Registration No. : | | | | | | | | | | |

*Total number of printed pages – 3*

B. Tech

PCEL 4301

# Fifth Semester Back Examination – 2014

## POWER ELECTRONICS

## BRANCH (S) : EEE, ELECTRICAL

**QUESTION CODE : L 232**

**Full Marks – 70**

**Time : 3 Hours**



*Answer Question No. 1 which is compulsory and any **five** from the rest.*

*The figures in the right-hand margin indicate marks.*

1. Answer the following questions : 2×10

(a) Enumerate advantages of power IGBT over power BJT.

(b) Give protection of SCR against over voltage.

(c) Why totempole configuration is used in the gate drive circuit of power BJT ?

(d) What will be the peak reverse voltage rating of the power switching device used in a 1-phase center tap type full converter if primary supply voltage is 100V ac (rms) and primary to secondary turn ratio is 2 : 1 ?

(e) A single phase fully controlled rectifier has 300 sin (314t) as input supply voltage and resistor R as load. What will be the average output voltage for firing angle of 30° for this rectifier ?

(f) What are the advantages of PWM control over frequency control in case of DC-DC converters ?

(g) At what duty cycle the load ripple current becomes maximum for a Boost converter ?

(h) A 3-phase sin-PWM inverter operates from a dc link voltage of 400 V. What will be the rms magnitude of fundamental line voltage for modulation index of 0.8 ?

(i) What is the switching frequency of the switches in case of Space Vector Modulation (SVM) as compared to SinPWM for the same carrier frequency ?

(j) What is boost charge setting in a battery charger ?

2. (a) How base current peaking during turn on and turn off of a power BJT is achieved ? Explain with relevant circuit diagram and waveforms. 5

(b) In the circuit of Fig. 1, the SCR is gated with a pulse width of 40 μsec. The latching latching current of SCR is 36 mA. For a load of R = 60 Ω and L= 2H, will the SCR get turn on ? If not, how this difficulty can be overcome ? 5

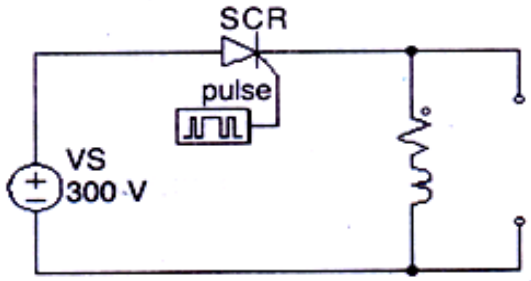


Fig. 1



3. (a) A UJT used in relaxation oscillator has the following data : $\eta = 0.67$, $I_p = 15\ \mu A$, $V_p = 18V$, $V_v = 2.5$, $I_v = 10$ mA. An oscillator, with an oscillation frequency of 1 kHz, is to be designed using this UJT. Compute the values of charging resistors and external resistors needed in the base circuits. Take C= 0.4 μF and forward-voltage drop of E-$B_1$ junction as 0.5 V. Source voltage is 24 V DC and triggering pulse width is width is 50 μs. 5

(b) How is a power MOSFET protected against 'dv/dt' and 'di/dt' ? Explain with relevant circuit diagram. 5

4. (a) A 3-phase full-converter charges a battery from a 3-phase power supply of 230 V, 50 Hz. The battery emf is 200 V and its internal resistance is 0.5 Ω. On account of inductance connected in series with the battery, charging current is constant at 20 A.

(i) Compute the firing angle delay and the supply power factor.

(ii) In case it is desired that power flows from dc source to ac load in above, find the firing angle delay for the same current. 5

(b) Derive the expression for average and rms output voltage of single phase fully controlled rectifier feeding R-L load and operating in continuous conduction mode. 5

5. (a) Explain the principle of working of single phase step down cycloconverter with relevant circuit diagram and waveforms. 5

(b) Explain the principle of working of single phase PWM rectifier with relevant circuit diagram and waveforms. 5

6. (a) A buck regulator has an input voltage of 18 V. The required average output voltage is 6V and the peak to peak output ripple voltage is 20 mV. The switching frequency is 20 kHz. The peak to peak current ripple of the inductor is limited to 0.5 A. Determine the filter inductance and filter capacitance. 5

(b) Derive the relationship between input and out voltage for a Cuk regulator. 5

7. (a) Explain the methods of generating the base/gate drive signals for a three phase Space Vector PWM controlled voltage source inverter. 5

(b) With an appropriate power circuit diagram, discuss the working principle of a three phase bridge type voltage source inverter. Draw phase and line voltage wave forms on the assumption that each controlled switch conducts for 180° and three phase resistive load is star connected. 5

8. Write short notes on any **two** : 5×2

(a) V-I characteristic of GTO

(b) Three phase semiconverter with RLE load

(c) Zero voltage switching resonant inverter

(d) Electronic Ballast.