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PRESIDENCYUNIVERSITY BENGALURU

 SCHOOL OF ENGINEERING

SUMMER TERM

END TERM EXAMINATION – AUGUST 2024

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| **Semester: V** | **Date: 06.08.2024**  |
| **Course Code: EEE2019** | **Time: 1.00pm to 04.00pm** |
| **Course Name: Power Electronics**  | **Max Marks: 100** |
| **Program: B. Tech EEE** | **Weightage: 50%** |

**Instructions:**

1. *Read all questions carefully and answer accordingly.*
2. *Question paper consists of 3parts.*
3. *Scientific and non-programmable calculator are permitted.*
4. *Do not write any information on the question paper other than Roll Number.*

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| **PART A** |
|  **ANSWER ANY 4 QUESTIONS 4Q X 5M=20M** |
| 1 | Define safe operating area for MOSFET. | (CO 1) | [Knowledge] |
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| 2 | Define latching and holding current for SCR. | (CO 1) | [Knowledge] |
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| 3 | Define phase-controlled rectifier, and what are its main applications? | (CO 2) | [Knowledge] |
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| 4 | Define firing angle and extinction angle. | (CO 2) | [Knowledge] |
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| 5 | Discuss the concept of the duty cycle in relation to DC-DC converters. | (CO 3) | [Knowledge] |
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| 6 | Write the application of voltage-source inverters and current-source inverters. | (CO 4) | [Knowledge] |
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| **PART B** |
|  **ANSWER ANY 4 QUESTIONS 4Q X 10M=40M** |
| 7 | A VS-VSK.230.PbF series SCR datasheet is provided to design a firing circuit to turn on the SCR. The specifications are as follows Maximum average on state current at 850C is 230ALow level of thresh hold voltage – 1.03VHigh level of thresh hold voltage - 1.08VMaximum on state voltage drop - 1.59VMaximum holding current -500mAMaximum latching current- 1000mA.Minimum gate pulse width-100µ SecGate pulse voltage-10VFor an application, If the SCR represented in data sheet is failed to trigger when the gate pulse magnitude of 10V and gate pulse width of 80µ sec are applied when connected to a load of L= 2H and DC source voltage of 200V. 1. Identify the problem to trigger the SCR
2. suggest the value of minimum gate pulse width required to trigger the SCR.
 | (CO 1) | [Comprehension] |
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| 8 | How does the Two Transistor Analogy enhance understanding of SCR operation? Explain the Two Transistor Analogy of an SCR, and illustrate it with a suitable circuit diagram.  | (CO 1) | [Comprehension] |
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| 9 | How does varying the firing angle of a phase-controlled rectifier influence the shape and behavior of its output voltage and current waveforms. | (CO 2) | [Comprehension] |
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| 10 | What are the key factors to consider when selecting inductors and capacitors for DC-DC converter designs? | (CO 3) | [Comprehension] |
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| 11 | Design a buck converter to produce an output of 18V across a 10 ohm load resistor. The output voltage ripple must not exceed 0.5 percent. The DC supply is 48V, and switching frequency is 40 kHz. Design for continuous inductor current. Specify1. Circuit Diagram (2M)
2. The Duty ratio (2M)
3. The value of inductor (3M)
4. The value of capacitor (3M)

 Assume ideal components. | (CO 4) | [Comprehension] |
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| 12 | For a single-phase inverter with a square wave output voltage, Calculate the percentage of the third harmonic component relative to the fundamental frequency component? | (CO 4) | [Comprehension] |
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| **PART C** |
|  **ANSWER ANY 4 QUESTIONS 4Q X 10M=40M** |
| 13 | Explain the construction, operation, and switching characteristics of a Bipolar Junction Transistor (BJT). How do the switching characteristics influence its performance? | (CO 1) | [Comprehension] |
| 14 | For a given circuit connected with a resistive load of 100Ω, when the firing angle 𝛼=𝜋/4 and supply voltage Vs= 330 sin(314t). Assume SCR to be ideal. What will be: 1. the average voltage,
2. Average power
3. Average current

Figure. Circuit diagram | (CO 2) | [Application] |
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| 15 | In a single-phase full-wave rectifier, the supply voltage is 200V AC , The resistive load is 10Ω, and the SCR firing angle is α = 60⁰. Find 1. the average voltage
2. the power consumed in the load.
 | (CO 2) | [Application] |
| 16 | The buck dc-dc converter has the following parameters: Vs =50 V, D = 0.4, L = 400 μH, C = 100 μF, f = 20 kHz, R = 20Ω; Assuming ideal components, calculate:1. The output voltage Vo,
2. The maximum and minimum inductor current,
3. The output voltage ripple.
 | (CO 3) | [Application] |
| 17 | For a single-phase full bridge inverter draw the output voltage and current wave of the inverter at the following loads: 1. At resistive load
2. At RL load
3. At RLC Over Damped load
4. At RLC Under damped load
 | (CO 4) | [Application] |
| 18 | Design a Voltage Source Inverter (VSI) using two MOSFET switches and a DC voltage source. Explain how the MOSFET switches and the DC voltage source interact to generate an alternating current (AC) output. | (CO 4) | [Comprehension] |