AMIETE – ET (OLD SCHEME)

Code: AE26
Time: 3 Hours

DECEMBER 2010

Subject: POWER ELECTRONICS
Max. Marks: 100

NOTE: There are 9 Questions in all.
- **Question 1 is compulsory and carries 20 marks. Answer to Q.1 must be written in the space provided for it in the answer book supplied and nowhere else.**
- **The answer sheet for the Q.1 will be collected by the invigilator after half an hour of the commencement of the examination.**
- **Out of the remaining EIGHT Questions answer any FIVE Questions. Each question carries 16 marks.**
- **Any required data not explicitly given, may be suitably assumed and stated.**

Q.1 **Choose the correct or the best alternative in the following:** (2×10)

a. When a thyristor is conducting the voltage drop across it is

   (A) Absolutely constant
   (B) Decreases with increase in load current
   (C) Increase slightly with increase in load current
   (D) Any of above

b. Triac can be turned on by applying gate signal which is

   (A) Positive   **(B)** Negative
   (C) Positive or negative   **(D)** None of the above

c. Power MOSFET is a

   (A) Voltage Controlled Device   **(B)** Current Controlled Device
   (C) Field Controlled Device   **(D)** A and C both

d. A UJT exhibits a negative resistance region:

   (A) Before the peak point   **(B)** Between the peak & valley point
   (C) After the valley point   **(D)** Both (A) & (B)

e. The effect of source inductance in a controlled rectifier is to

   (A) Increase the load voltage
   (B) Decrease the load voltage
   (C) Reduce the ripples in the load current.
   (D) Increase the ripples in the load current

f. If the duty cycle of the chopper circuit is exactly 50% then the pulse is considered to be

   (A) Sine wave   **(B)** Square Wave
   (C) Triangular wave   **(D)** None of these above

g. In a 3- phase half wave rectifier the duration of conduction of each thyristor is

(A) 30°　　　　　　　　　　　**(B)** 60°
(C) 45°　　　　　　　　　　　**(D)** 120°

h. A device that converts an dc source into ac is called

(A) Inverter　　　　　　　　　　**(B)** Chopper
(C) Rectifier　　　　　　　　　　**(D)** Cyclo-converter

i. The Natural commutation can be used in

(A) DC circuits　　　　　　　　　**(B)** AC circuits
(C) Both ac & dc circuits　　　　　**(D)** None of above

j. A device that converts a fixed frequency ac source into a lower frequency ac source is known as

(A) An inverter　　　　　　　　　**(B)** A PWM circuit
(C) A converter　　　　　　　　　**(D)** A cyclo-converter

Answer any FIVE Questions out of EIGHT Questions.
Each question carries 16 marks.

Q.2 a. What is a thyristor? Give constructional details of a typical thyristor. Also describe the necessary conditions for turning on of a thyristor. **(8)**

b. It is required to operate 250A SCR in parallel with 350A SCR with their respective on-state voltage drops of 1.6V and 1.2V. Calculate the value of resistance to be inserted in series with each SCR so that they can share the total load of 600A in proportion to their current ratings. **(8)**

Q.3 a. Draw and explain the waveform of supply voltage, load voltage, load current and current through SCR of a single phase half wave controlled rectifier feeding R-L load. **(8)**

b. Explain the following in brief **(8)**
   (i) Inverting mode of a converter
   (ii) Transformer ratings for rectifying circuits

Q.4 a. State the principle of chopper operation highlighting the operation of step down and step up chopper. **(10)**

b. A step up chopper has supply voltage of 250V while the output voltage is 500V. If the off period of chopper be 100μsec, determine the pulse width of the output voltage. **(6)**

Q.5 a. What is an ac voltage controller? Explain briefly on-off and phase control principles of ac voltage controller. **(8)**

b. The 1-φ Full wave controller supplies an RL load. The input rms voltage is 120V, 60 Hz. The load is such that L = 6.5 mH and $R = 2.5\Omega$. The delay angles of thyristors are equal and equal to $\frac{\pi}{2}$. Determine

  (i) input power factor
  (ii) rms thyristor and output current. **(8)**

Q.6 a. Explain the working of cycloconverter using simple diagram. What is meant by blocked group operation. Explain. **(8)**

  b. A three phase to single phase blocked group operated cycloconverter constituted by 6-pulse bridge converters is to supply an inductive load. The output frequency is 2 Hz and the inductive load reactance at this frequency is 1.6 Ω. The load circuit resistance is 2 Ω. The cycloconverter is directly supplied from a three phase 440 V rms (line to line), 50 Hz source The cycloconverter uses cosinusoidal modulating signal and sinusoidal reference voltage. Calculate **(8)**
  (i) RMS output voltage if modulation factor is 0.5 and
  (ii) RMS output current Neglect commutation intervals of thyristors.

Q.7 a. Explain the working principle of the following PWM techniques **(8)**
  (i) Multiple pulse-width modulation
  (ii) Sinusoidal pulse-width modulation

  b. A 1-phase centre-tapped supply inverter has a resistive load of R = 1 KΩ and the dc supply voltage is 230 V. Determine the rms output voltage, Voltage of the fundamental component, and the output power. **(8)**

Q.8 a. Discuss the methods by which power semiconductor devices may be used to control the speed of dc drives. **(8)**

  b. Explain with suitable block diagram the control of an induction motor using a microprocessor. **(8)**

Q.9 a. Explain the process of natural commutation. **(4)**

  b. Differentiate between
  (i) Load side and line side commutation
  (ii) Voltage and current commutation **(8)**

  c. An impulse commutated thyristor shown in Figure. Determine the available turn off time of circuit if $V_s = 200V$, $R = 10\Omega$, $C = 5\mu F$ and $V_o = V_s$. **(4)**