Seat No.: _____ Enrolment No._____

# GUJARAT TECHNOLOGICAL UNIVERSITY

## ME Semester –I Examination Feb. - 2012

**Subject code: 714501N** **Date: 11/02/2012**
**Subject Name: Power Electronics-I**
**Time: 10.30 am – 01.00 pm** **Total Marks: 70**

## Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

**Q.1** **(a)** Attempt the following short questions: **07**

i) A step up chopper takes 10 A current from the supply to deliver 1 A to a load for 20 μ sec during the total period of 1 cycle of 60 μ sec. The ripple in the output voltage is limited to 1 volt peak. Determine the filter capacitor required. Draw the circuit diagram.

ii) A buck-boost chopper supplies 6 volt to a load with 75% duty cycle. Determine battery voltage of the chopper.

iii) A step down chopper supplies to a load from 150 volt DC supply through 200 μH inductor which gives 10 A current ripple with Ton=20 μ sec. Determine the duty cycle and switching frequency.

**(b)** Sketch the neat circuit diagram of a step down chopper with RLE load. Obtain the expression for current ripple. Draw neat waveforms. A dc chopper drives a separately excited motor from 220 volt dc with 60% duty cycle. The chopping period is 2 msec. The emf in armature is 112 volt. The armature resistance is 1 Ω, an inductance is 5 mH. Find: (i) Average armature current (ii) Maximum and minimum current through the winding, (iii) Peak current ripple and (iv) additional inductance required to limit the current ripple of 10 A. **07**

**Q.2** **(a)** For the 1-phase full bridge inverter has a resistive load of R=10 Ω and dc input voltage is 220 volt. Determine: (i) the RMS output voltage at the fundamental frequency, (ii) the output power Po, (iii) the average, RMS and Peak current through each transistor, (iv) peak offset voltage of each transistor, (v) THD, (vi) Distortion factor, and (vii) the Harmonic factor and distortion factor of the lowest order harmonic. **07**

**(b)** Draw the vertical cross section of a power MOSFET and a power IGBT and emphasis on the constructional changes which make IGBT suitable for operating at higher power levels compared to power MOSFET. **07**

**OR**

**(b)** Draw a neat and illustrative circuit diagram of a driver circuitry for the power MOSFET. State the specific typical requirements of this driver circuitry and state most significant characteristic of an ideal power semiconductor switch. **07**

**Q.3** **(a)** Explain the effect of introduction of buffer layer on the performance of an IGBT. Explain the available types of IGBT with and without the buffer layer. **07**

**(b)** Explain sinusoidal Pulse modulation as used in PWM inverter. Write the important features of same. **07**

**OR**

**Q.3** **(a)** Explain the series operation of Silicon controlled Rectifier. Design the static equalising circuit for SCR. **07**

**(b)** State the need for reduction of harmonics in inverters. Outline the various methods for reduction of harmonics or the improvement in wave shape. **07**

**Q.4** **(a)** A single phase a.c. voltage regulator with RL load has the following details: **07**

Supply voltage= 230 V, 50Hz, R=4Ω and $\omega$ L=3Ω. Calculate:

(i) The control range of firing angle,
(ii) The maximum value of RMS load current,
(iii) The maximum power and power factor,
(iv) The maximum values of average and RMS thyristor current,
(v) The maximum possible value of di/dt that may occur in the SCR, and
(vi)The conduction angle for α=0 and α=120, assuming a gate pulse of duration ∏ radian.

**(b)** With help of neat circuit diagram and waveform explain briefly the operation of transistorized three phase bridge inverter with resistive load in 120 conduction mode. **07**

**Q.4** **(a)** Design a dual convertor to achieve a four-quadrant Operation of the separately excited d.c. motor and converter specification are given below. **07**

(i)Motor specifications Ea=220v, Ia=30A, N=1500rpm
(ii) Converter specifications supplied from 3-∅, 400v, 50Hz supply
Assume drop in the circuit 15%.

**(b)** Describe the operation of single phase full-wave a.c. Voltage regulator with RL load with the help of voltage and current waveforms. Also, derive expression for RMS value of output voltage. **07**

**Q.5** **(a)** Explain Heatsink Specification in Detail. **07**

**(b)** Explain the effect of source impedance on the performance of single phase full converter. **07**

**OR**

**Q.5** **(a)** Describe in detail the Operation of dual converter without circulating current. **07**

**(b)** Explain Push-Pull DC-DC Converter in detail with appropriate waveform. **07**

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