Sheet (3)

Electrical Machines IV - 2016/2017

(1) In a 3-phase, slip-ring induction motor, the open-circuit voltage across slip-rings is measured to be 110V with normal voltage applied to the stator. The rotor is Y-connected and has a resistance of 1Ω and reactance of 4Ω at standstill condition. Find the rotor current when the machine is:
(a) at stand-still with slip-rings joined to Y-connected starter with a resistance of 2Ω per phase. and negligible reactance.
(b) running normally with 5% slip.
[answer: (a) 12.7A (b) 3.11A]

(2) A 4-pole, 50-Hz induction motor has a full-load slip of 5%. Each rotor phase has a resistance of 0.3Ω and a standstill reactance of 1.2Ω. Find the ratio of Maximum Torque to full-Load Torque. Also, the speed at which Maximum Torque occurs. [ans.: 2.6 - 1125rpm]

(3) A 3-phase, 4-pole, 50-Hz induction motor has a Y-connected rotor. The voltage of each rotor phase at standstill and on open-circuit is 121V. The rotor resistance per phase is 0.3Ω and the reactance at standstill is 0.8Ω. If the rotor current is 15A. Calculate:
(a) the speed at which the motor is running [ans. (a) 1402 rpm (b) 938 rpm]
(b) the speed at which the Torque is Maximum.

(4) A 50-Hz, 3-φ, 8-pole Induction motor has a full-load slip of 4%. The rotor resistance is 0.001Ω per phase and standstill reactance is 0.005Ω per phase. Find:
(a) Ratio of Maximum Torque to full-Load Torque. [ans: 2.6 - 600rpm]
(b) speed at which Maximum Torque occurs.

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(5) A 3-ϕ, 50-Hz induction motor with its rotor Y-connected gives 500V (rms) at standstill between slip-rings on open-circuit. Calculate the current and power factor in each phase of the rotor windings at standstill when joined to Y-connected circuit, each limb of which has a resistance of 10Ω and an inductance of 0.03H. The resistance per phase of the rotor windings is 0.2Ω and inductance 0.03H. Calculate also the current and power factor in each rotor phase when the rings are short-circuited and the motor is running with slip of 4%.

[answer: 13.5A – 0.48 Lag]
27A – 0.47 Lag

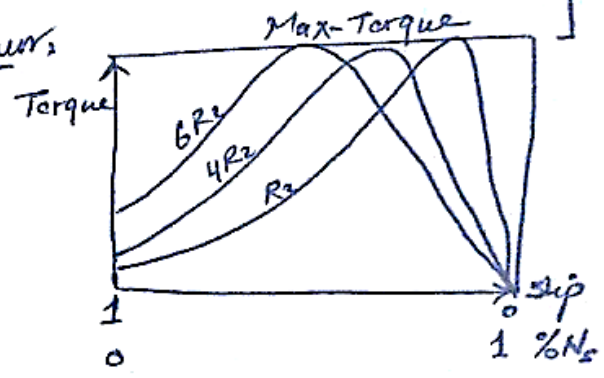
(6) Deduce the three phase induction motor under Running condition.

[answer: deduce: $T_r = \frac{3}{2\pi N_s} \cdot \frac{S E_2^2 R_2}{\sqrt{R_2^2 + (SX_2)^2}}$]

(7) Deduce the 3-phase induction motor Running Torque. Also, What is the value of slip? [answer: $T_{r(max)} = \frac{K_1 S}{2R_2} = \frac{K_1}{2X_2}$, $S = \frac{R_2}{X_2}$]

(8) Draw the Torque-slip characteriss for induction motor at different values of Rotor circuit resistance.

[answer:



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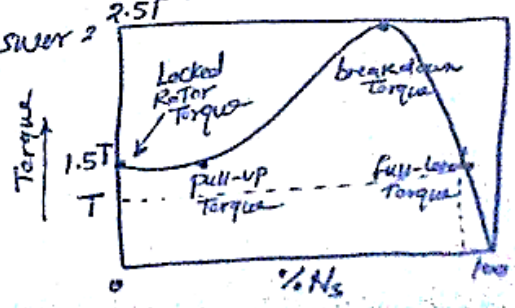
(9) Draw the torque-speed characteriss for induction motor. Showing the points of: Full-load Torque – breakdown Torque – Locked Rotor Torque – pull-up Torque on the curve.

[answer:



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(10) What is the induction motor speed regulation. Write the equation. Why the induction motor is classed as a constant-speed motor.

(11) What are the factors affects on speed of induction Motor ?

[answer f, P, S_{Slip}]

f ← supply freq.

P ↓ stator poles