USN

Internal Assessment Test 1– Dec 2021

Sub:	**POWER ELECTRONICS AND INSTRUMENTATION**					Sub Code:	**18EC36**	Branch:	ECE		
Date:	20-12-2021	Duration:	1.5 hour	Max Marks:	50	Sem/Sec:		3^{rd}sem /A,B,C,D		OBE	

|	**ANSWER ANY 5 FULL QUESTIONS**	MARKS	CO	RBT
1	With necessary sketches, explain the static V-I characteristics of SCR and its operation. Show the effect of various gate currents.	10	CO1	L2
2	What is Commutation? Differentiate between Natural and Forced Commutation. Discuss in detail Class A commutation.	10	CO1	L1
3	Describe the operation of UJT with neat sketches. Explain how a UJT firing circuit for an SCR works.	10	CO1	L2
4	Explain the working of a single phase half wave controlled rectifier for RL load with necessary sketches. Explain the effect of freewheeling diode.	10	CO2	L2
5	A step down chopper has a resistive load of R = 15 ohm and input voltage Edc = 200V. When the chopper remains ON, its voltage drop is 2.5 V. The chopper frequency is 1 KHz. If the duty cycle is 50%, determine: (a) Average output voltage (b) RMS Output voltage (c) Chopper Efficiency	10	CO2	L3
6 a	Explain the working of a single phase full wave controlled rectifier for resistive load with necessary sketches. Also derive the expression for RMS load voltage.	5	CO2	L2
6 b	If the half wave controlled rectifier has a purely resistive load of R and delay angle is $\alpha = \pi/3$, Determine:- (a) Rectification Efficiency (b) Ripple factor	5	CO2	L3
7a	Explain the principle of operation of Step Down Chopper (Buck Converter) with necessary circuit diagram and wave forms.	5	CO2	L2
7b	Describe the classification of choppers	5	CO2	L1
8a	Explain the working of a Resistance firing circuit with necessary circuit diagram and waveforms.	5	CO1	L2
8b	What are the different Turn ON methods of a Thyristor?	5	CO1	L1

Power Electronics (18EC36)   ①

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Answer key.

Q.1. Static VI characteristics of SCR.

Reverse blocking

Forward Conduction

$I_{G1} > I_{G2}$
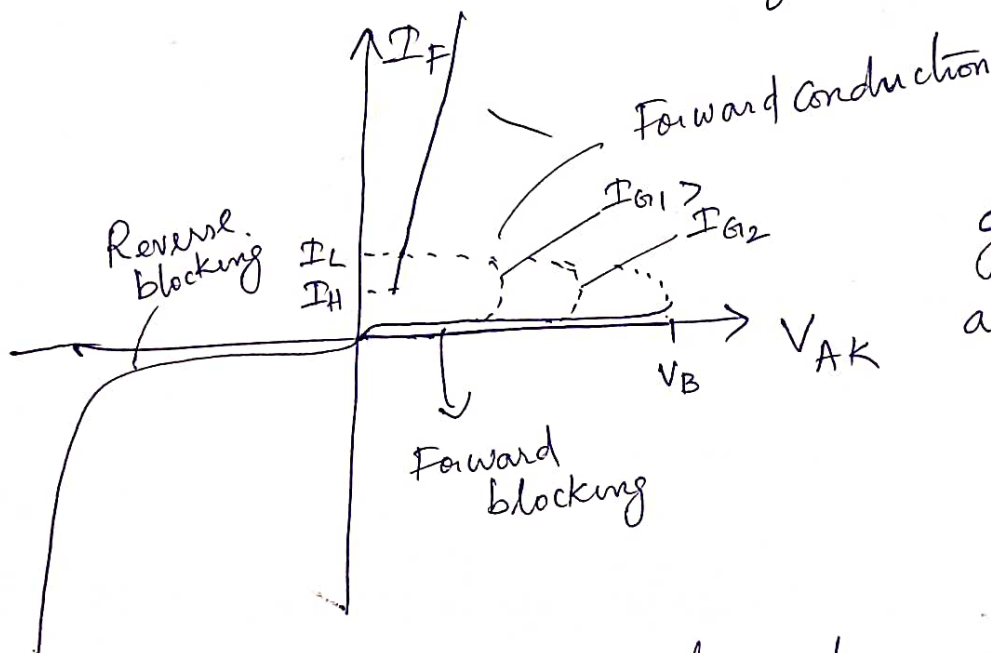
graph with all marking (5m)

explanation and definition of I_L & I_H (5m)

10M.

Q.2. Commutation is the process of turning off an SCR (1M).

Natural and Forced Diffrence (4m)

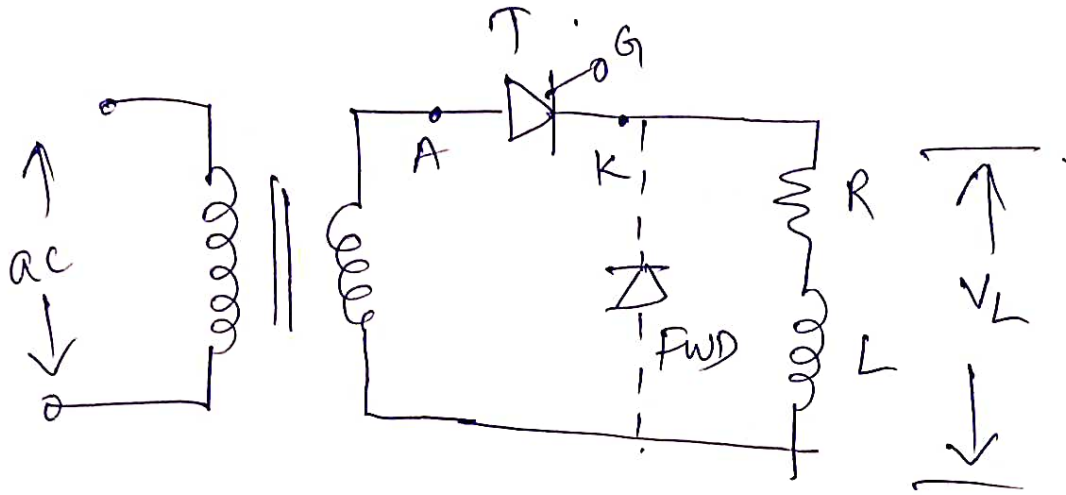Class A Commutation working (3m) + Waveform (2m)

10M.

Q.3 UJT operation with V-I graph (5m)

UJT firing circuit (2m) + working (3m)

10M.

Q.4

curent + waveforms (3m)

Explanation (3m)

free wheeling diode working + waveform (4m)

_____

10m.

Q.5 $R = 15$ $E_{dc} = 200V$ $E_{drop} = 2.5V$.

(a) Average output voltage $E_o = \alpha (E_{dc} - E_{drop})$ (1m)

$$E_o = \underline{98.75V} \text{ (2m)}$$

(b) RMS output voltage $E_{orms} = \sqrt{\alpha} (E_{dc} - E_{drop})$ (1m)
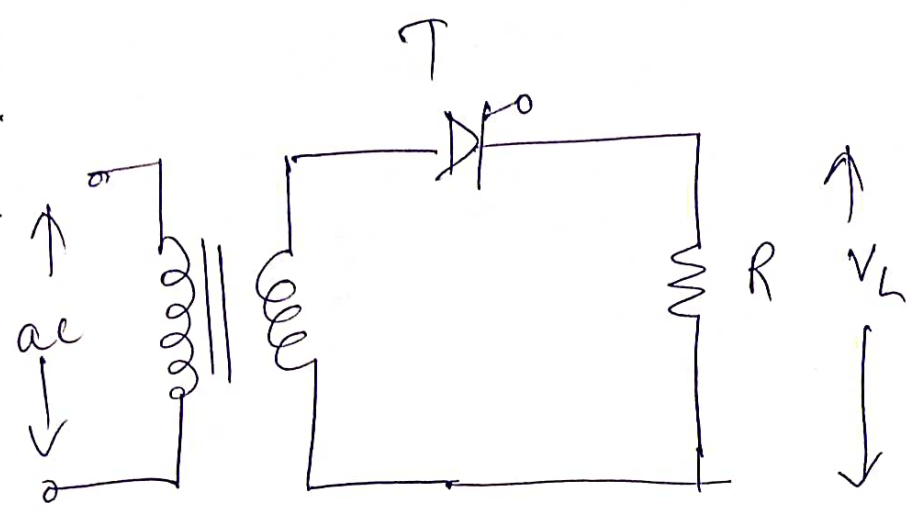
$$E_{orms} = \underline{139.653V}$$
(2m)·

(c) chopper efficiency $\eta = \dfrac{P_o}{P_i}$ derivation (2m)

$$\eta = \underline{98.74\% \text{ (2m)}}$$
_____

10m.

Q6a

Circuit diagram ~~(2m)~~ + Working and waveforms ~~(4m)~~ (3m)

Expression for RMS load voltage (02m)

05m ~~10m~~

$$E_{rms} = \frac{1}{2\pi} \int_{\alpha}^{\pi} (E_m \sin\omega t)^2 \, d\omega t$$

$$E_{rms} = E_m \left[\frac{\pi - \alpha}{4\pi} + \frac{\sin 2\alpha}{8\pi} \right]^{1/2}$$

Q6b $\alpha = \frac{\pi}{3}$.

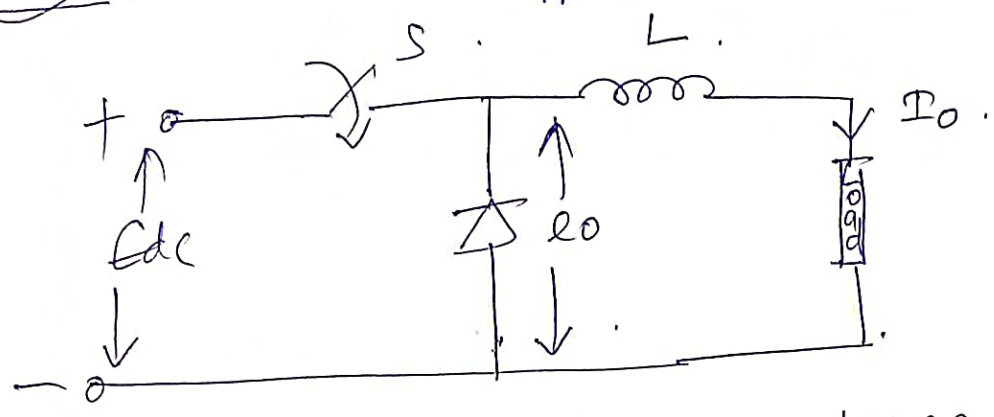Rectification efficiency $\eta = \dfrac{P_{dc}}{P_{ac}} = \dfrac{(0.239 E_m)^2}{(0.485 E_m)^2}$

$$= 24.28\% \quad \text{(3m)}$$

Ripple factor $(\gamma) = \sqrt{\left(\dfrac{E_{rm}}{E_{dc}}\right)^2 - 1} = 1.77$

(2m)

05m.

Q.7a) Step down chopper (Buck Converter) ④.

Circuit diagram + waveforms (3M)

Explanation and ~~also~~ expression $E_0 = \alpha E_{dc}$

(2m)

_____

5M

Q7b) classification of chopper

Line Commutated

Ae link chopper.

DC chopper.

_____

Step up/down chopper (1M)

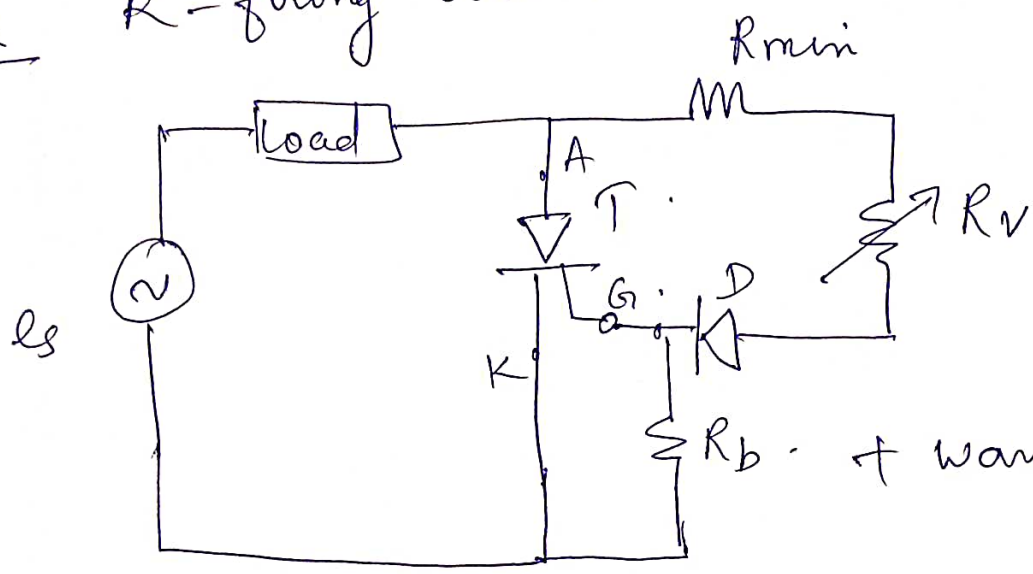class A, B, C, D, E₊ (1M)

first, Two, four quadrant chopper (2m)

Acording to Commutation (1M)

_____

5M

⑤

Q
8a   R-firing circuit

Working (2m)

5M.

8b   Turn ON methods .   (Explanation in one line)

Forward voltage triggering
Thermal triggering
Radiation Triggering

$\dfrac{dv}{dt}$ Triggering

Gate Triggering
- DC
- AC
- pulse

5M