Maximum Marks : 25 **PHYSICS** **Time: 50 Minutes**

Choose the correct answer :- **3x1=3**

1. The principle based on which a solar cell operates is

(a) Diffusion (b) Recombination

(c) Photovoltaic action (d) Carrier flow

2. If the input to the NOT gate is A = 1011, its output is

(a) 0100 (b) 1000

(c) 1100 (d) 0011

3. The frequency range of 2 KHz to 2 MHz is used for

(a) Ground wave propagation (b) Space wave propagation

(c) Sky wave propagation (d) Satellite communication

Answer the following :- **3x2=6**

4. What do you mean by leakage current in a diode?
5. What is meant by biasing? Mention its types.
6. In a transistor connected in the common base configuration, $\alpha = 0.95, I_E = 1mA$. Calculate the values of I_C and I_B.

Answer any two of the following:- **2x3=6**

7. List the applications of light emitting diode.
8. State and prove De Morgan's first and second theorem.
9. Prove the Boolean identity $AC + ABC = AC$ and give its circuit description.

Answer the following :- **2x5=10**

10. (a). Explain the construction and working of a full wave rectifier.

(OR)

(b) Describe the function of a transistor as an amplifier with the neat circuit diagram. Sketch the input and output wave forms.

11. i). Give the Barkhausen conditions for sustained oscillations.
ii) Verify the given Boolean equation $A + AB = A + B$ using truth table.

ALL THE BEST

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Answer key attached in next page!!!

This page is to prevent seeing answer key

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ANSWER KEY

Q NO	ANSWERS	MARKS
1.	(C) Photo voltaic action	**1**
2.	(A) 0100	**1**
3.	(A) Ground wave propagation	**1**
4.	Under this reverse bias, a very small current in μA flows across the junction. This is due to the flow of the minority charge carriers and is called the leakage current or reverse saturation current.	**2**
5.	Biasing means providing external energy to charge carriers to overcome the barrier potential and make them move in a particular direction. Depending on the polarity of the external source to the *p-n* junction, we have two types of biasing: i) Forward bias ii) Reverse bias	**2**
6.	$\alpha = \frac{I_C}{I_E} \Rightarrow I_C = \alpha I_E = 0.95\ mA$ $I_E = I_B + I_C \Rightarrow I_B = 0.05\ mA$	**2**
7.	The light emitting diodes are used in • indicator lamps on the front panel of the scientific and laboratory equipments. • seven-segment displays. • traffic signals, emergency vehicle lighting etc. • remote control of television, airconditioner etc.	**3**
8.	**De Morgan's First Theorem** **Statement** The first theorem states that the complement of the sum of two logical inputs is equal to the product of its complements. **Proof** The Boolean equation for NOR gate is $Y = \overline{A + B}$. The Boolean equation for a bubbled AND gate is $Y = \bar{A}.\bar{B}$. Both cases generate same outputs for same inputs. It can be verified using the following truth table.	**3**

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A	B	$A+B$	$\overline{A+B}$	$\overline{A}$	$\overline{B}$	$\overline{A}.\overline{B}$
0	0	0	1	1	1	1
0	1	1	0	1	0	0
1	0	1	0	0	1	0
1	1	1	0	0	0	0

De Morgan's Second Theorem

Statement

The second theorem states that the complement of the product of two inputs is equal to the sum of its complements.

Proof

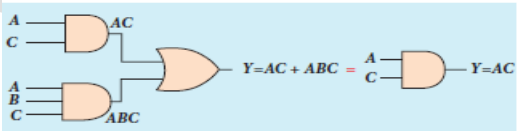
The Boolean equation for NAND gate is $Y = \overline{A.B}$.

The Boolean equation for bubbled OR gate is $Y = \bar{A} + \overline{B}$.

A and B are the inputs and Y is the output.

The above two equations produces the same output for the same inputs. It can be verified by using the truth table.

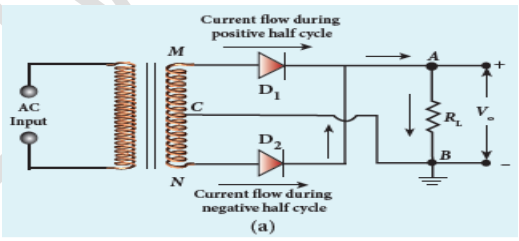
A	B	$A.B$	$\overline{A.B}$	$\overline{A}$	$\overline{B}$	$\overline{A}+\overline{B}$
0	0	0	1	1	1	1
0	1	0	1	1	0	1
1	0	0	1	0	1	1
1	1	1	0	0	0	0

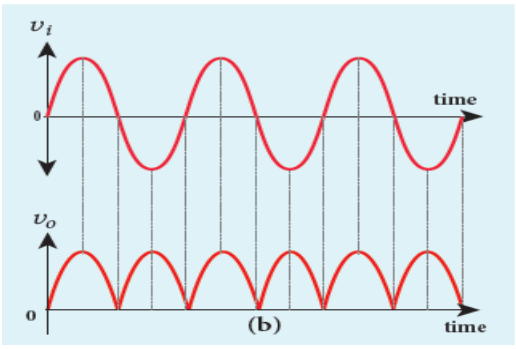
9.	Step 1: $AC\,(1 + B) = AC.1$ [OR law-2] Step 2: $AC\,.\,1 = AC$ [AND law – 2] Therefore, $AC + ABC = AC$ Thus the Boolean identity is proved. *Circuit description:* 	**3**
10. a	The positive and negative half cycles of the AC input signal are rectified in this circuit and hence it is called the full wave rectifier.It consists of two *p-n* junction diodes, a centre tap transformer and a load resistor R_L. The centre is usually taken as the ground or zero voltage reference point. With the help of the centre tap transformer, each diode rectifies one half of the total secondary voltage.	**5**

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During positive half cycle
When the positive half cycle of the AC input signal passes through the circuit, terminal *M* is positive, *C* is at zero potential and *N* is at negative potential. This forward biases diode *D*1 and reverse biases diode *D*2. Hence, being forward biased, diode *D*1 conducts and current flows along the path $MD_1 ABC_1$.

During negative half cycle
When the negative half cycle of the AC input signal passes through the circuit, terminal *N* becomes positive, *C* is at zero potential and *M* is at negative potential.
This forward biases diode *D*2 and reverse biases diode *D*1. Hence, being forward biased, diode *D*2 conducts and current flows along the path$ND ABC$ 2 .
During both postive and negative half cycles of the input signal, the current flows through the load in the same direction. The output signal corresponding to the input signal. Though
both half cycles of AC input are rectified, the output is still pulsating in nature. The efficiency (η) of full wave rectifier is twice that of a half wave rectifier and is found to be 81.2 %. It is because of power losses in the winding, the diode and the load resistance.





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10. b	A transistor operating in the active region has the capability to amplify weak signals. **Amplification is the process of increasing the signal strength (increase in the amplitude).** If a large amplification is required, the transistors are cascaded with coupling elements like resistors, capacitors, and transformers and they are called multistage amplifiers. Here, the amplification of an electrical signal is explained with a single stage transistor amplifier. Single stage indicates that the circuit consists of one transistor with the allied components. An NPN transistor is connected in the common emitter configuration. To start with, the Q point or the operating point of the transistor is fixed so as to get the maximum signal swing at the output (neither towards saturation point nor towards cut-off). A load resistance R_C is connected in series with the collector circuit to measure the output voltage. The resistance $R1$, $R2$ and R_E form the biasing and stabilization circuit. The capacitor $C1$ allows only the AC signal to pass through. The emitter bypass capacitor C_E provides a low reactance path to the amplified AC signal. The coupling capacitor C_C is used to couple one stage of the amplifier with the next stage while constructing multistage amplifiers. V_S is the sinusoidal input signal source applied across the base-emitter. The output is taken across the collector-emitter. $I_C = \beta I_B$ Output voltage is by kvl, $V_{CE} = V_{CC} - I_C R_C$	**5**
11	i) The following conditions called Barkhausen conditions should be satisfied for sustained oscillations in the oscillator. · There should be positive feedback. · The loop phase shift must be 00 or integral multiples of 2π. · The loop gain must be unity. That is, $\|A\beta\| = 1$. ii)	**5**

A	B	$\bar{A}$	$\bar{A}B$	$A + \bar{A}B$	A+B
0	0	1	0	0	0
0	1	1	1	1	1
1	0	0	0	1	1
1	1	0	0	1	1

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