(3 Hours) [Total Marks: 80]

N. B.: (1) Question No. 1 is compulsory.
    (2) Attempt any three questions from remaining five questions.
    (3) Assume suitable data if necessary.
    (4) Figures to the right indicate full marks.

1. Attempt **any four** questions: **20**
   (a) Explain block diagram of DC motor control. Name any four strategies for DC motor speed control.

   (b) Why only IGBT/MOSFET are preferred over thyristor in an inverter? Justify.

   (c) Draw torque-speed characteristics of three-phase induction motor during plugging, motoring and generating modes.

   (d) With help of neat block diagram explain the working of SMPS.

   (e) Give the significance of slip in AC motors.

2. (a) Explain the operation of AC induction motor at point A, B, and C in the **10** following figure. Which operating point is most suitable? Justify.
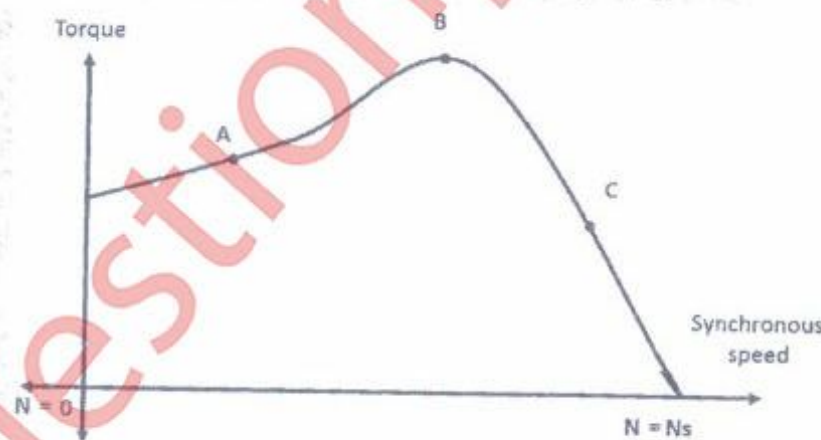

Fig. Q-2(a)

   (b) Explain the working principle of UPS. State their classification. Briefly **10** discuss each type in detail.

3. (a) Explain variable frequency control method of induction motor for two **10** different working modes.

   (b) Explain state vector sequence and switching used in SVM. State **10** advantages of SVM. Draw state vector sequence diagram for sector 1.

[TURN OVER]

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4. (a) Derive expression for output voltage of single phase fully controlled **10** rectifier in the presence of source inductance.

(b) A separately excited DC motor with ratings 200V, 1000 rpm, 50 **10** Amperes and Ra = 0.2Ω is driven using full converter fed with 230 V, 50 Hz, single-phase supply. Determine firing angle of the converter if motor speed is 500 rpm at half the rated torque. Assume field winding is fed with rated voltage.

5. (a) Derive and explain the average state space model of buck converter. Use **10** this state space model to derive equation for output voltage of buck converter at equilibrium condition (dv/dt = 0).

(b) Explain in detail the working principle of buck-boost converter with **10** help of neat diagram and waveform. Justify why the output is inverted.

6. Write short notes on **(any three)** **20**

   (a) Battery charging system.

   (b) PID control for DC to DC converter.

   (c) V/F control.

   (d) Harmonic reduction in inverters.

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