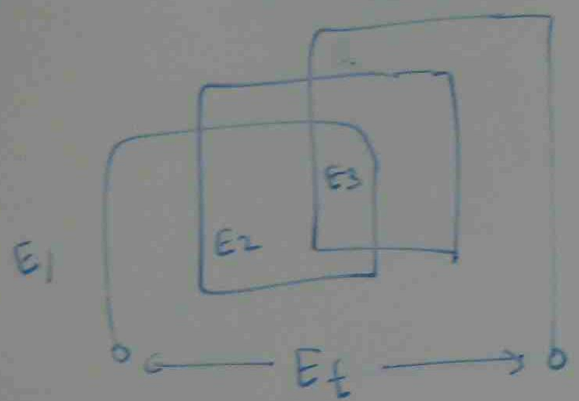
SLOT PITCH

$$\psi = \text{SLOT PITCH} = \frac{180°}{\frac{\text{No of SLOTS}}{2 \times \text{No. of POLES}}}$$



$$\text{DISTRIBUTION FACTOR} = \frac{E_t}{E_1 + E_2 + E_3}$$

$$K_d = \frac{\text{COMPLEX VECTOR SUM OF COIL EMFs}}{\text{ARITHMETIC SUM OF COIL EMFs}}$$

FULL PITCH

COIL SPAN = 9

SHORT PITCH

COIL SPAN = C

COIL

FULL PITCH

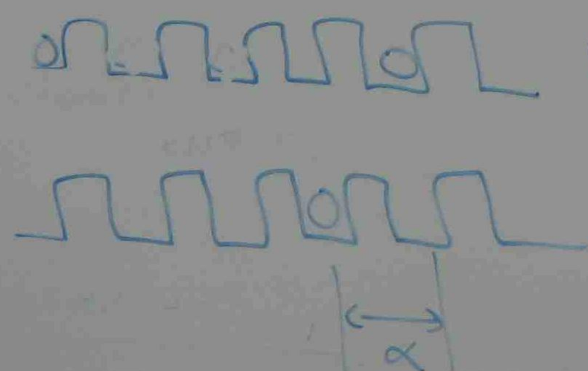
COIL SPAN = 9 $\longmapsto$ 10

SHORT PITCH

COIL SPAN = 9 $\longmapsto$ 9

COIL SPAN FACTOR (K_S) = $\dfrac{\text{EMF IN THE SHORT OR LONG COIL}}{\text{EMF IN FULL PITCH COIL}}$

m OF COIL EMFS
of COIL EMFS



FULL PITCH

$\alpha = \dfrac{360^\circ \times \text{NO OF SLOTS DIFFERENCE BETWEEN FULL PITCH AND SHORT PITCH COIL}}{\text{TOTAL NO. OF SLOTS ON STATOR}}$ ..

OIL S

EM

COIL SPAN FACTOR $K_s = \cos\frac{\alpha}{2}$

EMF INDUCED / PHASE OF 3φ WINDING (VOLT) $= 4.44\, K_d\, K_s\, f\, \phi\, N_p$

K_d = DISTRIBUTION FACTOR

K_s = COIL SPAN FACTOR

f = FREQUENCY (HZ)

ϕ = FLUX (Wb)

N_p = NO OF TURNS / PHASE

SLIP

$$s = \frac{N_s - N_r}{N_s}$$

S = SLIP

N_s = SYNCHRONOUS SPEED

N_r = ROTOR SPEED

Pb. A 0.5 HP 6 POLES INDUCTION MOTOR IS EXCITED BY A 1 PHASE 60 HZ SOURCE IF FULL LOAD SPEED IS 1140 RPM, CALCULATE THE SLIP.

N_s = SYNCHRONOUS SPEED $= \frac{120f}{P} = \frac{120 \times 60}{6} = 1200$ RPM

$$S = \frac{N_s - N_r}{N_s} = \frac{1200 - 1140}{1200} = 0.05$$

SLIP SPEED = $S\ N_S$

$= 0.05 \times 1200$

$= 60$ RPM.

ROTOR FREQUENCY = SLIP × STATOR VOLTAGE FREQUENCY

$$f_r = S \times f_s$$

ROTOR VOLTAGE = SLIP × OPEN CIRCUIT VOLTAGE IN ROTOR WHEN MOTOR IS STOPPED.

$$E_2 = S \times E_{OC}$$

Pb — THE 6 POLES WOUND ROTOR INDUCTION MOTOR IS EXCITED BY A 3ϕ 60 HZ SOURCE. CALCULATE THE FREQUENCY OF THE ROTOR CURRENT UNDER THE FOLLOWING CONDITIONS

(a) AT STAND STILL

(b) MOTOR TURNING AT 500 RPM IN THE SAME DIRECTION AS THE REVOLVING FIELD

(c) MOTOR TURNING AT 500 RPM IN THE OPPOSITE DIRECTION TO THE REVOLVING FIELD

(d) MOTOR TURNING AT 2000 RPM IN THE SAME DIRECTION TO THE REVOLVING FIELD.

(a) STAND STILL $N_r = 0$

$$N_s = \frac{120f}{P} = \frac{120 \times 60}{6} = 1200 \text{ RPM}$$

$$S = \frac{N_s - N_r}{N_s} = \frac{1200 - 0}{1200} = 1$$

$$f_r = S \times f_s = 1 \times 60 = 60 \text{ Hz}$$

(b) $N_r = 500$ RPM

$$S = \frac{N_s - N_r}{N_s}$$

$$= \frac{1200 - 500}{1200}$$

$$= 0.583$$

$$f_r = s f_s$$

$$= 0.583 \times 60$$

$$= 35 \text{ Hz}$$

(c) 500RPM OPPOSITE DIRECTION

$N_r = -500$ RPM

$$S = \frac{N_s - N_r}{N_s}$$

$$= \frac{1200 - (-500)}{1200}$$

$$= \frac{1200 + 500}{1200}$$

$$= 1.417$$

$$f_r = s f_s$$

$$= 1.417 \times 60$$

$$= 85 \text{ Hz}$$

(d) $N_r = 2000$ RPM

$N_s = 1200$ RPM

$$S = \frac{N_s - N_r}{N_s}$$

$$= \frac{1200 - 2000}{1200}$$

$$= -0.667$$

$$f_r = s \times f_s$$

$$= -0.667 \times 60$$

$$= -40 \text{ Hz}$$

GENERATOR ACTION

MOTOR ACTION — NORMAL ROTATION — PHASE SEQUENCE A B C — SLIP = +

GENERATOR ACTION — REVERSE ROTATION — PHASE SEQUENCE A C B — SLIP = −

ESTIMATING THE CURRENT IN INDUCTION MOTOR

$$I = \frac{746 \times HP}{\sqrt{3}\, E \times PF}$$

I = MOTOR CURRENT

HP = MOTOR HORSE POWER

E = MOTOR VOLTAGE

PF = MOTOR POWER FACTOR

$$\boxed{PF = \frac{\text{WATT METER READING}}{\text{VOLT METER READING} \times \text{AM METER READING}}}$$

APPROXIMATE EQUATION

$$I = \frac{600 \times HP}{E}$$

pb

(a) CALCULATE THE APPROXIMATE FULL LOAD CURRENT, LOCKED MOTOR CURRENT AND NO LOAD CURRENT OF A 3ϕ INDUCTION MOTOR HAVING A RATING OF 500 HP, 2300 V

(b) ESTIMATE THE APPARENT POWER DRAWN UNDER LOCKED ROTOR CONDITION

(c) STATE THE NORMAL RATING OF THIS MOTOR EXPRESSED IN KILOWATT.

(NO LOAD CURRENT = 30% OF FULL LOAD CURRENT
STARTING CURRENT = 500% OF FULL LOAD CURRENT)

(a) FULL LOAD CURRENT $= \dfrac{600\ \text{HP}}{E} = \dfrac{600 \times 500}{2300} = 130$ Amp.

NO LOAD CURRENT = 30% OF FULL LOAD CURRENT

$= 0.3 \times 130 = 39$ Amp

STARTING CURRENT = 500% OF FULL LOAD CURRENT

$= 5 \times 130 = 650$ Amp.

(b) APPARENT POWER UNDER LOCKED ROTOR CONDITION $= \sqrt{3} \times$ FULL LOAD LINE VOLTAGE $\times$ HIGHEST VALUE OF STARTING CURRENT

$= 1.7321 \times 2300 \times 650$

UA

=

(c) $kW = \dfrac{HP}{1.34} = \dfrac{500}{1.34} = 373\ kW$