

Code: AE26

Subject: POWER ELECTRONICS

AMIETE – ET (OLD SCHEME)

Time: 3 Hours

OCTOBER 2012

Max. Marks: 100

PLEASE WRITE YOUR ROLL NO. AT THE SPACE PROVIDED ON EACH PAGE IMMEDIATELY AFTER RECEIVING THE QUESTION PAPER.

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 45 Minutes 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. The maximum amount of voltage required to forward bias a p-n junction is called
- (A) Avalanche voltage (B) Breakdown voltage.
(C) Breakover voltage (D) Cut-in voltage.
- b. Secondary breakdown occurs in
- (A) MOSFET (B) BJT
(C) IGBT (D) All of the above
- c. Natural commutation method is applied in
- (A) AC voltage controllers. (B) Controlled rectifiers
(C) Inverters (D) Both (A) and (B)
- d. A dual converter used for the speed control of dc motors, will have two bridges, they are
- (A) Two rectifiers (B) Two inverters
(C) One rectifiers and one inverters (D) None of these
- e. In a three phase six pulse rectifier, each diode conducts for
- (A) 120° (B) 90°
(C) 60° (D) 150°
- f. If the duty cycle of a chopper circuit is exactly 50%, the pulse is considered to be a
- (A) Sine wave (B) Low duty cycle
(C) High duty cycle (D) Square wave

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- g. For a three phase bridge inverter with 180° conduction mode the nature of the line voltage waveform with a resistive load is
- (A) A stepped waveform (B) A square waveform
(C) A quasi square waveform (D) None of these
- h. The cycloconverter is capable of converting power to
- (A) A lower frequency (B) A higher frequency
(C) The same frequency (D) None of these
- i. The speed of a dc shunt motor above normal speed can be controlled by
- (A) Armature voltage control method (B) Flux control method
(C) Both (A) & (B) (D) None of these
- j. In a 3 phase full wave regulator feeding a star connected resistance load the input voltage is 400 V line to line. The firing angle is 160° . The line to line output voltage would be
- (A) 400 V (B) about 100 V.
(C) about 20 V (D) zero

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

- Q.2** a. What is a power BJT? Name the four modes of operation of BJT. Draw and explain the dynamic switching characteristics of a power BJT. (8)
- b. What is a TRIAC? How is it different from a thyristor. Explain the modes of operation of a TRIAC. (8)
- Q.3** a. A 3-phase fully controlled converter is connected to a 3-phase, 415 V, 50 Hz AC supply. The firing angle is 30° . The load current is 15 amps with negligible ripple current and the load voltage is 450 V. Find out load resistance, the source inductance and overlap angle. (8)
- b. What is the effect of source inductance on the operation of single phase & three phase controlled rectifier. Derive expressions for output of a (i) single phase (ii) 3-phase full converter including the effect of source. (8)
- Q.4** a. Draw the diagram of a 3-phase bridge inverter circuit and explain its working. What are the two modes of operation. How these two modes are obtained. (8)
- b. A step up chopper has input voltage of 250 V and output voltage of 600 V. If the non-conducting time of thyristor is $100 \mu\text{s}$, compute the pulse width. If the pulse width is halved for constant frequency operation, find the new output voltage. (8)

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- Q.5** a. What techniques are involved in voltage control of single phase inverters? Explain any one of them with appropriate waveform. (8)
- b. Draw diagrams to illustrate the principle of ON-OFF control. Derive equation for the RMS output voltage. Draw some configuration of 3 phase regulators. (8)
- Q.6** a. Explain the principle of a cycloconverter using a simple diagram. What is meant by positive and negative group converter. Differentiate between non-circulating and circulating mode of cycloconverters (8)
- b. A half controlled single phase bridge converter feeds a separately excited dc motor. Input voltage is 240 V, $\alpha = 100^\circ$, $R_a = 6\Omega$ and $I = 1.8$ A. Find back emf. (8)
- Q.7** a. In a resonant commutation circuit, the supply voltage is 250 V. Load current is 25 A and the device turn-off time is 20 μ s. The ratio of peak resonant current to the load current is 1.75. Find out the value of L and C of the commutation circuit. (8)
- b. Draw circuit diagram and wave shapes of input voltage, output voltage and load current in a single phase full wave regulator feeding resistance load. Derive equations for average and rms output voltage. (8)
- Q.8** a. Draw the circuit of a class A chopper feeding an RLE load. Derive the equations for maximum and minimum currents and steady state ripple. Find the expression for maximum steady state ripple. (8)
- b. A separately excited dc motor is fed from a 500 V dc source through a one quadrant chopper $R_a = 0.1\Omega$ and armature current is 200 A. The voltage and torque constants are 1.4 V/A-rad /sec and 1.4 N-m/A². The field current is 2 A. The duty cycle of chopper is 0.5. Find (i) input power (ii) speed (iii) torque. (8)
- Q.9** Write short note on :(any TWO)
- (i) Transformer rating for Rectifying circuits.
(ii) Switching mode regulators.
(iii) Natural & forced commutation. (8×2)