

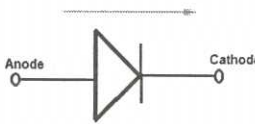
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Page: 15
 APRIL: 2024

COURSE NAME: Fundamentals of Electrical and Electronics

QID: 2106220066 B

COURSE CODE:2031

Q No	Scoring Indicators	Split Score	Sub Total	Total Score				
PART A				9				
I.1	<table border="1" style="width: 100%;"> <tr> <td style="width: 50%;">(A) Resistance</td> <td style="width: 50%;">(a) Ohms</td> </tr> <tr> <td>(B) Power</td> <td>(b) watts</td> </tr> </table>	(A) Resistance	(a) Ohms	(B) Power	(b) watts	0.5 0.5	1	
(A) Resistance	(a) Ohms							
(B) Power	(b) watts							
I.2	The phenomenon whereby an emf and hence a current is induced in any conductor which is cut across or is cut by magnetic flux is known as electromagnetic Induction.		1					
I.3	Amplitude		1					
I.4	Miniature Circuit Breaker		1					
I.5	Reactive Power $Q = VI \sin \phi$		1					
I.6	The property of a coil by which it opposes an increase/ decrease of current or flux through it is called Self Inductance		1					
I.7	Impedance matching Instrument transformer Used in power transmission and distribution as (Step up and step down of voltage). (any two)		1					
I.8			1					
I.9	Zener diode		1					
PART B								
				24				
II.1	The resistance offered by the conductor depends on the following factors (a) It varies directly as the length (b) It varies inversely as the area of cross section A of the conductor	0.5 0.5 0.5	3					

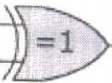
	(c) It depends on the nature of the conductor. (d) It also depends on the temperature of the conductor $R = \frac{\rho l}{A}$ Where ρ is the resistivity of the material	0.5 1														
II.2	<table border="1"> <thead> <tr> <th>Sl No</th> <th>Series Circuit</th> <th>Parallel circuit</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>Equivalent Resistance $R_{eq}=R_1+R_2+R_3$</td> <td>$\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$</td> </tr> <tr> <td>2</td> <td>Current remains the same</td> <td>Voltage remains the same</td> </tr> <tr> <td>3</td> <td>Total voltage=sum of individual voltage drops</td> <td>Total current= Sum of branch currents</td> </tr> </tbody> </table> (or any three similar)	Sl No	Series Circuit	Parallel circuit	1	Equivalent Resistance $R_{eq}=R_1+R_2+R_3$	$\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$	2	Current remains the same	Voltage remains the same	3	Total voltage=sum of individual voltage drops	Total current= Sum of branch currents	1 x3=3	3	
Sl No	Series Circuit	Parallel circuit														
1	Equivalent Resistance $R_{eq}=R_1+R_2+R_3$	$\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$														
2	Current remains the same	Voltage remains the same														
3	Total voltage=sum of individual voltage drops	Total current= Sum of branch currents														
II.3	First Law Whenever the magnetic flux linked with a circuit changes an emf is induced in it Second Law The magnitude of this induced emf is equal to rate of change of flux linkages $e = N \frac{d\phi}{dt}$	1.5 1.5	3													
II.4	Inductive reactance is the resistance to the flow of current provided by the inductance. $X_L = 2\pi fL$ Where f is the frequency The net opposition to the current flow in the electric circuit is called impedance. $Z = \sqrt{R^2 + X^2}$	1.5 1.5	3													
II.5	(a) Power factor: It is the ratio of active power to apparent power or It is the ratio of resistance to impedance. $\cos \phi = \frac{R}{Z}$ (b) Active Power: The power which is actually consumed or utilized is known as Active Power	1.5 1.5	3													

	$P=VI\cos \phi$			
II.6	<p>a) Active components: They are capable of amplifying/processing an electric signal. In other words they can supply energy/power. Eg: diodes,transistors etc</p> <p>b) Passive components: They are not capable of amplifying/processing signal.Passive components can store /dissipate energy/power. Eg: Resistors, Inductors, Capacitors</p>	1.5	3	
II.7	<ul style="list-style-type: none"> • The capacitor is used for storage of energy. • It is used in filter circuits to minimize the ripple voltage. • Capacitors are used in ac motors. • Bypass the high frequency signals. • Used in tank circuits in electronic oscillators. • Used in snubber circuit to suppress radio frequency interference <p>(Any 3)</p>	(3 x1)	3	
II.8	<ul style="list-style-type: none"> • Inductors are mainly of two types <ol style="list-style-type: none"> 1. Fixed Inductors 2. Variable Inductors <p>1. Fixed Inductors can be further classified as</p> <ul style="list-style-type: none"> • Air Core: It consists of a few turns of wire wound on a hollow former. • Iron Core Inductors: The core material made of laminated silicon steel(passes through the former such that it forms a closed magnetic path. • Ferrite Core Inductor: Core made of ferrite, used for high frequency applications <p>2.Variable Inductance: Inductance can be varied (or similar)</p>		3	
II.9	<ul style="list-style-type: none"> • A transformer operates on the principle of mutual induction, between (and sometimes more) inductively 		3	

coupled coils. It consists of two windings in proximity.

- The two windings are coupled by magnetic induction. (There is no conductive connection between the winding).
- One of the windings called primary is energized by a sinusoidal voltage.
- The second winding, called secondary, feeds the load.
- The alternating current in the primary winding sets up an alternating flux in the core.
- The secondary winding is linked by most of this flux and EMF is induced in it
- Energy is transformed from the primary circuit to the secondary circuit through the medium of the magnetic field.

II.10

Symbol		Truth Table		
A	 2-input Ex-OR Gate	A	B	Q
B		0	0	0
		0	1	1
		1	0	1
		1	1	0

Boolean Expression $Q = A \text{ XOR } B$

(Symbol :1 mark, Truth table:2 mark)

3

PART C

42

III

a)The ratio of potential difference (V) between any two points on a conductor to the current (I) flowing between them, is a constant ,provided the temperature of the conductor does not change

$$\frac{V}{I} = \text{constant} \text{ or } \frac{V}{I} = R$$

R is the resistance of the conductor between the two points considered

b)Voltage $V=240\text{V}$

$I=16\text{mA}=16 \times 10^{-3} \text{A}$

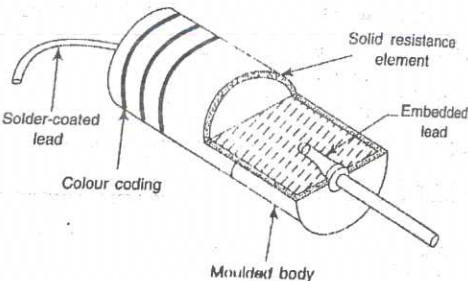
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1

1.5

	Resistance $R = \frac{V}{I} = \frac{240}{16 \times 10^{-3}} = 15 \times 10^3 = 15k\Omega$ Power, $P = VI$ or $I^2 R = 3.84W$	1.5		
IV	(a) Expression for equivalent resistance when in series $R_s = R_1 + R_2 + R_3$ $R_s = 6 + 10 + 20 = 36\Omega$ $I = V/R = 100/36 = 2.78A$ (b) Expression for equivalent resistance when in parallel $\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$ $1/R_p = 0.167 + 0.1 + 0.05 = 0.317$ $R_p = 3.157\Omega$ $I = 100/3.157 = 31.67A$	1 1.5 1 1 1.5 1	7	
V	Power consumed by 10 LED tubes of 20W = 200W Energy consumed by the 10 LED Tubes = 200 x 12 = 2400Wh Power consumed by 4 coolers of 100 W each = 400W Energy consumed by 4 coolers of 100W each working 4 hrs per day = 400 x 4 = 1600Wh Power consumed by 10 fans of 80W each working 8hrs per day = 800W Energy consumed per day by the fans = 6400Wh Power consumed by the 1500W electric oven = 1500 x 1 = 1500 Energy consumed per day by the oven = 1500 x 6 = 9000Wh Total Energy consumed per day = 2400 + 1600 + 6400 + 9000 = 19400Wh = 19.4kWh = 19.4Units Total energy consumed in a month = 30 x 19.4 = 582 units Energy cost = 582 x 5 = Rs2910/-	1 1 1 1 1 1 1 1 1	7	

VIII	<p>a) Service mains: The line bringing electric power from the supplier's low voltage distribution up to the energy meter installed at the consumer's premises is called service mains. It can be either by overhead lines/UG cables.</p> <p>b) Cut out fuse: In case the consumer draws more current than the rating of the meter the cut out will blow off and save the meter. It also enables the supply authority to discontinue the supply, if the consumer fails to pay the bill.</p> <p>c) MCB: Miniature Circuit Breaker provides protection to the wiring installation against overcurrent and short circuit.</p> <p>d) Neutral Link: They are metallic bars that are usually constructed of copper aluminium/brass. They act as terminating points for neutral wires in a typical electric circuit</p>	1.75 x4	7	
IX	 <p>Fig. 2.1 Cutaway view of a carbon composition resistor</p> <ul style="list-style-type: none"> • It gives a fixed value of resistance and hence it is widely used in discrete circuits. • The carbon resistors are made of finely divided carbon mixed with powdered insulating material such as 	4	7	3

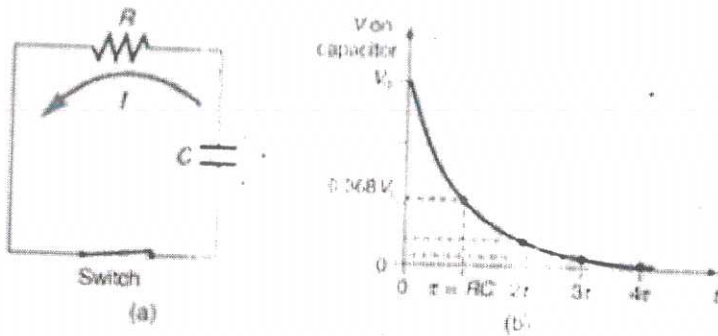
resin/clay in proportions needed for the desired resistance value

- These are then placed in a casing(moulded plastic) with lead wires of tinned copper.
- Resistances are available in the range from few ohms to few hundred ohms

X

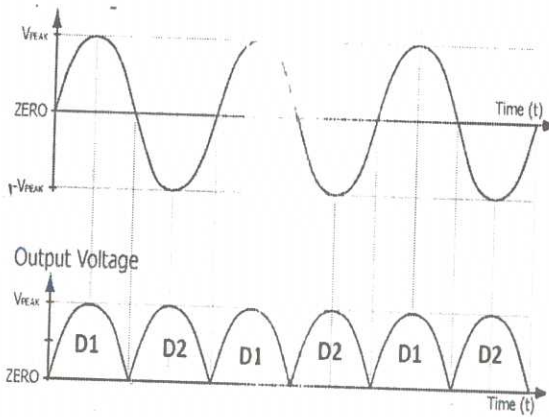
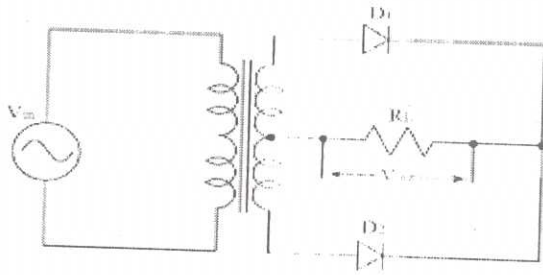


When a voltage is applied to the Capacitor, electrons accumulate on the Capacitor plate connected to the -ve of the battery and the plate connected to the positive of the voltage loses electrons to get positive charge. This simple redistribution of electrons is called the charging of capacitor. This continues till the potential difference across the capacitor plates is equal to the applied voltage ie $V_c = V$



In discharging process, the accumulated charge on the capacitor plates redistributes itself to attain the equilibrium state ie neutral state. The discharging current i_d flows till the capacitor voltage V_c reduces to zero

XI



(Diagram-2 marks+ waveforms-2 marks)

A centre-tapped full wave rectifier consists of a center tapped transformer and two diodes for rectification.

During the positive half cycle of the input voltage the diode D1 gets forward biased and hence the current flows from the source—D1—RL—Source.

During -ve half cycle of the input voltage the diode D2 gets forward biased and D1 reverse biased. Hence the current flows through Source—D2---RL—Source.

Thus for both half cycles the current direction in the load remains the same and hence a rectified dc output voltage is obtained across the resistor.

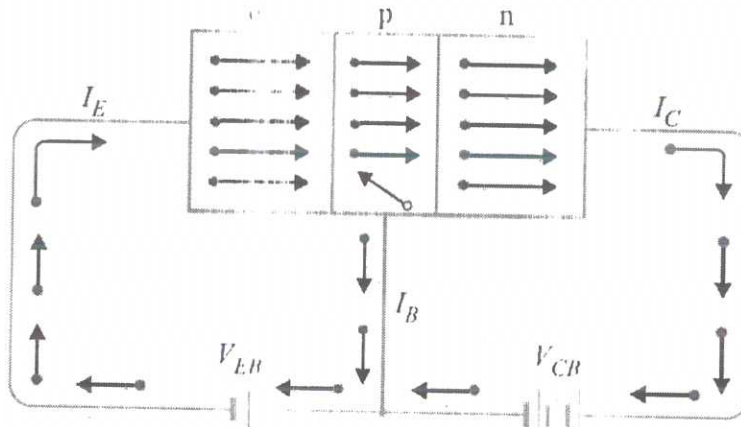
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Fig(
2+2)

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XII

A transistor should be given biasing to work properly. Figure shows an NPN transistor biased in the active region, ie EB junction is forward biased and collector base junction is reverse biased.



Basic connection of *npn* transistor

In an NPN transistor the majority charge carriers are electrons.

- EB junction forward biased, so the barrier potential is reduced and the electrons would flow from emitter to base region across the junction.
- Small percentage of electrons (2%) will recombine with holes in base region.
- Reverse bias of CB junction causes expansion of depletion layer.
- As the Width of the base region is thinner than the collector region the depletion region will penetrate deep into the base region.
- Electrons from the emitter region will reach the CB depletion region
- Due to large bias voltage VCB, electrons will be pulled across the CB junction.
- Collector collects 98 % of the electrons emitted by the emitter.

Fig(3.5) + Expl an(3. 5)

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XIII

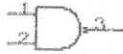
The universal gates are
NAND Gate and NOR Gate

2 Input NAND Gate

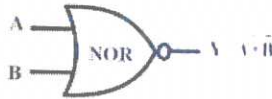
TRUTH TABLE

INPUTS		OUTPUT
X	Y	Z
0	0	1
0	1	1
1	0	1
1	1	0

NAND Gate



(Symbol:1mark+ Truth Table:2)



Inputs		Output
A	B	$Y = \overline{A + B}$
0	0	1
0	1	0
1	0	0
1	1	0

(Symbol:1mark+ Truth Table:2)

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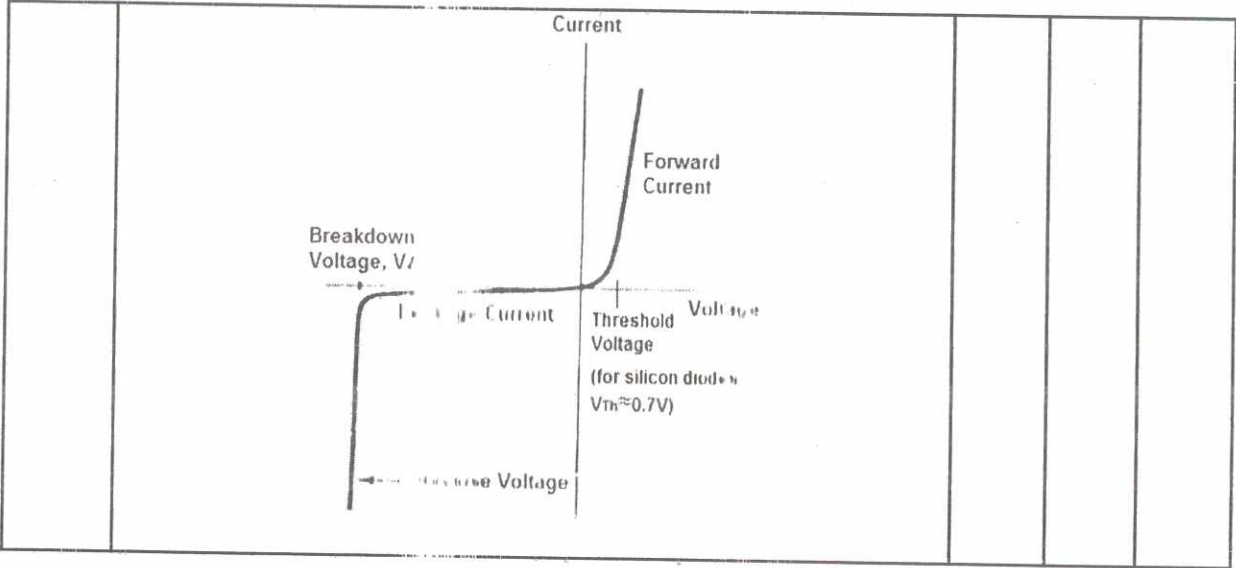
XIV

A Zener Diode, also known as a breakdown diode, is a heavily doped semiconductor device that is designed to operate in the reverse direction.

- A Zener diode operates just like a normal diode when it is forward-biased.
- Since zener diode is heavily doped, depletion region is narrow
- When a reverse voltage is applied to a zener diode, current due to minority carriers increases.
- When reverse voltage reaches the Zener Voltage (knee voltage), the junction breaks down and the reverse current increases drastically.
- This voltage is called breakdown voltage or Zener voltage (V_z)
- This effect is known as the Zener Effect.

Fig:(
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BLUE PRINT

Mark Distribution

Module	Hr/Module	$(hi / \sum Hi) * 123$	TYPE OF QUESTIONS							
			PART A		PART B		PART C		TOTAL	
			No of questions	Marks	No of questions	Marks	No of questions	Marks	No of questions	Marks
I	12	34.3	3	3	4	12	2	14	9	29
II	10	28.6	2	2	1	3	4	28	7	33
III	10	28.6	2	2	4	12	2	14	8	28
IV	11	31.5	2	2	1	3	4	28	7	33
	43	123	9	9	10	30	12	84	31	123

Cognitive Level wise Question analysis

Mark distribution

Cognitive Level	% Marks	Marks	TYPE OF QUESTIONS							
			PART A		PART B		PART C		TOTAL	
			No of questions	Marks	No of questions	Marks	No of questions	Marks	No of questions	Marks
R	24.4	36.9	9	9	7	21	0	0	16	30
U	52.8	61.5	0	0	3	9	8	56	11	65
A	22.8	24.6	0	0	0	0	4	28	4	28
TOTAL	100	123	9	9	10	30	12	84	31	123

Question Wise Analysis

Q.No	Module Outcome	Cognitive Level	Marks	Time
I.1	M1.01	R	1	2
I.2	M1.03	R	1	2
I.3	M1.04	R	1	2
I.4	M2.01	R	1	2
I.5	M2.02	R	1	2
I.6	M3.03	R	1	2
I.7	M3.04	R	1	2
I.8	M 4.01	R	1	2
I.9	M 4.02	R	1	2
II.1	M1.01	R	3	7
II.2	M1.02	U	3	7
II.3	M1.03	R	3	7
II.4	M1.04	R	3	7
II.5	M2.02	R	3	7
II.6	M3.01	R	3	7
II.7	M3.02	R	3	7
II.8	M3.03	U	3	7
II.9	M4.04	R	3	7

II.10	M4.04	R	3	7
III.	M1.01	A	7	17
IV.	M1.02	A	7	17
V	M2.03	A	7	18
VI	M2.02	A	7	18
VII	M2.04	U	7	17
VIII	M2.01	U	7	17
IX	M3.01	U	7	17
X	M3.02	U	7	17
XI	M4.01	U	7	17
XII	M4.03	U	7	17
XIII	M4.04	U	7	17
XIV	M4.02	U	7	17
Total			123	295