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Total No. of Questions : 09] [Total No. of Pages : 03

B.Tech. (Sem. - 3rd)

THEORY OF MACHINES

SUBJECT CODE : PE - 207

Paper ID : [A0205]

[Note : Please fill subject code and paper ID on OMR]

Time : 03 Hours **Maximum Marks : 60**

Instruction to Candidates:

1) Section - A is **Compulsory**.
2) Attempt any **Four** questions from Section - B.
3) Attempt any **Two** questions from Section - C.

Section - A

Q1) *(10 x 2 = 20)*

a) Give two examples of higher pair.

b) If J is number of binary joints, H is number of higher kinematic pairs and L is number of links in kinematic chain, write the equation for criterion of constraint.

c) What will be the maximum peripheral velocity in a flywheel having safe stress = $252 N/m^2$ and density $7 gm/cm^3$.

d) What is R.B.E. as used in brakes?

e) What is a reverted gear train?

f) Why is crowning of pulley done?

g) Define pressure angle as used in cams.

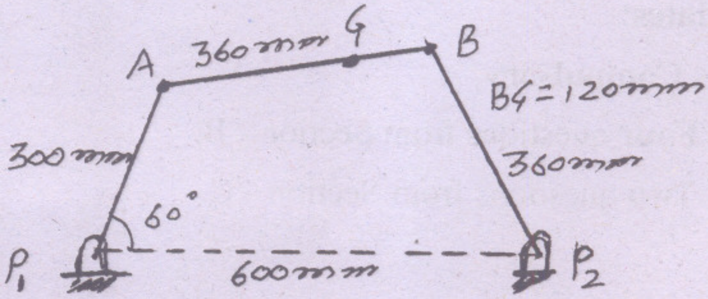
h) State law of gearing.

i) Give relation for minimum number of teeth in case of two gears in mesh with involute teeth to avoid interference when diameters of both gears is same.

j) Explain impact velocity as referred to chain drive.

(4 × 5 = 20)

Q2) The dimensions and configuration of a four bar mechanism shown below are:
$P_1A = 300$ mm; $P_2B = 360$ mm; $AB = 360$ mm; and $BG = 120$ mm
$P_1P_2 = 600$ mm; angle $AP_1P_2 = 60°$
The crank P_1A has an angular velocity of 10 rad/s and angular acceleration of 30 rad/s^2, both clockwise. Determine the angular velocities and angular accelerations of P_2B and AB and the velocity and acceleration of points B and G.



Q3) A punching machine punches 3 cm holes in a 4 cm plate. It does 540 N-m of work per sq.cm. of sheared area. The punch has a stroke of 10 cm and punches one hole every 10 seconds. The maximum speed of flywheel at the radius of gyration is 28 m/s. Find the weight of the flywheel if the speed at this radius is not to fall below 25 m/s during each punch.

Q4) A band and block brake having 14 blocks, each of which subtends an angle of 15° at the centre, is applied to a drum of 1 m effective diameter. The drum and flywheel mounted on the same shaft weigh 19620 N and a combined radius of gyration of 50 cm. The two ends of the band are attached to pins on opposite sides of the brake lever at a distance of 3 cm and 12 cm from fulcrum. If a force of 196.2 N is applied at distance of 75 cm from the fulcrum find:

(i) maximum braking torque

(ii) angular retardation of drum

(iii) time taken by system to come to rest from rated speed of 360 r.p.m. The coefficient of friction between blocks and drum may be taken as 0.25.

Q5) Two equal involute gear wheels of 20° pressure angle have 20 teeth each. Calculate length of arc of contact for standard addendum of 1 module. Pitch of teeth is 6 mm of diameter per tooth. What should be the addendum, if the arc of contact is to be maximum possible? What is then the length of arc of contact?

Q6) Derive an expression for the torque transmitted be single plate clutch assuming uniform pressure.

Section - C

(2 x 10 = 20)

Q7) Two shafts A and B in the same line are geared together through an intermediate parallel shaft C. The wheels connecting A and C have a module of 4 mm and those connecting C and B a module of 9 mm, the least number of teeth in any wheel being not less then 15. The speed of B is to be about but not greater than 1/12 the speed of A, and the ratio of each reduction is same. Find suitable wheels, the actual reduction and the distance of shaft C from A and B.

Q8) (a) Derive the relation for maximum power transmission in a belt drive.

(b) An open belt drive connects two pulleys 1.2 and 0.5 m diameter on parallel shafts 3.6 m apart. The belt has a mass of 0.9 kg/m length, and maximum tension in it is not to exceed 2.0 kN.
The 1.2 m pulley, which is the driver, runs at 200 r.p.m. Due to belt slip on one of the pulleys, the velocity of driven shaft is only 450 r.p.m. Calculate torque on each of two shafts, the power transmitted, and power lost in friction . $\mu = 0.3$.
What is efficiency of the drive?

Q9) Draw the profile of a cam when the roller follower moves with cycloidal motion during outstroke and return stroke as detailed below:

(a) Outstroke with maximum displacement of 44 mm during 180° of cam rotation.

(b) Return stroke for next 150° of cam rotation, and

(c) Dwell for the remaining 30° of cam rotation

Minimum radius of the cam is 1.5 cm and roller diameter of follower is 1.0 cm. The axis of follower is offset by 1 cm towards the right from axis of cam shaft.