**15MT45**

# Theory of Machines

Time: 3 hrs. 

Max. Marks:80

**Note:** *Answer any FIVE full questions, choosing ONE full question from each module.*

## Module-1

1  a.  What are the difference between higher and lower pair? **(04 Marks)**
   b.  Explain the following mechanism with neat sketches : (any two)
      i)  Crank and slotted lever mechanism
      ii)  Geneva mechanism.
      iii) Gnome or Rotary engine **(12 Marks)**

**OR**

2  The dimensions and configuration of the four bar mechanism shown in Fig Q2. The crank $P_1A$ has an angular velocity of 10 rad/sec and angular acceleration of 30 rad/sec$^2$, both clockwise. Determine the angular velocities and angular acceleration of $P_2B$ and AB and the velocity and acceleration of the joint 'B'.
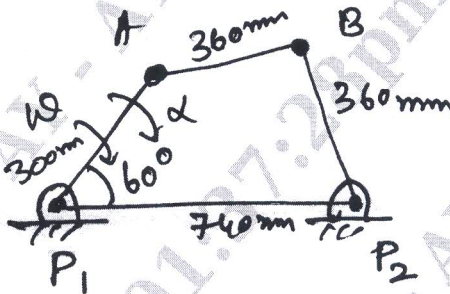


Fig Q2 **(16 Marks)**

## Module-2

3  a.  Derive an expression for arc of contact for two meshing spur gears having involute profile. **(08 Marks)**
   b.  Two mating gears with module pitch 6mm have 20 and 50 teeth of pressure angle 20° and addendum 6mm. determine the number of pairs of teeth in contact. **(08 Marks)**

**OR**

4  a.  Explain any two types of gear trains with neat sketches. **(04 Marks)**
   b.  An epicyclical gear train is composed of fixed annular wheel 'A' having 150 teeth. Meshing with 'A' is wheel 'B' which drives wheel 'D' through an idler wheel 'C', 'D' being concentric with 'A' , Wheels B and C are carried on an arm which rotates clockwise at 100 rpm about the axis of A and D. If the wheel B and D have 25 and 40 teeth respectively, find the number of teeth on C and the speed and sense of rotation of 'C'. **(12 Marks)**

## Module-3

5    A cam rotating clockwise at uniform speed of 300rpm operates a reciprocating follower through a roller 15mm dia. The following motion is defined as below :
   i)   Outward during 150° with UARM
   ii)  Dwell for next 30°
   iii) Return during next 120° with SHM    iv) Dwell for the remaining period. Stroke of the follower is 30mm. Minimum radius of the cam is 30mm. Draw the cam profile when the follower axis passes through cam axis.    **(16 Marks)**

**OR**

6    A cam rotating clockwise at uniform speed 1200rpm operates a reciprocating follower through a knife edge follower. The following motion is defined as below :
   i)   Follower to move outward though 30mm during 120° of cam rotation with SHM
   ii)  Dwell of the next 60°
   iii) Follower to return to its staring position during next 90° with UARM.
   iv)  Dwell for the remaining
   Minimum radius 40mm. Draw the cam profile when the follower axis offset to the right by 10mm.    **(16 Marks)**

## Module-4

7  a.  Define static and dynamic balance.    **(02 Marks)**
   b.  A, B, C, D are four masses carried by a rotating shaft at radius 100, 125, 200 and 150mm respectively. The planes in which the masses revolve are spaced 600mm apart and the masses B, C and D are 10, 5, 4 is respectively. Find the required mass 'A' and the relative angular positions of the 4 masses to keep the shaft in balance.    **(14 Marks)**

**OR**

8  a.  Derive an expression for tension ratio of flat belt drive.    **(10 Marks)**
   b.  For maximum power condition prove that $T_c = T/3$ and $V = \sqrt{T/3m}$    **(06 Marks)**

## Module-5

9  a.  Derive an equation for gyroscopic couple by considering a plane disc.    **(06 Marks)**
   b.  Derive an expression for heel angle of a motor cycle to avoid skidding. Take right turn.    **(10 Marks)**

**OR**

10 a.  Define the terms :
       i) Sensitiveness    ii) Isochronous    iii) Effort    **(06 Marks)**
   b.  A porter governor has all four arms 300mm long. The upper arms are pivoted on the axis of rotation and lower arms are attached to th sleeve at a distance 35mm from axis. The mass of each ball is 7kg and the load on the sleeve is 540N. Determine the equilibrium speed for the two extreme radii of 200mm and 260mm of rotation of governor balls.    **(10 Marks)**

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