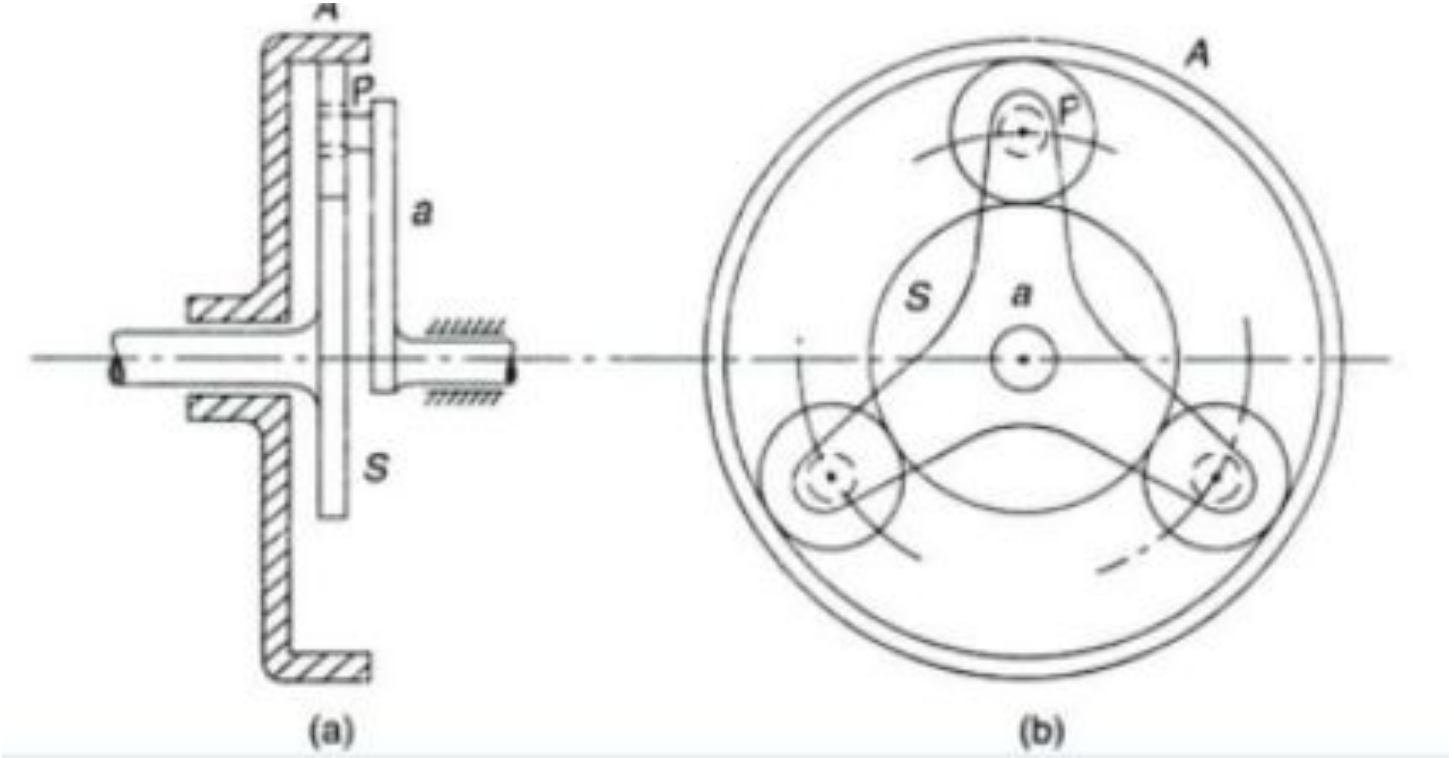
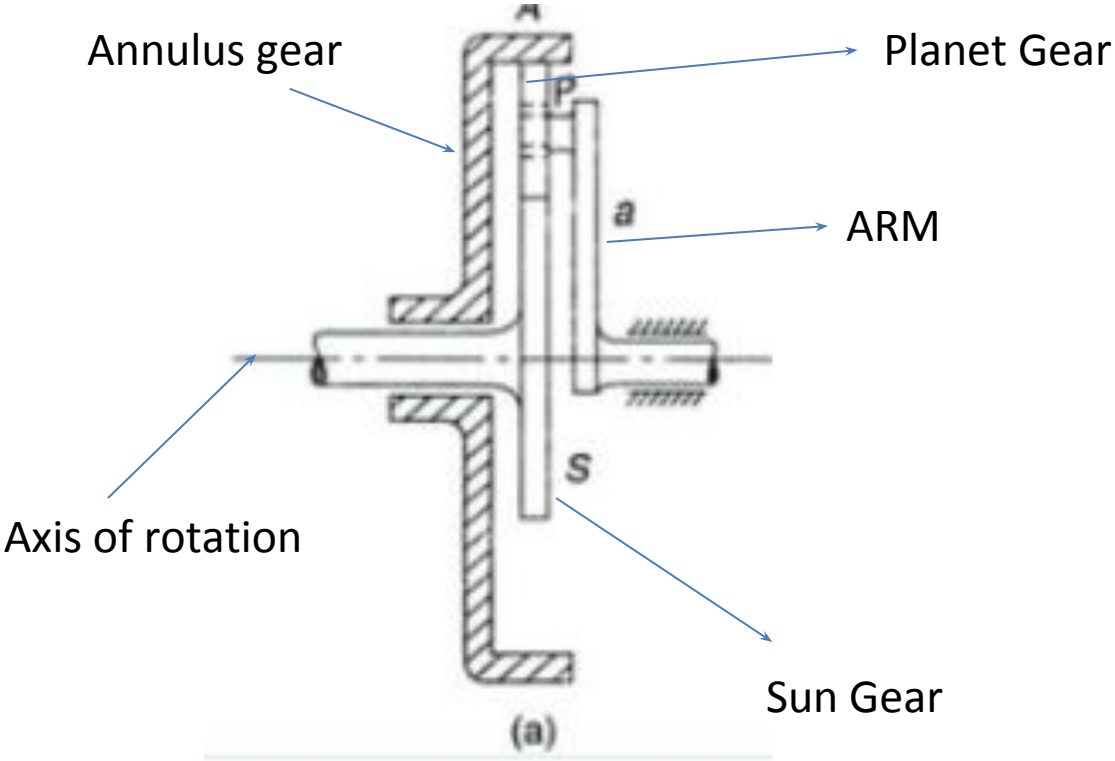
MEE-S301

Epicyclic gear train

Q1. The annulus A in the gear shown in the fig 1. rotates at 300 rpm about the axis of the fixed wheel S which has 80 teeth. The three-armed spider (only one arm a is shown in figure) is driven at 180 rpm. Determine the number of teeth required on the wheel P.



First identify gear name



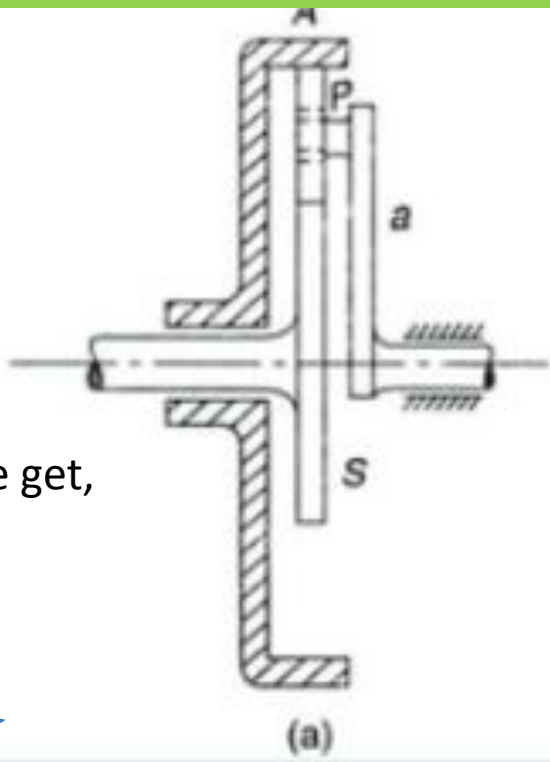
Internal gear

Sun Gear : Sun gear rotates about fixed axis of rotation.

Arm : Arm rotates about fixed axis of rotation.

Planet: Axis of rotation of planet is not fixed.

	Sun gear (S)	Planet gear (P)	Annulus (A)	ARM (a)
Speed (N)	$N_S = 0$	$N_P = ??$	$N_A = 300$ rpm	$N_{arm} = 180$ rpm
No of teeth	$Z_S = 80$	$Z_P = ??$	$Z_A = ??$	-



(a)

- Sun gear, planet gear, arm constitute external epicyclic gear train

By using relative velocity method,

$$\frac{N_S - N_{Arm}}{N_P - N_{Arm}} = -\frac{Z_P}{Z_S} \quad [N_S = 0,\ N_{ARM} = 180 \text{ rpm}]$$

$$\frac{0-180}{N_P-180} = -\frac{Z_P}{80} \text{ - - - - (1)}$$

- Internal gear A, planet gear P , arm constitute internal epicyclic gear train

By using relative velocity method,

$$\frac{N_A - N_{Arm}}{N_P - N_{Arm}} = +\frac{Z_P}{Z_A} \quad [N_A = 300 \text{ rpm},\ N_{ARM} = 180 \text{ rpm}]$$

$$\frac{300-180}{N_P-180} = +\frac{Z_P}{Z_A} \text{ - - - - (2)}$$

Divide (1) and (2) we get,

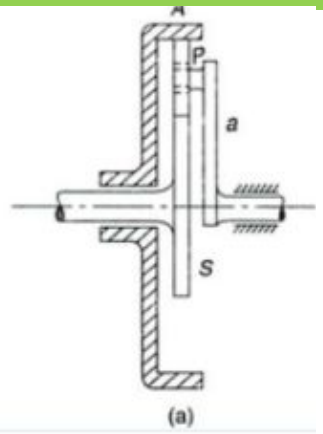
$$\frac{\left(\frac{0-180}{N_P-180}\right)}{\left(\frac{300-180}{N_P-180}\right)} = \frac{-\frac{Z_P}{80}}{\frac{Z_P}{Z_A}}$$

$$\frac{180}{120} = \frac{Z_A}{80}$$

$$Z_A = \frac{3}{2} \times 80 = 120$$

Number of teeth on gear A is equal to 120.

	Sun gear (S)	Planet gear (P)	Annulus (A)	ARM (a)
Speed (N)	$N_S = 0$	**$N_P = 900$ rpm**	$N_A = 300$ rpm	$N_{arm} = 180$ rpm
No of teeth	$Z_S = 80$	$Z_P = 20$	**$Z_A = 120$**	-



Since gear S is mesh with gear P. Therefore module of gear S is equal to module of gear P

Module of gear S = $\frac{2r_s}{Z_S}$

Module of gear P = $\frac{2r_p}{z_P}$

Similarly gear P is mesh with internal gear A. Therefore module of gear P is equal to module of gear A.

Module of gear P = $\frac{2r_p}{z_P}$

Module of gear A= $\frac{2r_A}{Z_A}$

Module of gear S = Module of gear P = Module of gear A

$$\frac{2r_s}{Z_S} = \frac{2r_p}{z_P} = \frac{2r_A}{Z_A} = m$$

Also $r_A = r_s + 2r_P$

$Z_A = Z_S + 2Z_P$

120 = 80 + 2 x Z_P

$Z_P = 20$

$N_P = 900\ rpm$

$$\frac{0 - 180}{N_P - 180} = -\frac{Z_P}{80}$$

From this equation we can find speed of planet gear