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Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FIFTH SEMESTER B.TECH DEGREE EXAMINATION, DECEMBER 2017

Course Code: EE305

Course Name: POWER ELECTRONICS (EE)

Max. Marks: 100 Duration: 3 Hours

Graph sheets will be supplied.

PART A

Answer all questions, each carries 5 marks. Marks

1		Draw the circuit for two transistor analogy of silicon controlled rectifier and briefly describe the working.	(5)
2		Derive the expression for the output voltage of half wave controlled rectifier with R load.	(5)
3		Draw the input and output voltage waveforms of 3ø half controlled rectifier with R load for a firing angle of 30^0.	(5)
4		What are the different classifications of inverters?	(5)
5		Explain the terms modulation index and frequency modulation ratio related to pulse width modulation.	(5)
6		What are the control strategies for the regulation of output voltage in ac voltagecontrollers?	(5)
7		Explain time ratio control method to vary the output voltage in choppers.	(5)
8		Derive an expression for average output voltage in terms of input dc voltage and duty cycle for a step up chopper.	(5)

PART B

Answer any twofull questions, each carries10 marks.

9	a)	Derive the expression for resistance used for static voltage equalisation for a series connected string.	(5)
	b)	In a power circuit, 4 SCRs are to be connected in series in a string to handle 6kV and 1kA. The voltage and current ratings of SCRs are 1800V and 1000A and have a maximum difference in their blocking currents of 10mA. Difference in recovery charge is 10μC. Design a suitable equalizing circuit with figure.	(5)
10		A single phase semi converter delivers a constant load current I_O . Express its source current in Fourier Series and derive the expressions for displacement factor and current distortion factor.	(10)
11	a)	Explain the structure & principle of operation of IGBT.	(5)
	b)	Draw RC triggering circuit for SCR and explain with relevant wave forms.	(5)

PART C

Answer any two full questions, each carries10 marks.

12 Draw the circuit of 3 phase fully controlled rectifier with RLE load and explain the working for $\alpha=60^{o}$ with necessary waveforms. Derive the expression for output voltage. (10)

13 Explain the operation of 3 phase voltage source inverter with 180^{o} mode of operation. (10)

14 Explain how two 3 phase full converters can be connected back to back to form a circulating current type of dual converter with the help of waveforms. (10)

PART D

Answer any two full questions, each carries 10 marks.

15 For a single phase voltage controller feeding a resistive load, describe the working with reference to source voltage, source current, output voltage and output current. (10)

16 Describe the working of four quadrant chopper with relevant circuit diagrams and its operation in all the four quadrants. (10)

17 Explain with circuit diagram and waveforms, the working of Buck regulator for continuous current mode. Obtain expressions for inductance and capacitance**.** (10)

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Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FIFTH SEMESTER B.TECH DEGREE EXAMINATION, APRIL 2018

Course Code: EE305

Course Name: POWER ELECTRONICS (EE)

(Graph sheets to be permitted)

Max. Marks: 100 Duration: 3 Hours

PART A

Answer all questions, each carries 5 marks Marks

1 "A thyristor can be triggered by an external gate pulse"- Justify using two transistor analogy of thyristor. (5)

2 Explain how the firing angle of an SCR can be varied by using a UJT relaxation oscillator. (5)

3 What is the role of freewheeling diode in a 3 phase semi-converter? (5)

4 Compare voltage source and current source inverters. (5)

5 What is sequence control in single phase ac voltage controllers? What are the advantages of employing it? (5)

6 Explain sine PWM technique, with relevant waveforms. Define modulation index and mention its significance. (5)

7 A type A chopper has input voltage of 200 V. The current through a load of R=10Ω in series with L=80 mH, varies between 12 A and 16 A. Find the form factor of the output voltage waveform. (5)

8 Design a dc-dc converter with 12 V input and 200 V output at up to 50W. The ripple in the output voltage and input current should not exceed ±5% and ±20% respectively. Choose an appropriate switching device and frequency. (5)

PART B

Answer any two full questions, each carries 10 marks

9 a) With neat sketches, explain the static V-I characteristics of an SCR. Define latching and holding current. (6)

b) Two thyristors having a difference of 4 mA in latching current are connected in series. The voltage across the devices are 500 V and 480 V. Calculate the derating factor and thestatic equalizing resistance value for maximum string efficiency. (4)

10 a) Compare Thyristor, Power MOSFET and IGBT on the basis of following parameters: (5)

i) Switching frequency ii) Voltage and current ratings

iii) Applications (at least two)

b) Compare the maximum power that can be handled by fully controlled rectifier in mid-point and bridge configuration if the firing angle is 30º and the reverse voltage rating (peak) of the thyristors is 200V. (5)

11 a) Explain a half-wave controlled rectifier feeding RL load, with waveforms of output voltage and output current. Derive the expression for average output voltage. (6)

b) A single phase semi-converter fed from 120 V, 50 Hz supply is connected to a load resistance of 10 Ω. If the average output voltage is 25% of its maximum possible average output voltage, find the circuit turn off time. (4)

PART C

Answer any two full questions, each carries 10 marks

12 a) Draw the circuit for three phase full converter feeding RLE load. Sketch the output voltage waveform for a firing angle of 60^0. (6)

b) A three-phase half-wave controlled converter is connected to 380 V (line) supply. If the load current is constant at 32 A independent of the firing angle and on state forward drop of SCRs is 1.2 V, Find: (4)

i) Peak reverse voltage rating of SCRs

ii) Average power dissipation in each SCR

13 a) Explain the basic working of an ideal Dual converter and its four-quadrant operation. (6)

b) A single-phase half bridge inverter has a resistive load of 10 Ω, and a center-tap dc input voltage of 96 V. Obtain the Fourier series representation of the output voltage waveform and hence find the value of distortion factor. (4)

14 Explain the 120^0conduction mode of a three-phase bridge inverter with output voltage waveforms, indicating the devices conducting in each state. (10)

PART D

Answer any two full questions, each carries 10 marks

15 a) Explain the operation of single phase voltage controller with RL load with output voltage and current waveforms. (6)

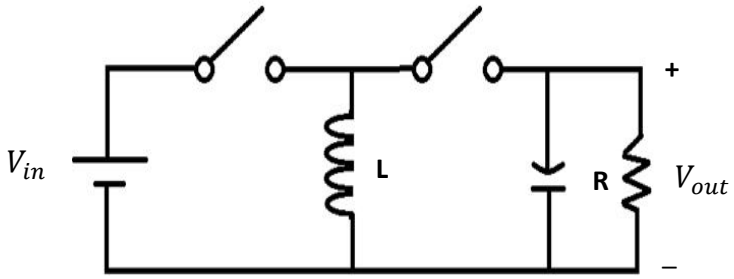
b) For a single-phase voltage controller, develop a relationship between conduction angle and firing angle. Under what condition conduction angle equals π? (4)

16 a) Design a simple light dimmer circuit using TRIAC including the trigger circuit. (4)

b) Explain the working of Two quadrant (Class C) chopper, with relevant waveforms. (6)

17 a) Derive the expression for output voltage of a Buck-Boost regulator, showing relevant waveforms. (6)

b) The switches in the figure are operated alternatively, each switch being on for half of each cycle. Determine the relationship between V_{in} and V_{out} . (4)



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Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

V SEMESTER B.TECH DEGREE EXAMINATION, DECEMBER 2018

Course Code: EE305

Course Name: POWER ELECTRONICS

Max. Marks: 100 Duration: 3 Hours

Graph sheets may be supplied on demand

PART A

Answer all questions, each carries 5 marks. Marks

1. Define holding current and latching current of SCR. Show these currents on the static IV characteristics of SCR. (5)
2. With the help of circuit diagram and waveform, explain the operation of RC triggering circuit for one thyristor. (5)
3. A three phase half wave converter is operated from 3–phase, 230 V, 50Hz supply with load resistance R= 10Ω. An average output voltage of 50% of the maximum possible output voltage is required. Determine i) the firing angle, ii) average and rms values of load current. (5)
4. With the help of circuit diagram explain the working of current source inverter. (5)
5. What is pulse width modulation? List the various PWM techniques. (5)
6. Explain the principle of phase control in a single phase ac voltage controller. (5)
7. Draw the circuit of step up chopper and explain its working. (5)
8. For a type A chopper, dc source voltage is 230 V, load resistance 10 Ω, drop across the switch is 2Vand duty cycle 0.4. Calculate average and RMS value of output voltage and chopper efficiency. (5)

PART B

Answer any two full questions, each carries10 marks.

9 a) Discuss the condition which must be satisfied for turning on the SCR with a gate signal. (5)

b) Explain the significance of di/dt protection in thyristors and describe the method employed for improving the same. (5)

10 With the help of circuit diagram explain the working of single phase fully controlled converter with RL load. Draw the waveform of output voltage with and without freewheeling diode and output current. (10)

11 a) What are the steps to be employed to prevent the difficulties of parallel operation of thyristors? (4)

b) With the help of circuit diagram explain the operation of single phase semi converter with RL load. Draw the waveform of input voltage, output voltage, load current and voltage across the thyristor. (6)

PART C

Answer any two full questions, each carries10 marks.

12 a) With the help of circuit diagram explain the working of three phase fully controlled converter. (5)

b) Sketch the waveform of input voltage, output voltage and output current of a three phase fully controlled converter with R load operating at $\alpha = 30^o$. (5)

13 a) Describe the working of a three phase voltage source inverter with an appropriate circuit diagram. (4)

b) Draw the phase and line voltagewaveform of the three phase voltage source inverter with star connected resistive load on the assumption that each IGBT conducts for 180^o (6)

14 a) With the help of circuit diagramexplain the working of single phase dual converter with circulating current mode. (5)

b) Write Fourier series expression for the output voltage from the single phase half bridge and full bridge inverter and determine the equation for THD. (5)

PART D

Answer any two full questions, each carries 10 marks.

15 a) Explain with suitable diagram, the principle of voltage control with single pulse width modulation. (5)

b) With the help of circuit diagram explain the working of single phase ac voltage controller with R load. (5)

16 a) A step up chopper has input voltage of 120V and output voltage of 360 V. If the conducting time of the thyristor chopper is 100 μs, Compute the pulse width of output voltage (5)

b) With the help of circuit diagram and waveform explain the operation of buck converter and derive the equation of output voltage. (5)

17 a) Describe how multiple pulse modulated wave can be generated from carrier and reference wave. (5)

b) Explain the design procedure of filter circuit for a boost converter with continuous current mode (5)

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Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

V SEMESTER B.TECH DEGREE EXAMINATION(S), MAY 2019

Course Code: EE305

Course Name: POWER ELECTRONICS

Max. Marks: 100 Duration: 3 Hours

Graph sheet may be supplied on demand

PART A

Answer all questions, each carries5 marks. Marks

1. Draw static characteristics of SCR, and based on that explain different modes of operation of SCR. (5)
2. With the help of circuit diagram and waveform explain the operation of UJT triggering circuit for one thyristor. (5)
3. Draw the circuit and derive the expression for output voltage of a single phase bridge converter. (5)
4. Differentiate between voltage source inverter and current source inverter. (5)
5. With the help of waveform explain sinusoidal pulse width modulation used in single phase inverter. (5)
6. Derive the equation for power factor for a single phase ac voltage controller feeding a resistive load. (5)
7. Explain the necessity of filter in chopper circuit. (5)
8. Describe the working of type B chopper. (5)

PART B

Answer any twofull questions, each carries10 marks.

9 a) Explain with figures the switching characteristics of SCR during turn on and turn off. (5)

b) With help of detailed structure explain the operation of MOSFET. (5)

10 a) With the help of circuit diagram and waveform explain the operation of RC triggering circuits for one SCR and also draw the voltage across the SCR. (5)

b) Differentiate between features of UJT firing circuit, RC triggering circuit and R triggering circuit. (5)

11 a) Mention the important ratings of the thyristors along with their significance. (5)

b) A battery is charged through a single phase half wave controlled converter. The supply voltage is 230 V, 50 Hz and battery emf is constant at 160 V. Find the value of average charging current for firing angle of 30 degrees. Internal resistance of battery is 2 Ω. (5)

PART C

Answer any twofull questions, each carries10 marks.

12 a) With the help of circuit diagram explain the working of three phase semi controlled converter. (5)

b) Sketch the waveform of input voltage, output voltage and output current of the three phase fully controlled converter with R load with $\alpha = 0^o$ (5)

13 a) Describe the working of a three phase voltage source inverter with an appropriate circuit diagram. (5)

b) Draw the phase and line voltage waveform of the three phase voltage source inverter with star connected resistive load on the assumption that each IGBT conducts for 120^o. (5)

14 a) A single phase bridge inverter fed from 200 V dc, is connected to an RL load of R = 9 Ω and L = 0.04 H. Determine the power delivered to the load in case the inverter is operating at 50 Hz with square wave output. (5)

b) With the help of circuit diagram explain the working of single phase dual converter with circulating current mode. (5)

PART D

Answer any twofull questions, each carries 10 marks.

15 a) Explain different methods for controlling the voltage at the output terminals of an inverter. (5)

b) With the help of circuit diagram explain the working of single phase ac voltage controller with R load. (5)

16 a) Explain the sinusoidal pulse width modulation used in single phase inverter and draw its waveform. (5)

b) Draw the circuit of buck boost converter and explain its working. (5)

17 a) Explain different types of chopper. (5)

b) A step up chopper has input voltage of 220V and output voltage of 400 V. If the conducting time of the switch is 100 μs, Compute the pulse width of output voltage. (5)

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Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FIFTH SEMESTER B.TECH DEGREE EXAMINATION(R&S), DECEMBER 2019

Course Code: EE305

Course Name: POWER ELECTRONICS

Max. Marks: 100 Duration: 3 Hours

Graph sheet may be supplied on demand

PART A

Answer all questions, each carries5 marks. Marks

1		Sketch the static VI characteristics of SCR and define latching current and holding current.	(5)
2		Describe briefly the RC triggering circuit for SCR with a neat circuit diagram. With the help of a graph explain how firing angle control up to 180 degrees is obtained.	(5)
3		Explain the operation of three-phase dual converter with circulating current..	(5)
4		Sketch the diagram and output voltage waveform of a single phase half bridge Voltage Source Inverter with R load and describe the working.	(5)
5		Define modulation index and Frequency modulation ratio.	(5)
6		What are the control strategies for the regulation of output voltage in AC Voltage Controllers?	(5)
7		Explain the different methods by which control of output voltage is obtained in Choppers.	(5)
8		Derive the expression for the voltage gain in a Boost regulator.	(5)

PART B

Answer any two full questions, each carries10 marks.

9	a)	Compare the characteristic features of MOSFET AND IGBT	(4)
	b)	Give the structure and operation of TRIAC.	(6)
10	a)	Describe a single phase half controlled converter with RL load along with necessary circuit diagram and waveforms.	(4)
	b)	With neat circuit diagram explain the operation of a Single Phase Half Wave Rectifier with R, load. Sketch the shape of output voltage waveform.	(6)
11	a)	Explain how di/dt and dv/dt protection is accomplished in SCR.	(4)

b) A fully controlled full wave converter has a source of 240 V rms, 50 Hz and 10 Ω, 50mH, 50V Emf opposing series load. The delay angle is 45^o. Determine (6)

a) Average output voltage and current.

b) Rms load voltage and Rms voltage across the RL part of the load.

c) The power absorbed by the 50V load back emf.

PART C

Answer any twofull questions, each carries10 marks.

12 Sketch the circuit diagram and explain the working of a 3 phase full wave controlled rectifier with RLE load. Draw the output voltage waveforms corresponding to $\alpha = 60^o$, $\alpha = 90^o$ and $\alpha = 150^o$ (10)

13 Draw the circuit and explain the 180^o operation of a 3 phase bridge inverter with R load. Draw the phase voltage and line voltage waveforms. (10)

14 a) With necessary waveforms explain the working and four quadrant operation of a single phase circulating current type Dual converter. (5)

b) Differentiate a Current source inverter from a Voltage source Inverter. (5)

PART D

Answer any twofull questions, each carries 10 marks.

15 Explain with relevant waveforms a Single phase AC voltage controller with RL load. (10)

16 How four-quadrant operation is achieved in a Type E Chopper? Explain with neat circuit diagram. (10)

17 a) What is meant by Pulse Width Modulation? Describe the various PWM techniques used in Voltage control of Inverters. (5)

b) Explain Sequence control with R load. (5)

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Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

Fifth semester B.Tech degree examinations (S) September 2020

Course Code: EE305

Course Name: POWER ELECTRONICS

Max. Marks: 100 Duration: 3 Hours

Graph sheets will be provided

PART A

Answer all questions, each carries 5 marks. Marks

1 Draw the static VI characteristics of a SCR and explain. (5)

2 Explain R firing circuit of SCR with circuit diagram and waveforms. (5)

3 Draw the output voltage waveform of a 3-phase controlled half wave rectifier for $\alpha=30^0$. (5)

4 Explain the working of a single phase half bridge voltage source inverter with pure R load. Draw the output voltage & output current waveforms and derive an expression for rms output voltage. (5)

5 For a single phase ACVC with source voltage as$v_s = 100sin\omega t$, and load as$R = 50\Omega$, draw the output voltage and current waveforms if Thyristor firing angle is (i) $\alpha=30^0$ (ii) $\alpha=90^0$. (5)

6 Define the terms amplitude modulation index and frequency modulation index. (5)

7 Draw the waveform of inductor voltage of a boost dc-dc converter and obtain an expression for output dc voltage in terms of input voltage and duty cycle. (5)

8 In a step down chopper the dc input voltage is of *100V*. The MOSFET switch is having a switching frequency of 2*kHz.* Find the duty cycle and average dc output voltage if the turn on period of switch is *0.2ms.* (5)

PART B

Answer any two full questions, each carries 10 marks.

9 Deduce the Two Transistor Model for a Thyristor and explain the Thyristor operation using this model. (10)

10 a) Describe the variation of current and voltage during turn- on time of an SCR with the help of characteristics. (5)

b) With circuit diagram and relevant waveforms, explain the operation of UJT firing circuit for triggering a SCR. (5)

11 a) Illustrate how a Thyristor based 1-phase fully controlled rectifier can be used to convert ac into variable dc. Draw the waveforms of output voltage & output current for both R and RL load at $\alpha=30^0$. (6)

b) Obtain an expression for average dc output voltage of a 1-phase fully controlled rectifier for R load with firing angle, α. (4)

PART C

Answer any two full questions, each carries 10 marks.

12 Describe the operation of a 3-phase semi-converter with RLE load having constant output current when firing angle is 30^0 with output voltage waveform and derive an expression for average dc output voltage. (10)

13 a) Explain how four quadrant operation is possible using a 1-phase dual converter operating in both circulating and non-circulating current modes. (5)

b) A 50Hz single phase full bridge square wave inverter is fed form 500V dc input. Find output rms voltage and current for a load of R=5Ω and L=10mH. (5)

14 Illustrate the operation of a 3-phase bridge inverter operating in 180^0 conduction mode with output line voltage and phase voltage waveforms. Derive expressions for output line voltage and phase voltage. (10)

PART D

Answer any two full questions, each carries 10 marks.

15 Illustrate the generation of sine pulse width modulated control signals for a single phase VSI with output voltage waveform. (10)

16 a) Describe the operation of single phase AC voltage controller for R load with waveforms and derive expression for output rms voltage. (5)

b) For a dc-dc buck-boost converter with a dc input voltage of *50V* and output voltage of 100V, calculate (i) duty cycle (ii) value of inductor if inductor ripple current ΔI =10mA. Given the switching frequency is 10kHz (5)

17 With circuit diagram and waveforms, describe the operation of a buck-boost dc-dc converter. Derive expressions for output dc voltage and the design equations for filter inductor & capacitor. (10)

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