School of Engineering & Built Environment

African Leadership College Notes

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Module: Engineering Design and Analysis 2

Epicyclic Gear Train Analysis: Tutorial

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Original Epicyclic and Power Screw notes prepared by G.K. Vijayaraghavan (2006), Original Clutch, Belt and Brake Systems by Dr M. Macdonald, Updated notes prepared by A. Cowell (2017)

Epicyclic Gears Tutorial Sheet

1. The epicyclic gear train shown in Figure Q1 is driven through input shaft A running at 600 r.p.m anticlockwise by an electric motor. Gears B and C are joined and freely rotate on arm F. Gears A, B and D have 40, 25 and 80 teeth respectively, and casing E can either be stationary or driven in either direction. Determine:
   (i) the number of teeth on gear C and casing E;
   (ii) the speed and direction of rotation of gear D and output shaft F when casing E is stationary;
   (iii) the speed and direction of rotation of output shaft F when casing E rotates at 300 r.p.m in the opposite direction to input shaft A.

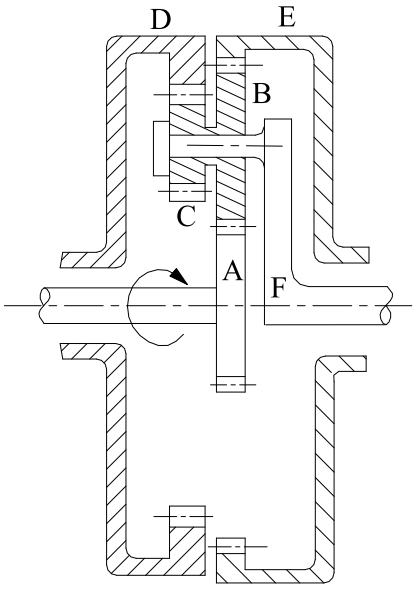

Figure Q1

[Ans: (i) 15 & 90 teeth; (ii) gear D rotates at 60.0 r.p.m anticlockwise and output shaft F rotates at 184.6 r.p.m anticlockwise; (iii) output shaft F rotates at 23.1 r.p.m clockwise]

2. An epicyclic gear shown in Figure Q2 is composed of a fixed annular gear A having 150 teeth. The gear A meshes with gear B which drives gear D through an idle gear C, D being concentric with A. The gears 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 gears B and D have 25 teeth and 40 teeth respectively, find the number of teeth on C and the speed and direction of rotation of gear C.

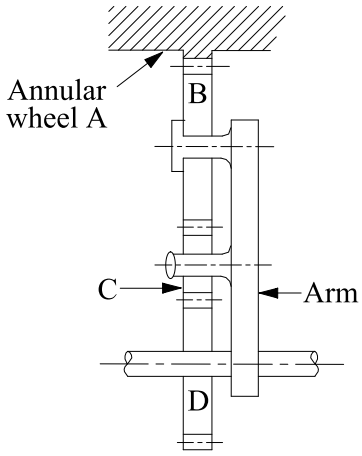

Figure Q2

[Ans: (i) Number of teeth on C is 30; (ii) Gear C rotates at 600 r.p.m clockwise]

3. An epicyclic gear train shown in Figure Q3 is driven through input shaft A running at 100 r.p.m. Gears A,B, C, D and E have 80, 40, 20, 30 and 20 teeth respectively, and casing F is kept stationary. Determine

   (i) the number of teeth on casing F

   (ii) the speed and direction of rotation of output shaft G for an input speed of 100 revs/min in the clockwise direction

   (iii) the speed and direction of rotation of output shaft G when input shaft A rotates clockwise at a speed of 100 revs/min and casing F rotates anticlockwise at a speed of 200 revs/min.

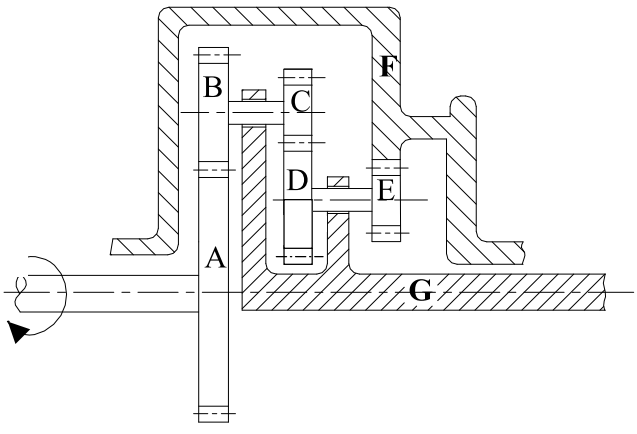

Figure Q3

[Ans: (i) 90 teeth; (ii) output shaft G rotates at 42.1 r.p.m anticlockwise;
(iii) output shaft G rotates at 326.32 r.p.m anticlockwise]

4. In a gear drive shown in Figure Q4, the casing is fixed. Gear B rotates freely on shaft Y and carries a pin on which rotates the gears C and D, which are fixed together. Gears F and G are fixed together and rotate freely on the shaft Y. The pitch of the teeth is same for all gears, and the numbers of teeth on each gear are given in the table

Gear	A	B	C	D	F	G	H
Teeth	32	80	20	16	28	24	30

The gear E is fixed on shaft Y.

If the shaft X rotates at 200 rev/min anticlockwise, find the speed and direction of rotation of shaft Y for the following two cases

(i) shaft Z is fixed,

(ii) shaft Z rotates at 100 rev/min in the same direction as X.

[Ans: (i) shaft Y rotates at 225.8 r.p.m clockwise;
(ii) shaft Y rotates at 408.1 r.p.m clockwise]

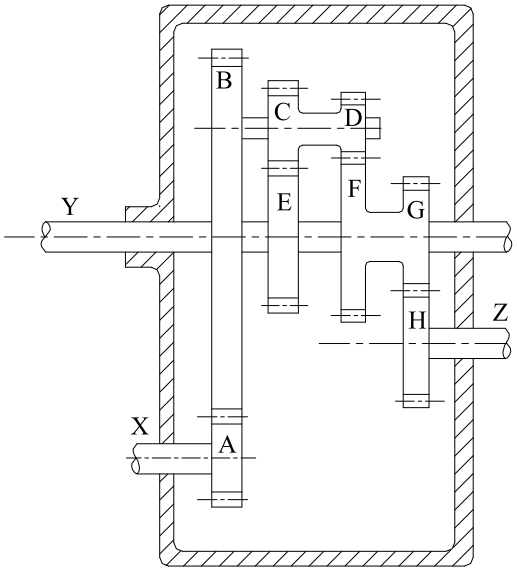

Figure Q4

5. A compound epicyclic gear is shown in Figure Q5. C and D form a compound gear which rotates freely on shaft G. The planet gear B and E rotate on pins fixed on arms attached to shaft G. C and F have internal teeth; and others have external teeth, with the following numbers: A, 40; B, 30; D, 50; E, 20.

If A rotates at 500 r.p.m in clockwise direction and gear F is fixed, find the speed of shaft G.

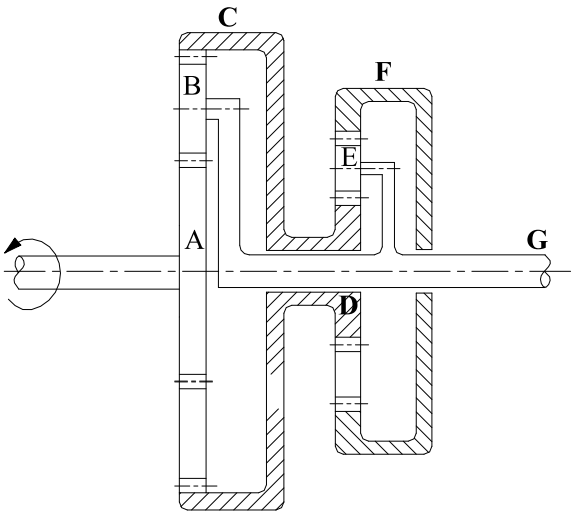

Figure Q5

[Ans: Speed of shaft G is 143 r.p.m anticlockwise]

6. In the epicyclic gear shown in Figure Q6, the sun shaft X is driven in a clockwise direction at 1200 rev/min while the annulus B is driven in an anticlockwise direction at 600 rev/min. Determine the speeds and directions of rotation of the annulus C and of the shaft Y. The number of teeth in the various gears A, B, C and D are 30, 100, 75 and 25 respectively.

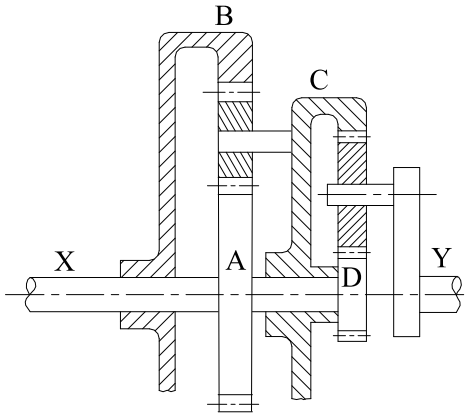

Figure Q6

[Ans: (i) Annulus gear C rotates at 184.6 r.p.m anticlockwise;
(ii) shaft Y rotates at 161.5 r.p.m clockwise]