Hall Ticket No: | | | | | | | | | | |

Question Paper Code: AEE010

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad - 500 043

MODEL QUESTION PAPER

B.Tech V Semester End Examinations (Regular), Nov – 2019

Regulation: IARE–R16

POWER ELECTRONICS

(Electrical and Electronics Engineering)

Time: 3 hours **Max Marks: 70**

Answer ONE Question from each Unit
All Questions Carry Equal Marks
All parts of the question must be answered in one place only

UNIT – I

1	a)	Explain the switching performance of BJT with relevant waveforms indicating clearly the turn on, turn off times and their components.	[7M]
	b)	It is required to operate 250A SCR in parallel with 350A SCR with their respective on state voltage drops of 1.6V and 1.2V. Calculate the value of resistance to be inserted in series with each SCR so that the share the total load of 600A in proportion to their current ratings.	[7M]
2	a)	Explain the operation of class A commutation along with neat circuit diagram and waveforms.	[7M]
	b)	The trigger circuit of a thyristor has a source voltage of 15V and the load line has a slope of -120V per ampere. The minimum gate current to turn on the SCR is 25mA. Compute i. Source resistance required in the gate circuit ii. The trigger voltage and trigger current for an average gate power dissipation of 0.4 watts	[7M]

UNIT – II

3	a)	Explain the operation of a single phase half wave converter for R-L load with neat circuit diagram and necessary waveforms	[7M]
	b)	For the single phase fully controlled bridge converter having load of 'R', determine the average output voltage, rms output voltage and input power factor if the supply is 230V, 50 Hz, single phase AC and the firing angle is 60 degrees	[7M]
4	a)	Explain the working of a three phase full wave controlled rectifier with R-L load with neat circuit diagram and waveforms.	[7M]
	b)	A single phase semi converter delivers to RLE load with R=5Ω, L = 10mH and E = 80V. The source voltage is 230V, 50Hz. For continuous conduction, Find the average value of output current for firing angle = 60^{o} and draw a rough sketch of output voltage, current and source current.	[7M]

UNIT – III

5 a) Derive the expression for the input power factor in an AC voltage controller using ON-OFF control. [7M]

b) A single phase full-wave AC voltage controller feeds a load of R=20Ω with an input voltage of 230V, 50Hz. Firing angle for both the thyristors is 45°. Calculate [7M]
(i) rms value of output voltage
(ii) Load power and input pf
(iii) Average and rms current of thyristors.

6 a) Compare the operational features of single phase midpoint and bridge type cyclo-converter for R-L loads, with neat circuit diagrams and waveforms. [7M]

b) A single-phase to single-phase mid-point cyclo-converter is delivering power to a resistive load. The supply transformer has turns ratio of 1: 1: 1. The frequency ratio is fo/fs = 1/5. The firing angle delay α for all the four SCRs are the same. Sketch the time variations of the following waveforms for α = 0° and α = 30° [7M]
(a) Supply voltage (b) Output current and (c) Supply current. Indicate the conduction of various thyristors also.

UNIT – IV

7 a) Describe the principle of step-down chopper. Derive an expression for the average output voltage in terms of input dc voltage & duty cycle. [7M]

b) In a type A chopper, the input supply voltage is 230 V the load resistance is 10Ω and there is a voltage drop of 2 V across the chopper thyristor when it is on. For a duty ratio of 0.4, calculate the average and rms values of the output voltage. Also find the chopper efficiency [7M]

8 a) Explain the operation of cuk regulator with neat circuit diagram, output waveforms and also list the advantages of cuk regulator. [7M]

b) Input to step-up chopper is 100V. The output required is 300V. If the conducting time is 200μs. Calculate. [7M]
a) chopping frequency
b) If the pulse width is halved for constant frequency of operation find the output voltage.

UNIT – V

9 a) Describe the operation of series inverter with aid of diagrams. Describe an expression for output frequency, current and voltages. What are the disadvantages of basic series inverter? [7M]

b) A single phase full bridge inverter has a resistive load of R = 10 Ω and the input voltage V_{dc} of 100 V. Find the average output voltage and rms output voltage at fundamental frequency. [7M]

10 a) Explain the operation of 3 phase bridge inverter for 120 degree mode of operation with aid of relevant phase and line voltage waveforms. [7M]

b) Single phase half bridge inverter has a resistive load of R = 4ohms and dc input voltage E_{dc} = 60V. Calculate [7M]
a) rms output voltage at fundamental frequency E1
b) the output power
c) average and peak current of each thyristor

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COURSE OBJECTIVES:

The course should enable the students to:

I	Integrate the revolutionary development in power transmission, distribution and utilization with the advent of semiconductor devices.
II	Demonstrate rectifiers, choppers and various schemes of pulse width modulated inverters.
III	Explain AC voltage converters and cycloconverters
IV	Outline complete range of power supplies, including switched mode and uninterruptible power supplies.

COURSE OUTCOMES (COs):

CO 1	Describe the characteristics of basic elements, turn on and turn off methods of SCR, protection, ratings of SCRs and series parallel operations of SCRs.
CO 2	Discuss the operation of single phase, three phase rectifiers and single phase, three phase dual converters.
CO 3	Analyze the principle of operation of AC voltage controllers and cycloconverters
CO 4	Discuss the principle of operation of chopper, classification of choppers, AC chopper and switched mode regulators
CO 5	Describe the operation of series, parallel inverters, single phase inverters, three phase inverters, voltage source inverters and current source inverters

COURSE LEARNING OUTCOMES:

AEE010.01	Understand the characteristics of basic elements of power electronics
AEE010.02	Understand the turn on and turn off methods of Silicon controlled rectifier
AEE010.03	Describe the protection and ratings of thyristors
AEE010.04	Understand the operation of single phase rectifiers with different loads
AEE010.05	Understand the operation of three phase rectifiers with different loads
AEE010.06	Describe the operation of single phase and three phase dual converter
AEE010.07	Understand the principle of operation of AC voltage controller and modes of operation
AEE010.08	Compute input power factor, total harmonic distortion of various input and output waveforms of AC voltage controllers
AEE010.09	Describe the principle of operation and classification of cycloconverters.
AEE010.10	Understand the principle of operation and control strategies of chopper
AEE010.11	Describe the classification of choppers
AEE010.12	Describe the importance of AC chopper and switched mode regulators
AEE010.13	Understand the concept of single phase voltage source inverters and waveforms
AEE010.14	Understand the principle of operation of three phase voltage source inverters and waveforms

AEE010.15	Understand the principle of operation of current source inverters and waveforms
AEE010.16	Apply the concept of power electronics and converters to solve real time world applications
AEE010.17	Explore the knowledge and skills of employability to succeed in national and international level competitive examinations

MAPPING OF SEMESTER END EXAMINATION - COURSE OUTCOMES:

SEE Question No		Course Learning Outcomes		Course Outcomes	Blooms Taxonomy Level
1	a	AEE010.01	Understand the characteristics of basic elements of power electronics	CO 1	Understand
	b	AEE010.03	Describe the protection, series parallel and ratings of thyristors	CO 1	Remember
2	a	AEE010.02	Understand the turn on and turn off methods of Silicon controlled rectifier	CO 1	Understand
	b	AEE010.02	Understand the turn on and turn off methods of Silicon controlled rectifier	CO 1	Understand
3	a	AEE010.04	Understand the operation of single phase rectifiers with different loads	CO 2	Remember
	b	AEE010.04	Understand the operation of single phase rectifiers with different loads	CO 2	Understand
4	a	AEE010.05	Understand the operation of three phase rectifiers with different loads	CO 2	Understand
	b	AEE010.04	Understand the operation of single phase rectifiers with different loads	CO 2	Understand
5	a	AEE010.07	Understand the principle of operation of AC voltage controller and modes of operation	CO 3	Remember
	b	AEE010.08	Compute input power factor, total harmonic distortion of various input and output waveforms of AC voltage controllers	CO 3	Understand
6	a	AEE010.09	Describe the principle of operation and classification of cycloconverters.	CO 3	Understand
	b	AEE010.09	Describe the principle of operation and classification of cycloconverters.	CO 3	Understand
7	a	AEE010.10	Understand the principle of operation and control strategies of chopper	CO 4	Understand
	b	AEE010.10	Understand the principle of operation and control strategies of chopper	CO 4	Understand
8	a	AEE010.12	Describe the importance of AC chopper and switched mode regulators	CO 4	Understand
	b	AEE010.11	Describe the classification of choppers	CO 4	Remember
9	a	AEE010.13	Understand the concept of single phase voltage source inverters and waveforms	CO 5	Understand
	b	AEE010.13	Understand the concept of single phase voltage source inverters and waveforms	CO 5	Understand
10	a	AEE010.14	Understand the principle of operation of three phase voltage source inverters and waveforms	CO 5	Understand
	b	AEE010.13	Understand the concept of single phase voltage source inverters and waveforms	CO 5	Understand

Signature of Course Coordinator **HOD, EEE**