

**B. E. (Sixth Semester) Examination,
Nov.-Dec. 2015**

(Old Scheme)

(Elect., EEE Engg.)

POWER ELECTRONICS

Time Allowed : Three hours

Maximum Marks : 80

Minimum Pass Marks : 28

Note : Attempt all questions. Part (a) is compulsory and carries 2 marks. Attempt any two parts from (b), (c) and (d) which carry 7 marks.

1. (a) Define the following rating of SCR and give its typical value :

(i) Latching current

- (i) steady state characteristics
- (ii) switching limit
- (iii) safe operating area
- (c) Enlist at least five major difference between a power IGBT and a SCR.
- (d) A 220 V, 1000 rpm, 60 A separately excited dc motor has an armature resistance of 0.1Ω . It is fed from a single-phase full converter with an ac source voltage of 230 V, 50 Hz. Assuming continuous conduction, compute :
- (i) firing angle for rated motor torque at 600 rpm
- (ii) firing angle for rated motor torque at (-500) rpm
- (iii) motor speed for $\alpha = 150^\circ$ and half rated-torque

(ii) Critical rate of rise voltage

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(b) Describe qualitatively the problem associated with series operation of SCR & derive an expression for the static equalizing circuit resistance under steady state condition used during series operation of SCRs.

(c) A relaxation oscillator using UJT is to be designed for triggering an SCR. The UJT has the following data :

$$\eta = 0.72, I_p = 0.6 \text{ mA}, V_p = 18.0 \text{ V}, V_v = 1.0 \text{ V},$$

$$I_v = 2.5 \text{ mA}, R_{BB} = 5 \text{ k}\Omega, \text{ Normal leakage current with emitter open} = 4.2 \text{ mA}.$$

The firing frequency is 2 kHz for $C = 0.04 \mu\text{F}$ compute the values of R , R_1 & R_2 .

(d) Describe the dynamic characteristics of SCR with neat sketches.

2. (a) State the difference between Half wave controlled and Half controlled converter.

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(b) What is the effect of source inductance on the operators of single phase full bridge converter?

Derive expression for output voltage, including the effect of source inductance.

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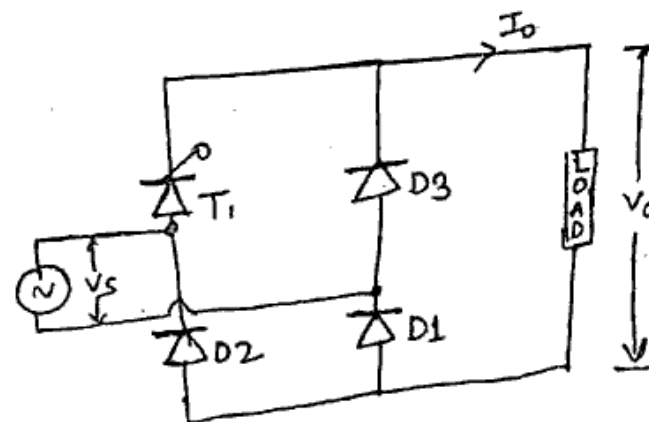
(c) A 3-phase half wave controlled converter is fed from 3-phase, 400 V, 50 Hz source and is connected to load taking a constant current of 36 A. Thyristor have a voltage drop of 1.4 V.

(i) Calculate average value of load voltage for a firing angle of 30° and 60° .

(ii) Determine average and rms current ratings as well as PIV of thyristor.

(iii) Find the average power dissipated in each thyristor.

(d) A single phase controlled bridge rectifier consists of one SCR and three diodes as shown in fig.



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For an ac source voltage of 230 V, 50 Hz and firing angle of 45° , find the average output current and power delivered to battery in case load consists of $R = 5\Omega$, $L = 8\text{mH}$ and $E = 100\text{V}$.

(Assuming constant load current)

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3. (a) State how can a conducting thyristor be turned off?
- (b) Explain the voltage-commutated chopper along with various waveform. Also write the merits and demerits of voltage commutated chopper.
- (c) For type-A chopper, source voltage $V_s = 220\text{V}$ chopping frequency $f = 500\text{Hz}$, $T_{ON} = 800\mu\text{s}$, $R = 1\Omega$, $L = 1\text{mH}$ and $E = 72\text{V}$.
- (i) Find whether load current is continuous or not.
- (ii) Calculate the values of average output voltage and average output current.
- (iii) Compute the maximum and minimum values of steady state output current.
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- (d) Describe the principle of step up chopper. Derive an expression for the average output voltage in terms of input voltage and duty cycle. State the assumptions made.

4. (a) List two difference between a voltage source and current source inverter.

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- (b) With relevant waveforms, describe the working of a single phase to single phase cycloconverter with output frequency $1/3$ the input frequency for a resistive load and firing and $\alpha = 30^\circ$.

- (c) For a 3- ϕ bridge interval with star connected resistive load, plot the output line to line and line to phase voltage for 180° conduction mode.

- (d) Calculate the output frequency of a series inverter with the following parameters :

Inductance $L = 6\text{mH}$, Capacitor $C = 1.2\mu\text{F}$, Load resistance $R = 100\text{ohms}$, $T_{off} = 0.2\text{ms}$. If the load resistance is varied from 40 to 140 ohms; find out the range of output frequency.

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5. (a) State the term switching limit as applicable to semiconductor device.
- (b) Explain the power MOSFET as per points given below :