CMR INSTITUTEOF TECHNOLOGY

USN

Internal Assessment Test–I

Sub:	**Introduction to Electronics Engineering**							**Code:**	**BESCK204C**
Date:	**06/05/2025**	**Duration:**	**90 mins**	**Max Marks:**	**50**	**Sem:**	**II**	**Sec:**	**I, J, K, L**

Answer Any FIVE FULL Questions

		Marks	OBE CO	OBE RBT
1.	Perform the following Conversions. (i)$(725.25)_8 \rightarrow (?)_{10}$ (ii)$(95.25)_{10} \rightarrow (?\quad)_2$ (iii)$(1000111110.1101)_2 \rightarrow (?)_8$ (iv)$(345.AB)_{16} \rightarrow (?)_2$ (v)$(478.24)_8 \rightarrow (?)_{16}$	[10]	CO2	L3
2.	a) Express the Boolean function F=A' +B'C in sum of minterms, b) Perform $(2415)_{10}$-$(41234)_{10}$ using 10'scomplement.	[5+5]	CO2	L3
3	With neat block diagram, explain the working of DC power supply. Also mention the principal components used in each block.	[10]	CO2	L3
4	a) With a neat circuit diagram brief out the operation of voltage doubler. b) Express the following function F = A'B + AC as the product of maxterms.	[5+5]	CO1	L2
5	With a neat circuit diagram and waveforms explain the full wave bridge rectifier circuit.	**[10]**	**CO1**	**L3**
6	Implement the full adder circuit with its truth table and express full adder as two half adders.	**[10]**	**CO1**	**L2**
7	a) What is voltage regulator? With neat circuit diagram, explain the operation of a voltage regulator using Zener diode. b) Simplify the Boolean expression and realize using logic gates F = (A+B') (B+C) (C'+B)	**[6]**	**CO1**	**L2**
8.	a) A 6V zener diode has a maximum rated power dissipation of 450 mW. If the diode is to be used in a simple regulator circuit to supply a regulated 6V to a load having a resistance of 900 Ω, determine a suitable value of series resistor for operation in conjunction with a supply of 9V. b) Write the symbol, expression and truth table for the following Logic gates. (i) NAND (ii) OR (iii)XOR	**[4+6]**	**CO1** **CO2**	**L3** **L2**

IAT1 Solutions

1) i) $(725.25)_8 = (?)_{10}$

$= 7\times8^2 + 2\times8^1 + 5\times8^0 + 2\times8^{-1} + 5\times8^{-2}$

$= 448 + 16 + 5 + 0.25 + 0.0781$

$= (469.3281)_{10}$

ii) $(95.25)_{10} \rightarrow (?)_2$

$$\begin{array}{r|l}
2 & 95 \\
2 & 47 - 1 \\
2 & 23 - 1 \\
2 & 11 - 1 \\
2 & 5 - 1 \\
2 & 2 - 1 \\
 & 1 - 0
\end{array}$$

$(0.25)_{10}$

$0.25 \times 2 = 0.5 - 0$

$0.5 \times 2 = 1.0 - 1$

$(0.25)_{10} = (0.01)_2$

$(95)_{10} = (1011111)_2$

$\therefore (95.25)_{10} = (1011111.01)_2$

iii) $(1000111110.1101)_2 \Rightarrow (?)_8$

Zeros padded — Zeros padded

$\underbrace{001}_{1}\ \underbrace{000}_{0}\ \underbrace{111}_{7}\ \underbrace{110}_{6}\ .\ \underbrace{110}_{6}\ \underbrace{100}_{4}$

1 0 7 6 . 6 4

$= (1076.64)_8$

iv) $(345.AB)_{16} \rightarrow (?)_2$ ②

3 - 0011

4 - 0100

5 - 0101

A - 1010

B - 1011

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

v) $(478.24)_{10} = (\ ?\ )_{16}$

$$\begin{array}{r|l} 16 & 478 \\ \hline 16 & 29 - 14\ (E) \\ \hline & 1 - 13\ (D) \end{array}$$

$(478)_{10} = (1DE)_{16}$

$0.24 \times 16 = 3.84 - 3$

$0.84 \times 16 = 13.44 - 13(D)$

$0.44 \times 16 = 7.04 = 7$

$(0.24)_{10} = (0.3D7)_{16}$

$\therefore (478.24)_{10} = (1DE.3D7)_{16}$

2) a) Express boolean function $F = A' + B'C$ as sum of minterms.

$F = A' + B'C$

$F = A'(B+B')(C+C') + (A+A')B'C$

$= A'(BC + B'C + BC' + B'C') + AB'C + A'B'C$

$= A'BC + A'B'C + A'BC' + A'B'C' + AB'C + A'B'C$

$= m_3 + m_1 + m_2 + m_0 + m_5 + m_1$

$= \Sigma(0,1,2,3,5)$

b) Perform $(2415)_{10} - (41234)_{10}$ using 10's complement.

Minuend - 02415

Subtrahend = 41234

→ 10's complement of Subtrahend

$$\begin{array}{r} 99999 \\ -\,41234 \\ \hline 58765 \end{array} \rightarrow 9\text{'s comp}$$

$$\begin{array}{r} +1 \\ \hline 58766 \end{array} \rightarrow 10\text{'s comp.}$$

→ Minuend + 10's comp of S

$$\begin{array}{r} 02415 \\ +\,58766 \\ \hline 61181 \end{array}$$

No carry. Take 10's comp of the result obtained (4)

$$\begin{array}{r} 99999 \\ -\ 61181 \\ \hline 38818 \end{array} \rightarrow 9\text{'s comp}$$

$$\begin{array}{r} +1 \\ \hline 38819 \end{array} \rightarrow 10\text{'s comp.}$$

$= -(38819)_{10}$

Verification

$$\begin{array}{r} 41234 \\ -\ 2415 \\ \hline 38819 \end{array}$$

4) c) Express the following function $F = A'B + AC$ as a product of Maxterms.

$F = A'B + AC$

Applying Distributive laws,

$A + BC = (A+B)(A+C)$

$F = A'B + AC$

$F = (A'B + A)(A'B + C)$

$F = (A+A')(A+B)(A'+C)(B+C)$

$= (1)(A+B+CC') + (A'+C+BB')(AA'+B+C)$

$= (A+B+C)(A'+B+C)(A'+B+C)(A+B+C)(A'+B+C)$

$= M_0 \cdot M_4 \cdot M_6 \cdot M_0 \cdot M_4 = \Pi(0,4,6)$

7) a) $F = (A+B')(B+C)(C'+B)$

$= (AB + BB' + AC + B'C)(C'+B)$

$= (AB + 0 + AC + B'C)(C'+B)$

$= ABC' + ACC' + B'CC' + AB + ABC + B'BC$

$= ABC' + 0 + B(0) + AB(1+C) + 0 \quad (\because B.B' = 0)$

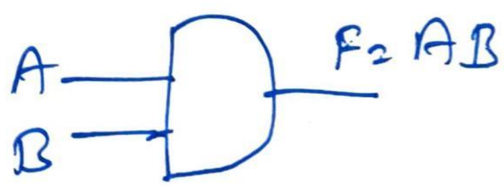
$= ABC' + AB + ABC$

$= AB(C' + 1 + C)$

$= AB(1) \quad (\because 1 + C' = 1)$

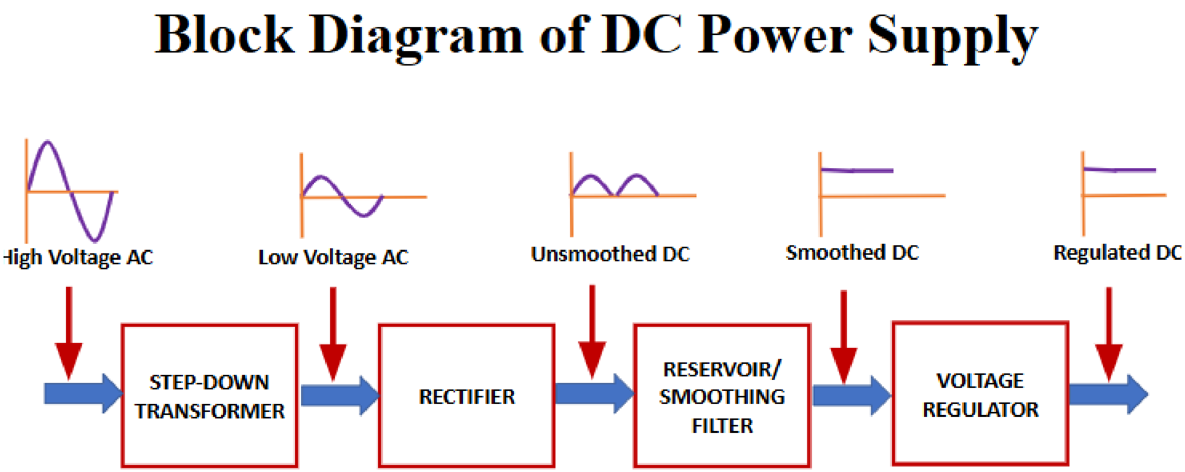
$= \underline{\underline{AB}}$

Realization using logic gates.



3) With a neat block diagram, explain the working of a DC power supply. Also mention the principal components used in each block.

Power supply is a device that supplies electric power to a load. The following is the block diagram of the power supply.

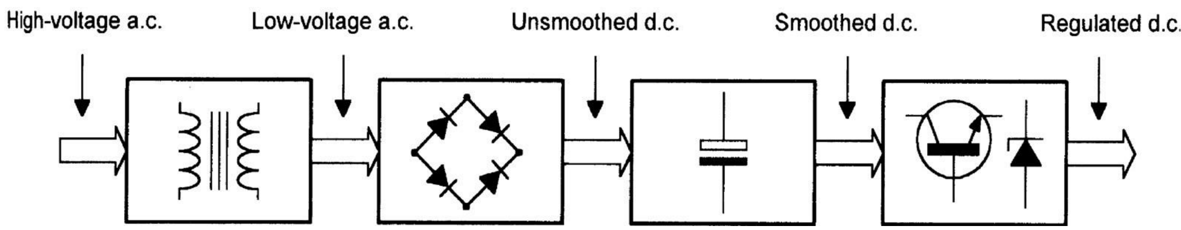


Step-Down Transformer – Steps down the AC main voltage which is usually high (220V) to a lower value (9V, 12V, 15V, 20V, 30V). ***This is achieved by varying the turns ratio on the transformer***.

Rectifier – The AC output from transformer secondary is then rectified using convectional silicon rectifier diodes to produce an unsmoothed output (pulsating DC). Generally, a bridge rectifier is used.

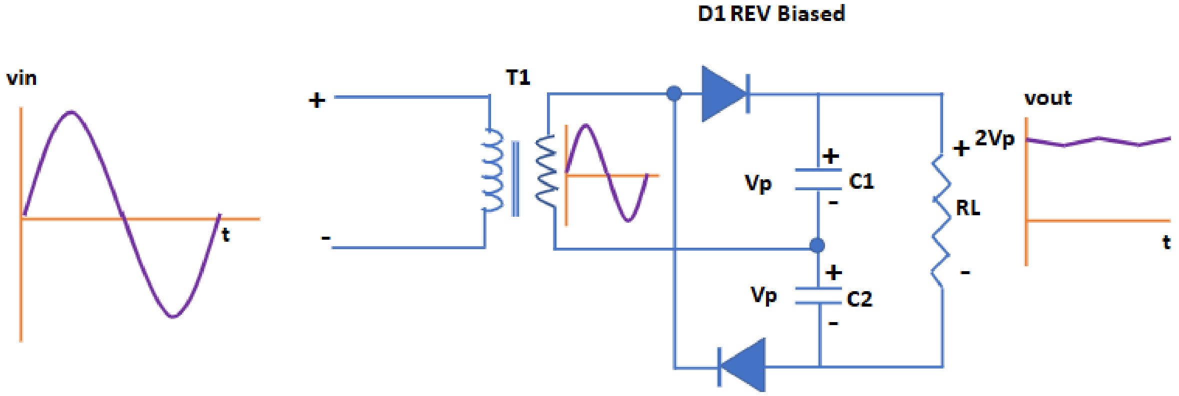
Reservoir/Filtering Circuit – The unsmoothed output from rectifier is smoothened by reservoir/filtering circuit (a ***high value capacitor***). The high value capacitor stores a considerable charge. The capacitor helps smooth out the voltage pulses produced by the rectifier and produces a smoothened DC output.

Voltage Regulator – A series transistor regulator using a Zener diode as a fixed voltage source stabilizes and provides a constant DC voltage.

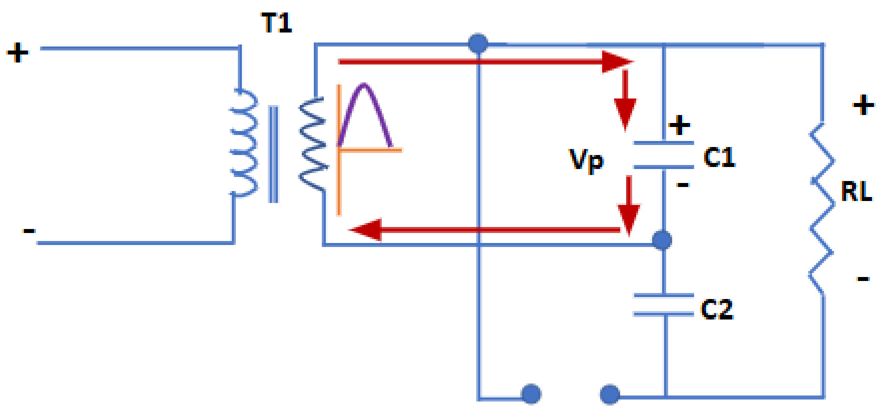


4) a) With a neat circuit diagram brief out the operation of a voltage doubler.

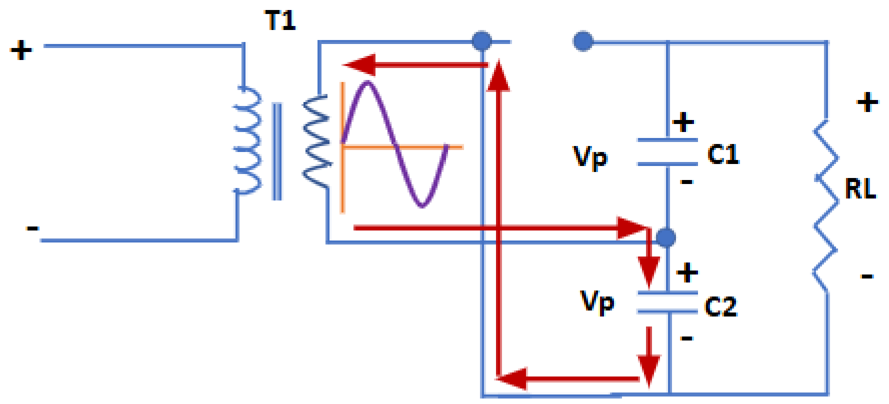
Voltage doubler is a circuit in which the output voltage is twice the input voltage.



During the positive half cycle, diode D1 is forward biased while D2 is reverse biased.Hence D1 can be replaced by a closed switch and D2 can be replaced by an open switch. The capacitor C1 gets charged to its peak value through D1.The flow of current through the circuit is as shown below.



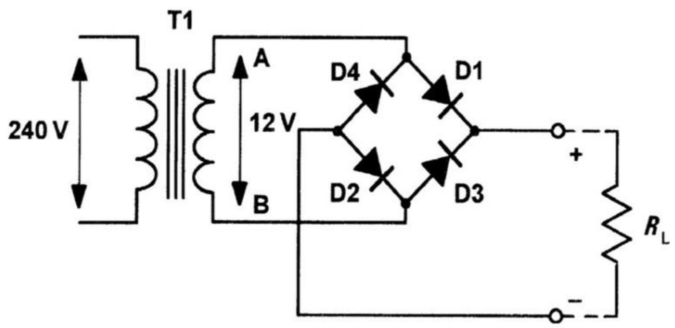
Similarly during negative half cycle,diode D2 is forward biased while D1 is reverse biased.Hence D2 can be replaced by a closed switch and D1 can be replaced by an open switch. The capacitor C2 gets charged to its peak value through D2.The flow of current through the circuit is as shown below.



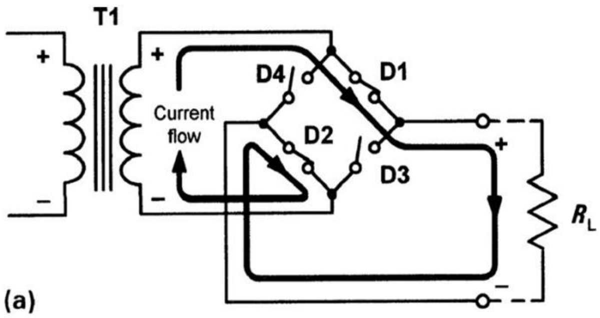
Since the output is taken from C1 and C2 connected in series the resulting output voltage is twice that of the input voltage.

5) a) With a neat circuit diagram and waveforms explain the full wave bridge rectifier circuit.

A full wave rectifier is a circuit which conducts during both the half cycles of the input signal. Bridge rectifier is a full wave rectifier which uses for diodes connected in the form of a bridge.

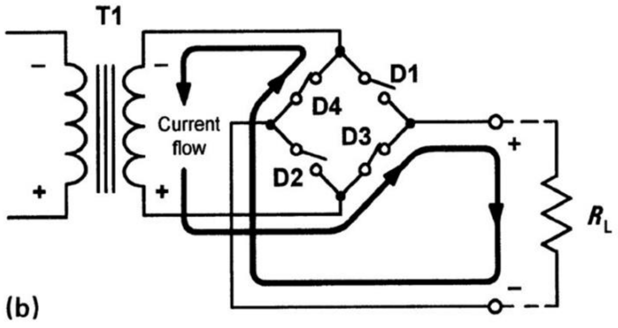


During positive half cycle, the end A is positive and end B is negative. Hence the diode D1 and D3 are forward biased while diodes D2 and D4 are reverse biased. Diodes D1 and D3 can thus be replaced by closed switch while D2 and D4 can be replaced by open switch as shown in the figure below.

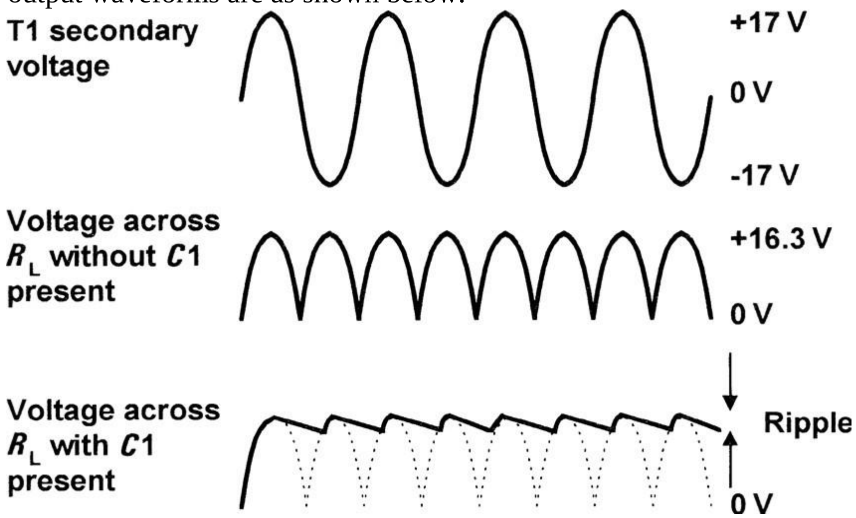


(a)

During negative half cycle, the end A is negative and end B is positive. Hence the diode D1 and D3 are reverse biased while diodes D2 and D4 are forward biased. Diodes D1 and D3 can thus be replaced by open switch while D2 and D4 can be replaced by closed switch as shown in the figure below.



The input and output waveforms are as shown below.



6) Implement a full adder circuit with its truth table and express full adder as two half adders.

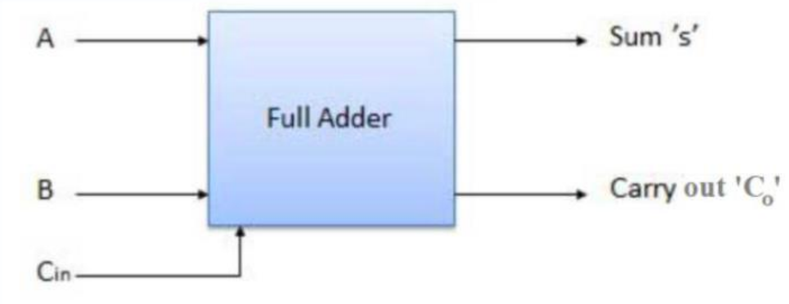
Full adder is a combinational logic circuit that is used to perform binary addition of 3 bits. It has two inputs and three outputs.

Full Adder

Half adder does not takes the carry-in value into account.

Full adder is developed to overcome this drawback of Half Adder circuit. It can add two one-bit numbers A and B, along with carry C_{in}.

The full adder is a three input and two output combinational circuit.



Block diagram

Inputs			Output	
A	B	Cin	S	Co
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

From truth table, Logic expression for sum is given by

$$S = \bar{A}\bar{B}C_{in} + \bar{A}B\bar{C}_{in} + A\bar{B}\bar{C}_{in} + ABC_{in}$$

$$S = \bar{A}(\bar{B}C_{in} + B\bar{C}_{in}) + A(\bar{B}\bar{C}_{in} + BC_{in})$$

$$= \bar{A}(B \oplus C_{in}) + A(\overline{B \oplus C_{in}})$$

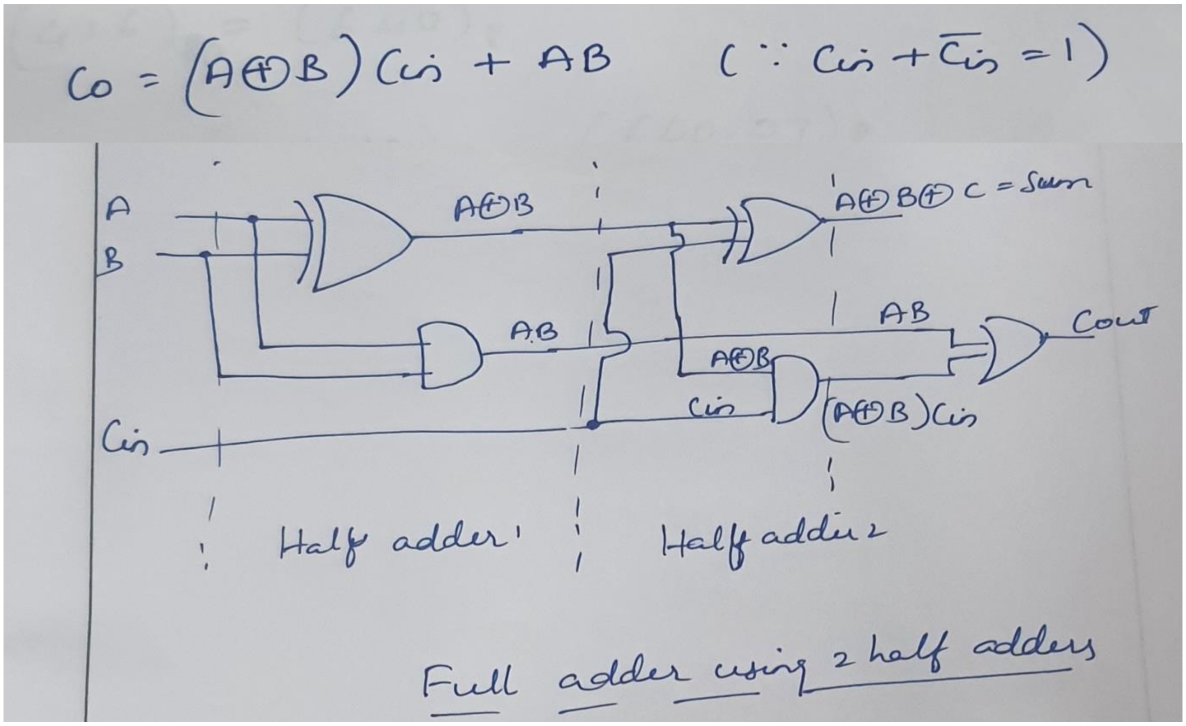
$$\boxed{S = A \oplus B \oplus C_{in}}$$

$\because A \oplus B = A\bar{B} + \bar{A}B$ and $A \odot B = \bar{A}\bar{B} + AB$

and $A \odot B = \overline{A \oplus B}$

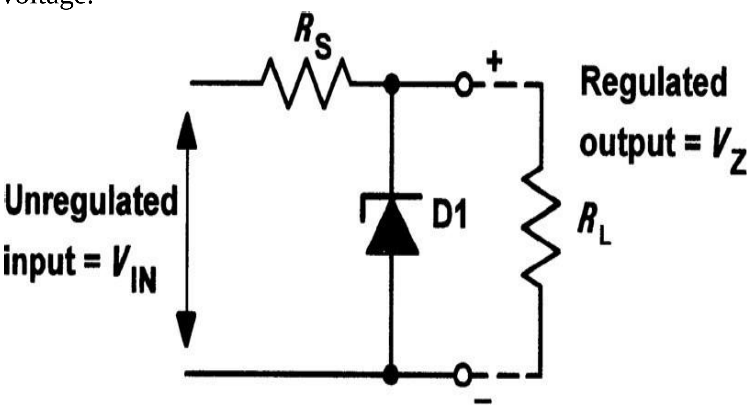
$$C_o = \bar{A}BC_{in} + A\bar{B}C_{in} + AB\bar{C}_{in} + ABC_{in}$$

$$C_o = (\bar{A}B + A\bar{B})C_{in} + AB(\bar{C}_{in} + C_{in})$$



7) What is voltage regulator? With a neat circuit diagram explain the operation of voltage regulator.

A voltage regulator provides a constant DC output voltage that is independent of AC line voltage variations, load current and temperature.
The input to a voltage regulator comes from the filtered output of a rectifier derived from an AC voltage.



- Zener diode operates in the reverse biased condition and maintains a constant voltage. It has a series current limiting resistor that limits the Zener current to safe limit.
- The source current is divided as Iz (current through Zener) and IL (current through RL)
- It is usual to allow 2-5mA to ensure Zener diode conducts
- The output voltage is equal to Zener breakdown voltage.

- The ratio of Rs to RL is significant as the input voltage is voltage divided by them and made available as Vz

$$V_Z = V_{IN}\ X\ \frac{R_L}{R_L + R_S}$$

Where V_{IN} is unregulated input voltage

The maximum value of Rs can be calculated from $R_{s(max)} = R_L\ X\ \left(\frac{V_{IN}}{V_z} - 1\right)$

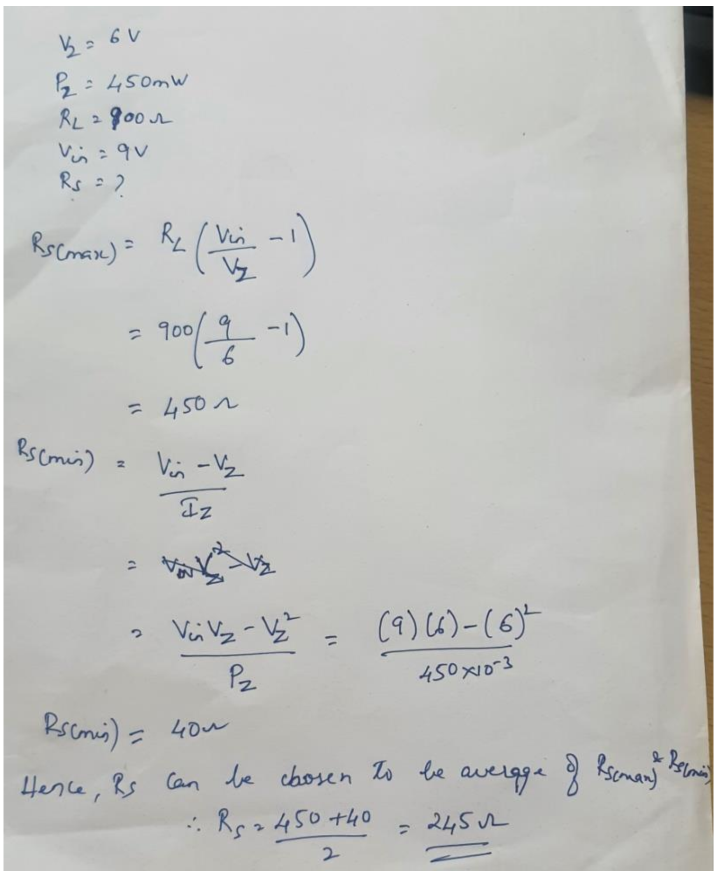
- The power dissipated in the Zener diode will be given as **<u>Pz= Iz X Vz</u>**.
- The minimum value for Rs is determined from **off-load condition** –

$$R_{s(Min)} = \frac{V_{in} - V_Z}{I_Z}$$

$$R_{s\,min} = \frac{(V_{IN} V_Z - V_Z^2)}{Pz\ \text{max}}$$

where Pz max is the maximum rated power dissipation for the Zener diode.

8) A 6V zener diode has a maximum rated power dissipation of 450 mW. If the diode is to be used in a simple regulator circuit to supply a regulated 6V to a load having a resistance of 900 Ω, determine a suitable value of series resistor for operation in conjunction with a supply of 9V.



$V_Z = 6V$

$P_Z = 450mW$

$R_L = 900\,\Omega$

$V_{in} = 9V$

$R_S = ?$

$R_{S(max)} = R_L\left(\frac{V_{in}}{V_Z} - 1\right)$

$= 900\left(\frac{9}{6} - 1\right)$

$= 450\,\Omega$

$R_{S(min)} = \frac{V_{in} - V_Z}{I_Z}$

$= \cancel{V_{in} V_Z^2 - V_Z}$

$= \frac{V_{in} V_Z - V_Z^2}{P_Z} = \frac{(9)(6) - (6)^2}{450 \times 10^{-3}}$

$R_{S(min)} = 40\,\Omega$

Hence, Rs can be chosen to be average of $R_{S(max)}$ & $R_{S(min)}$

$\therefore R_S = \frac{450 + 40}{2} = 245\,\Omega$

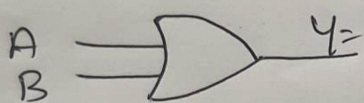
8)b) b) Write the symbol, expression and truth table for the following Logic gates.
(i) NAND (ii) OR (iii)XOR

i) NAND Gate

$Y = \overline{AB}$

A	B	$Y = \overline{AB}$
0	0	1
0	1	1
1	0	1
1	1	0

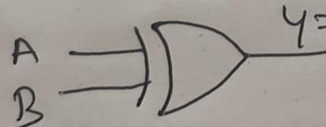
ii) OR gate



$Y = A + B$

A	B	$Y = A + B$
0	0	0
0	1	1
1	0	1
1	1	1

iii) XOR gate



$$Y = A \oplus B$$
$$= A\bar{B} + \bar{A}B$$

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