CMR INSTITUTEOF TECHNOLOGY

USN

Internal Assessment Test–I

Sub:	**Introduction to Electronics Engineering**							**Code:**	**BESCK104C**
Date:	**21/11/2024**	**Duration:**	**90 mins**	**Max Marks:**	**50**	**Sem:**	**I**	**Sec:**	**A-G**

	Answer Any FIVE FULL Questions	**Marks**	**OBE**	
			CO	**RBT**
1.	Perform the following Conversions. (i)$(FACE)_{16}\rightarrow(?)_{10}$ (ii)$(65.45)_{10}\rightarrow(?\quad)_2$ (iii)$(1101110110.1001)_2\rightarrow(?)_8$ (iv)$(345.AB)_{16}\rightarrow(?)_2$ (v)$(771.6)_8\rightarrow(?)_{16}$	[10]	CO2	L3
2.	a) Express the Boolean function F=A +B'C in sum of minterms, b) Perform $(4456)_{10}$-$(34234)_{10}$ using 10'scomplement.	[5+5]	CO2	L3
3	Implement the full adder circuit with its truth table and draw the logic diagram and obtain expressions for sum and carry.	[10]	CO2	L3
4	With a neat circuit diagram and waveforms explain the full wave bridge rectifier circuit.	[10]	CO1	L2

5	a) With a neat circuit diagram brief out the operation of voltage doubler. b) An amplifier produces an output voltage of 2V for an input of 50mV. If the input and output currents in this condition are 4mA and 200mA respectively, Find i) Voltage gain ii) Current gain iii) Power gain	[6+4]	CO1	L3
6	What is regulated power supply? With neat block diagram, explain the working of DC power supply. Also mention the principal components used in each block.	[10]	CO1	L2
7	a) What is voltage regulator? With neat circuit diagram, explain the operation of a voltage regulator using Zener diode. b) Using basic Boolean theorem prove that XY+XZ+YZ'=XZ+YZ'	[7] [3]	CO1 CO2	L2 L3
8.	a) What is the amplifier? Define two different types of amplifiers. b) Write the symbol, expression and truth table for the following Logic gates. (i) AND (ii) OR (iii)XOR	[4+6]	CO1 CO2	L2 L2

1. Conversions

(i) $(FACE)_{16} \to (?)_{10}$

Expand using hexadecimal-to-decimal conversion:

$$(FACE)_{16} = F \cdot 16^3 + A \cdot 16^2 + C \cdot 16^1 + E \cdot 16^0$$

Substitute values: $F = 15, A = 10, C = 12, E = 14$:

$$(15 \cdot 16^3) + (10 \cdot 16^2) + (12 \cdot 16^1) + (14 \cdot 16^0) = 61440 + 2560 + 192 + 14 = 64206$$

$$\boxed{(FACE)_{16} = 64206_{10}}$$

(ii) $(65.45)_{10} \to (?)_2$

1. **Convert integer part (65) to binary:**

$$65 \div 2 = 32\,\text{R}1, \quad 32 \div 2 = 16\,\text{R}0, \quad 16 \div 2 = 8\,\text{R}0, \cdots \to (1000001)_2$$

2. **Convert fractional part (0.45) to binary:**

$$0.45 \times 2 = 0.9\,(\text{integer part } 0), \quad 0.9 \times 2 = 1.8\,(\text{integer part } 1), \ldots$$

Repeat until precision is achieved:

$$(0.45)_{10} = (0.0111001)_2$$

Final result:

$$\boxed{(65.45)_{10} = (1000001.0111001)_2}$$

(iii) $(1101110110.1001)_2 \to (?)_8$

Group binary digits in threes (from the decimal point):

$$110\,111\,011\,0.100\,1 \to (6734.44)_8$$

$$\boxed{(1101110110.1001)_2 = (6734.44)_8}$$

(iv) $(345.AB)_{16} \to (?)_2$

Convert each hex digit to 4-bit binary:

$$3 = 0011,\ 4 = 0100,\ 5 = 0101,\ A = 1010,\ B = 1011$$

Combine:

$$(345.AB)_{16} = (001101000101.10101011)_2$$

$$\boxed{(345.AB)_{16} = (001101000101.10101011)_2}$$

(v) $(771.6)_8 \to (?)_{16}$

1. Convert octal to binary:

$$7 = 111,\ 7 = 111,\ 1 = 001,\ 6 = 110 \implies (111111001.110)_2$$

2. Convert binary to hex:

$$1111\,1100\,1.110 \to (1F9.C)_{16}$$

$$\boxed{(771.6)_8 = (1F9.C)_{16}}$$

2 (a)

The Boolean function $F = A + B'C$ has three variables: A, B, and C, so all minterms must include these variables.

Expand A as $A(B + B')(C + C') = AB'C' + AB'C + ABC' + ABC$.
Expand $B'C$ as $(A + A')B'C = AB'C + A'B'C$.

Combine all terms:

$$F = AB'C' + AB'C + ABC' + ABC + A'B'C$$

Each term corresponds to a minterm:
$AB'C' = m(4), AB'C = m(5), ABC' = m(6), ABC = m(7), A'B'C = m(1)$.

Thus, $F = \Sigma m(1, 4, 5, 6, 7)$.

2 (b)

(b) **Perform $4456_{10} - 34234_{10}$ using 10's complement**

1. Find 10's complement of 34234:

$$99999 - 34234 + 1 = 65766$$

2. Add $4456 + 65766 = 70222$. Discard carry:

$$\boxed{-29778}$$

3. Full Adder

(a) **Truth Table**:

A	B	Cin	Sum S	Carry C
0	0	0	0	0
0	0	1	1	0
0	1	0	1	0
0	1	1	0	1
1	0	0	1	0
1	0	1	0	1
1	1	0	0	1
1	1	1	1	1

(b) **Equations**:

1. Sum:

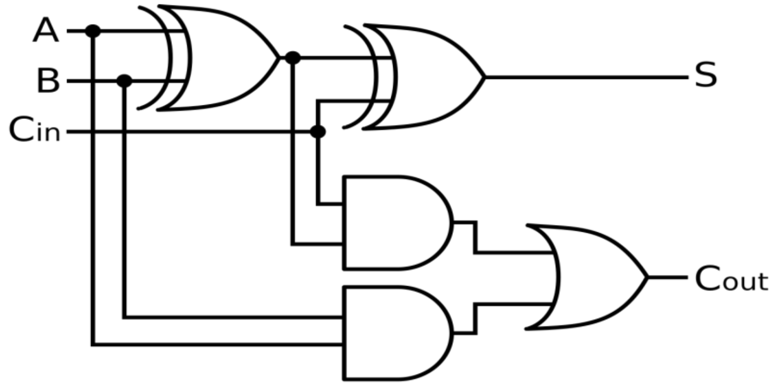
$$S = A \oplus B \oplus \text{Cin}$$

2. Carry:

$$C = AB + \text{Cin}(A \oplus B)$$

(c) **Logic Diagram**:

A circuit combining XOR gates for sum and AND/OR gates for carry.



---

4. Full-Wave Bridge Rectifier

(a) **Circuit Diagram**:

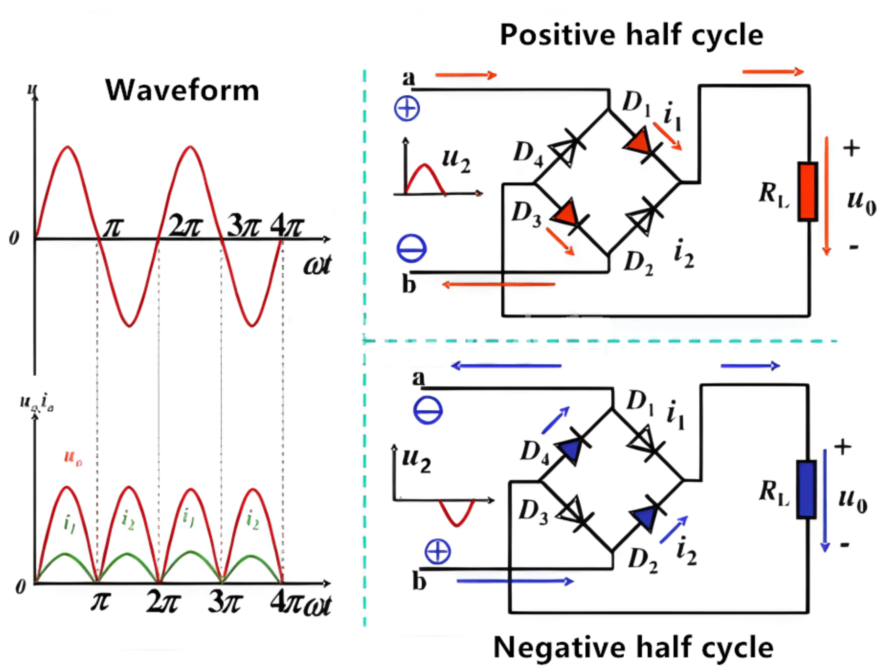
Four diodes connected in a bridge configuration with a load resistor.

(b) **Operation:**

- During the positive half-cycle, two diodes conduct, allowing current through the load in one direction.
- During the negative half-cycle, the other two diodes conduct, maintaining the current direction.
- Output: Pulsating DC.

(c) **Waveforms:**

Input AC and rectified DC waveforms show both half-cycles converted to DC.



Positive Half-Cycle

1. **Input Polarity:** The upper terminal of the transformer secondary winding is **positive**, and the lower terminal is **negative.**
2. **Diodes Conducting:**
   - D_1: Forward-biased (conducts).
   - D_3: Forward-biased (conducts).
   - D_2 and D_4: Reverse-biased (block current).
3. **Current Flow:**
   - Current flows from the positive terminal of the transformer through D_1, the load resistor R_L, and back to the transformer through D_3.
   - **Load current flows in one direction.**

Negative Half-Cycle

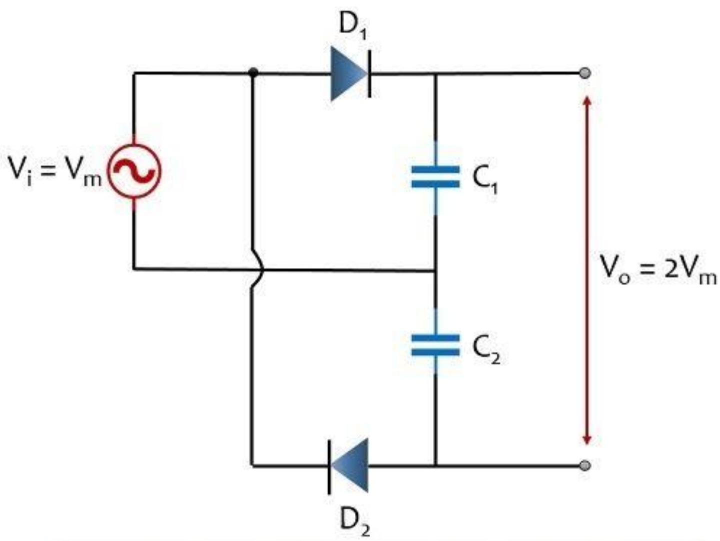
1. **Input Polarity:** The upper terminal of the transformer secondary winding is **negative**, and the lower terminal is **positive.**
2. **Diodes Conducting:**
   - D_2: Forward-biased (conducts).
   - D_4: Forward-biased (conducts).
   - D_1 and D_3: Reverse-biased (block current).
3. **Current Flow:**
   - Current flows from the positive lower terminal of the transformer through D_4, the load resistor R_L, and back to the transformer through D_2.
   - **Load current flows in the same direction as in the positive half-cycle.**

- D_1 and D_3 conduct during the **positive half-cycle.**
- D_2 and D_4 conduct during the **negative half-cycle.**
- The output across the load resistor R_L is a **pulsating DC voltage** where both halves of the AC input are rectified.

5 (a)

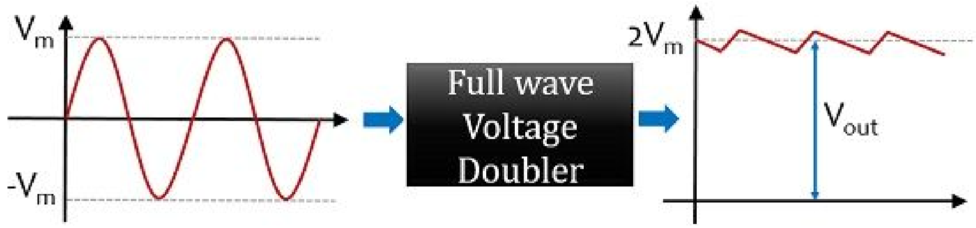
Full-Wave Voltage Doubler

1. **Circuit Components:**
   - Two diodes (D_1, D_2).
   - Two capacitors (C_1, C_2).
   - Center-tapped transformer.
2. **Working:**
   - **Positive Half-Cycle:**
     - The upper winding of the transformer charges C_1 through D_1 to V_m.
   - **Negative Half-Cycle:**
     - The lower winding of the transformer charges C_2 through D_2 to V_m.
   - The output voltage across C_1 and C_2 in series is $2V_m$.



Circuit of full wave voltage doubler

The figure below shows the input and output waveform of full wave voltage doubler:



Advantages of Voltage Doubler

- It eliminates the use of a high voltage transformer. As it changes a low voltage to high at a low rate.
- Voltage multiplication can be greatly increased by cascading such circuits.

Disadvantages of Voltage Doubler

- The output present has undesired fluctuations called ripples.

(b) **Amplifier Gain Calculations**:

Given:

$$V_{\text{in}} = 50\,\text{mV},\ V_{\text{out}} = 2\,\text{V},\ I_{\text{in}} = 4\,\text{mA},\ I_{\text{out}} = 200\,\text{mA}$$

1. Voltage Gain:

$$A_v = \frac{V_{\text{out}}}{V_{\text{in}}} = \frac{2}{0.05} = 40$$

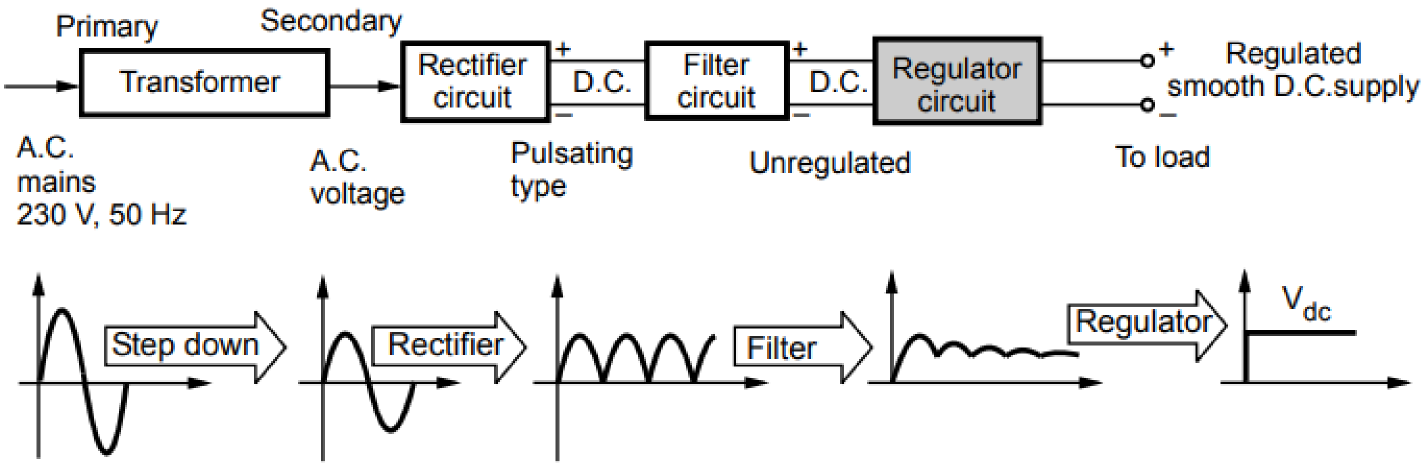
2. Current Gain:

$$A_i = \frac{I_{\text{out}}}{I_{\text{in}}} = \frac{200}{4} = 50$$

3. Power Gain:

$$A_p = A_v \cdot A_i = 40 \cdot 50 = 2000$$

6.



Block Schematic of Regulated Power Supply - Block Diagram

Working

Transformer:

The transformer is the first stage of the regulated power supply. It steps down the high AC voltage from the main supply to a lower AC voltage suitable for the load.

Rectifier:

The AC voltage from the transformer is converted into pulsating DC by the rectifier, typically implemented using diodes. A full-wave rectifier or half-wave rectifier is used depending on the application.

Filter:

The rectified output is still not smooth, as it contains ripples. The filter, usually a capacitor or combination of capacitors and inductors, smooths the pulsating DC and reduces the ripple, providing a relatively stable DC signal.

Voltage Regulator:

The final stage is the voltage regulator, which ensures that the output voltage remains constant despite fluctuations in the input AC voltage or changes in the load. There are two main types:

Linear Regulator: Provides a fixed output voltage with low ripple but is less efficient.

Switching Regulator: More efficient and can provide variable output voltages, using techniques such as pulse-width modulation.

Summary

The regulated power supply guarantees a steady DC voltage for electronic devices by using a transformer to step down AC, a rectifier to convert it to DC, a filter to remove ripples, and a regulator to maintain a constant output voltage. This system is essential for powering sensitive equipment that requires stable and noise-free voltage.

---

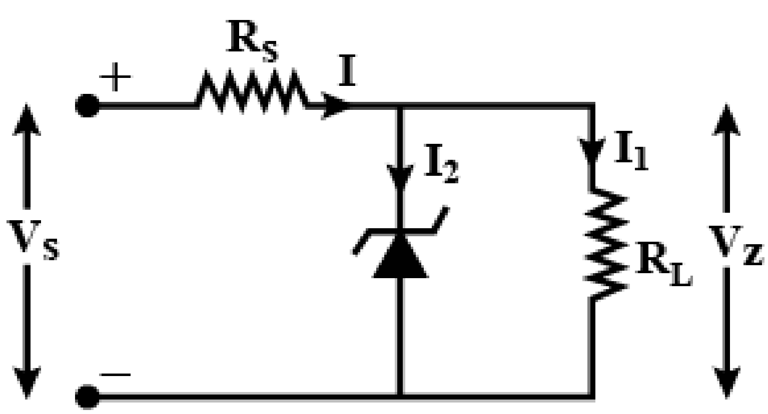
7. Zener Voltage Regulator

A **Zener diode** voltage regulator is a simple and efficient way to maintain a stable output voltage in electronic circuits, primarily by using the Zener diode's reverse breakdown region. The Zener diode operates in reverse bias and maintains a constant output voltage when the input voltage exceeds a certain value. This regulator is commonly used in low-power applications to provide a steady voltage supply.

Working Principle

1. **Reverse Bias Operation**:
   In a normal diode, current flows in the forward direction, and it blocks current in reverse. However, when a **Zener diode** is connected in reverse bias, it behaves differently. When the reverse voltage exceeds a certain threshold known as the **Zener breakdown voltage**, the diode starts conducting in reverse, but the voltage across the diode remains almost constant.
2. **Voltage Regulation**:
   As the input voltage increases beyond the Zener voltage, the Zener diode starts to conduct and **maintains a constant voltage** across it (the Zener voltage). The current that flows through the Zener diode increases with the input voltage, but the voltage remains the same. When the input voltage drops below the Zener voltage, the diode stops conducting, and the output voltage also decreases.
3. **Stabilizing the Output**:
   The Zener diode's ability to maintain a constant voltage across it, even as the input voltage varies, ensures a stable output voltage. The Zener voltage is typically specified in the diode's datasheet and ranges from a few volts to several hundred volts.

Zener Voltage Regulator Circuit



Zender diode as a voltage regulator

The circuit typically consists of the following components:

- **Zener Diode**: Connected in reverse bias.
- **Series Resistor**: Connected in series with the input voltage source to limit the current flowing through the Zener diode.
- **Load**: The device or circuit that requires a stable voltage supply.

Operation in the Circuit:

- When the input voltage is high enough, the Zener diode conducts and stabilizes the output voltage at the Zener breakdown voltage.
- The series resistor limits the current flowing into the Zener diode and prevents damage to the diode.

Advantages:

1. **Simple Design**: Requires few components (Zener diode, resistor).
2. **Low Cost**: Relatively inexpensive and easy to implement.
3. **Compact**: Suitable for low-power applications.

Limitations:

1. **Limited Current Handling**: Suitable only for low current applications.
2. **Voltage Drop**: The Zener diode has a small voltage drop, which can affect the precision in some cases.
3. **Temperature Sensitivity**: The Zener voltage can vary with temperature, although modern Zener diodes are designed to minimize this effect.

Applications:

1. **Voltage regulation in low-power circuits**: Powering small electronic devices and sensors.
2. **Overvoltage protection**: Protecting circuits from overvoltage conditions by clamping the voltage.
3. **Reference voltages**: Providing a stable reference voltage for other components

7b.

Step 1: Starting with the left-hand side

We start with the left-hand side of the equation:

$$XY + XZ + YZ'$$

Step 2: Factor out common terms

Notice that the terms XZ and XY both contain X. So, we can factor out X from the first two terms:

$$= X(Y + Z) + YZ'$$

Step 3: Apply the Idempotent Law

The term $Y + Z$ doesn't simplify further, but we can leave it as it is.

So, the equation becomes:

$$= X(Y + Z) + YZ'$$

Step 4: Analyze the expression

Now observe that we have two parts: $X(Y + Z)$ and YZ'.

- The term $X(Y + Z)$ involves X, but YZ' involves no X.
- Now, let's consider when $X = 1$, the term $X(Y + Z)$ will be true. If $X = 0$, then $X(Y + Z) = 0$, and we are left with YZ'.

This simplifies the expression to:

=XZ+YZ′

a) What is an amplifier? Define two different types of amplifiers.

An **amplifier** is an electronic device or circuit that increases the amplitude (or power) of a signal, typically a voltage or current, without altering its other characteristics like frequency. Amplifiers are used in a wide variety of applications, including audio systems, radio communications, and signal processing.

There are two main types of amplifiers:

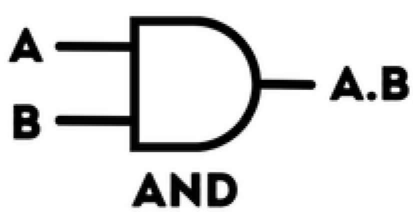
1. **Voltage Amplifier**: A voltage amplifier increases the voltage level of an input signal while maintaining its current level. It typically has a high input impedance and low output impedance. Voltage amplifiers are often used in applications where the voltage needs to be increased, such as in audio preamplifiers.
2. **Power Amplifier**:
   A power amplifier increases the power (voltage and current) of the input signal. It is designed to drive a load with a higher current. Power amplifiers are used in applications like audio systems, where they drive speakers, or in RF transmitters to boost signals for transmission.

---

b) Write the symbol, expression, and truth table for the following Logic gates:

(i) AND Gate

- **Symbol**:
  The AND gate has two or more inputs and one output. The output is true (1) only when all inputs are true (1).



2 input AND Gate

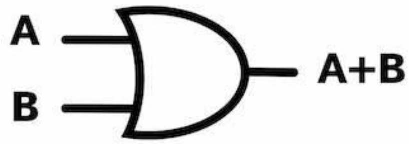
A	B	A.B
0	0	0
0	1	0
1	0	0
1	1	1

- **Expression**:

  $Y = A \cdot B$

(ii) OR Gate

- **Symbol**:
  The OR gate has two or more inputs and one output. The output is true (1) when at least one of the inputs is true (1).

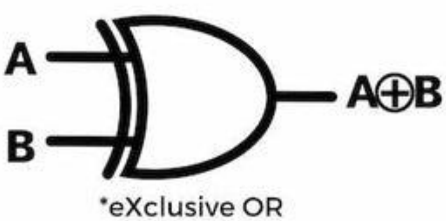


2 input OR gate

A	B	A+B
0	0	0
0	1	1
1	0	1
1	1	1

(iii) XOR Gate

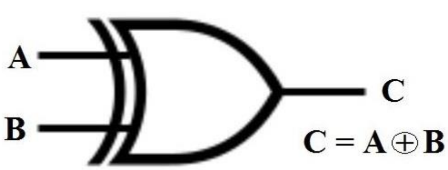
- **Symbol**:
  The XOR (exclusive OR) gate has two inputs and one output. The output is true (1) only when the inputs are different, i.e., one input is 1 and the other is 0.



2 input XOR gate

A	B	A⊕B
0	0	0
0	1	1
1	0	1
1	1	0

XOR GATE Truth Table



INPUT		OUTPUT
A	B	A XOR B
0	0	0
0	1	1
1	0	1
1	1	0

BOOLEAN EXPRESSION

$$A \cdot \overline{B} + \overline{A} \cdot B$$

$$(A + B) \cdot (\overline{A} + \overline{B})$$