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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 - 2019

Theory of Machines

Time: 3 hrs *Max. Marks: 100*

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

UNIT - I

1. Sketch all the inversions of the four bar chain for one application in each inversion. 20

2 a. Derive the Kutzbach's criterion: $m = 3(n-1) - 2j_1 - j_2$. Where;
m = Mobility; n = No. of links; j_1 = No. of lower pair joints; j_2 = No. of higher pair joints. 10

b. Derive the condition of Ackermann steering gear mechanism. 10

UNIT - II

3 a. Derive an expression for the path of contact for a pair of spur gears. 10

b. Explain the concept of interference and discuss the methods of avoiding it. 10

4. A fixed annular wheel A and a smaller concentric rotating wheel B are connected by a compound wheel A_1 B_1, the gear A_1 mesh with wheel A and B_1 with B. The compound wheel resolves on a pin on arm R, which revolves about the axis of A and B. A has 130 teeth, B = 20, and B_1 = 80, the pitch of A and A_1 being twice the pitch of B and B_1. How many revolutions will B make for one revolution of the arm R? 20

UNIT - III

5. Derive the expression for ratio of friction tensions for V-Belt drive considering centrifugal tension into account $\frac{\tau_1 - \tau_C}{\tau_2 - \tau_C} = e^{\mu\vartheta/\sin\alpha}$. 20

6 a. Prove that for the condition of maximum power transmission, the Centrifugal tension, $\tau_C = \frac{\text{maximum tension}}{3}$. 10

b. Determine the maximum power that can be transmitted through a flat belt having the following data :
Cross-section of the belt = 300 mm × 12 mm
Ratio of friction tensions = 2.2
Maximum permissible tension in belt = 2 MPa
Maximum density of the Material = 0.0011 g/mm^3 10

Contd…2

UNIT - IV

7. Four masses A, B, C and are D are completely balanced. Masses C and D make angles of 90° and 210° respectively with B in the same sense. The planes containing B and C are 300 mm apart. Masses A, B, C and D can be assumed to be concentrated at radii of 360, 480, 240 and 300 mm respectively. The masses B, C and D are 15 kg, 25 kg and 20 kg respectively. Determine; 20

   i) Mass A and its angular position

   ii) Position of planes A and D

8 a. Show that for a porter Governor $N^2 = \frac{895}{h}\left[\frac{2mg + (Mg \pm f)(1+K)}{2mg}\right]$ with usual notations. 10

b. In a Hartnell governor, the extreme radius of rotation of the balls is 40 mm and 60 mm, and the corresponding speeds are 210 rpm and 230 rpm. The mass of each ball is 3 kg. The lengths of the ball and the sleeve arms are equal. Determine the initial compression and the constant of the central spring. 10

UNIT - V

9 a. Show that Gyroscopic couple is $C = Iww_p$, with usual notations. 10

b. Explain the Gyroscopic couple in aeroplane. 10

10. Explain the Gyroscopic couple in Naval ships during pitching, on-pitching and rolling. 20

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