Ex (23)

A 3ϕ INDUCTION MOTOR HAVING SYNCHRONOUS SPEED OF 1200 RPM DRAWS 80 KW FROM A 3ϕ FEEDER. COPPER LOSS AND IRON LOSS IN STATOR AMOUNT TO 5 KW. IF THE MOTOR RUNS AT 1152 RPM, CALCULATE THE FOLLOWINGS

(a) ACTIVE POWER TRANSMITTED TO THE ROTOR

(b) ROTOR I^2R LOSS

(c) MECHANICAL POWER DEVELOPED

(d) THE MECHANICAL POWER DELIVERED TO THE LOAD KNOWING THAT THE WINDAGE AND FRICTION LOSSES ARE EQUAL TO 2 KW.

(e) THE EFFICIENCY OF MOTOR.

(a) ACTIVE POWER TRANSMITTED TO ROTOR (P_o) $= P_s - (\text{IRON} + I^2R \text{ LOSS})$

$= 80 - 5 = 75 \text{ KW}$

$$SLIP = \frac{n_s - n}{n_s} = \frac{1200 - 1152}{1200} = 0.04$$

(b) ROTOR I^2R LOSS $= S \times P_o$

$= 0.04 \times 75$

$= 3 \text{ KW}$

(c) MECHANICAL POWER DEVELOPED $= (1 - S) P_o$

$= (1 - 0.04) \times 75$

$= 72 \text{ KW}$

(d)

MECHANICAL POWER DELIVERED TO LOAD = MECHANICAL POWER DEVELOPED − FRICTION AND WINDAGE LOSS

$= 72 - 2 = 70\ kW$

(e)

$$\text{EFFICIENCY of motor} = \frac{\text{MECHANICAL POWER DELIVERED TO LOAD}}{\text{ELECTRICAL POWER SUPPLIED TO MOTOR}} \times 100$$

$$= \frac{70}{80} \times 100 = 87.5\%$$

Ex (24) A 3ϕ 8 POLES SQUIRREL CAGE INDUCTION MOTOR CONNECTED TO A 60 HZ LINE POSSESSES A ROTOR SPEED 900 RPM. THE MOTOR ABSORBS 40 kW AND THE COPPER AND IRON LOSSES IN THE STATOR AMOUNT TO 5 kW AND 1 kW RESPECTIVELY. CALCULATE THE TORQUE DEVELOPED BY MOTOR.

ACTIVE POWER SUPPLIED TO ROTOR = ACTIVE POWER ABSORBED FROM SUPPLY − (IRON LOSS + COPPER LOSS)

$= 40 - (1 + 5) = 34\ kW$

MECHANICAL POWER DEVELOPED BY ROTOR = ACTIVE POWER SUPPLIED TO ROTOR (P_o) − ROTOR COPPER LOSS

$= 34 - 0$

$= 34$ kW

$$T_m = \frac{P_m \times 9.55}{\text{ROTOR SPEED}} = \frac{34000 \times 9.55}{900} = 361 \text{ N-m}$$

Ex 25

A 3ϕ INDUCTION MOTOR HAVING A NOMINAL RATING OF 100 HP (75 kW) AND SYNCHRONOUS SPEED OF 1800 RPM IS CONNECTED TO A 600 V SOURCE. TWO WATT METERS METHOD SHOWS A TOTAL POWER CONSUMPTION 78 kW AND AN AMMETER INDICATES A LINE CURRENT 78 Amp. ROTOR SPEED IS 1763 RPM. THE FOLLOWING RESULTS ARE ALSO OBTAINED.

STATOR IRON LOSS = 2 kW

WINDAGE AND FRICTION LOSS = 1.2 kW

RESISTANCE BETWEEN TWO STATOR TERMINALS = 0.34 Ω

CALCULATE

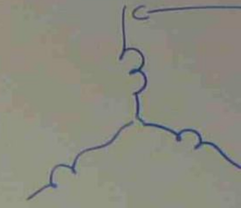
(i) POWER SUPPLIED TO THE ROTOR

(ii) ROTOR I^2R LOSS

(iii) MECHANICAL POWER SUPPLIED TO THE LOAD

(iv) EFFICIENCY

(v) TORQUE DEVELOPED AT 1763 RPM



(i)

INPUT ELECTRIC

STATOR COPPER

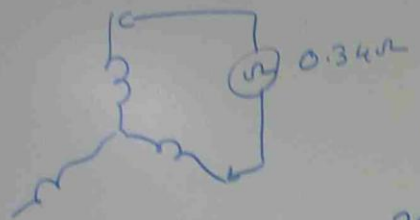
ELECTRICAL POW

(ii) ROTOR C

SLIP

ROTO

(iii)



$R_{ph} = \frac{0.34}{2} = 0.17\,\Omega$

(i)

INPUT ELECTRICAL POWER = 78 kW

STATOR COPPER LOSS = $3I^2R = 3 \times 78^2 \times 0.17 = 3.1$ kW

ELECTRICAL POWER SUPPLIED TO ROTOR (P_o) = I/P POWER − (IRON LOSS + COPPER LOSS)

$= 78 - (2 + 3.1)$

$= 64.9$ kW

(ii) ROTOR COPPER LOSS = $S \times P_o$

SLIP = $S = \frac{n_s - n}{n_s} = \frac{1800 - 1763}{1800} = 0.0205$

ROTOR COPPER LOSS = $0.0205 \times 64.9 = 1.33$ kW

(iii) MECHANICAL POWER DEVELOPED IN ROTOR P_m = P_o − ROTOR COPPER LOSS

$= 64.9 - 1.33$

$= 63.5$ kW

(iv) SHAFT POWER = P_m − FRICTION AND WINDAGE LOSS

$= 63.5 - 1.2 = 62.3$ kW

$Hp = 1.34 \times kW = 1.34 \times 62.3 = 83.5\,Hp$

(v)

EFFICIENCY = $\frac{\text{SHAFT POWER}}{\text{INPUT POWER}} \times 100$

$= \frac{62.3}{78} \times 100$

$= 79.8\%$

(vi)

TORQUE = $\frac{P_m \times 9.55}{(1-S) \times n_s}$

$= \frac{63.5 \times 10^3 \times 9.55}{1763}$

$= 344$ N-m

q

to the rotor

loss

power supplied

ed

cy

developed at

n