Gears

1. The pitch circle diameter of the smaller of the two spur wheels which mesh externally and have involute teeth is 100 mm. The number of teeth are 16 and 32. The pressure angle is 20° and the addendum is 0.32 of the circular pitch. Find the length of the path of contact of the pair of teeth.

[Ans. 29.36 mm]

2. A pair of gears, having 40 and 30 teeth respectively are of 25° involute form. The addendum length is 5 mm and the module pitch is 2.5 mm. If the smaller wheel is the driver and rotates at 1500 r.p.m., find the velocity of sliding at the point of engagement and at the point of disengagement.

[Ans. 2.8 m/s ; 2.66 m/s]

3. Two gears of module 4mm have 24 and 33 teeth. The pressure angle is 20° and each gear has a standard addendum of one module. Find the length of arc of contact and the maximum velocity of sliding if the pinion rotates at 120 r.p.m.

[Ans. 20.58 mm ; 0.2147 m/s]

4. The number of teeth in gears 1 and 2 are 60 and 40 ; module = 3 mm ; pressure angle = 20° and addendum = 0.318 of the circular pitch. Determine the velocity of sliding when the contact is at the tip of the teeth of gear 2 and the gear 2 rotates at 800 r.p.m**.**

[Ans. 1.06 m/s]

5. Two spur gears of 24 teeth and 36 teeth of 8 mm module and 20° pressure angle are in mesh. Addendum of each gear is 7.5 mm. The teeth are of involute form. Determine :

1. The angle through which the pinion turns while any pair of teeth are in contact.

2. The velocity of sliding between the teeth when the contact on the pinion is at a radius of 102 mm. The speed of the pinion is 450 r.p.m.

[Ans. 20.36°, 1.16 m/s]

6. A pinion having 20 involute teeth of module pitch 6 mm rotates at 200 r.p.m. and transmits 1.5 kW to a gear wheel having 50 teeth. The addendum on both the wheels is 1/4 of the circular pitch. The angle of obliquity is 20°. Find;

(a) the length of the path of approach

(b) the length of the arc of approach

(c) the normal force between the teeth at an instant where there is only pair of teeth in contact.

[Ans. 13.27 mm ; 14.12 mm ; 1193 N]

7. Two mating involute spur gear of 20° pressure angle have a gear ratio of 2. The number of teeth on the pinion is 20 and its speed is 250 r.p.m. The module pitch of the teeth is 12 mm. If the addendum on each wheel is such that the path of approach and the path of recess on each side are half the maximum possible length, find :

1. the addendum for pinion and gear wheel

2. the length of the arc of contact

3. the maximum velocity of sliding during approach and recess. Assume pinion to be the driver.

[Ans. 19.5 mm, 7.8 mm ; 65.5 mm ; 807.5 mm/s, 1615 mm/s]

8. Two mating gears have 20 and 40 involute teeth of module 10 mm and 20° pressure angle. If the addendum on each wheel is such that the path of contact is maximum and interference is just avoided, find the addendum for each gear wheel, path of contact, arc of contact and contact ratio.

[Ans. 14 mm ; 39 mm ; 102.6 mm ; 109.3 mm ; 4]

9. A 20° involute pinion with 20 teeth drives a gear having 60 teeth. Module is 8 mm and addendum of each gear is 10 mm.

1. State whether interference occurs or not. Give reasons.

2. Find the length of path of approach and arc of approach if pinion is the driver.

[Ans. Interference does not occur ; 25.8 mm, 27.45 mm]

10. A pair of spur wheels with involute teeth is to give a gear ratio of 3 to 1. The arc of approach is not to be less than the circular pitch and the smaller wheel is the driver. The pressure angle is 20°. What is the least number of teeth that can be used on each wheel? What is the addendum of the wheel in terms of the circular pitch?

[Ans. 18, 54 ; 0.382 Pc]

11. Two gear wheels mesh externally and are to give a velocity ratio of 3. The teeth are of involute form of module 6. The standard addendum is 1 module. If the pressure angle is 18° and pinion rotates at 90 r.p.m., find :

1. the number of teeth on each wheel, so that the interference is just avoided

2. the length of the path of contact

3. the maximum velocity of sliding between the teeth.

[Ans. 19, 57 ; 31.5 mm ; 213.7 mm/s]

12. A pinion with 24 involute teeth of 150 mm of pitch circle diameter drives a rack. The addendum of the pinion and rack is 6 mm. Find the least pressure angle which can be used if under cutting of the teeth is to be avoided. Using this pressure angle, find the length of the arc of contact and the minimum number of teeth in contact at one time.

[Ans. 16.8° ; 40 mm ; 2 pairs of teeth]

Gear Trains

1. A compound train consists of six gears. The number of teeth on the gears are as follows :

Gear	: A	B	C	D	E	F
No. of teeth	: 60	40	50	25	30	24

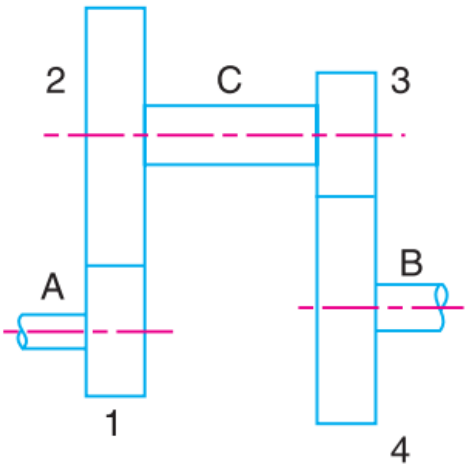
The gears B and C are on one shaft while the gears D and E are on another shaft. The gear A drives gear B, gear C drives gear D and gear E drives gear F. If the gear A transmits 1.5 kW at 100 r.p.m. and the gear train has an efficiency of 80 per cent, find the torque on gear F.

[Ans. 30.55 Nm]

2. Two parallel shafts are to be connected by spur gearing. The approximate distance between the shafts is 600 mm. If one shaft runs at 120 r.p.m. and the other at 360 r.p.m., find the number of teeth on each wheel, if the module is 8 mm. Also determine the exact distance apart of the shafts.

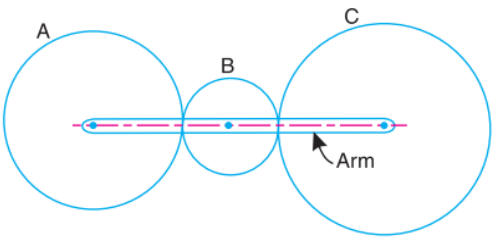
[Ans. 114, 38 ; 608 mm]

3. In a reverted gear train, as shown in Figure, two shafts A and B are in the same straight line and are geared together through an intermediate parallel shaft C. The gears connecting the shafts A and C have a module of 2 mm and those connecting the shafts C and B have a module of 4.5 mm. The speed of shaft A is to be about but greater than 12 times the speed of shaft B, and the ratio at each reduction is same. Find suitable number of teeth for gears. The number of teeth of each gear is to be a minimum but not less than 16. Also find the exact velocity ratio and the distance of shaft C from A and B.



[Ans. 36, 126, 16, 56 ; 12.25 ; 162 mm]

4. In an epicyclic gear train, as shown in Figure, the number of teeth on wheels A, B and C are 48, 24 and 50 respectively. If the arm rotates at 400 r.p.m., clockwise, find :

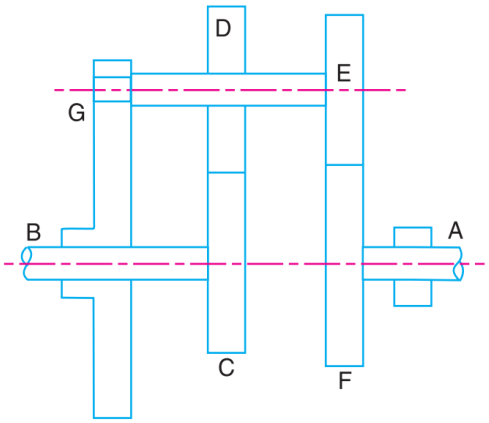


1. Speed of wheel C when A is fixed.

2. Speed of wheel A when C is fixed.

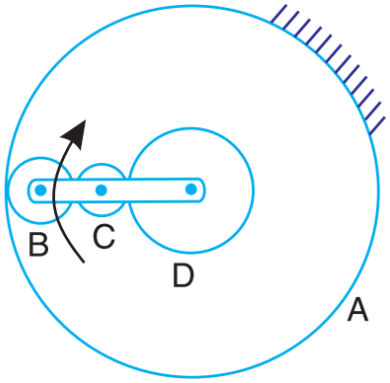
[Ans. 16 r.p.m. (clockwise) ; 16.67 (anticlockwise)]

5. In an epicyclic gear train, as shown in Figure, the wheel C is keyed to the shaft B and wheel F is keyed to shaft A. The wheels D and E rotate together on a pin fixed to the arm G. The number of teeth on wheels C, D, E and F are 35, 65, 32 and 68 respectively. If the shaft A rotates at 60 r.p.m. and the shaft B rotates at 28 r.p.m. in the opposite direction, find the speed and direction of rotation of arm G.

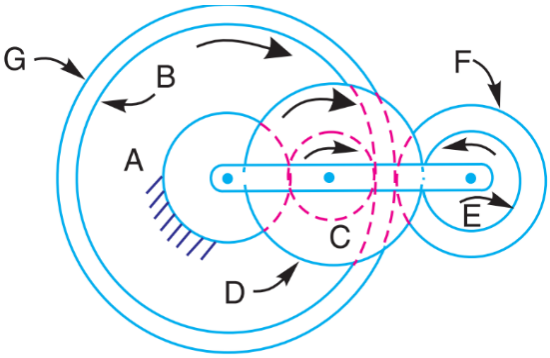


[Ans. 90 r.p.m., in the same direction as shaft A]

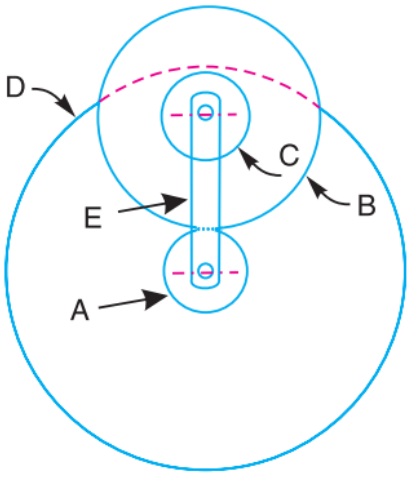
6. An epicyclic gear train, as shown in Figure, is composed of a fixed annular wheel A having 150 teeth. The wheel A is meshing with wheel B which drives wheel D through an idle wheel C, D being concentric with A. The wheels B and C are carried on an arm which revolves clockwise at 100 r.p.m. about the axis of A and D. If the wheels B and D have 25 teeth and 40 teeth respectively, find the number of teeth on C and the speed and sense of rotation of C. **[Ans. 30 ; 600 r.p.m. clockwise]**



7. Figure shows an epicyclic gear train with the following details : A has 40 teeth external (fixed gear) ; B has 80 teeth internal ; C - D is a compound wheel having 20 and 50 teeth (external) respectively, E-F is a compound wheel having 20 and 40 teeth (external) respectively, and G has 90 teeth (external). The arm runs at 100 r.p.m. in clockwise direction. Determine the speeds for gears C, E, and B. **[Ans. 300 r.p.m. clockwise ; 400 r.p.m. anticlockwise ; 150 r.p.m. clockwise]**



8. A reverted epicyclic gear train for a hoist block is shown in Figure. The arm E is keyed to the same shaft as the load drum and the wheel A is keyed to a second shaft which carries a chain wheel, the chain being operated by hand. The two shafts have common axis but can rotate independently. The wheels B and C are compound and rotate together on a pin carried at the end of arm E. The wheel D has internal teeth and is fixed to the outer casing of the block so that it does not rotate. The



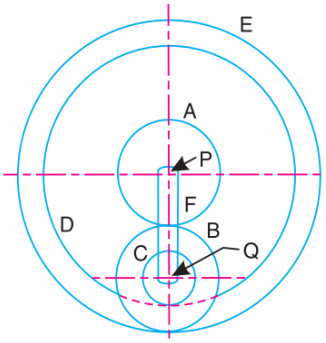
wheels A and B have 16 and 36 teeth respectively with a module of 3 mm. The wheels C and D have a module of 4 mm. Find :

1. the number of teeth on wheels C and D when the speed of A is ten times the speed of arm E, both rotating in the same sense.

2. the speed of wheel D when the wheel A is fixed and the arm E rotates at 450 r.p.m. anticlockwise.

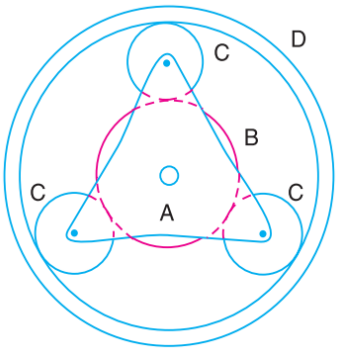
[Ans. TC = 13 ; TD = 52 ; 500 r.p.m. anticlockwise]

9. A compound epicyclic gear is shown diagrammatically in Figure. The gears A, D and E are free to rotate on the axis P. The compound gear B and C rotate together on the axis Q at the end of arm F. All the gears have equal pitch. The number of external teeth on the gears A, B and C are 18, 45 and 21 respectively. The gears D and E are annular gears. The gear A rotates at 100 r.p.m. in the anticlockwise direction and the gear D rotates at 450 r.p.m. clockwise. Find the speed and direction of the arm and the gear E.



[Ans. 400 r.p.m. clockwise ; 483.3 r.p.m. clockwise]

10. In an epicyclic gear train of the 'sun and planet type' as shown in Figure, the pitch circle diameter of the internally toothed ring D is to be 216 mm and the module 4 mm. When the ring D is stationary, the spider A, which carries three planet wheels C of equal size, is to make one revolution in the same sense as the sun wheel B for every five revolutions of the driving spindle carrying the sunwheel B. Determine suitable number of teeth for all the wheels and the exact diameter of pitch circle of the ring.



[Ans. TB = 14 , TC = 21 , TD = 56 ; 224 mm]