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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; June - 2017

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 classification of kinematic pairs with the help of neat sketches. 8

b. Determine the degree of freedom of the linkages shown in the Fig. 1b. 4

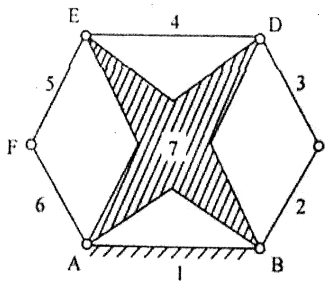

Figure 1b.

c. A mechanism is required to draw an ellipse. Suggest and explain the mechanism with a neat sketch. 8

2 a. A mechanism is required to operate a shaping machine. Suggest suitable mechanisms for it and explain any one of them with a neat sketch. 8

b. Explain Ratchet and pawl mechanism with a neat sketch. 6

c. Explain Ackermann steering gear mechanism with the help of neat sketch. 6

UNIT - II

3 a. State and prove law of gearing with the help of simple diagram. 6

b. Two spur gears have a velocity ratio of 4. The driven gear has 96 teeth, 8 mm module and rotates at 400 rpm. Calculate: 6

i) Number of teeth on driver ii) Speed of the driver iii) Pitch line velocity.

c. Two mating involute spur gears with module 8 mm have 23 and 57 teeth and pressure angle 20º. The addenda on pinion and gear wheels are equal to one module. Determine 8

i) Length of path of contact ii) Length of arc of contact

iii) Number of pairs of teeth in contact.

4 a. A compound gear train is required for power transmission from a motor shaft to output shaft. The first gear is mounted on motor shaft where as sixth gear is mounted on output shaft. The motor shaft is rotating at 2500 rpm in clockwise direction. The number of teeth on each gear is given below: 8

Contd…2

Gear	1	2	3	4	5	6
No. of Teeth	30	60	40	28	70	60

Gears 2 and 3 are on the same shaft (compound gear) Also, gears 4 and 5 are on the same shaft (compound gear). Find the direction and speed of output shaft for the following cases.

i) Gear 1 is connected to gear 2 and gear 5 is connected to gear 6

ii) Gear 1 is connected to gear 4 and gear 2 is connected to gear 6.

b. An epicyclic gear consists of three gears A, B and C as shown in Fig. 4b. The gear A has 72 internal teeth and gear C has 32 external teeth. The gear B meshes with both A and C and is carried on an arm EF which rotates about the centre of A at 18 rpm. If the gear A is fixed, determine the speed of gears B and C. 12

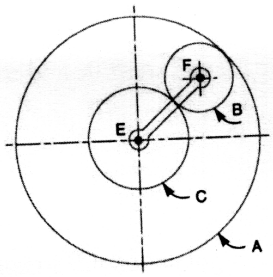

Figure 4b

UNIT - III

5 a. Derive an expression for centrifugal tension in belt drive. 8

b. Two parallel shafts 3.5m apart are connected by two pulleys of 1m and 400 mm diameters, the larger pulley being the driver runs at 220 rpm. The belt weighs 1.2 kg per meter length. The maximum tension in the belt is not to exceed 1.8 kN. The Coefficient of friction is 0.28. Owing to slip on one of the pulleys, the velocity of the driven shaft is 520 rpm only. Determine the following: 12

i) Torque on each shaft ii) Power transmitted

iii) Power lost in friction iv) Efficiency of the drive.

6 a. Derive the conditions for maximum power transmitted by a flat belt from one pulley to another pulley. 10

b. The maximum allowable tension in a V belt of groove angle of 45º is 1500 N. The angle of lap is 170º and the coefficient of friction between the belt and pulley is 0.27, if the belt runs at 120m/ minute. Determine: 10

i) Net driving Tension ii) Power transmitted by the pulley.

7 a. Explain the method of balancing of several masses rotating in the same plane with simple sketch. 10

Contd…3

b. A distributed mass of 600 kg is attached to a shaft at a distance of 270 mm. The shaft runs at uniform angular velocity 'ω'. This distributed mass is balanced by two masses in two different planes. The two masses attached to shaft at a distance of 450 mm. The distance between the two planes of balancing masses is 1500 mm. The distance between the plane of one of the balancing mass and a plane is distributed mass is 300 mm. Determine the magnitude of balancing masses when: 10

i) The planes of the balancing masses are on the same side of the plane of distributed mass

ii) The planes of the balancing masses are on either side of the plane of distributed mass.

8 a. Define the following terms related to governors:

i) Height of a governor ii) Equilibrium speed 8

iii) Maximum and minimum equilibrium speed iv) Sleeve lift.

b. The arms of a porter governor are 250 mm long are pivoted on the axis of the governor. The mass of each ball is 5 kg and the mass of central sleeve is 30 kg. The radius of roration of the balls is 150 mm when the sleeve begins to rise and reaches a value of 200 mm for a maximum speed. Determine the speed range of the governor. If the friction at the sleeve is equivalent to 20N of load at the sleeve, determine how the speed range is modified. 12

UNIT - V

9 a. Explain the effect of gyroscopic couple on the reaction of the four wheels of a vehicle by negotiating a curve. 10

b. Find the angle of inclination with respect to vertical of a two wheeler negotiating a turn from the following data.

i) Combined mass of a vehicle with its rider = 250 kg

ii) Moment of intertia of the engine flywheel = 0.3 kg-m^2

iii) Movement of interia of each road wheel = 1 kg-m^2

iv) Speed of engine flysheel = 5 times that of road wheels and in the same direction 10

v) Height of the centre of gravity of rider with vehicle = 0.6 m

vi) Two wheeler speed = 90 km/hr

vii) Wheel radius = 300 mm

viii) Radius of the turn = 50 m.

10 a. Explain the effect of gyroscopic couple on a naval ship during steering, pitching and rolling with neat sketches. 12

b. The turbine rotor of ship has mass of 8000 kg and a radius of gyration 600 mm. The rotor of the turbine rotates at 1800 rpm in clockwise direction when looking from the stern. If the ship moves at a speed of 100 km/hr and steers to the left in a curve of radius 75 m, determine the gyroscopic couple on the ship. 8

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