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**Presidency University**

**Bengaluru**

**SCHOOL OF ENGINEERING**

**SUMMER TERM END TERM EXAMINATION AUGUST 2024**

**Semester**: ST

**Course Code**: ECE 3016

**Course Name**: Electronic Controlled Converter

**Program** : B.Tech.

**Date**: 05-08-2024

**Time**: 1.00 PM – 4.00 PM

**Max Marks**: 100

**Weightage**: 50%

**Instructions:**

1. *Read the question properly and answer accordingly.*
2. *Question paper consists of 3 parts.*
3. Scientific and Non-programmable calculators are permitted.

**Part A**

**Answer any Five Questions. [Memory Recall Questions] (5Qx2M=10)**

**Q.NO.1.** Power converters employ power semiconductor devices to transform power between different forms. What is the name of the gadget that, in the absence of a gate terminal, can conduct both ways?

[2M] (C.O.NO. 1) [Bloom’s level-L1]

**Q.NO.2.** If a power electronic converter is used to change the form of energy, harmonic injection will occur in both the source and the load. To eliminate these harmonics, one possible solution is to use filters on both the input and output sides. However, adding these filters increases the weight, delay, and expense of the converter. Could you suggest an alternative method for eliminating these harmonics that wouldn't increase the weight, cost, or processing time of the converter? [2M] (C.O.NO. 1) [Bloom’s level-L1]

**Q.NO.3.** With a rated power dissipation of 0.5 W, a maximum collector current of 0.8 A, and a collector-emitter breakdown voltage of 30 V, bipolar transistors like the 2N2222 are commonly utilised. In a conventional analogue circuit, energy is usually managed within the bounds of its 0.5W power dissipation rating. How much power handling would you recommend, if you were an engineer specialising in power electronics?

[2M] (C.O.NO. 2) [Bloom’s level-L1]

**Q.NO.4.** The full-wave controlled rectifier circuit is used to boost efficiency to a level similar to a half-wave controlled rectifier when converting AC power to controlled DC power. Is it feasible to connect a large enough capacitor across the resistive load in the full-wave controlled rectifier circuit to achieve a regulated output?

[2M] (C.O.NO. 2) [Bloom’s level-L1]

**Q.NO.5.** The Buck converter, also known as the step-down chopper circuit, changes a fixed DC voltage to a variable DC voltage by varying the duty cycle (K) between 0 and 1. Could you provide a suitable method for calculating the effective input resistance of the chopper in terms of K while accounting for the practical chopper (voltage across the switch when it is ON is Vch)?

[2M] (C.O.NO. 3) [Bloom’s level-L1]

**Q.NO.6.** An example of this would be a DC motor with a back emf of Eb connected to a step-up chopper circuit or Boost converter with an input voltage of Vs. Indicate which prerequisite needs to be fulfilled in order for Boost to function.

[2M] (C.O.NO. 3) [Bloom’s level-L1]

**Q.NO.7.** A type of power electronic converter called an inverter converts steady DC power into fluctuating AC power. Could you explain the purpose of the diode placed across each IGBT or MOSFET in the complete bridge voltage source inverter circuit?

[2M] (C.O.NO. 4) [Bloom’s level-L2]

**Part B**

**Answer any Five Questions. [Thought Provoking Questions] (5Qx10M=50)**

**Q.NO.8.** In theory, a dc motor can be rotated in the forward direction by a Class-A chopper when it is operated in the first quadrant, and in the forward regenerative breaking mode by a Class-B chopper when it is run in the second quadrant. Could you explain the use of the circuit schematic and associated waveforms to accomplish a bidirectional DC/DC converter using the Class-C chopper? [15M] (C.O.NO. 3) [Bloom’s level-L2

**Q.NO.9.** The Q1 and Q2 diagonal switches must be activated by 50% duty cycle switching pulses, and the Q3 and Q4 switches must be activated by complementary switching pulses, in order to operate a single phase full bridge inverter in square wave mode. When the inverter output generates a square wave that includes all of the harmonics, the fundamental component of the rms value is at its maximum. Make an appropriate scheme to generate several pulse width modulated switching pulses to activate the inverter. You can improve the harmonic profile of the inverter and eliminate some harmonics by doing this. Compute the root mean square output voltage of the multiple pulse width modulation.

[15M] (C.O.NO. 4) [Bloom’s level-L2]

**Q.NO.10.** The single phase bidirectional AC voltage controller circuit uses two SCRs connected in an anti-parallel topology to control power in both directions. If you were to swap out any one SCR for a diode, draw the input, output, and current waveforms for a resistive load while considering the proper firing angle. [15M] (C.O.NO. 5) [Bloom’s level-L2]

**Q.NO.11.** A single phase full wave regulated rectifier with a resistive load of R = 10 ohm is powered by a 220V, 50 Hz supply. Ascertain the following: If the firing angle is 70 degrees, the following variables will be measured: (a) average output voltage; (b) root mean square output voltage; (c) normalised output voltage; (d) efficiency; (e) form factor; (f) ripple factor. [15M] (C.O.NO. 2) [Bloom’s level-L3]

**Q.NO.12.** When the step-down chopper is turned on, it has a voltage drop of Vch = 1.5V, a resistive load of R = 10 ohm, an input voltage of Vs = 12V, and a chopping frequency of f = 1kHz. Is a 30% duty cycle appropriate? Determine the following: average output voltage, chopper efficiency, rms output voltage, effective input resistance, and chopper efficiency. [15M] (C.O.NO. 3) [Bloom’s level-L3]

**Q.NO.13.** Flyback converters are widely utilised in systems that require many outputs for DC to DC conversion. Typically, they are found in switch-mode power supplies due to their ability to provide isolation, which protects users operating on the system's output side. Draw the flyback converter's waveforms and circuit diagram together.

[15M] (C.O.NO. 3) [Bloom’s level-L3]

**Q.NO.14.** Often called a single phase bidirectional AC voltage controller, a single phase full wave AC voltage controller is composed of two SCRs connected in an anti-parallel configuration between the source and the load. Please provide an example of the input, output, voltage across any one SCR waveform and the output current if the load consists of a large inductor linked in series with a resistor. [15M] (C.O.NO. 5) [Bloom’s level-L3]

**Part C**

**Answer any Two Questions. [Problem Solving Questions] (2Qx20M=40)**

**Q.NO.15.** Find the following values for a single phase full wave regulated rectifier: (a) average output current; (b) firing angle; (c) rms output voltage; (d) rms output current; and (e) firing angle. The rectifier is powered by a 220V, 50 Hz supply and has a resistive load of R = 5 ohm. if the greatest possible average output voltage is 20% of the average output voltage. [20M] (C.O.NO. 2) [Bloom’s level-L3]

**Q.NO.16.** The resistive load of the single phase full wave AC voltage controller is R = 18 ohm, and its input voltage is Vs = 230V, 50 Hz. If the delay angle of the thyristors T1 and T2 is alpha1 = alpha 2 = alpha = (pi)/2. Look for the following: (a) the average output voltage; (b) the input power factor; (c) the T1 thyristor's average current; and (d) the T1 thyristor's rms current. [20M] (C.O.NO. 5) [Bloom’s level-L3]

**Q.NO.17.** For a single phase full bridge inverter with a resistive load of R = 12 ohm and dc input voltage Vs = 48V, find (a) the rms output voltage, (b) the rms value of the fundamental component, (c) output power, (d) the average current of each device, (e) the peak device current, (f), and the reverse blocking voltage of each device.

[20M] (C.O.NO. 4) [Bloom’s level-L3]