Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

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(A constituent unit of MAHE, Manipal)

VI SEMESTER B.TECH (ELECTRICAL & ELECTRONICS ENGINEERING)

END SEMESTER EXAMINATIONS, APRIL 2019

SUBJECT: POWER ELECTRONICS [ELE 3201]

REVISED CREDIT SYSTEM

Time: 3 Hours **Date: 25 April 2019** **Max. Marks: 50**

Instructions to Candidates:

- Answer **ALL** the questions.
- Missing data may be suitably assumed.

1A. With the help of a neat sketch, explain the salient features of an IGBT. Mention the modification(s) to be done for avoidance of latch-up phenomena. ***(03)***

1B. An R-L load with R = 50 Ω and L = 2.5 H is connected to 300 V dc source through an SCR. Given, minimum anode current for the SCR to turn on is 36 mA, pulse width of the gating signal used is 35 ms. Determine whether the SCR turns on. In case the SCR does not turn on, provide suitable solution so as to turn on the SCR, when keeping all the given parameters unchanged for the same load. ***(03)***

1C. With the help of two transistor model, derive an expression for the anode current of an SCR. Hence, justify "Small gate current is sufficient enough to trigger an SCR". ***(04)***

2A. A 3-phase full converter feeds power to an R-L load such that the converter operates in continuous conduction mode. For a firing angle of 30°, the average output voltage is 450 V. Find the rms value of per phase input voltage, assuming star connected supply. Accordingly, calculate the voltage rating of each switch. ***(03)***

2B. A single-phase full converter bridge, is connected to a RLE load. The source is 230 V rms and the average load current is 10 A. Consider E = 120 V, R = 0.4 Ω and L is very high resulting in continuous load current. Find the firing angle,

i. When the power flows from AC source to the DC load.
ii. When the power flows from the DC load to the AC source. ***(03)***

2C. A single phase full converter feeding an RL load operates from a 230 V, 50 Hz supply. The converter provides an average load current of 6 A at a delay angle of 45°. If the ripple content of the load current is negligible,

i. Determine the dc output power.
ii. If a freewheeling diode is now connected across the output for the same load resistance and firing angle, calculate the percentage change in the dc output power. ***(04)***

3A. Discuss the differences between voltage source inverters and current source inverters ***(02)***

3B. For a step down DC-DC converter, plot the following waveforms

i. Inductor current
ii. Switch current and switch voltage
iii. Diode current and diode voltage
iv. Capacitor current

(04)

3C. Design a dc dc converter for a load rated at 1 kW and drawing an average current of 5 A such that it operates at boundary conditions. Consider, output voltage ripple to be 1 %, switching frequency = 20kHz, input voltage = 100V. ***(04)***

4A. A single phase full bridge square wave inverter has a resistive load of R =10 Ω and a DC input voltage of Vs = 100 V. The desired output frequency is 50 Hz. Determine

i. RMS output voltage of fundamental component
ii. The output power
iii. The peak current and peak voltage of the switch.
iv. THD

(03)

4B. A single phase full bridge sinusoidal PWM inverter is fed from a 120 V dc .The output of the inverter is connected to the load via a step up transformer with turns ratio of 1:3. The fundamental component of the load voltage is 210 V rms. Assuming linear modulation, determine the amplitude modulation index.

If modulation index is now increased to 4, determine the new DC link voltage required to maintain the same voltage across the load. ***(03)***

4C. With a neat circuit diagram, explain the Bipolar switching scheme for a Full bridge inverter. Also, draw the output voltage waveform corresponding to the carrier and control signals. Plot the harmonic spectrum for m_f = 17 and m_a = 0.8. ***(04)***

5A. Explain the operation of a 3-level cascaded inverter. Support your answer with a neat circuit diagram, waveforms of the gate pulses and the output voltage. ***(03)***

5B. With the help of a neat circuit, discuss space vector pulse width modulation technique with respect to a 3 pole VSI. Explain clearly the use of null states. ***(03)***

5C. Plot the waveforms for the current through resonant inductor and voltage across resonant capacitor of a zero current switched buck dc-dc converter. ***(04)***