor running at 600 rpm. The belt is 12 mm thick and has a mass density of 0.001 gm/mm^3 safe stress in the belt is not to exceed 2.5 N/mm^2. Diameter of the driving pulley is 250 mm whereas the speed of the driver pulley is 220 rpm. Two shafts are 1.25 m apart. The coefficient of friction is 0.25. Determine the width of the belt. 10

UNIT - IV

7 a. What is static of dynamic balancing? Explain with a neat sketch, balancing of several masses in different planes. 10

b. Four masses rotating in different planes are to be arranged to give complete balance planes containing ‘Q’, ‘R’ are 450 mm apart. The masses ‘Q’ and ‘R’ are at right angles to each other ‘S’ makes 140° and 230° respectively with respect to ‘Q’ and ‘R’ in the same sense. Find where the planes containing ‘P’ and ‘S’ should be placed and also the magnitude and angular position of mass ‘P’ 10

Planes	Mass (in kg)	Radius
P	M/P	0.3
Q	200	0.5
R	300	0.2
S	225	0.4

8 a. Deduce an expression for height of porter governor [By instantaneous centre method]. 8

b. The arms of a porter governor are each 300 mm long and are hinged on the axis of rotation. The mass of each ball is 5 kg. The radius of rotation of the ball is 200 mm when the governor begins to lift and 250 mm at the maximum speed. Determine the maximum and minimum speeds, if the mass of the sleeve is 15 kg. Also find the range of speed, if the frictional force at the sleeve is 30 N. 12

UNIT - V

9 a. Define Gyroscopie couple and deduce an expression for Gyroscopic couple. 8

Contd…3

b. The mass of the rotary engine of an aeroplane is 400 kg and has radius of gyration 300 mm. When viewed from the front, the engine rotates in clockwise direction at 1500 rpm. When flying at 180 km/hr, the aeroplane loops in a circle of 40 m diameter in a vertical plane tending to raise the nose. Find magnitude and direction of gyroscopic couple acting on the aeroplane. 12

10 a. Explain the gyroscopic effect on ship in the following case:

i) Steering, assuming the rotor turns clockwise, when viewed from the stern and ship takes left turn.

ii) Pitching, Assume the Rotor turning clockwise when viewed from the stern and bow assends. 8

b. A rear engine automobile is travelling along a track of 100 m mean radius. Each of four road wheels has a moment of inertia of 2 kg.m^2 and an effective diameter of 60 cm. The rotating parts of the engine has a moment of inertia of 1 kg.m^2. The engine axis is parallel to the rear axle. The crank shaft rotates in the same sense as the road wheels. The gear ratio of engine to back axle is 3:1. The mass of the vehicle is 1500 kg and has its C.G. 500 mm above road level. Width of track is 1.5 m. Determine the limiting speed of the vehicle around the curve for all four wheels to maintain contact with the road surface, if this is not cambered. 12

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