



Manipal Institute of Technology, Manipal

(A Constituent Institute of Manipal University)



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SEVENTH SMESTER B.TECH (INSTRUMENTATION AND CONTROL ENGINEERING) END SEMESTER EXAMINATIONS, NOV/DEC 2015

SUBJECT: POWER ELECTRONICS [ICE 405]

Time: 3 Hours

MAX. MARKS: 50

Instructions to Candidates:

- ✤ Answer ANY FIVE FULL questions.
- ✤ Missing data may be suitably assumed.
- 1A. Define string efficiency. Explain how serially connected SCR's can be made to share 4 equal voltage under transient conditions.
- **1B.** List the different triggering methods for SCR and explain the gate triggering in detail. **3**
- 1C. An UJT relaxation oscillator to be designed for triggering an SCR, has the following 3 data: η =0.72, $I_p = 0.6$ ma, $V_p = 18V$, $V_v = 1V$, $I_v = 2.5$ ma, $R_{bb} = 5k\Omega$, leakage current with emitter open is 4.2 ma, firing frequency is 2 khz. For C = 0.04µF, design the value R and external resistances R1 and R2.
- 2A. Why is IGBT preferred over BJT and PMOSFET? Explain the switching 4 characteristics of an Insulated Gate Bipolar Transistor (IGBT) with neat waveforms.
- **2B.** Describe the relaxation oscillator application of an UJT with neat waveforms.
- 2C. For a SCR, the gate-cathode characteristics for a straight line has a slope of 180. For a triggering source voltage of 20 volts and allowable power dissipation of 1 watts, compute the gate source resistance
- **3A.** Explain complementary commutation technique of turning off an SCR with **4** appropriate circuit and waveforms.
- **3B.** Discuss the operation of dual converters with respect to circulating current.
- **3C.** A 230V, 50 Hz single phase half wave SCR converter is triggered at an angle of 45° **3** and the conduction angle is 120°. Find the circuit turn off time, average output voltage and average load current for R = 10 Ω and L = 2mH.
- 4A. Explain the principle of operation of a single phase half wave converter feeding a 4 RLE load with circuit diagram and appropriate waveforms.
- **4B.** A single phase full converter delivers power to the resistive load R. For AC source **3** voltage V_s , show that the average output voltage is given by :

$$V_{0=}\frac{\sqrt{2Vs (1+\cos\alpha)}}{\pi}$$

Sketch the time variations of Source voltage, output voltage, output current and voltage across one pair of SCR's.

- 4C. A single phase 230 volts, 1 KW heater is connected across single phase 230 volts, 50
 3 hz supply through an SCR for a resistive load. The peak value of the input supply is 230 volts. For firing angles of 45° and 90° calculate the power absorbed in the heater.
- 5A. Discuss the operation of single-phase full-wave converters feeding RL load with the 4 help of neat waveforms.
- **5B.** Describe the operation of step up choppers with appropriate waveforms and **4** expressions.
- **5C.** For a Step up chopper, input voltage is 240 V, and output voltage is 960 V. If the output pulse width time of the chopper is 180 μ s, compute the conducting time of the chopper. In case the conducting time of the chopper is made one third of the initial value, for a constant frequency operation, calculate the average value of new output voltage.
- **6A.** What are Inverters? Describe the working of a single phase half bridge inverter with appropriate circuit and waveforms.
- **6B.** Describe the working of a series inverter with appropriate circuit and waveforms. **3**
- 6C. With help of circuit diagram and waveforms, explain the operation of a single phase 3AC voltage controller feeding a resistive load.
