

EE3124 Tutorial 7

Special Machines and Applications

Name:

Student No.:

Q1 - Why is the torque-speed characteristic of a universal motor on an ac source different from the torque-speed characteristic of the same motor on a dc source?

Q2 - Why is a single-phase induction motor unable to start itself without special auxiliary windings?

Q3 - A three-phase P.M. brushless DC motor has a torque constant ($k\Phi$) of 0.12 Nm/A referred to the DC supply. If the armature resistance is 0.150 Ω /phase and the voltage drop across the semiconductor switch is 1 V.

- i) what is the no-load speed in r.p.m. when it is connected to a 48 V DC supply.
- ii) What is the pullout torque and current of the motor?
- iii) What is the maximum power speed in r.p.m.?

Q4 - An universal motor is very similar to a DC series motor in construction, but it is modified slightly to allow the motor to operate properly on AC power. A washing machine is driven by an universal motor, which is powered by single-phase AC source having 110 Vac and 60 Hz. The armature winding of the motor has the resistance and inductance of 0.4 Ω and 3 mH, respectively. The field winding of the motor has the resistance and inductance of 0.8 Ω and 6 mH, respectively. When the washing machine operates at half load torque, the motor draws 10 Aac and runs at 1000 rpm. Calculate the input current and speed of the motor when the washing machine operates at full load torque.

At half load torque,

- (i) Calculate impedance of the armature and field windings.
- (ii) Calculate the average electromotive force (emf) and average current in the armature.

At full load torque.

- (iii) Determine the average and root mean square armature current.
- (iv) Determine the average emf in the armature.
- (v) Determine the speed of the motor.