Bharath

INSTITUTE OF HIGHER EDUCATION AND RESEARCH

(Declared as deemed to be university under section 3 of UGC Act 1956, vide notification No.F.9-5/2000-U.3)

COURSE FILE CONTENTS

FACULTY NAME	Ms.S.Dhivya	FACULTY DEPT	EEE
SUBJECT NAME	BEEE	CODE	U18ESEE101
YEAR	2019-2020	SEMESTER	II
DEGREE & BRANCH	B. TECH (AE&AS)	DURATION	45

S.NO	DETAILS IN COURSE FILE	REMARKS
1.	LEARNING OUTCOMES	
2.	LESSON PLAN WITH CO MAPPING	
3.	INDIVIDUAL TIMETABLE	
4.	SYLLABUS & COURSE OUTCOMES	
5.	LECTURE NOTES	
6.	INTERNAL ASSESSMENT TEST -1 QUESTION PAPER	
7.	INTERNAL ASSESSMENT-1 ANSWER KEY	
8.	INTERNAL ASSESSMENT TEST -1 SAMPLE ANSWER SHEETS	
9.	INTERNAL ASSESSMENT TEST -2 QUESTION PAPER	
10.	INTERNAL ASSESSMENT TEST -2 ANSWER KEY	
11.	INTERNAL ASSESSMENT -2 SAMPLE ANSWER SHEETS	
12.	ASSIGNMENT QUESTIONS	
13.	SAMPLE ASSIGNMENTS	
14.	END SEMESTER EXAM QUESTION PAPER	
15.	END SEMESTER EXAM - ANSWER KEY	
16.	TEXT BOOK & REFERENCE BOOK FOLLOWED	
17.	PREVIOUS QUESTION PAPERS	
18.	QUESTION BANK	
19.	STUDENT PERFORMANCE RECORD	
20.	STUDENT ATTENDANCE RECORD	
21.	COURSE EXIT SURVEY	
22.	CO ATTAINMENT	

STAFF

HOD

COURSE FILE

U18ESEE101-BASIC ELECTRICAL AND ELECTRONICS ENGINEERING

S.DHIVYA

EEE DEPARTMENT

ACADEMIC YEAR 2019-2020(EVEN SEM)

LEARNING OUTCOMES

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

LEARNING OUTCOMES

Course Name: **BASIC ELECTRICAL AND ELECTRONICS ENGINEERING**

Course Code: **U18ESEE101**

The learning of Basic Electrical and Electronics Engineering helps the

- Students to obtain the knowledge of basic electrical circuits and network theorems.
- Students to understand the electrical parameters like voltage, current, power and able to draw the phase diagram for a given ac circuits.
- Students to expand the basic knowledge of DC, AC Machines and Transformer.
- Students to expand the acquired knowledge about semiconductor devices and digital electronics.

LESSON PLAN WITH CO MAPPING

CO-PO MAPPING

Name of the School : School of Electrical Sciences

Name of the Department : Electrical and Electronics Engineering

Program Name/Code :B.Tech

Course Name/Code :Basic Electrical And Electronics Engineering –U18ESEE101

Course Coordinator details

a. Name :S.Dhivya
b. Designation :Assistant Professor
c. Department :Electrical and Electronics Engineering

List of POs:

Engineering Graduates will be able to:

PO1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2. Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4. Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6. The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9. Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11. Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12. Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	-	-	-	-	-	-	-	-	-
CO2	3	2	1	-	-	-	-	-	-	-	-	-
CO3	3	2	1	-	-	-	-	-	-	-	-	-
CO4	3	-	1	-	-	-	-	-	-	-	-	-
CO5	3	2	2	-	-	-	-	-	-	-	1	-
CO6	3	3	3	2	2	-	-	-	-	-	1	-

Note: L – Low; M – Medium; H - High

CO-PSO Mapping

CO/PSO	PSO1	PSO2	PSO3
CO1	-	-	-
CO2	-	-	-
CO3	-	-	-
CO4	-	-	-
CO5	-	-	-
CO6	-	-	-

Note: L – Low; M – Medium; H - High

Prepared by	Course Coordinator S.Dhivya	Signature
Verified & Forwarded by	HoD Dr.A.Manikandan	Signature

Lesson Plan

Name of the Department : **Basic Electrical & Electronics**

EngineeringName of the School : School of Electrical Science

Program Name/Code : B.Tech, I Year(AE,AS)

Academic Year / Semester : 2019-2020/EVEN

Course Name/Code : **BEEE / U18ESEE101**

a. No. of Credits : 3

b. Total Contact Hours : 45

Staff Name :S.Dhivya

Hours	Topic	CO	Reference	Teaching Tool	Proposed Date	Completed Date	Remarks
UNIT 1 DC CIRCUITS							
1	Electrical circuit elements, voltage and current sources	CO1	R1,R3	T1	08.01.2020	08.01.2020	
2	Fundamentals Relationship of VI for RLC circuit, Ohms Law	CO1	R1	T1	09.01.2020	09.01.2020	
3	Ohms Law ,Source Transformation	CO1	R1	T1	10.01.2020	10.01.2020	
4	Kirchoff current and voltage laws	CO1	R1	T1	20.01.2020	20.01.2020	
5	Kirchoff current law problems	CO1	R1	T1	21.01.2020	21.01.2020	
6	Kirchoff voltage law problems	CO1	R1	T1	22.01.2020	22.01.2020	
7	analysis of simple circuits with dc excitation,RL circuit	CO1	R1,R3	T1	27.01.2020	27.01.2020	
8	RC and RLC circuit	CO1	R1	T1	28.01.2020	28.01.2020	
9	Superposition Theorem	CO1	R2	T1	29.01.2020	29.01.2020	
10	Thevenin's Theorem	CO1	R2	T1	03.02.2020	03.02.2020	
11	Norton Theorem	CO1	R2	T1	04.02.2020	04.02.2020	

12	Maximum Power Transformations Theorem	CO1	R2	T1	05.02.2020	05.02.2020	
	UNIT 2 AC CIRCUITS						
1	Representation of sinusoidal waveforms, peak and rms values	CO2	R1,R6	T1	10.02.2020	10.02.2020	
2	phasor representation, real power, reactive power, apparent power, power factor	CO2	R1	T1	11.02.2020	11.02.2020	
3	Analysis of single-phase ac circuits consisting of R, L, C	CO2	R1	T1	12.02.2020	12.02.2020	
4	Analysis of RL,RC and RLC AC series circuits	CO2	R1,R6	T1	17.02.2020	17.02.2020	
5	Analysis of RL,RC and RLC AC parallel circuits	CO2	R1,R6	T1	18.02.2020	18.02.2020	
6	Resonance	CO2	R1	T1	19.02.2020	19.02.2020	
7	Time-domain analysis of first-order RL and RC circuits.	CO2	R1	T1	24.02.2020	24.02.2020	
8	Three-phase balanced circuits	CO2	R1,R6	T1	25.02.2020	25.02.2020	
9	voltage and current relations in star connection	CO2	R1	T1	26.02.2020	26.02.2020	
	UNIT 3 ELECTRICAL MACHINES & TRANSFORMERS						
1	voltage and current relations in delta connection	CO3	R1	T1	02.03.2020	02.03.2020	
2	DC machines, DC generator operation and characteristics	CO3	R1	T1	03.03.2020	03.03.2020	
3	DC motor operation and characteristics	CO3	R1	T1	04.03.2020	04.03.2020	
4	Synchronous machines	CO3	R1	T1	09.03.2020	09.03.2020	
5	single phase induction motors	CO3	R1	T1	10.03.2020	10.03.2020	
6	Three phase induction motors	CO3	R1	T1	11.03.2020	11.03.2020	
7	Single phase Transformers regulation and efficiency, all day efficiency	CO3	R1	T2	16.03.2020	16.03.2020	
8	Three phaseTransformers regulation and efficiency, all day efficiency	CO3	R1	T2	17.03.2020	17.03.2020	
9	auto-transformer	CO3	R1	T1	18.03.2020	18.03.2020	

UNIT 4 SEMICONDUCTOR DEVICES AND APPLICATIONS							
1	Characteristics of PN Junction Diode	CO4	R2,R5	T2	23.03.2020	23.03.2020	
2	Zener Effect – Zener Diode and its Characteristics	CO4	R2	T2	24.03.2020	24.03.2020	
3	Half wave and Full wave Rectifiers	CO4	R2	T2	25.03.2020	25.03.2020	
4	Voltage Regulation	CO4	R2	T1	30.03.2020	30.03.2020	
5	Bipolar Junction Transistor – CB Configuration and Characteristics	CO4	R2,R5	T2	31.03.2020	31.03.2020	
6	Bipolar Junction Transistor – CE Configuration and Characteristics	CO4	R2	T1	01.04.2020	01.04.2020	
7	Bipolar Junction Transistor – CC Configuration and Characteristics	CO4	R2	T1	06.04.2020	06.04.2020	
8	Elementary Treatment of Small Signal Amplifier and its applications	CO4	R2	T1	07.04.2020	07.04.2020	
9	Introduction to OP-AMP	CO4	R2	T1	07.04.2020	07.04.2020	
UNIT 5 DIGITAL ELECTRONICS							
1	Binary Number System, Logic Gate	CO5	R2,R4	T1	08.04.2020	08.04.2020	
2	Boolean Algebra	CO5	R2,R4	T1	13.04.2020	13.04.2020	
3	Half and Full Adders	CO5	R2	T1	15.04.2020	15.04.2020	
4	Flip-Flops	CO5	R2	T1	20.04.2020	20.04.2020	
5	Registers and Counters	CO5	R2	T1	21.04.2020	21.04.2020	
6	Fundamentals of A/D and D/A Conversion	CO5	R2	T2	22.04.2020	22.04.2020	

TYPE CODE	TEACHING TOOL PLANNED
T1	Black Board
T2	Power Point Presentation
T3	Video Presentation
T4	Notes
T5	Models
T6	Tutorial & Problem solving etc.
T7	Simulation/Practical etc.
T8	Others

REFERENCE CODE	DESCRIPTION
R1	E. Hughes, "Electrical and Electronics Technology", Pearson, 10th Edition, 2011.
R2	K.A.Krishnamurthy and M.R.Raghuveer, `Electrical and Electronics Engineering for Scientists', New Age International Pvt Ltd Publishers, 2011.
R3	D. P. Kothari and I. J. Nagrath, "Basic Electrical Engineering", Tata McGraw Hill, Third Reprint, 2016.
R4	Smarajit Ghosh, Fundamentals of Electrical and Electronics Engineering, Second Edition, PHI Learning, 2007.
R5	Jacob Millman and Christos C-Halkias, "Electronic Devices and Circuits", McGraw Higher Ed, 4th Edition, 2015.
R6	John Bird, Electrical Circuit Theory &Technology, Taylor & Francis Ltd, 6th, edition.2017.

Prepared By	S.Dhivya	(signature)
Verified By	Dr. A. Manikandan HOD	(signature)

INDIVIDUAL TIMETABLE

INSTITUTE OF HIGHER EDUCATION AND RESEARCH
(Declared as Deemed - to - be - University under section 3 of UGC Act 1956)
BHARATH INSTITUTE OF SCIENCE AND TECHNOLOGY
No.173, Agharam Road, Selaiyur, Chennai - 600 073.

STAFF NAME: Ms. S. DHIVYA

COURSE NAME: BASIC ELECTRICAL AND ELECTRONICS ENGINEERING

THEORY:–AERO B & MECH C

LAB: AERO A, MECH A&C

DAY/ HRS	1 9.00AM - 9.50AM	2 9.50AM - 10.40AM		3 10.50AM - 11.40AM	4 11.40AM - 12.30PM		5 1.30PM - 2.10PM	6 2.10PM - 2.50PM	7 2.50PM - 3.30PM
MON	MECH C		BREAK			LUNCH	MECH A LAB		
TUE		AERO B		AERO B	AERO B				
WED					AERO B		MECH C LAB		
THU	AERO B								MECH C
FRI	MECH C				AERO B		AERO A LAB		

CO-ORDINATOR

HOD

SYLLABUS & COURSE OUTCOMES

		L	T	P	C
U18ESEE101	**Basic Electrical and Electronics Engineering**	L	T	P	C
	Total contact hours-45	3	0	0	3
	Prerequisite: School Level Physics				
	Course offered by –Department of Electrical and Electronics Engineering				
OBJECTIVES	To gain fundamental knowledge of Electrical and Electronics Engineering and its applications.				

COURSE OUTCOMES(COs)

CO1	Apply simple electrical circuits and verify DC network theorems.
CO2	Obtain electrical parameters like voltage, current, power and sketch phase diagram of a given ac circuits.
CO3	Explain the working principle of DC, AC Machines and transformer.
CO4	Draw the characteristics of semiconductor devices and to obtain signal analysis of BJT.
CO5	Perform the basic Boolean operations.

Mapping of course outcomes with programme outcomes(POs)

(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
2	CO1	H	H	L	L	-	-	-	-	-	-	-	-
	CO2	H	M	L	L	-	-	-	-	-	-	-	-
	CO3	H	L	-	-	-	-	-	-	-	-	-	-
	CO4	H	-	L	L	-	-	-	-	-	-	-	-
	CO5	H	M	M	L	-	-	-	-	-	-	-	-
3	Category	**Engineering Science(ES)**											
4	**Approval**												

UNIT 1 DC CIRCUITS **9 hours**

Electrical circuit elements, voltage and current sources, Fundamentals Relationship of VI for RLC circuit, Ohms Law, Source Transformation, Kirchoff current and voltage laws, analysis of simple circuits with dc excitation. Basics of Superposition, Thevenin and Norton Theorems, Maximum Power Transfer Theorem.

UNIT 2 AC CIRCUITS **9 hours**

Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power, reactive power, apparent power, power factor. Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel), resonance. Time-domain analysis of first-order RL and RC circuits. Three-phase balanced circuits, voltage and current relations instar and delta connections.

UNIT 3 ELECTRICAL MACHINES TRANSFORMERS **9 hours**

Principles of operation and characteristics of; DC machines, Synchronous machines, three phase and single phase induction motors. Transformers (single and three phase) regulation and efficiency, all day efficiency and auto-transformer.

UNIT 4 SEMICONDUCTOR DEVICES AND APPLICATIONS **9 hours**

Characteristics of PN Junction Diode -- Zener Effect – Zener Diode and its Characteristics – Halfwave and Full wave Rectifiers – Voltage Regulation. Bipolar Junction Transistor – CB, CE, CC Configurations and Characteristics – Elementary Treatment of Small Signal Amplifier and its applications, Introduction to OP-AMP.

UNIT 5 DIGITAL ELECTRONICS **6hours**

Binary Number System – Logic Gates – Boolean Algebra – Half and Full Adders – Flip-Flops –Registers and Counters – Fundamentals of A/D and D/A Conversion.

TEXT BOOKS:

1. E. Hughes, "Electrical and Electronics Technology", Pearson, 10th Edition, 2011.
2. K.A.Krishnamurthy and M.R.Raghuveer, `Electrical and Electronics Engineering for Scientists', New Age International Pvt Ltd Publishers, 2011.

REFERENCES:

1. D. P. Kothari and I. J. Nagrath, "Basic Electrical Engineering", Tata McGraw Hill, Third Reprint, 2016.
2. Smarajit Ghosh, Fundamentals of Electrical and Electronics Engineering, Second Edition, PHI Learning, 2007.
3. Jacob Millman and Christos C-Halkias, "Electronic Devices and Circuits", McGraw Higher Ed, 4th Edition, 2015.
4. John Bird, Electrical Circuit Theory &Technology, Taylor & Francis Ltd, 6^{th}, edition.2017.

LECTURE NOTES

UNIT I
DC CIRCUITS

Elements of an Electric circuit:

(1) An Electric circuit consists of following types of Elements.

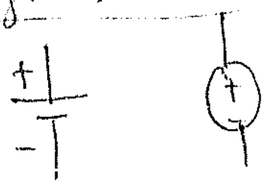
Active elements:

Active Elements are the elements of a circuit which posses energy of their own and impart it to other element of the circuit.

Active elements of two types.

(a) Voltage Source
(b) current Source

Voltage Source



Current Source

Passive Elements.

The passive Elements of an electric circuit do not posses energy of their own. They receive from the Sources.

Passive elements are resistance, inductance and capacitance,

UNIT - I

Electric Circuits (DC)

Basic Electrical quantities:

Current (I): The flow of free electrons in any conductor is called current. It is denoted by the letter I.

The unit of current is ampere.

Voltage (V): It is the force which causes to flow the electrons in any closed circuit.

The unit of voltage is volts.

Power (P): Power is the rate of doing work.

$$Power = \frac{Work\ done}{time}$$

The unit of power is Joules / sec (or) watts.

$$Power\ (P) = VI \quad watts$$

$$P = (IR)\,I = I^2R$$

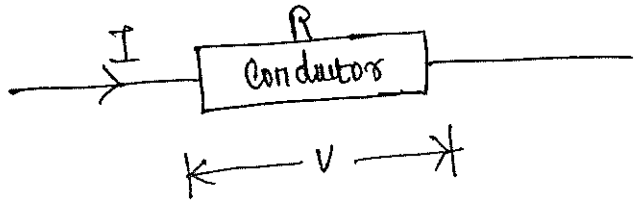
$$P = I^2R \quad watts$$

$$P = \frac{V^2}{R} \quad watts$$

$$\boxed{P = VI = I^2R = \frac{V^2}{R}} \quad watts.$$

Ohm's Law:

Ohms law states that at constant temperature the current flow through a conductor is directly proportional to the potential difference between the two ends of the conductor



$$I \propto V$$

(or) $$V \propto I$$

$$\boxed{V = IR}$$

where R – constant (or) Resistance of the conductor.

Applications of Ohms law:

By using Ohm's law we can find the resistance of a circuit, knowing only the voltage and the current in the circuit.

—— x ——

Problems:

(1) Current flowing through conductor is 5 A and voltage across the conductor is 20V. Find the resistance of the conductor?

Given data:

Voltage (V) = 20V

current (I) = 5A

To find: Resistance (R) = ?

1. Voltage divisio rule :

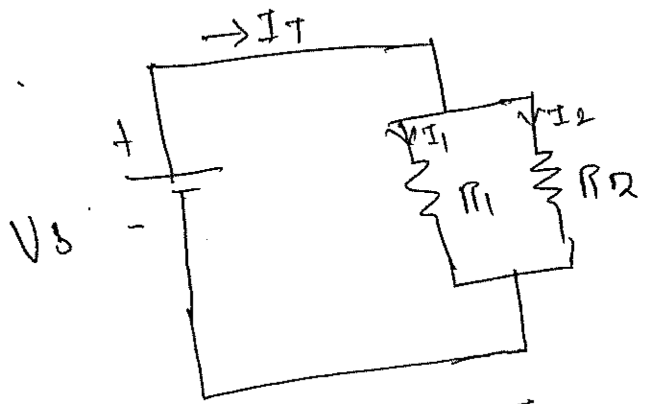
A Voltage across a resistor in a series circuit is equal to the total voltage across the series elements multiplied by the value of that resistor divided by the total resistance of the series elements.

Voltage drop across resistor = Total voltage × $\frac{R_{AB}}{\text{Total Resistance}}$

2. State current division rule :

current in any branch is equal to the ratio of the opposite parallel branch resistance to the total resistance value, multiplied by the total current in the circuit.

eg.



I = Total current × $\frac{\text{Opposite Resistor}}{\text{Total Resis}}$

$I_1 = I_T \cdot \frac{R_2}{R_1+R_2}$

$I_2 = I_T \cdot \frac{R_2}{R_1+R_2}$

From the above fig.

$$I_L = \frac{V_0}{R_{TH} + R_L}$$

Where I_L — Load current

R_L — Load resistor

V_0 = open circuit voltage across A & B Terminals.

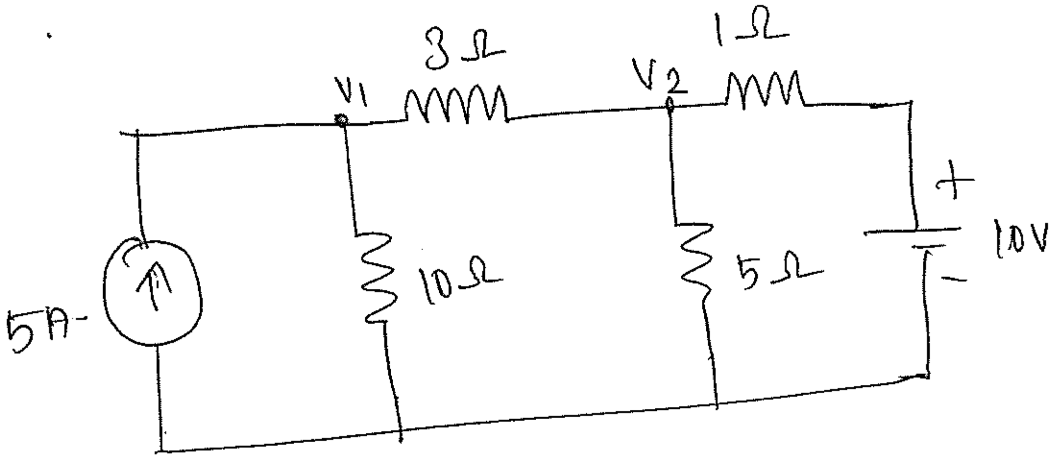
R_{TH} — Thevenin's Resistance.

(7) What is the limitation of superposition theorem?

1. Super position can be applied to linear network only.
2. The network should satisfy to homogenity principle.

Additional problem of Nodal Voltage method.

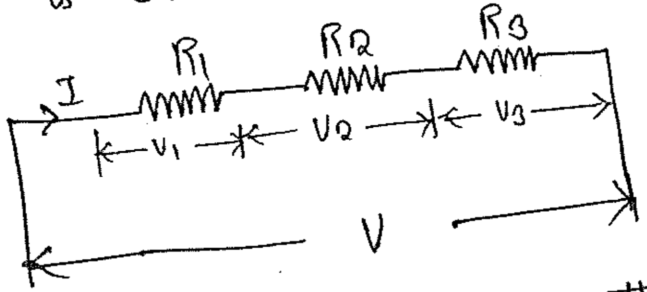
1. Find the branch current using Nodal voltage method.



Resistors in Series and Parallel connection :

Resistance in Series : (Series Circuit)

The circuit in which resistances are connected end to end is called a series circuit.



In Series circuit, the current through all the resistors are same, but voltage drop across each is different.

The sum of the voltage drops across each resistor is equal to the applied voltage.

$$V = V_1 + V_2 + V_3$$

By Ohm's law

$V_1 = I R_1$

$V_2 = I R_2$

$V_3 = I R_3$

$V = IR$

$$V = IR_1 + IR_2 + IR_3$$

$$V = I (R_1 + R_2 + R_3)$$

$$\cancel{I}R = \cancel{I} (R_1 + R_2 + R_3)$$

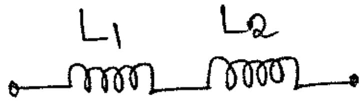
$$\boxed{R_T = R_1 + R_2 + R_3}$$

where R_T is the Total (or) equivalent resistance of the circuit.

Inductors in Series and Parallel.

Inductors in Series

If two inductors are connected in Series, the Total inductance will be Sum of individual inductances:

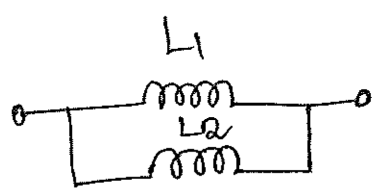


$$L_T = L_1 + L_2$$

Inductors in Parallel:

If two inductors are connected in Parallel, the equivalent inductance (or) Total inductance is given by the Sum of reciprocal of individual inductances.

$$\frac{1}{L_T} = \frac{1}{L_1} + \frac{1}{L_2}$$

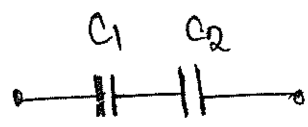


$$L_T = \frac{L_1 L_2}{L_1+L_2}.$$

Capacitors in Series and Parallel.

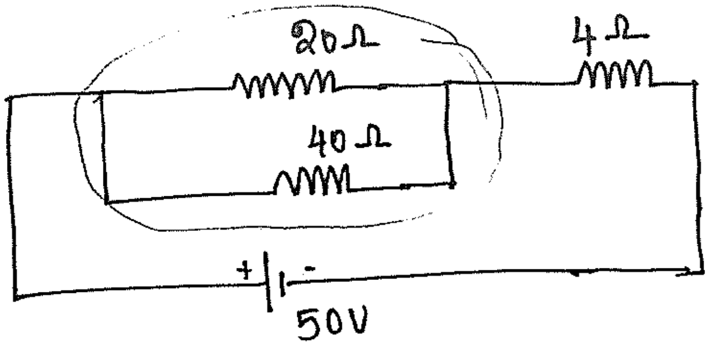
Capacitors in Series:

If two capacitors are connected in Seri the equivalent capacitance is given by the Sum of reciproc Of individual capacitances.



$$\frac{1}{C_T} = \frac{1}{C_1} + \frac{1}{C_2}$$

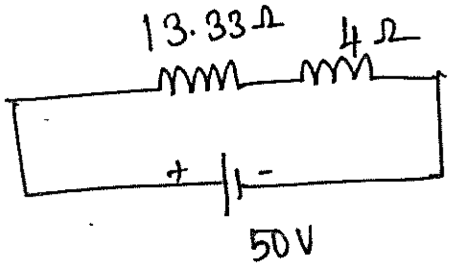
$$C_T = \frac{C_1 C_2}{C_1+C_2}$$



⇒ 20Ω and 40Ω are connected in parallel

$$R = \frac{20 \times 40}{20+40}$$

$R = 13.33\,\Omega$



⇒ 13.33Ω and 4Ω are connected in serie

$R = 13.33 + 4\,\Omega$

$$\boxed{R_T = 17.33\,\Omega}$$

By ohms law

$V = IR$

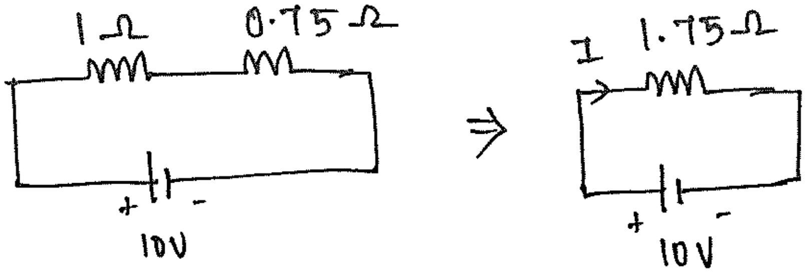
Total (or) equal Resistance $\boxed{R_T = 17.33\,\Omega}$

$$I = \frac{V}{R}$$

$$= \frac{50}{17.33}$$

$$I = \frac{50}{17.33}$$

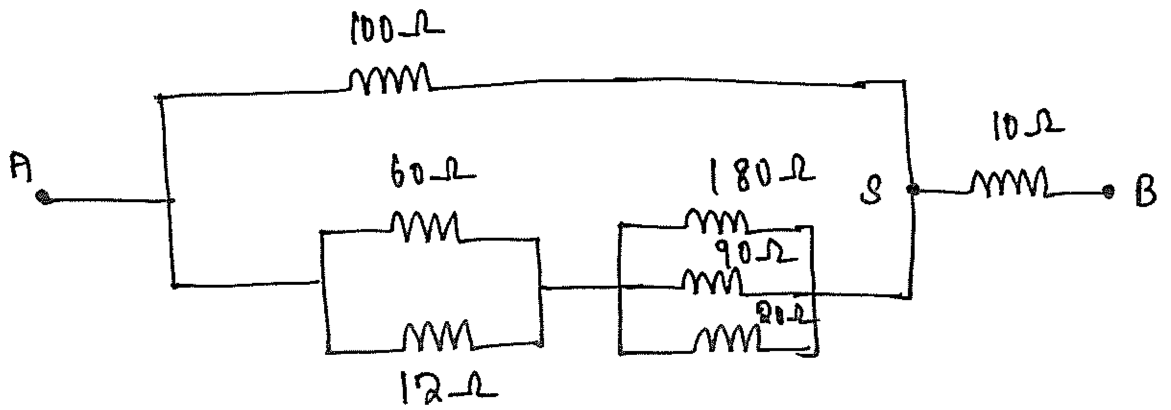
$$\boxed{I = 2.88 \text{ Amps}}$$



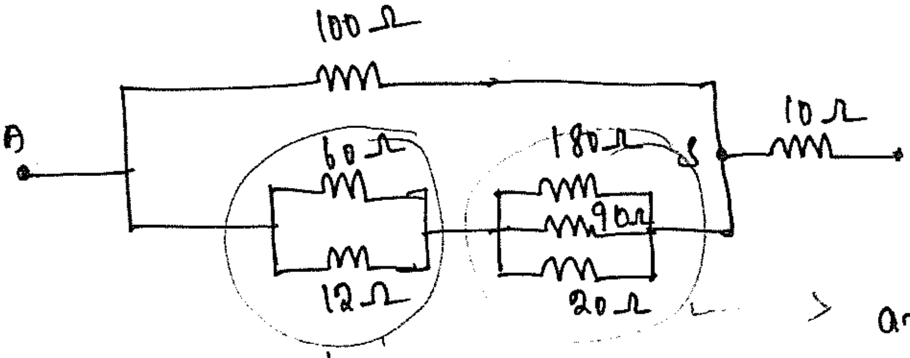
Current $I = \dfrac{10}{1.75}$

$$\boxed{I = 5.714 \text{ Amps}}$$

(3) Find the resistance between the points A & B in the series - Parallel network shown in figure.



Solution:



60Ω and 12Ω are connected in Parallel

$$R = \frac{60 \times 12}{60+12}$$

$$R = \frac{720}{72}$$

$$\boxed{R = 10\,\Omega}$$

180Ω, 90Ω & 20Ω are connected in Parallel.

$$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$$

$$\frac{1}{R} = \frac{1}{180} + \frac{1}{90} + \frac{1}{20}$$

$$\frac{1}{R} = \frac{1+2+9}{180}$$

V - I relationship of Circuit Elements (R, L & C)

Circuit Element	Voltage	Current	Power
Resistance	$V = IR$	$I = \frac{V}{R}$	$P = VI$
Inductance	$V = L\frac{dI}{dt}$	$I = \frac{1}{L}\int V dt$	$P = LI\frac{dI}{dt}$
Capacitance	$V = \frac{1}{C}\int I dt$	$I = C\frac{dV}{dt}$	$P = CV\frac{dV}{dt}$

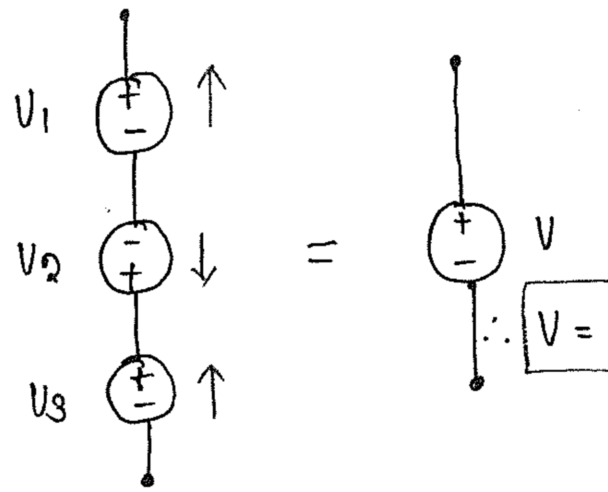
Series and Parallel Connected Sources.

(i) Voltage Sources in Series:

Voltage Sources in series may be replaced by an equivalent Voltage Sources having a voltage equal to the algebraic sum of the individual sources

$\uparrow^{+}_{-}$ ⇒ Potential rise. (+ sign)

$\downarrow^{-}_{+}$ ⇒ Potential drop (− sign)



$\therefore$ $V = V_1 - V_2 + V_3$

Kirchoff's Laws

Sometimes complicated circuit can not be simplified into a simple series (or) simple parallel (or) series-parallel circuit and cannot be solved by applying ohm's Law. Such circuits may be solved by applying kirchoff's laws.

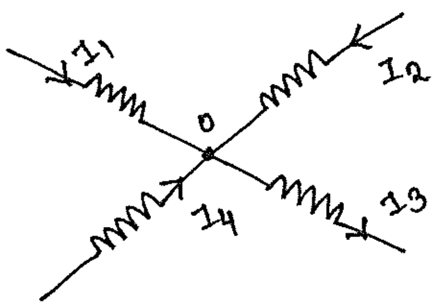
* First law [KIRCHOFF'S CURRENT LAW (KCL)]
  (OR)
  POINT LAW

① Kirchoff's current Law: The algebraic sum of current flowing towards a junction in an electric circuit is zero

$$\Sigma I \text{ at junction point } = 0$$

Sum of entering current = Sum of Leaving current

eg.



currents I_1, I_2, I_3 and I_4 meeting at point 'O'

entering current = +ve sign
Leaving current = −ve sign

Total current at junction 'O'

$$\Rightarrow I_1 + I_2 + I_4 - I_3 = 0$$

$$\boxed{I_1 + I_2 + I_4 = I_3}$$

In closed Loop CDEFC

Apply KVL

$$I_2R_2 - E_2 + (I_1+I_2)R_1 = 0$$

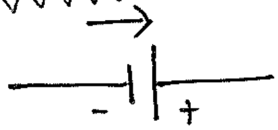
$$I_2R_2 + I_1R_1 + I_2R_1 = E_2$$

$$I_1R_1 + I_2(R_1+R_2) = E_2 \rightarrow (2)$$

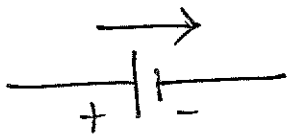
Solve the above equation for I_1 & I_2.

Sign of emf's and Voltage drops.

Sign of emf's (battery terminal)



⇒ We go from −ve terminal of a battery to +ve terminal. (+ve sign)



⇒ We go from +ve terminal of a Battery to −ve t (−ve Sign)

Sign of Voltage drops

Voltage drop means 

$V = IR$

$= -IR$ (−ve)

$= +IR$ (+ve)

Superposition Theorem

Statement: Any electric circuit energised by two (or) more sources, the response in any element in the network is equal to the algebraic sum of the responses caused by individual sources acting separately.

Steps to apply Superposition principle:

1. Turn off all independent sources except one source, Find the output [Voltage (or) current] due to that active source using Nodal (or) Mesh analysis.
2. Repeat step 1 for each of the other independent sources.
3. Find the total current (or) Voltage by adding all the contributions due to the independent sources.

Voltage division rule: A Voltage across a resistor in a series circuit is equal to the total Voltage across the series elements multiplied by the value of that resistor divided by the total resistance of the series elements.

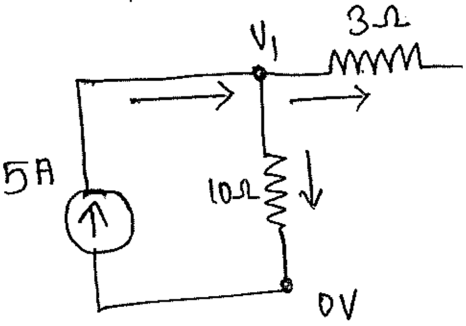
$$\text{Total Voltage drop (across resistor)} = \text{Total Voltage} \times \frac{R_{AB}}{\text{Total Resistance}}$$

R_{AB} – Branch resistance

Apply Kirchoff's current law in node 1

Sum of entering current = Sum of leaving current

$$5 = \frac{V_1 - 0}{10} + \frac{V_1 - V_2}{3}$$



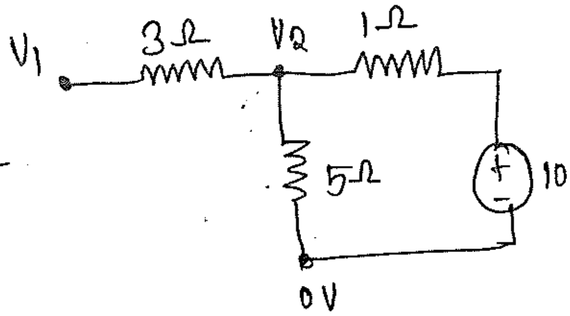
$$5 = \frac{3V_1 + 10(V_1 - V_2)}{30}$$

$$5 = \frac{3V_1 + 10V_1 - 10V_2}{30}$$

$$5 \times 30 = 3V_1 + 10V_1 - 10V_2$$

$$13V_1 - 10V_2 = 150 \longrightarrow (1)$$

Apply KCL at node 2.



$$0 = \frac{V_2 - V_1}{3} + \frac{V_2 - 10}{1} + \frac{V_2 - 0}{5}$$

$$0 = \frac{V_2 - V_1}{3} + \frac{V_2 - 10}{1} + \frac{V_2}{5}$$

$$0 = \frac{5(V_2 - V_1) + 15(V_2 - 10) + V_2(3)}{15}$$

$$0 \times 15 = 5V_2 - 5V_1 + 15V_2 - 150 + 3V_2$$

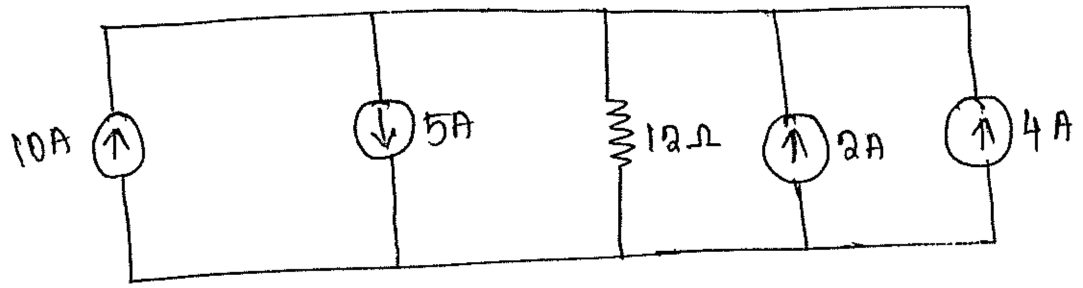
$$0 = 8V_2 - 5V_1 + 15V_2 - 150$$

$$-5V_1 + 23V_2 = 150 \longrightarrow (2)$$

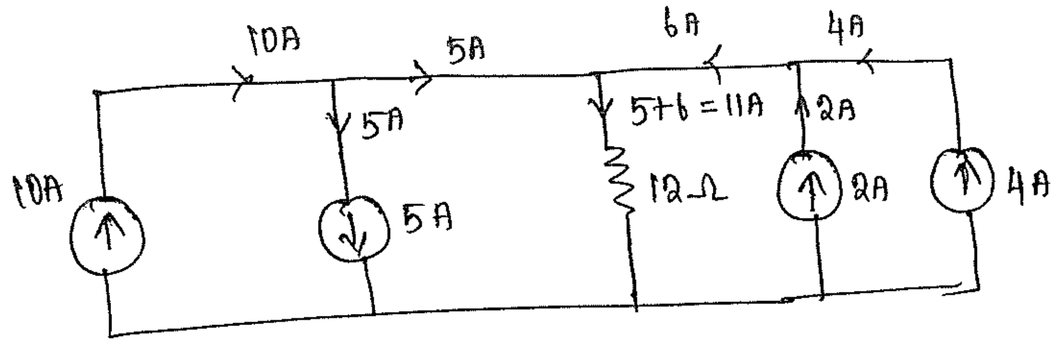
$$V_2 = \frac{\Delta V_2}{\Delta} = \frac{2700}{249} = 10.84\text{ V}$$

$$V_1 = 19.87\text{ V}$$
$$V_2 = 10.84\text{V}$$

(2) Find the current through 12Ω resistor in fig.

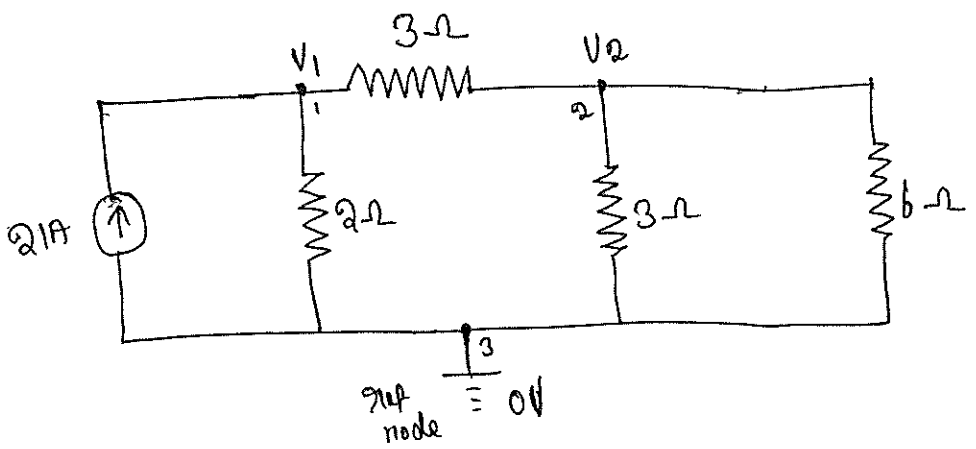


Solution.

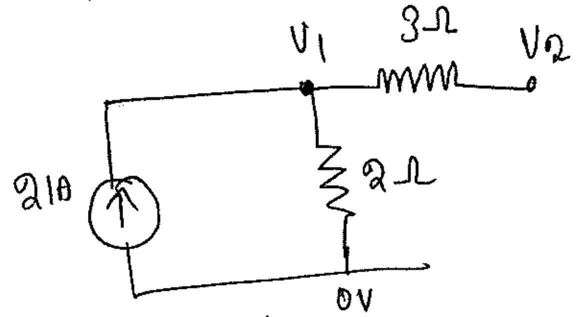


Incoming current at 12Ω resistor is 5+6 = 11A

current through 12Ω resistor = 11 Amps.



Apply KCL at node 1



Sum of entering current = Sum of Leaving current

$$21 = \frac{V_1 - V_2}{3} + \frac{V_1 - 0}{2}$$

$$21 = \frac{2(V_1 - V_2) + 3V_1}{6}$$

$$21 \times 6 = 2V_1 - 2V_2 + 3V_1$$

$$126 = 5V_1 - 2V_2$$

$$5V_1 - 2V_2 = 126 \longrightarrow (1)$$

$$-6V_1 + 15V_2 = 0 \rightarrow (2)$$

Simplifying equation (1) & (2) we get V_1 & V_2 values by using Cramer rule.

$$\begin{bmatrix} 5 & -2 \\ -6 & 15 \end{bmatrix} \begin{bmatrix} V_1 \\ V_2 \end{bmatrix} = \begin{bmatrix} 126 \\ 0 \end{bmatrix}$$

$$\Delta = \begin{bmatrix} 5 & -2 \\ -6 & 15 \end{bmatrix} = 75 - 12 = 63$$

$$\boxed{\Delta = 63}$$

$$\Delta V_1 = \begin{bmatrix} 126 & -2 \\ 0 & 15 \end{bmatrix} = 1890 - 0$$

$$\boxed{\Delta V_1 = 1890}$$

$$\Delta V_2 = \begin{bmatrix} 5 & 126 \\ -6 & 0 \end{bmatrix} = 0 + 756$$

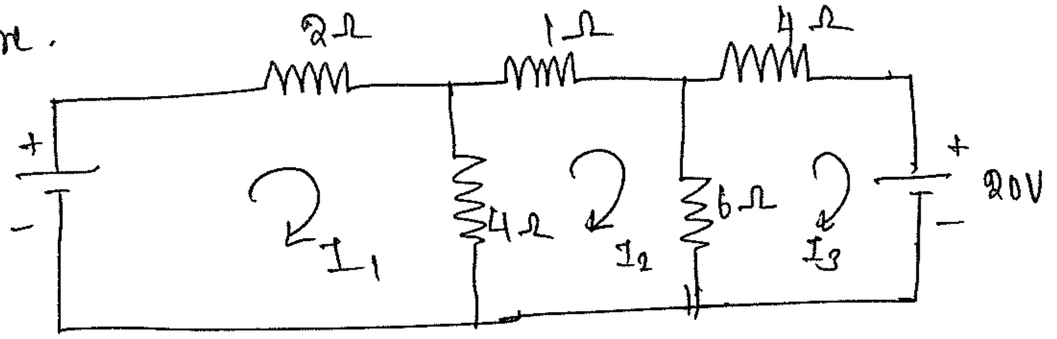
$$\boxed{\Delta V_2 = 756}$$

Total current through the circuit $(I) = \frac{V}{R}$

$$= \frac{140}{40}$$

$$I = 3.5 \text{ Amps}$$

(2) Calculate current through 6 Ω resistor by KVL for figure.



Solution:

Apply KVL at Loop 1

(i) $\Sigma V = 0$

$$-2I_1 - 4(I_1 - I_2) + 10 = 0$$

$$-2I_1 - 4I_1 + 4I_2 + 10 = 0$$

$$-6I_1 + 4I_2 + 10 = 0$$

$$6I_1 - 4I_2 = 10 \rightarrow (1)$$

(or)

(ii) Potential drop = Potential rise.

$$2I_1 + 4(I_1 - I_2) = 10$$

$$2I_1 + 4I_1 - 4I_2 = 10$$

$$6I_1 - 4I_2 = 10 \longrightarrow (1)$$

$$\Delta = 284$$

$$\Delta I_2 = \begin{bmatrix} 6 & 10 & 0 \\ -4 & 0 & -6 \\ 0 & -20 & 10 \end{bmatrix}$$

$$= 6(0-120) - 10(-40+0) + 0(0)$$

$$= -720 + 400$$

$$\Delta I_2 = -320$$

$$\Delta I_3 = \begin{bmatrix} 6 & -4 & 10 \\ -4 & 11 & 0 \\ 0 & -6 & -20 \end{bmatrix}$$

$$= 6(-220+0) + 4(80-0) + 10(24-0)$$

$$\Delta I_3 = -1320 + 320 + 240$$

$$\Delta I_3 = -760$$

$$I_2 = \frac{\Delta I_2}{\Delta} = \frac{-320}{284} = -1.1267 \text{ Amps}$$

$$I_3 = \frac{\Delta I_3}{\Delta} = \frac{-760}{284} = -2.676 \text{ Amps}$$

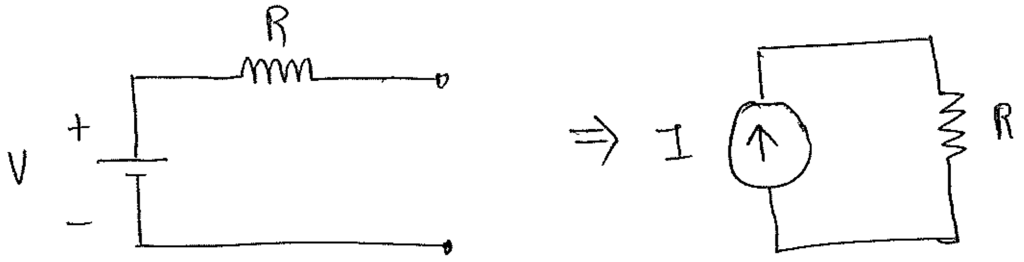
Current and Voltage Source Transformation :

The Voltage and current Sources may be interchanged without affecting the remainder of the circuit, this technique is called " Source Transformation ".

Source Transformation

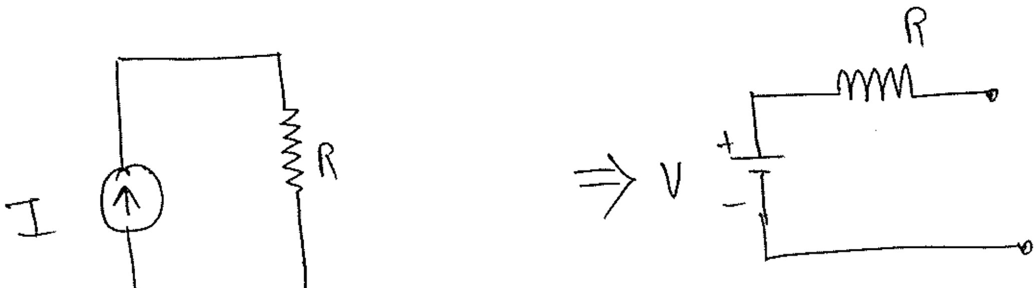
- Voltage to current Source
- current to Voltage Source.

VOLTAGE TO CURRENT SOURCE : Voltage Source in Series with the resistance can be replaced by current source in Parallel with resistance & Vice Versa.



$I = V/R$

CURRENT TO VOLTAGE SOURCE : current Source in Parallel with the resistance can be replaced by Voltage Source in Series with resistance.



$V = IR$

Mesh current method [Loop current method]

In this method Kirchoff's Voltage law is applied to a network to write mesh equations in terms of Mesh currents instead of branch currents..

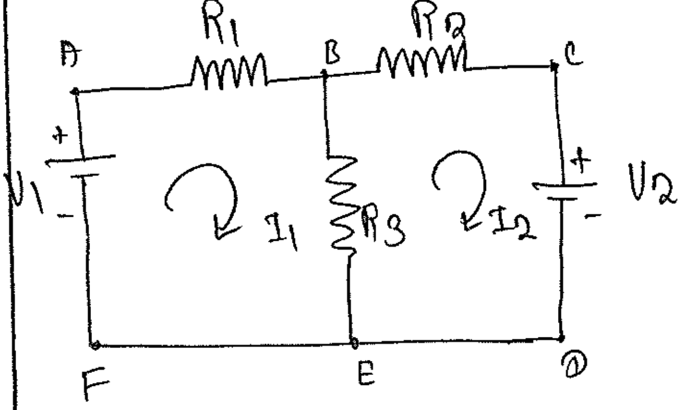
Steps followed for mesh current method

(i) Each mesh (or) Loop is assigned a separate mesh currents

(ii) Assume all Loop currents are flow in clockwise direction.

(iii) If two Mesh currents are flowing through a circuit element, actual current in the circuit element is algebraic sum of two.

<u>eg</u>. In fig I_1 & I_2 are flowing through R_3
⇒ current through R_3 is $I_1 - I_2$ (Loop1)
current through R_3 is $I_2 - I_1$ (Loop2)



(iv) Kirchoff's Voltage law is applied to write equation for each mesh in terms of mesh currents.

(v) Now solve the mesh equations and find all the Loop currents.

$$\begin{bmatrix} R_{11} & R_{12} & R_{13} \\ R_{21} & R_{22} & R_{23} \\ R_{31} & R_{32} & R_{33} \end{bmatrix} \begin{bmatrix} I_1 \\ I_2 \\ I_3 \end{bmatrix} = \begin{bmatrix} V_1 \\ V_2 \\ V_3 \end{bmatrix}$$

R_{11} is the total resistance of Loop 1

R_{22} is the total resistance of Loop 2

R_{33} is the total resistance of Loop 3

R_{12} & R_{21} is the common resistance between Loop 1 & 2

R_{23} & R_{32} is the common resistance between Loop 2 & 3

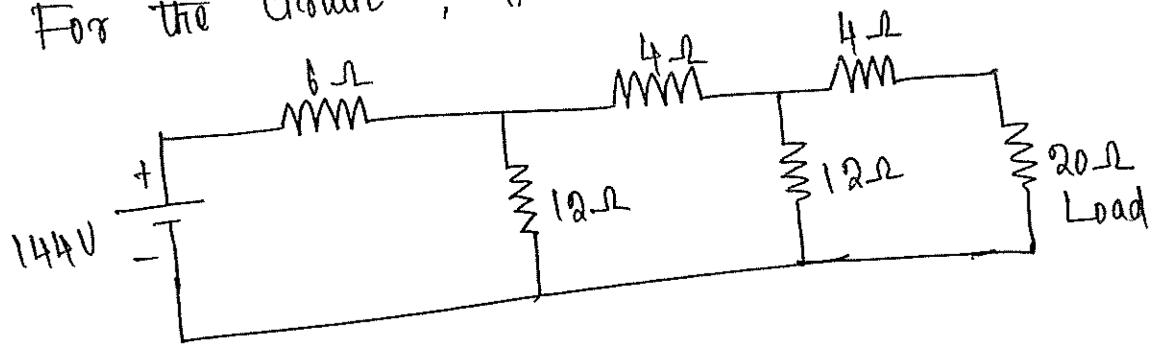
R_{13} & R_{31} is the common resistance between Loop 1 & 3

From the matrix we can find the various Loop currents by using Cramer rule.

$$I_1 = \frac{\Delta I_1}{\Delta} \quad ; \quad I_2 = \frac{\Delta I_2}{\Delta} \quad ; \quad I_3 = \frac{\Delta I_3}{\Delta}$$

Problems:

1) For the circuit, find the Load current and power?



By applying Cramer's rule

$$\Delta = \begin{bmatrix} 18 & -12 & 0 \\ -12 & 28 & -12 \\ 0 & -12 & 36 \end{bmatrix}$$

$$\Delta = 18(1008 - 144) + 12(-432 - 0) + 0(0)$$

$$\Delta = 15552 - 5184$$

$$\boxed{\Delta = 10368}$$

$$D I_3 = \begin{bmatrix} 18 & -12 & 144 \\ -12 & 28 & 0 \\ 0 & -12 & 0 \end{bmatrix}$$

$$= 18(0) + 12(0) + 144(144 - 0)$$

$$\boxed{D I_3 = 20736}$$

$$I_3 = \frac{D I_3}{\Delta} = \frac{20736}{10368}$$

$$\boxed{I_3 = 2 \text{ Amps}}$$

Load Resistor (R_L) = 20 Ω

Current flowing through Load resistor (I_L) = 2 Amps.

Power delivered to the load (P_L) = $I_L^2 R_L = (2)^2 \times 20$

$$\boxed{P_L = 80 \text{ watts}}$$

∴ From equation (1), (2) & (3) we get matrix form.

$$\begin{bmatrix} 15 & -12 & -1 \\ -12 & 17 & -3 \\ -1 & -3 & 8 \end{bmatrix} \begin{bmatrix} I_1 \\ I_2 \\ I_3 \end{bmatrix} = \begin{bmatrix} 12 \\ -10 \\ 24 \end{bmatrix}$$

Current through $4\,\Omega$ resistor $= I_3$

Find I_3 by using Cramer's rule.

$$\Delta = \begin{bmatrix} 15 & -12 & -1 \\ -12 & 17 & -3 \\ -1 & -3 & 8 \end{bmatrix}$$

$$\Delta = 15(136-9) + 12(-96-3) - 1(36+17)$$

$$\Delta = 1905 + (-1188) - 53$$

$$\boxed{\Delta = 664}$$

$$\Delta I_3 = \begin{bmatrix} 15 & -12 & 12 \\ -12 & 17 & -10 \\ -1 & -3 & 24 \end{bmatrix}$$

$$= 15(408-30) + 12(-288-10) + 12(36+17)$$

$$= 5670 - 3576 + 636$$

$$\boxed{\Delta I_3 = 2730}$$

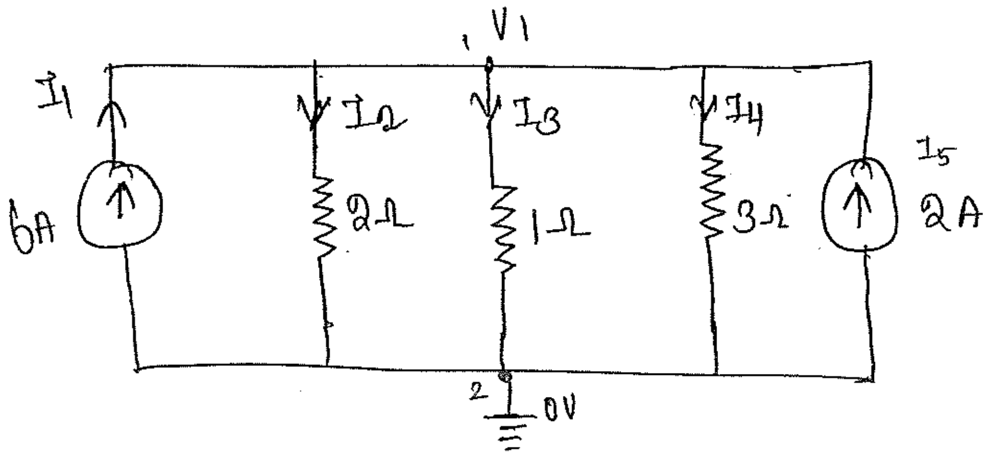
Solution:

All voltage sources are converted in to their equivalent current sources.

current through source 12V, $I_1 = \frac{12}{2} = 6A$

current through sources 6V, $I_2 = \frac{6}{3} = 2A$.

$\therefore$ circuit becomes



Apply KCL at node 1,

$$I_1 + I_5 = I_2 + I_3 + I_4$$

$$6 + 2 = \frac{V_1}{2} + \frac{V_1}{1} + \frac{V_1}{3}$$

$$6 + 2 = \frac{V_1}{2} + \frac{V_1}{1} + \frac{V_1}{3}$$

$$8 = V_1 \left(\frac{1}{2} + 1 + \frac{1}{3} \right)$$

$$8 = V_1 \left[\frac{3+6+2}{6} \right)$$

$$8 = V_1 \left[\frac{11}{6} \right]$$

Apply KCL at node 1

$$0.8 = \frac{V_1}{5} + \frac{V_1 - V_2}{10} + \frac{V_1}{15}$$

$$0.8 = \frac{V_1}{5} + \frac{V_1}{10} - \frac{V_2}{10} + \frac{V_1}{15}$$

$$0.8 = \frac{6V_1 + 3V_1 - 3V_2 + 2V_1}{30}$$

$$0.8 \times 30 = 6V_1 + 3V_1 - 3V_2 + 2V_1$$

$$24 = 11V_1 - 3V_2 \longrightarrow (1)$$

Apply KCL at node 2.

$$0.5 = \frac{V_2}{12} + \frac{V_2}{8} + \frac{V_2 - V_1}{10}$$

$$0.5 = \frac{10V_2 + 15V_2 + 12(V_2 - V_1)}{120}$$

$$0.5 \times 120 = 10V_2 + 15V_2 + 12V_2 - 12V_1$$

$$60 = -12V_1 + 37V_2 \longrightarrow (2)$$

$$11V_1 - 3V_2 = 24 \longrightarrow (1)$$

$$-12V_1 + 37V_2 = 60 \longrightarrow (2)$$

Current through 8Ω resistor $I_{8\Omega} = \frac{V_2}{8}$

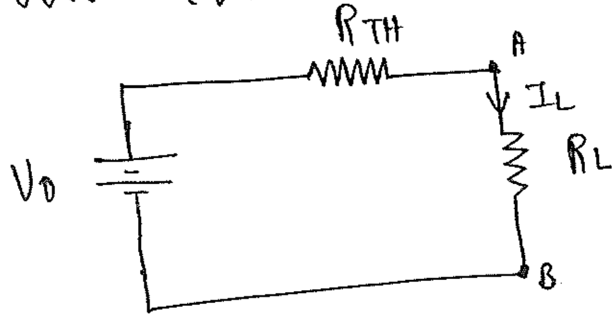
$= \frac{2.56}{8}$

$$I_{8\Omega} = 0.32 \text{ Amps}$$

Thevenin's Theorem

A linear two terminal network can be replaced by Voltage Source V_0 in series with resistance R_{TH}.

Thevenin's equivalent circuit



where

V_0 – Open circuit Voltage at terminals AB

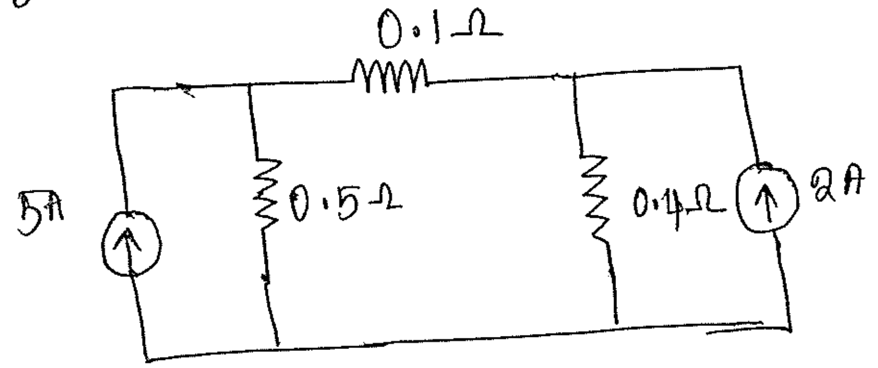
R_{TH} – Thevenin's looking back resistances between terminals A and B

I_L – Load current through resistor R_L

$$I_L = \frac{V_0}{R_{TH} + R_L}$$

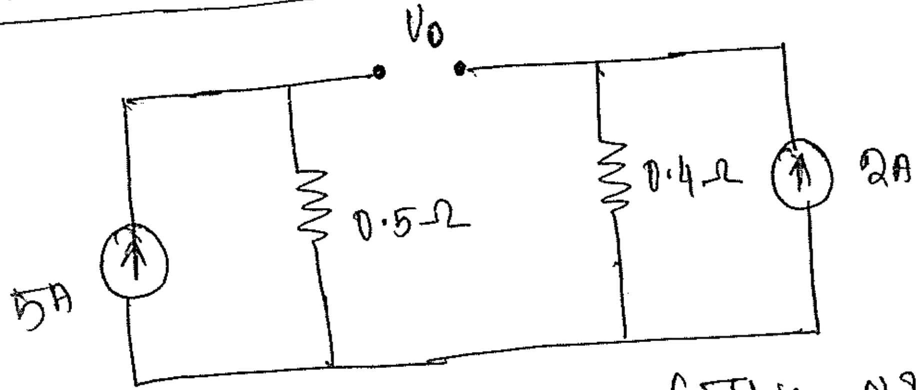
(i) Problems

Find the current through the 0.1 Ω resistor in the fig using Thevenin's method.



Solution

Step 1 : To find Vo = ?

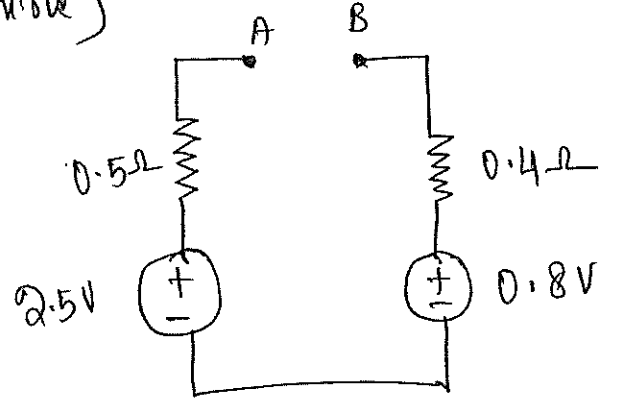


$V_1 = 5 \times 0.5 = 2.5V$

$V_2 = 2 \times 0.4 = 0.8V$

(This circuit is reduced by using Source Transformation).

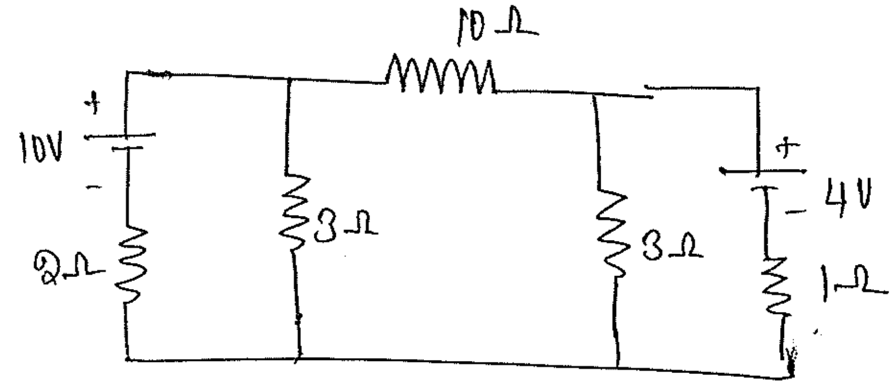
[If we need use Transformation Voltage Source to current Source (or) current Source to Voltage Source)



$$I_L = \frac{1.7}{0.9+0.1}$$

$$\boxed{I_L = 1.7 \text{ Amps}}$$

(2) Using Thevenin's theorem find the current I_L in the circuit shown in fig.



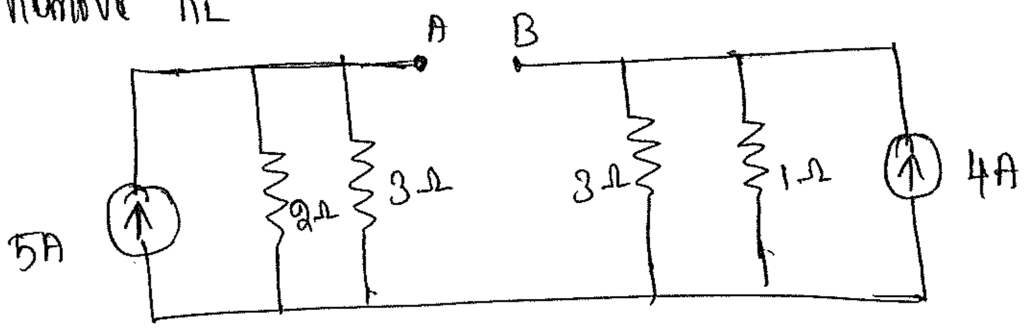
Solution. Use Source Transformation.

(1) Voltage source to current source.

$$I_1 = \frac{V}{R} = \frac{10}{2} = 5A$$

$$I_2 = \frac{V}{R} = \frac{4}{1} = 4A.$$

Remove R_L



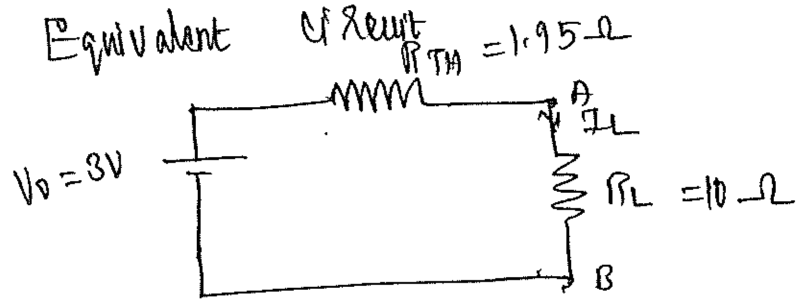
Now Reduce the parallel resistances.

$$3\Omega \parallel 2\Omega \Rightarrow \frac{3\times 2}{3+2} = 1.2\Omega$$

$$3\Omega \parallel 1\Omega \Rightarrow \frac{3\times 1}{3+1} = \frac{3}{4} = 0.75\Omega$$

Step 3 — To find I_L = ?

Equivalent circuit



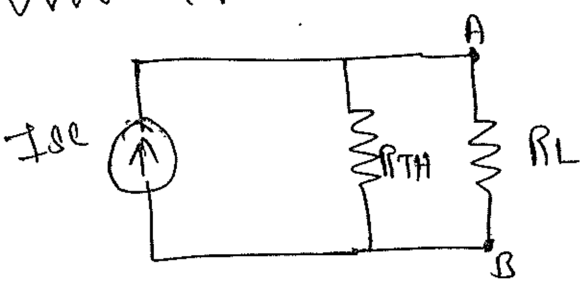
$$I_L = \frac{V_0}{R_{th} + R_L} = \frac{3}{1.95 + 10}$$

$$\boxed{I_L = 0.251\ A}$$

Norton's Theorem.

Statement:- Any two terminals network can be reduced to a current source in parallel with a resistor.

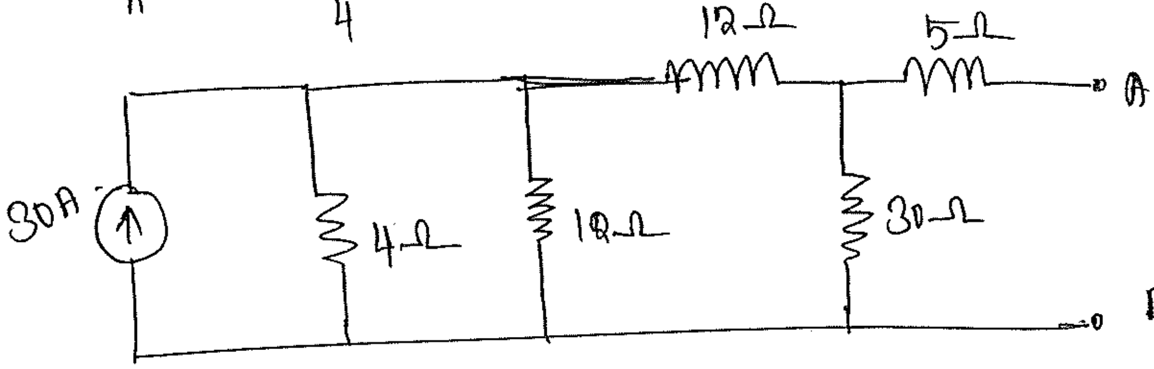
Equivalent circuit



Where I_{sc} = Short circuit current at AB

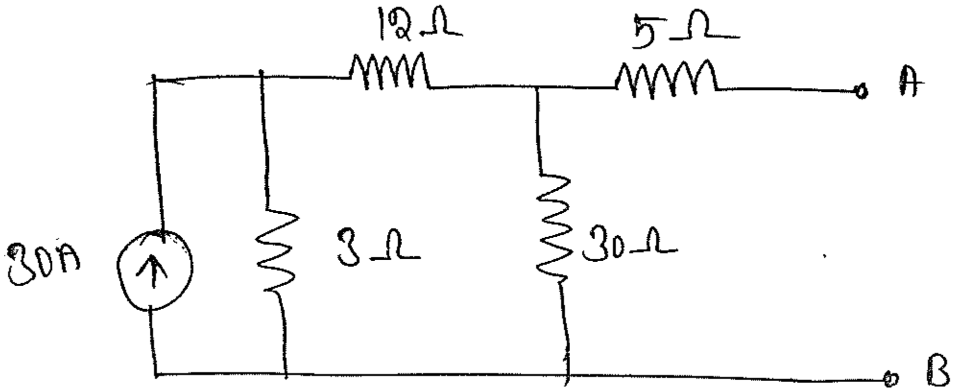
R_{TH} = Thevenin's looking back resistance.

$I = \frac{V}{R} = \frac{120}{4} = 30\ A$



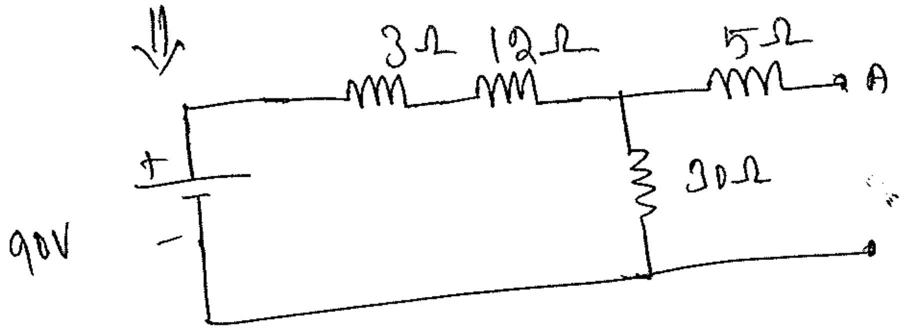
The resistors 4Ω & 12Ω are in parallel

$R = \frac{4 \times 12}{4+12} = 3\Omega$

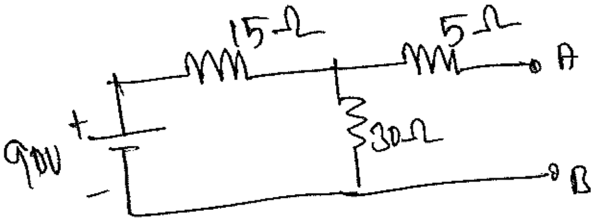


$V = IR = 30 \times 3 = 91V$

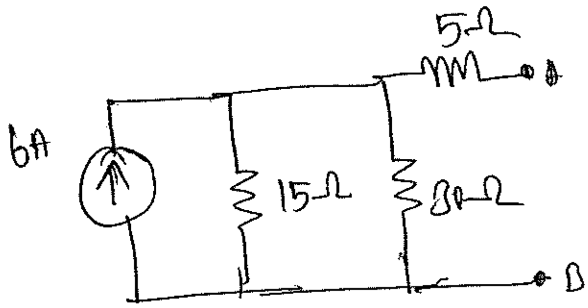
⇓



3Ω & 12Ω are in series

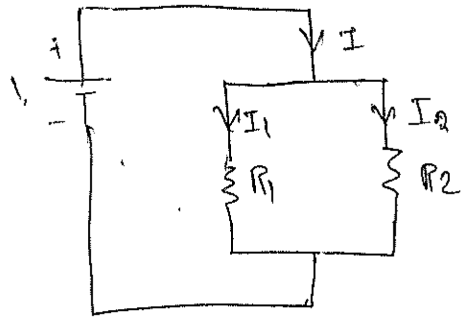


⇒



$I = 90/15 = 6A$

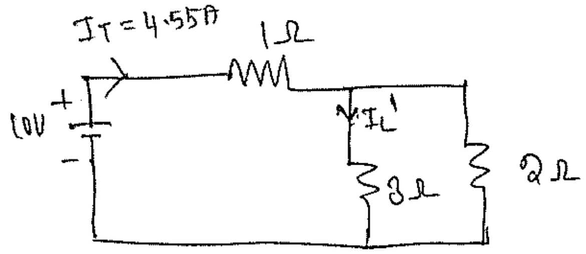
Current Division rule (CDR)



Current through any resistor = Total current × $\dfrac{\text{Opposite Resistance}}{\text{Opposite Resistance} + \text{Load resistance}}$

$$I_1 = I \times \frac{R_2}{R_1+R_2}$$

$$I_2 = I \times \frac{R_1}{R_1+R_2}$$



By using current division rule.

$$\text{current through } 3\Omega \ (I_L') = I_T \times \frac{\text{Opposite Resistance}}{\text{Opposite Resistance} + \text{Load Resistance}}$$

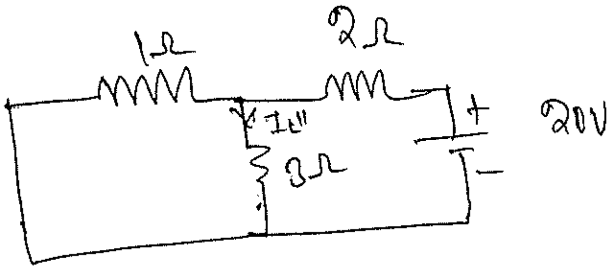
$$I_L' = 4.55 \times \frac{2}{3+2}$$

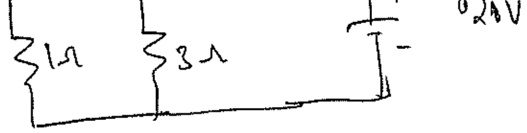
$$I_L' = \frac{9.1}{5} = 1.82$$

$$\boxed{I_L' = 1.82 \text{ Amps}}$$

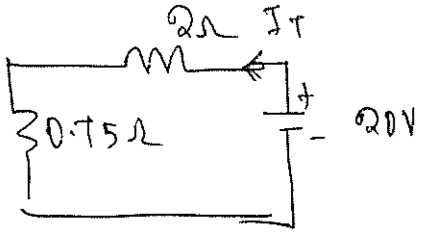
Step 2. 20V battery is acting alone.

10V battery is short circuited





$$= \frac{3 \times 1}{3+1} = \frac{3}{4} = 0.75 \Omega$$

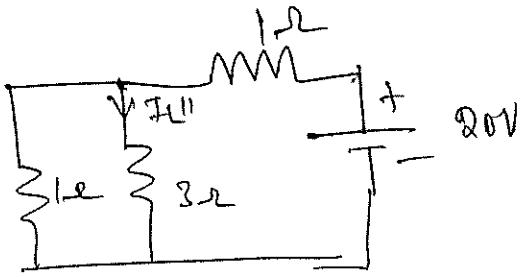


$$I_T = \frac{20}{2+0.75} = \frac{20}{2.75}$$

$$I_T = \frac{20}{2.75} = 7.27$$

$$\boxed{I_T = 7.27 \text{ Amps}}$$

By using current division rule.



$$\text{current through } 3\Omega \text{ resistor } (I_L'') = I_T \times \frac{\text{Opposite Resistance}}{\text{Opp. Resistance} + R_L}$$

$$= 7.27 \times \frac{1}{1+3}$$

$$= \frac{7.27}{4} = 1.8175$$

$$\boxed{I_L'' = 1.82 \text{ Amps}}$$

Step 3 Both sources are acting

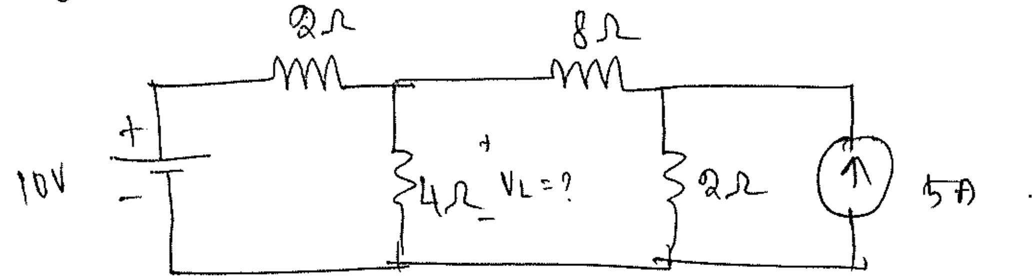
$$\left.\begin{array}{l}\text{current through } (I_L) \\ 3\Omega \text{ resistor}\end{array}\right\} = I_L' + I_L''$$

$$= 1.82 + 1.82$$

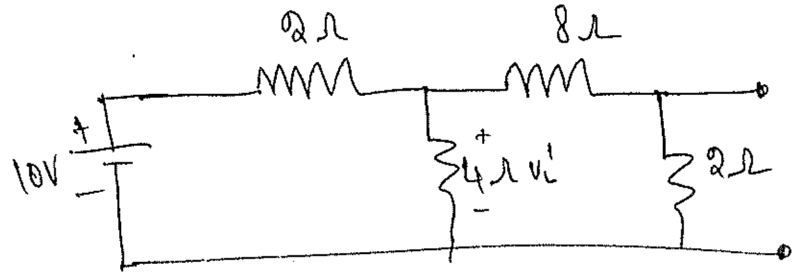
$$= 3.64 \text{ A}$$

$$\boxed{I_L = 3.64 \text{A}}$$

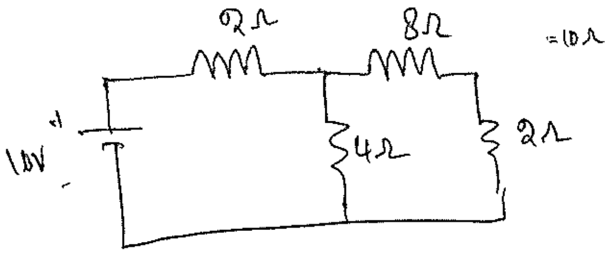
(2) Determine the Voltage across the 4Ω resistor by using Super position theorem.

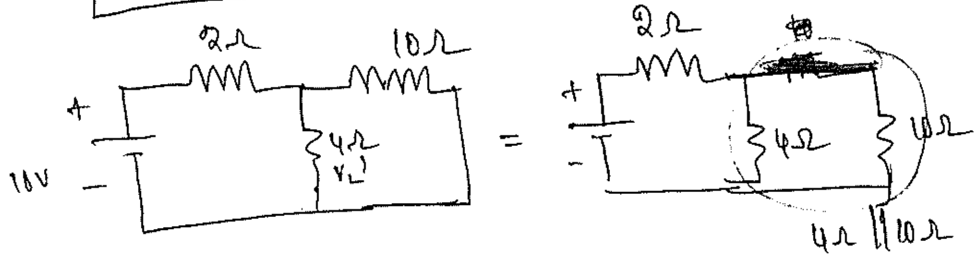


Step 1   10V battery is acting alone.
5A current source is open circuited.



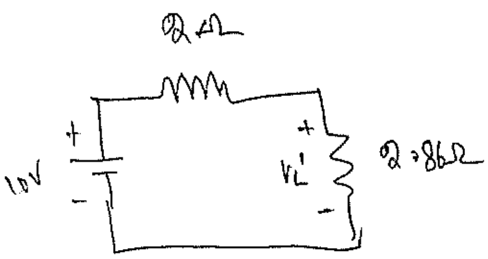
8Ω and 2Ω series.
= 10Ω





4Ω || 10Ω

$$\frac{4 \times 10}{4+10} = \frac{40}{14} = 2.86\Omega$$



Total Voltage = 10V

Apply Voltage division rule.

Voltage across 4Ω resistor (V_L') = Total Voltage × $\frac{\text{Branch resistance}}{\text{Total resistance}}$

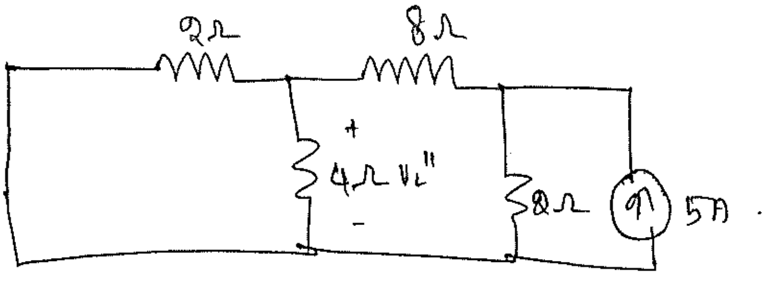
$$= 10 \times \frac{2.86}{2+2.86}$$

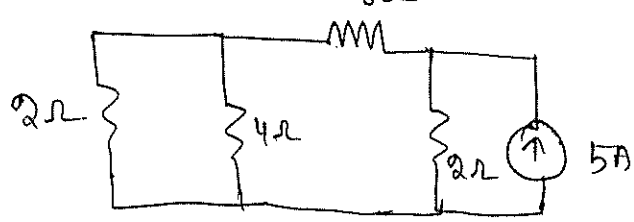
$$= \frac{28.6}{4.86} = 5.88V$$

$$V_L' = 5.88V$$

Step 2 :

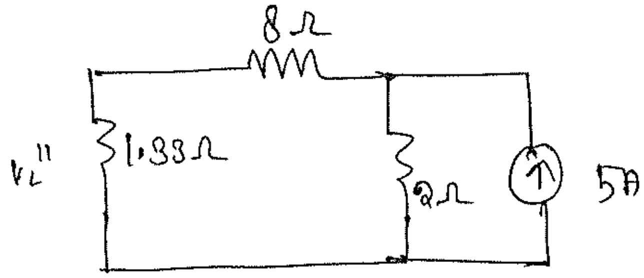
5A acting alone and 10V battery is Short circuited.



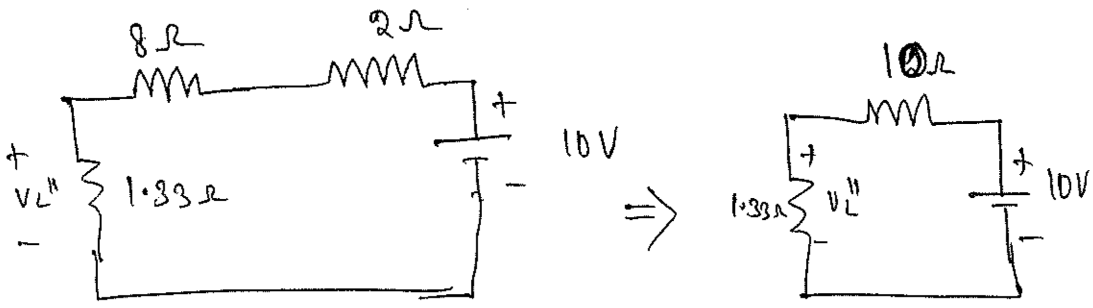


2Ω || 4Ω

$$\frac{2 \times 4}{2+4} = \frac{8}{6} = 1.33\Omega$$



$V = 5 \times 2 = 10V$



Apply Voltage division rule.

Voltage across 4Ω resistor (V_L'') = Total Voltage × $\frac{\text{Branch Resistance}}{\text{Total Resistance}}$

$$= 10 \times \frac{1.33}{10 + 1.33}$$

$$= \frac{13.3}{11.33} = 1.17V$$

$$V_L'' = 1.17V$$

<u>Step 3</u> Both sources are acting

$$V_L = V_L' + V_L''$$

$$= 5.88 + 1.17$$

Voltage across 4Ω resistor.

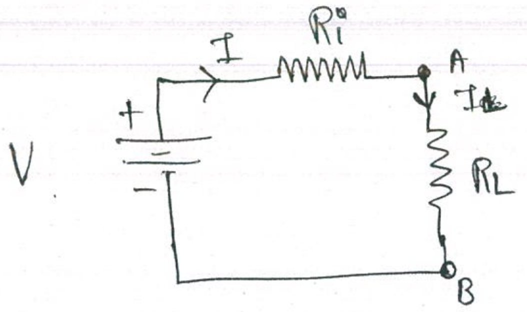
$$V_L = 7.05V$$

Maximum Power Transfer Theorem

In dc circuits maximum power is Transferred from a Source to Load when the load resistance is made equal to the internal resistance or looking back resistance of the network from the load terminals.

$V = V_0$ = Thevenin's open circuit Voltage

$R_i = R_{th}$ → Thevenin's resistance



$I = I_L$

An electric circuit can be replaced by a Thevenin's equivalent circuit consisting of Thevenin's Voltage series with Thevenin's looking back resistance $R_{TH} = R_i$ as shown in fig.

Circuit current $I_L = \dfrac{V}{R_i + R_L}$

Power consumed by the load $P_L = I_L^2 R_L$

$$P_L = \left(\frac{V}{R_i + R_L}\right)^2 \times R_L = \frac{V^2 R_L}{(R_i + R_L)^2}$$

$$\boxed{P_L = \frac{V^2 R_L}{(R_i + R_L)^2}}$$

For maximum power $\dfrac{dP_L}{dR_L} = 0$

For maximum Power $\frac{dP_L}{dR_L} = 0$

$$\frac{d}{dR_L}\left(\frac{V^2 R_L}{(R_i+R_L)^2}\right) = 0$$

$$\frac{(R_i+R_L)^2 V^2 - V^2 R_L\, 2(R_i+R_L)}{(R_i+R_L)^4} = 0$$

$u = V^2 R_L$
$du = V^2$
$v = (R_i+R_L)^2$
$dv = 2(R_i+R_L)$
$d\left(\frac{u}{v}\right) = \frac{v\,du - u\,dv}{v^2}$

$$(R_i+R_L)^2 V^2 - V^2 R_L\, 2(R_i+R_L) = 0$$

$$(R_i+R_L)^2 V^2 = V^2 R_L\, 2(R_i+R_L)$$

$$(R_i+R_L) = 2R_L$$

$$R_i = 2R_L - R_L$$

$$\boxed{R_i = R_L}$$

For maximum power condition

$$\boxed{R_i = R_L}$$

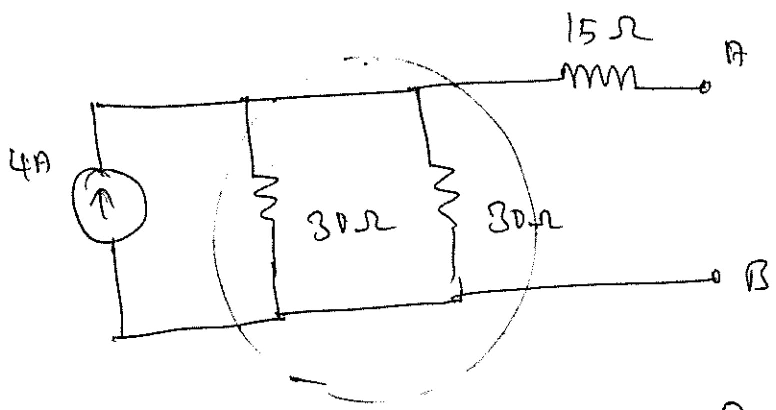
Maximum Power $P_{max} = I_L^2 R_L$

$$= \left(\frac{V}{(R_i+R_L)}\right)^2 R_L$$

$$= \left(\frac{V^2}{(R_L+R_L)^2}\right) \cdot R_L = \frac{V^2}{(2R_L)^2} \cdot R_L$$

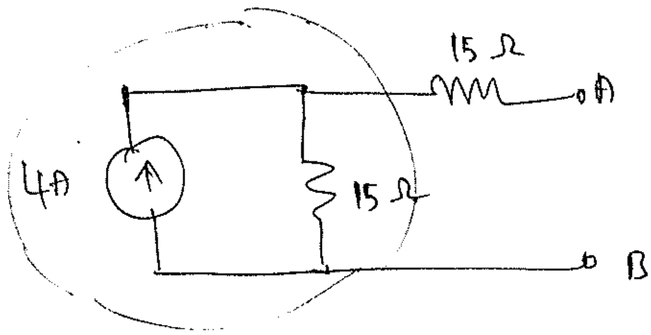
$$= \frac{V^2 R_L}{4R_L^2} = \frac{V^2}{4R_L}$$

Find $V_0 = ?$ $R_{th} = ?$



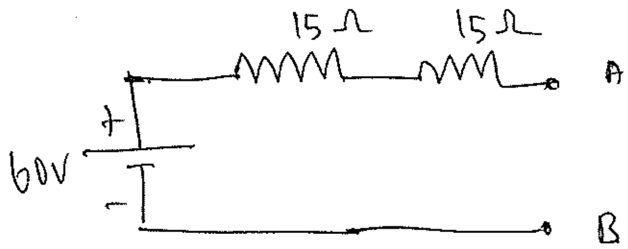
30 Ω and 30 Ω Parallel

$$= \frac{30 \times 30}{30+30} = \frac{900}{60} = 15\,\Omega$$



$V = IR$

$V = 4 \times 15 = 60V$



$$\boxed{V_0 = 60V}$$

$R_{TH} = 15 + 15$

$$\boxed{R_{th} = 30\,\Omega}$$

$R_i = R_{th}$

R_L for maximum Power Transfer $= R_i$

$$\boxed{R_L = R_i}$$

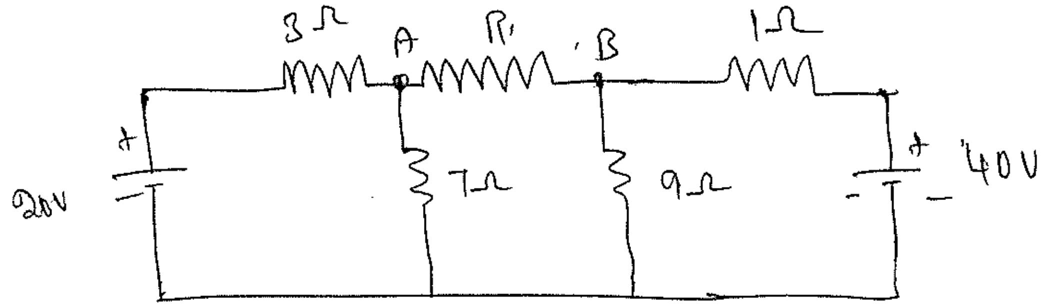
$$R_L = 30\,\Omega$$

$$\text{Maximum power at load} = \frac{V^2}{4R_L}$$

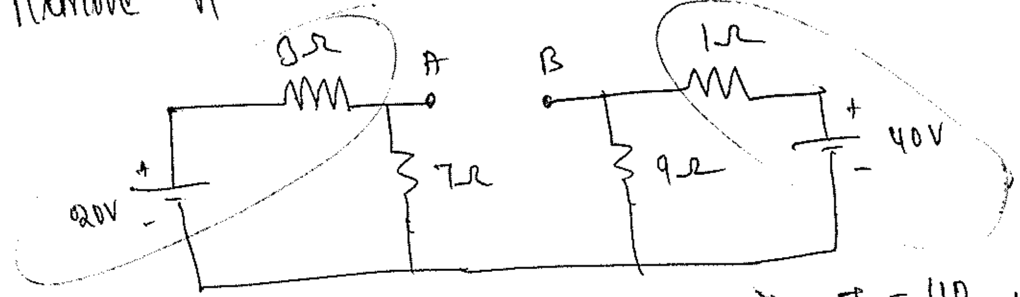
$$= \frac{60^2}{4 \times 30} = \frac{3600}{120}$$

$$\boxed{P_{max} = 30 \text{ watts}}$$

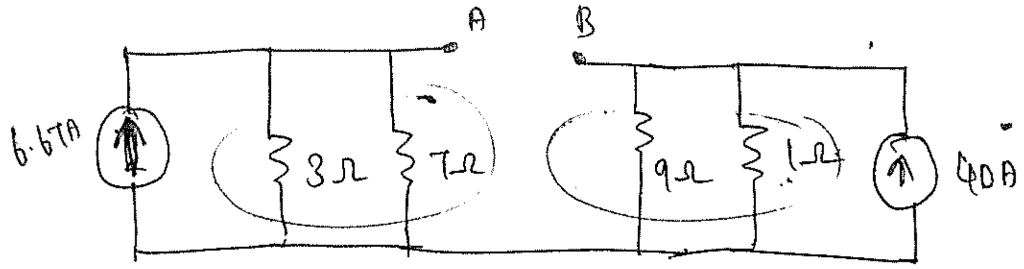
Problem: 2. In the circuit shown below, Find the resistance R to be connected b/w A & B So that the power dissipated in this maximum. Find also the maximum power.



Remove R

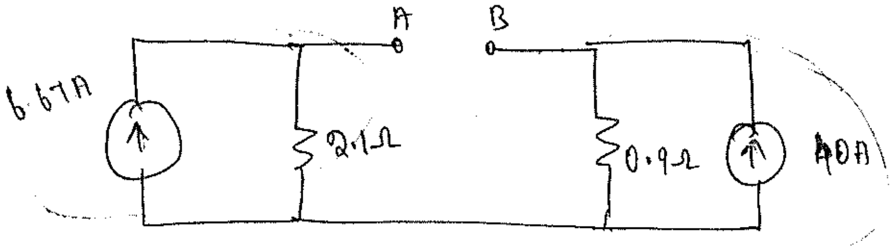


$I = \frac{V}{R} = \frac{20}{3} = 6.67\,A$ $\qquad I = \frac{40}{1} = 40\,A$



$$\frac{3\times 7}{3+7} = \frac{21}{10} = 2.1\,\Omega$$

$$\frac{9\times 1}{9+1} = \frac{9}{10} = 0.9\,\Omega$$



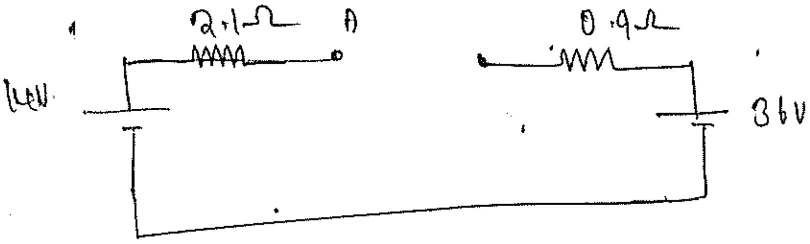
$V = IR$

$= 6.67 \times 2.1$

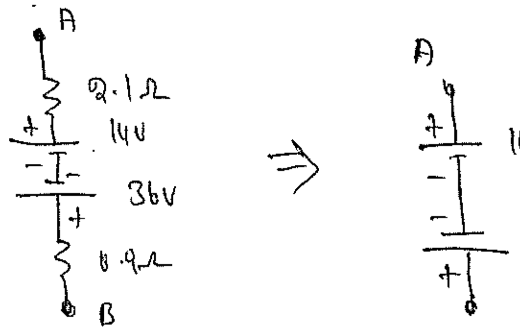
$V = 14V$

$V = 0.9 \times 40$

$V = 36V$



To find V_0 = ?



$= 14 - 36$

$$\boxed{V_0 = -22V}$$

B is positive & A is negative

$$\boxed{V = 22V}$$

(2)

UNIT - II

AC CIRCUITS

SERIES CIRCUITS:

SINUSOIDAL VOLTAGE AND CURRENT:

* COMMERCIAL ALTERNATORS Produce Sinusoidal Voltage. (ie) alternating voltage is a Sinewave.
* A Sinusoidal Voltage can be Produced by rotating a coil in a uniform magnetic field.

The Sinusoidal alternating Voltage can be expressed by the equation.

$$v = V_m \sin \omega t \rightarrow (1)$$

v = Instantaneous value of alternating Voltage

V_m = Maximum value of alternating Voltage.

ω = angular Velocity of the coil

Sinusoidal Voltage always produces Sinusoidal currents.

$\therefore$ a Sinusoidal current can be expressed in the Same way as Voltage.

$$i = I_m \sin \omega t \rightarrow (2)$$

i = Instantaneous value of alternating current

I_m = Maximum value of alternating Current.

Instantaneous Value: – The Value of an alternating quantity at any instant is called instantaneous Value.

Cycle: One Complete set of positive and negative Values of an alternating quantity is called cycle.

Time Period (T). The time taken to complete one cycle of an alternating quantity is called its Time period (T).

Frequency (f): – The number of cycles made by an alternating quantity Per Second is called its frequency.

unit = Herz (Hz).

Amplitude (or) Peak Value: The maximum +ve (or) –ve Value of an alternating quantity is called amplitude (or) Peak Value.

Average Value: This is the average of the Instantaneous Values of an alternating quantity over one complete cycle of the wave.

Let i = Instantaneous Value of current

and I_m = Maximum Value of current.

$$i = I_m \sin\theta.$$

Average Value = $\dfrac{\text{Area under the curve}}{\text{Base length}}$.

$$I_{av} = \int_0^{\pi} \frac{i\, d\theta}{\pi}$$ (for symmetric waves take half cycle only)

$$= \int_0^{\pi} \frac{I_m \sin\theta\, d\theta}{\pi}$$

$$= \frac{I_m}{\pi} \int_0^{\pi} \sin\theta\, d\theta.$$

$$= \frac{I_m}{\pi} \left[-\cos\theta\right]_0^{\pi}$$

$$I_{av} = \frac{I_m}{\pi} \left[-\cos\pi - (\cos 0)\right]$$

$$= \frac{I_m}{\pi} \left[-(-1) - (-1)\right] = \frac{I_m}{\pi}(1+1)$$

$$\boxed{I_{av} = \frac{2 I_m}{\pi}} \Rightarrow \boxed{I_{av} = 0.637\, I_m}$$

Similarly

$$\boxed{V_{av} = \frac{2 V_m}{\pi}} \Rightarrow \boxed{V_{av} = 0.637\, I_m}$$

$$I_{rms} = \sqrt{\frac{I_m^2}{\pi} \int_0^{\pi} \left(\frac{1-\cos 2\theta}{2}\right) d\theta}$$

$$I_{rms} = \sqrt{\frac{I_m^2}{2\pi} \int_0^{\pi} (1-\cos 2\theta)\, d\theta}$$

$$I_{rms} = \sqrt{\frac{I_m^2}{2\pi} \left[\theta - \frac{\sin 2\theta}{2}\right]_0^{\pi}}$$

$$= \sqrt{\frac{I_m^2}{2\pi} \left[\left[\pi - \frac{\sin 2\pi}{2}\right] - \left[0 - \frac{\sin 2(0)}{2}\right]\right]}$$

$$= \sqrt{\frac{I_m^2}{2\pi} (\pi)} = \sqrt{\frac{I_m^2}{2}}$$

$$I_{rms} = \frac{\sqrt{I_m^2}}{\sqrt{2}}$$

$$\boxed{I_{rms} = \frac{I_m}{\sqrt{2}} \quad (or) \quad 0.707\, I_m}$$

Similarly

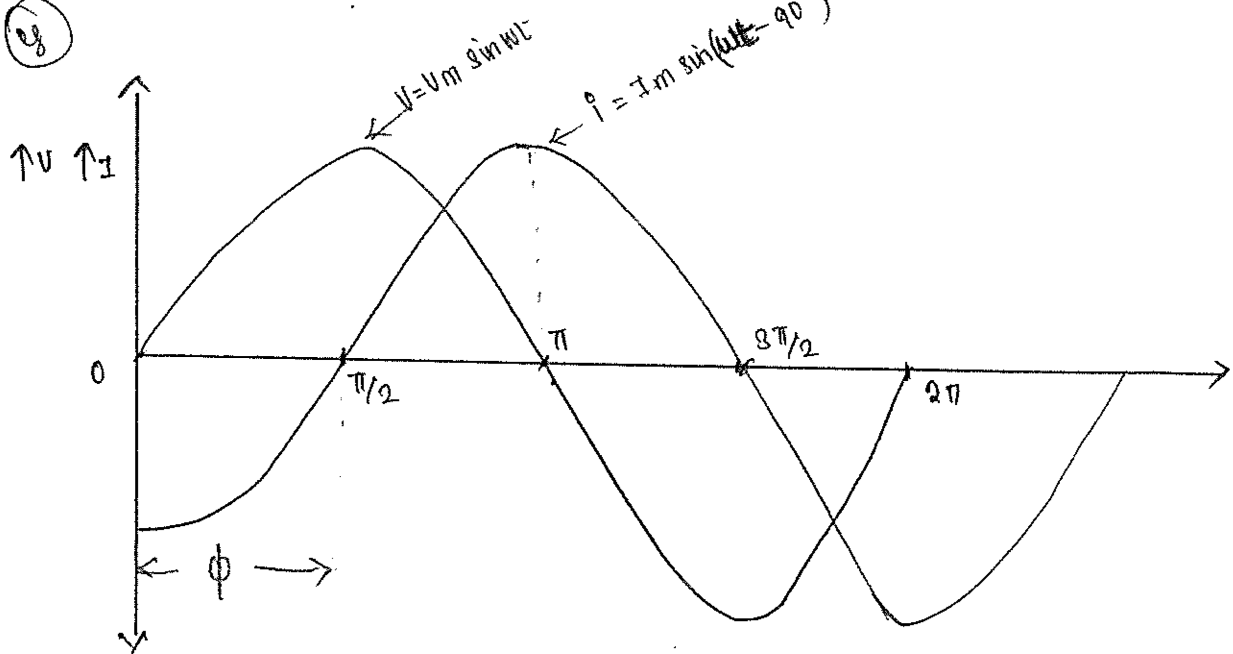
$$\boxed{V_{rms} = \frac{V_m}{\sqrt{2}} \quad (or) \quad 0.707\, V_m}$$

PHASORS :

Fig shows two sinusoidal waves.

* One wave represent the voltage and the other current.

(eg)



Therefore current wave is said to be lagging behind the voltage by an angle 90°. It can also stated that voltage leads the current by an angle 90°

Phase difference: When two quantities of the same frequency have different zero points, they are said to have a phase difference.

(d) Instantaneous Value when $t = 0.02$ sec

$$i = 141.4 \sin 314.2 \times 0.02$$

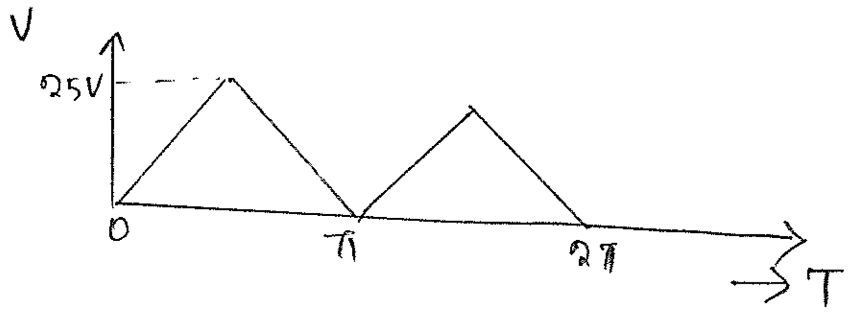
$$i = 141.4 \sin \left(\frac{180}{\pi}\right) \times 314.2 \times 0.02$$

$$i = 141.4 \sin 360^{\circ}$$

$$\boxed{i = 0}$$

degree = radian $\times \frac{180}{\pi}$

(2) Find the average Value of the triangular wave form below:



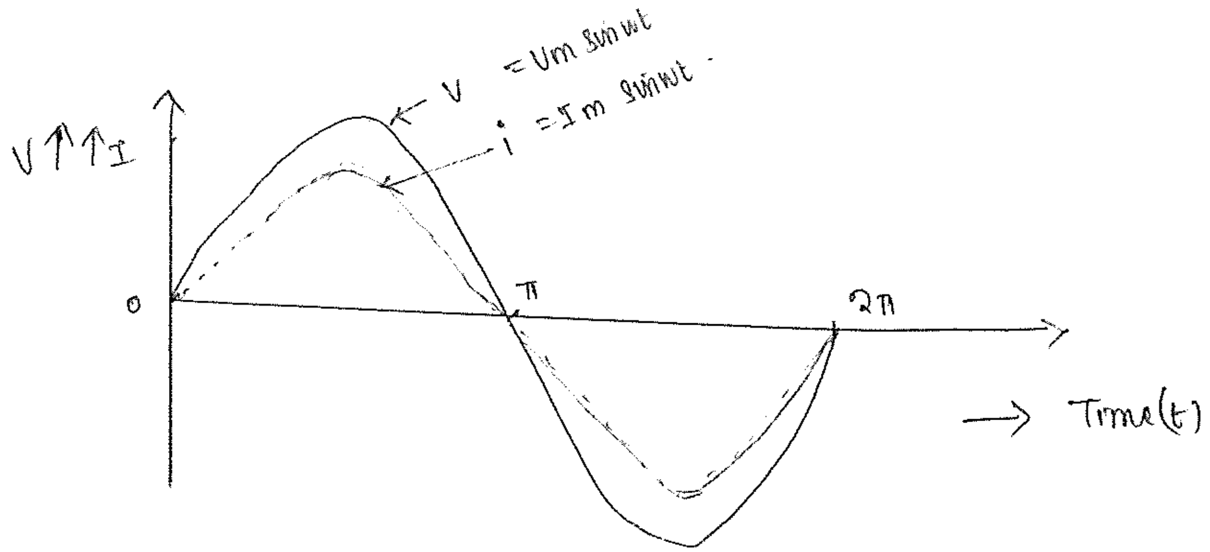
Area under one cycle = Area of triangle ($\frac{1}{2}bh$)

$$= \frac{1}{2} \times 25 \times \pi$$

$$\text{Average Value} = \frac{\text{Area under the wave}}{\text{Base}}$$

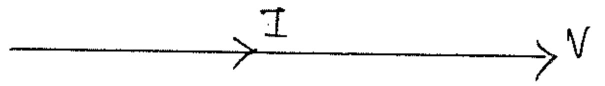
$$= \frac{\frac{1}{2} \times 25 \times \pi}{\pi}$$

$$= 12.5\,V$$



ϕ = Phase angle between Voltage and current

For Resistive circuit Vector diagram.



Vector diagram

In Pure resistance circuit the current is inphase with the applied Voltage.

$$\phi = 0^\circ$$

Power factor :

Cosine angle is called Power factor.

$$\text{Power factor} = \cos\phi.$$

$$P.F = \cos 0^\circ$$

$$\boxed{P.F = 1}$$

In Pure resistive circuit P.F is unity.

$$\text{Average power} = \frac{V_m I_m}{4\pi}(2\pi)$$

$[2 = \sqrt{2} \times \sqrt{2}$
$2 = \sqrt{4} = 2]$

$$= \frac{V_m I_m}{2}$$

$$= \frac{V_m I_m}{\sqrt{2}\sqrt{2}} = \left(\frac{V_m}{\sqrt{2}}\right)\left(\frac{I_m}{\sqrt{2}}\right)$$

$$\boxed{\text{Average power} = VI \text{ watts}}$$

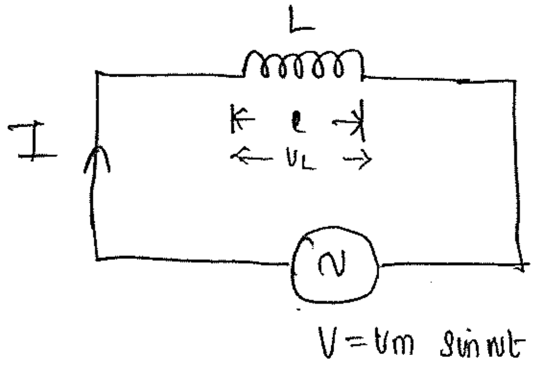
$$\boxed{P = VI \text{ watts}}$$ for pure Resistive circuits.

Where

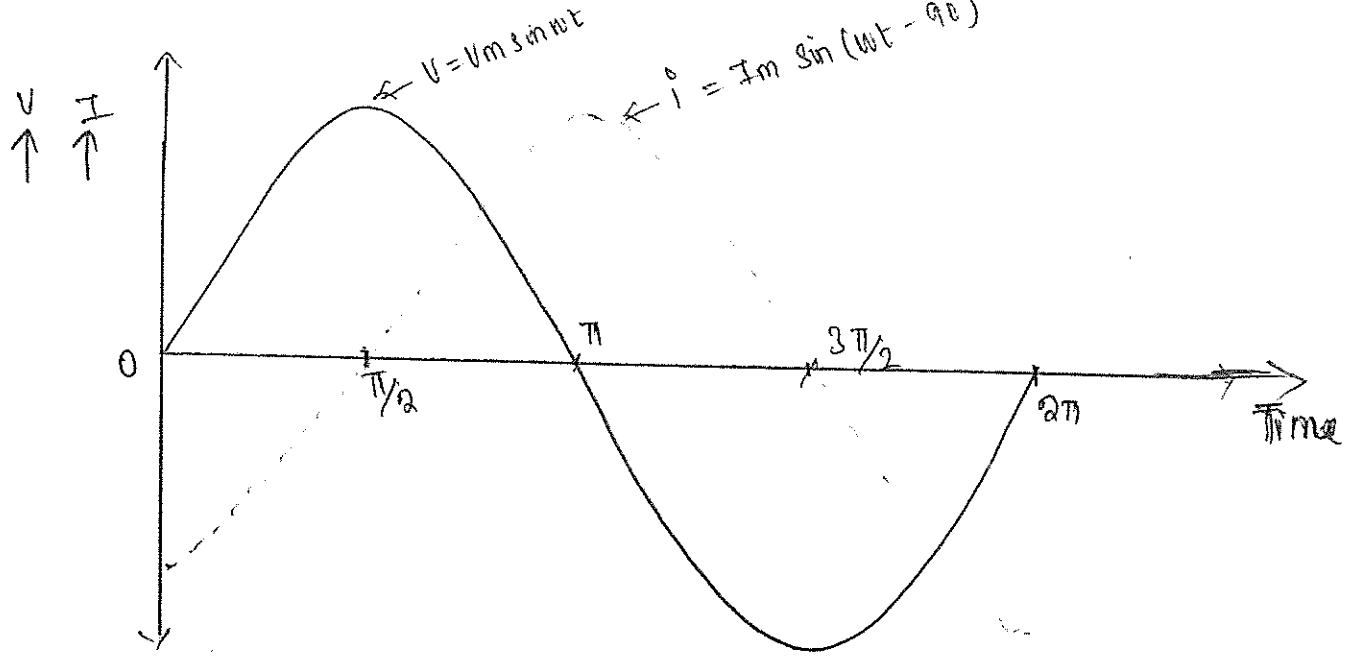
V = Rms value of voltage.
I = Rms value of currents.

AC THROUGH PURE INDUCTOR

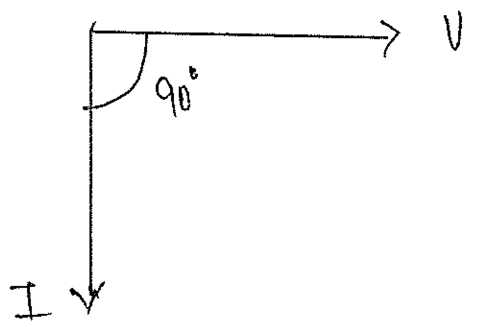
When an alternating current flows through a pure inductive coil, a back emf is induced due to the inductance of the coil. This emf opposes the applied voltage at instant.



For pure inductor circuit -



Vector diagram:



$V = V_m \sin \omega t$
$i = i_m \sin(\omega t - 90°)$

The current I lags behind the applied voltage V by 90°

Power in pure inductor circuit.

$V = V_m \sin \omega t$

$i = I_m \sin(\omega t - 90°)$

$P = vi$

$= V_m \sin \omega t \cdot I_m \sin(\omega t - 90°)$

$P = V_m \sin \theta \cdot I_m \sin(\theta - 90°)$

$$P = \frac{-V_m I_m}{4\pi \times 2}\left[\sin(4\pi - 90^\circ) - \sin(0 - 90^\circ)\right]$$

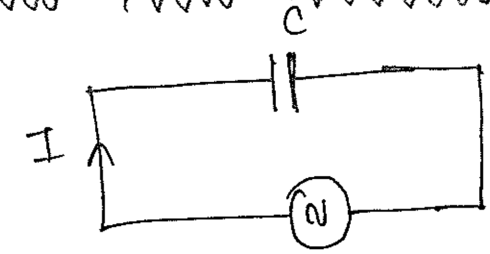
$$P = \frac{-V_m I_m}{8\pi}\left[\sin(720 - 90^\circ) - \sin(-90^\circ)\right]$$

$$P = \frac{-V_m I_m}{8\pi}\left(\sin 630^\circ + \sin 90^\circ\right]$$

$$P = \frac{-V_m I_m}{8\pi}\left(-1 + 1\right)$$

$$\boxed{P = 0 \text{ watts}}$$

AC THROUGH PURE CAPACITOR



$V = V_m \sin\omega t$.

A Pure capacitor C is connected across a supply voltage of V volts as shown in fig.

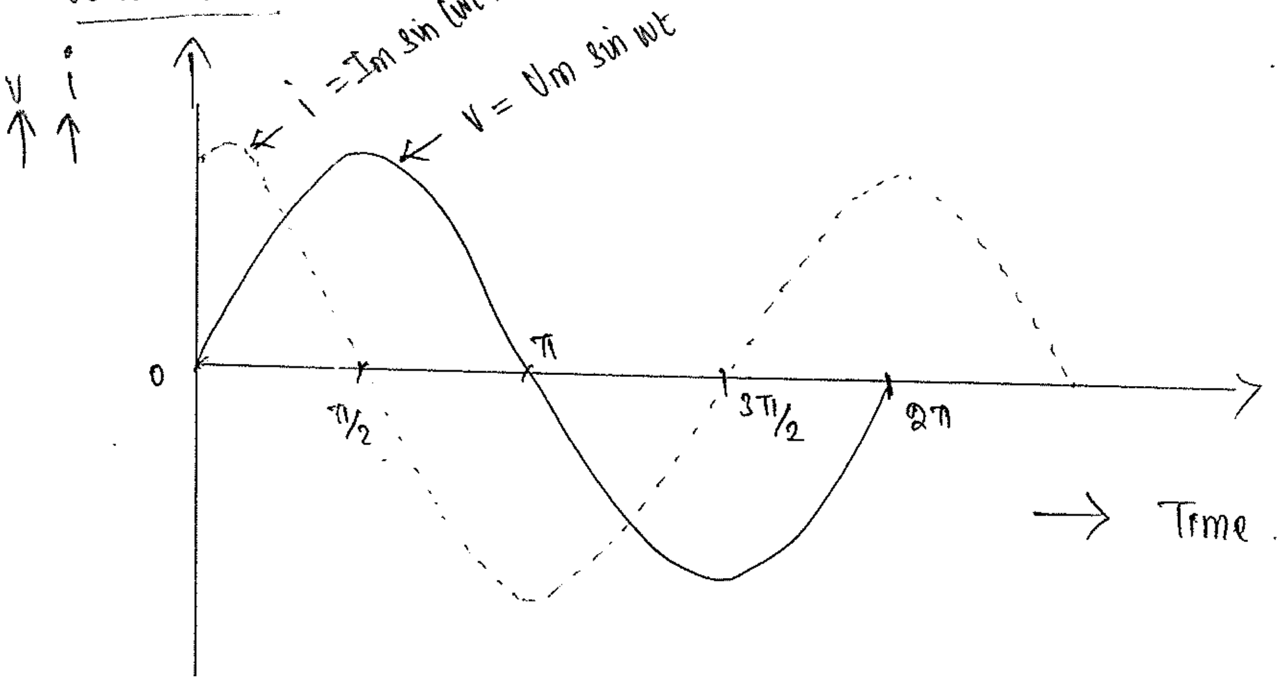
$$V = V_m \sin\omega t$$

When alternating voltage is given to a capacitor the capacitor is charged in one direction and then in the opposite direction.

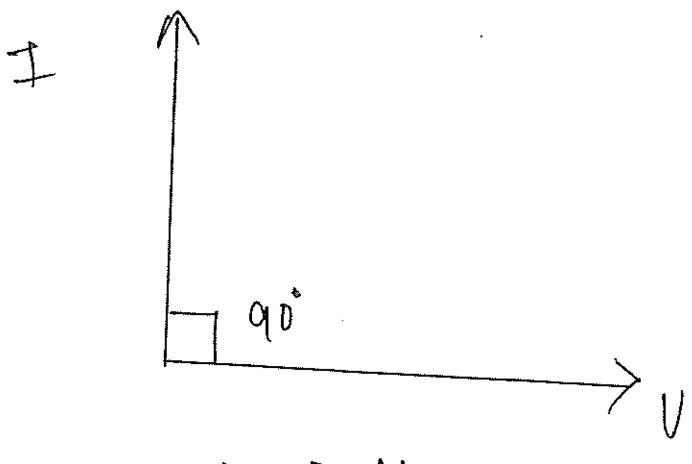
For Pure Capacitive Circuits

$$V = V_m \sin \omega t$$
$$i = I_m \sin(\omega t + 90^\circ)$$

Wave form.



Vector diagram: for Pure capacitive Circuit.



It is clear that from the equation current i leads the voltage V by an angle 90°

$$\therefore P = \frac{V_m I_m}{2\pi \times 2} \int_0^{2\pi} \cos 90^\circ - \cos(2\theta + 90^\circ)\, d\theta$$

$$P = \frac{V_m I_m}{4\pi} \int_0^{2\pi} \left(0 - \cos(2\theta + 90^\circ)\right) d\theta$$

$$P = -\frac{V_m I_m}{4\pi} \int_0^{2\pi} \cos(2\theta + 90^\circ)\, d\theta$$

$$P = -\frac{V_m I_m}{4\pi} \left[\frac{\sin(2\theta + 90^\circ)}{2} \right]_0^{2\pi}$$

$$P = \frac{-V_m I_m}{4\pi \times 2} \left[\sin(2\theta + 90^\circ) \right]_0^{2\pi}$$

$$P = \frac{-V_m I_m}{8\pi} \left[\sin\left(\overset{(720+90)}{2(2\pi) + 90^\circ}\right) - \sin(2(0) + 90) \right]$$

$$P = \frac{-V_m I_m}{8\pi} \left[\sin 810 - \sin 90^\circ \right]$$

$$P = \frac{-V_m I_m}{8\pi} \times (1 - 1)$$

$$\boxed{P = 0 \text{ watts}}$$ For pure capacitive circuits.

$$V = \sqrt{I^2R^2 + I^2X_L^2}$$

$$= \sqrt{I^2(R^2+X_L^2)}$$

$$= \sqrt{I^2} \cdot \sqrt{R^2+X_L^2}$$

$$V = I \cdot \sqrt{R^2+X_L^2}$$

$$\frac{V}{I} = \sqrt{R^2+X_L^2}$$

$$\boxed{Z = \sqrt{R^2+X_L^2}}$$

Where Z is the impedance of the circuit.

From Vector diagram.

$$\tan\phi = \frac{AB}{OA} = \frac{V_L}{V_R} = \frac{IX_L}{IR} = \frac{X_L}{R}$$

$$\tan\phi = \frac{X_L}{R}$$

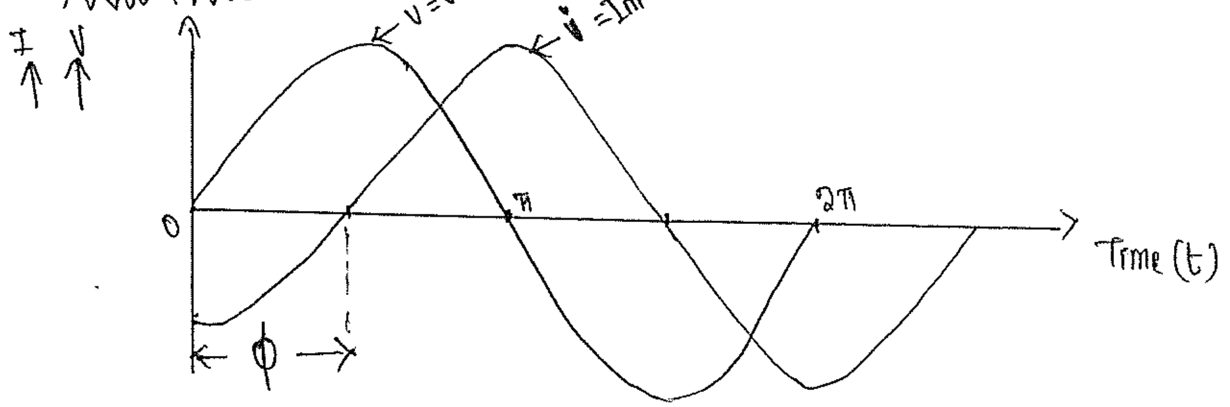
Phase angle.

$$\boxed{\phi = \frac{X_L}{R}}$$

$$\text{Power factor } (\cos\phi) = \frac{OA}{OB} = \frac{V_R}{V} = \frac{IR}{IZ}$$

Power factor ⟹ $\boxed{\cos\phi = \frac{R}{Z}}$

Wave form:



$$\text{Average power} = \frac{V_m I_m}{4\pi}\left[\left(\cos\phi\,(2\pi) - \frac{\sin(2(2\pi)-\phi)}{2}\right) - \left(\cos\phi\,(0) - \frac{\sin(2(0)-\phi)}{2}\right)\right]$$

$$= \frac{V_m I_m}{4\pi}\left[\left(2\pi\cdot\cos\phi - \frac{\sin(4\pi-\phi)}{2}\right) - \left(0 - \frac{\sin(-\phi)}{2}\right)\right]$$

$$= \frac{V_m I_m}{4\pi}\left[2\pi\cdot\cos\phi - \frac{\sin(4\pi-\phi)}{2} + \frac{\sin(-\phi)}{2}\right]$$

$$= \frac{V_m I_m}{4\pi}\left[2\pi\cdot\cos\phi + \frac{\sin\phi}{2} - \frac{\sin\phi}{2}\right]$$

$$= \frac{V_m I_m}{2\,4\pi}\left[2\pi\cos\phi\right]$$

$$= \frac{V_m I_m}{2}\cos\phi \qquad \left[2 = \sqrt{2}\cdot\sqrt{2}\right]$$

$$= \frac{V_m}{\sqrt{2}}\cdot\frac{I_m}{\sqrt{2}}\cos\phi$$

$$\boxed{P = VI\cos\phi \text{ watts}}$$

where.

V & I are rms value of voltage and currents.

$$V = I\sqrt{R^2 + X_C^2}$$

$$\frac{V}{I} = \sqrt{R^2 + X_C^2}$$

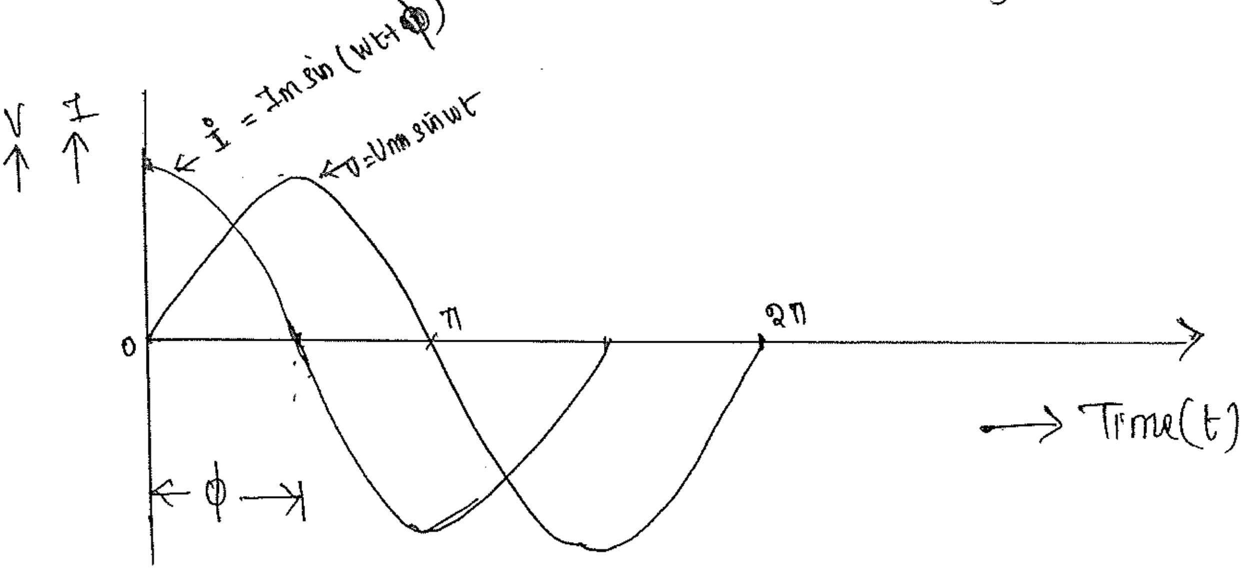
$$\boxed{Z = \sqrt{R^2 + X_C^2}}$$

Z = Impedance of R-C Series Circuit.

$$\text{Power factor} = \cos\phi = \frac{OA}{OB} = \frac{V_R}{V} = \frac{IR}{IZ}$$

$$\boxed{\cos\phi = \frac{R}{Z}}$$

From Vector diagram in R-C Series Circuit the current I leads the applied Voltage V by an angle $\phi°$



ϕ = phase angle b/w V & I

$$v = V_m \sin \omega t \qquad \text{(or)} \qquad v = V_m \sin\theta$$

$$i = I_m \sin(\omega t + \phi) \qquad\qquad i = I_m \sin(\theta + \phi)$$

For R-C Series Circuit.

$$P = \frac{V_m I_m}{4\pi}\left[2\pi \cdot \cos\phi - \left(\frac{\sin(4\pi+\phi)}{2} - \frac{\sin\phi}{2}\right)\right]$$

$$P = \frac{V_m I_m}{4\pi}\left(2\pi \cdot \cos\phi - \frac{\sin\phi}{2} + \frac{\sin\phi}{2}\right)$$

$$P = \frac{V_m I_m}{4\pi} 2\pi \cos\phi$$

$$P = \frac{V_m I_m}{2} \cos\phi$$

$$P = \frac{V_m}{\sqrt{2}} \cdot \frac{I_m}{\sqrt{2}} \cos\phi$$

$$\boxed{P = V I \cos\phi \text{ watts}}$$

$V_{rms} = \frac{V_m}{\sqrt{2}}$

$I_{rms} = \frac{I_m}{\sqrt{2}}$

where

V & I are rms value of voltage and currents.

$$V = \sqrt{(IR)^2 + (IX_L - IX_C)^2}$$

$$= \sqrt{I^2R^2 + [I(X_L - X_C)]^2}$$

$$= \sqrt{I^2R^2 + I^2(X_L - X_C)^2}$$

$$= \sqrt{I^2(R^2 + (X_L - X_C))^2}$$

$$V = I\sqrt{R^2 + (X_L - X_C)^2}$$

$$\frac{V}{I} = \sqrt{R^2 + (X_L - X_C)^2}.$$

$$\boxed{Z = \sqrt{R^2 + (X_L - X_C)^2}}$$ ⇒ Impedance of RLC circuit.

Power factor $(\cos\phi) = \frac{OA}{OD}$

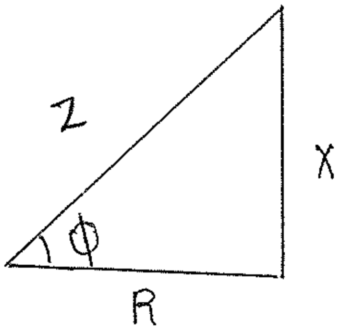
$$\cos\phi = \frac{V_R}{V} = \frac{IR}{IZ}$$

$$\boxed{\cos\phi = \frac{R}{Z}}$$ ⇒ Power factor

Phase angle. $\tan\phi = \left(\frac{X_L - X_C}{R}\right)$

$$\phi = \tan^{-1}\left(\frac{X_L - X_C}{R}\right)$$

Impedance Triangle



Where

R = Resistance in Ω

Z = Impedance in Ω

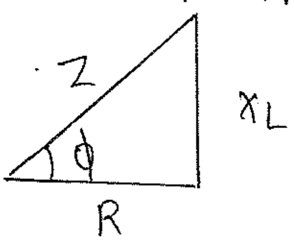
X = Reactance in Ω

ϕ = phase angle b/w Voltage and current.

$$Z = \sqrt{R^2 + X^2}$$

Power factor = $\cos\phi = \frac{R}{Z}$

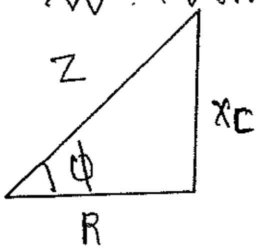
For RL circuit



$$Z = \sqrt{R^2 + X_L^2}, \quad \cos\phi = \frac{R}{Z}$$

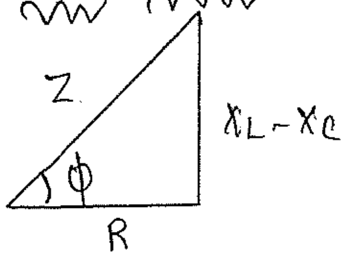
$$\phi = \tan^{-1}\left(\frac{X_L}{Z}\right)$$

RC circuit



$$Z = \sqrt{R^2 + X_C^2} \qquad \phi = \tan^{-1}\left(\frac{X_C}{Z}\right)$$

RLC circuit



$$Z = \sqrt{R^2 + (X_L - X_C)^2} \qquad \phi = \tan^{-1}\left(\frac{(X_L - X_C)}{Z}\right)$$

$$X_C = \frac{1}{2\pi f C} = \frac{1}{(2 \times 3.14 \times 50 \times 40 \times 10^{-6})}$$

$$\boxed{X_C = 79.58\ \Omega}$$

Impedance $Z = \sqrt{R^2 + (X_C - X_L)^2}$

$$Z = \sqrt{50^2 + (79.58 - 47.12)^2}$$

$$= \sqrt{50^2 + 32.46^2}$$

$$Z = \sqrt{2500 + 1053.65}$$

$$Z = \sqrt{3553.65}$$

$$\boxed{Z = 59.61\ \Omega}$$

Power factor $= \cos\phi$

Power factor $= \frac{R}{Z} = \frac{50}{59.61}$

$$\boxed{\text{Power factor} = 0.84}$$

Circuit current $I = \frac{V}{Z}$

$$= \frac{230}{59.61}$$

$$\boxed{I = 3.858\ \text{Amps}}$$

Power $= VI\cos\phi$

$= 230 \times 3.858 \times 0.84$

$P = 745.36$ watts

$$\boxed{P = 745.36\ \text{watts}}$$

$$Z = \sqrt{R^2 + (X_C - X_L)^2}$$

$$Z = \sqrt{8^2 + (42.44 - 31.42)^2}$$

$$\boxed{Z = 13.62\ \Omega}$$

Circuit current $I = \frac{V}{Z}$

$$I = \frac{240}{13.62}$$

$$\boxed{I = 17.62\ \text{Amps}}$$

Power factor $\cos\phi = \frac{R}{Z}$

$$P.F = \frac{8}{13.62}$$

$$\boxed{P.F = 0.59}$$

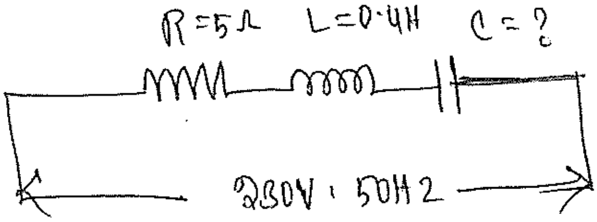
Power $= VI\cos\phi$

$$= 240 \times 17.62 \times 0.59$$

$$\boxed{P = 2494.992\ \text{watts}}$$

(5) A inductor having an inductance 0·4 H and resistance of 5 Ω is connected series with a capacitor across 50 Hz, 230V supply. Calculate the capacitance required to give the circuit power factor 0·5 lagging.

Solution



$R = 5\,\Omega$

$f = 50\,Hz$

$L = 0{\cdot}4\,H$

Power factor = 0·5 lagging.

To find $C = ?$

$X_L = 2\pi f L$

$X_L = 2 \times 3{\cdot}14 \times 50 \times 0{\cdot}4\,H$

$X_L = 125{\cdot}66\,\Omega$

$P{\cdot}F = \cos\phi = 0{\cdot}5$

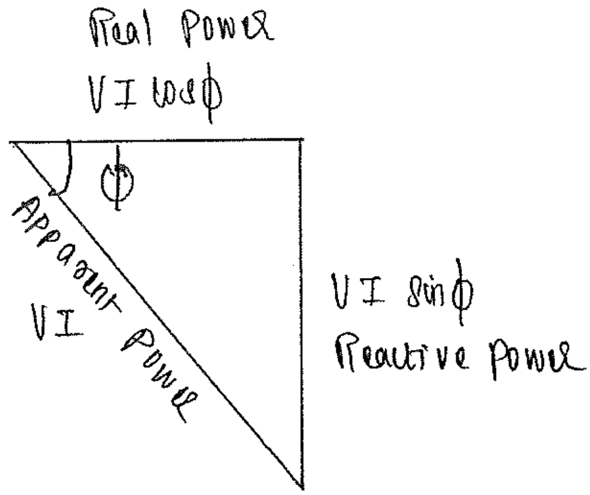
$\frac{R}{Z} = 0{\cdot}5$

$Z = \frac{R}{0{\cdot}5} = \frac{5}{0{\cdot}5} = 10\,\Omega$

$Z = 10\,\Omega$

Power Triangle:

The apparent power, active power and reactive power drawn by a circuit can be represented by a right angled triangle called power Triangle.



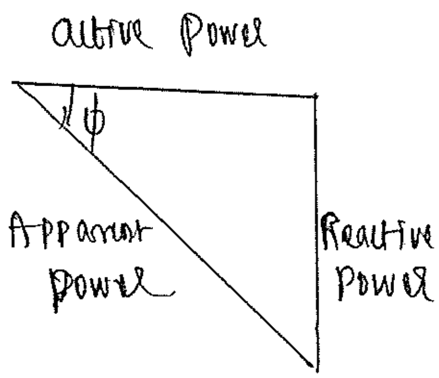
		unit	(OR) in kilo unit
apparent power	$= VI$	VA	KVA
Active (or) Real power	$= VI\cos\phi$	watts	Kwatts
Reactive power	$= VI\sin\phi$	VAR	KVAR

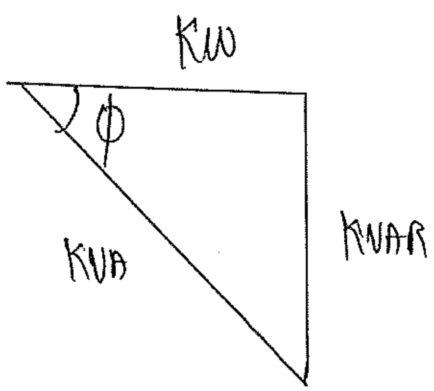
Note :

KVA = Kilo Volt Amperes

KW = Kilo watts

KVAR = Kilo Volt Ampere Reactive.





Vectors (Conversion)

(1) Convert the phasor $10\angle 30^\circ$ and $100\angle 60^\circ$ into j-form and find out their sum in j form.

$$A = 10\angle 30^\circ$$
$$= 10(\cos 30 + j\sin 30)$$
$$= 10\cos 30^\circ + j10\sin 30^\circ$$
$$= 10 \times 0.866 + j\,10\,(0.5)$$
$$\boxed{A = 8.66 + j5}$$

$$B = 100\angle 60^\circ$$
$$= 100\cos 60^\circ + j\,100\sin 60^\circ$$
$$= 100\,(0.5) + j\,100\,(0.866)$$
$$\boxed{B = 50 + j\,86.6}$$

$$A+B = 8.66 + j5 + 50 + j\,86.6$$
$$\boxed{A+B = 58.66 + 91.6}$$

(or)

* Use calculator to convert Polar form to rectangular form and Rectangular form to Polar form

Parallel AC Circuits

Like dc Parallel circuits the Voltage across all branches is same in parallel AC circuits. The current in any branch depends upon the impedance of that branch. The total current in the circuit is the Phasor sum of the branch currents.

Methods of Solving Parallel AC Circuits.

(i) Vector (or) Phasor method

(ii) Phasor algebra method

(iii) Admittance method.

Formulas used for Parallel circuits

$$P = VI\cos\phi \text{ watts}$$

In parallel circuits Voltage across each branch same

$$V = IZ$$

$$I = \frac{V}{Z}$$

where

I - Total current

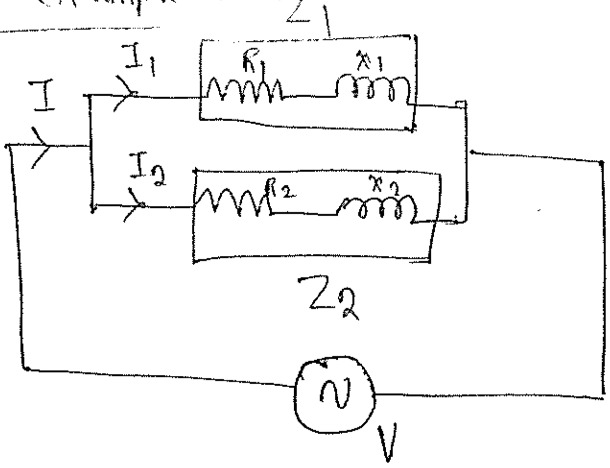
Z - Total impedance.

V - Total Voltage.

$$I_1 = \frac{V}{Z_1}$$ Z_1 = branch 1 impedance

$$I_2 = \frac{V}{Z_2}$$ Z_2 = branch 2 impedance

For example.



where

I_1 = branch 1 current

I_2 = branch 2 current

* Total current $\vec{I} = \vec{I_1} + \vec{I_2}$

* Total impedance $Z = \frac{V}{I}$

(or)

Z_1 & Z_2 are in parallel $Z = \frac{Z_1 Z_2}{Z_1 + Z_2}$

* $\cos\phi \Rightarrow$ Power factor.

* Take angle from polar form value of Total current (or) Total impedance.

* For addition (or) subtraction of any two values use rectangular form of quantity.

* For multiplication and Division of any two values use polar form of quantity.

$G = y \cos\phi$

$B = y \sin\phi$.

Formulas used in Admittance method

Two impedances are connected in parallel.

$$\frac{1}{Z} = \frac{1}{Z_1} + \frac{1}{Z_2}.$$

$$\boxed{y = y_1 + y_2} \Rightarrow (1)$$

(or)

$$Z = \frac{Z_1 Z_2}{Z_1 + Z_2}$$

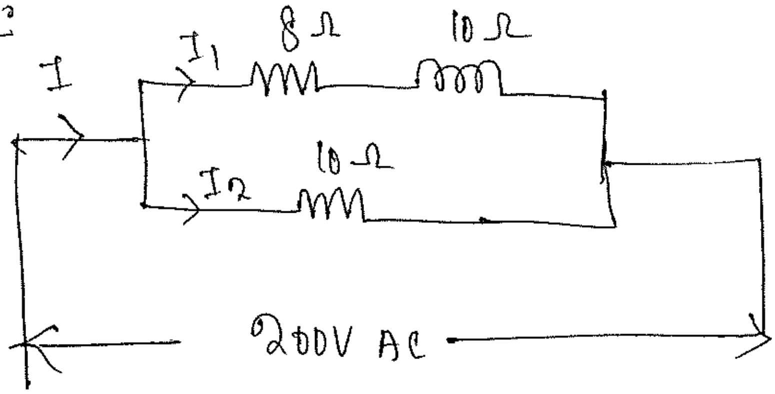
$$\frac{1}{Z} = \frac{Z_1 + Z_2}{Z_1 Z_2}$$

$$\boxed{y = \frac{Z_1 + Z_2}{Z_1 Z_2}} \Rightarrow 2.$$

y = Admittance in ℧

(1) A coil of resistance of 8 ohm and a reactance of 10 ohm are connected in parallel with resistor of 10 ohm. If the voltage across the combination of 200 V, AC. Find the Total current taken from the mains. Also find the power factor of the circuit.

Solution:



$$Z_1 = 8 + j10\ \Omega$$

$$Z_2 = 10 + j0\ \Omega$$

$$Z = \frac{Z_1 Z_2}{Z_1 + Z_2}$$

$$= \frac{(8+j10)(10+j0)}{(8+j10)+(10+j0)}$$

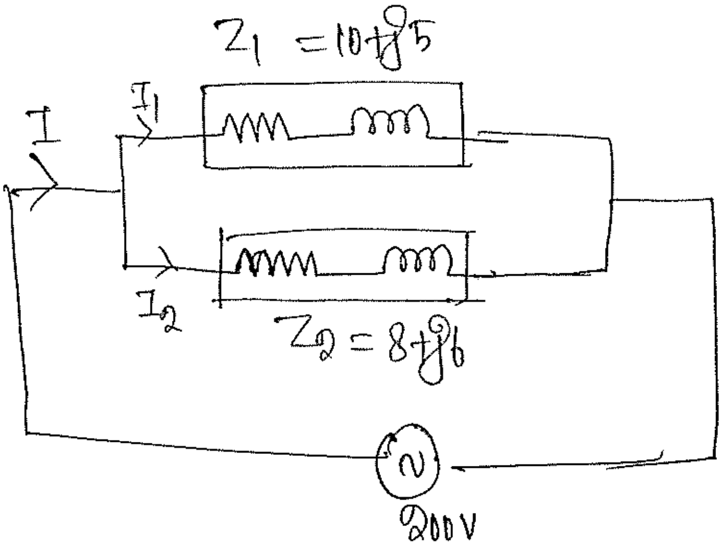
$$Z = \frac{80 + j100}{18 + j10}$$

Take conjugate

$$Z = \frac{80 + j100}{18 + j10} \times \frac{18 - j10}{18 - j10}$$

(2) Two impedance $Z_1 = (10+j5)$ and $Z_2 = (8+j6)\Omega$ are connected in Parallel across a Voltage of 200V. Find the Total current, power factor and Power?

Solution:



$Z_1 = (10+j5)\ \Omega$

$Z_2 = (8+j6)\ \Omega$

$Z_1 = 10+j5$

$= \sqrt{10^2+5^2}$ | $\phi = \tan^{-1}\frac{5}{10}$

$$Z_1 = 11.18 \angle 26.56^\circ\ \Omega$$

$Z_2 = (8+j6)\ \Omega$

$Z_2 = \sqrt{8^2+6^2}$ | $\phi = \tan^{-1}\frac{6}{8}$

$$Z_2 = 10 \angle 36.87^\circ\ \Omega$$

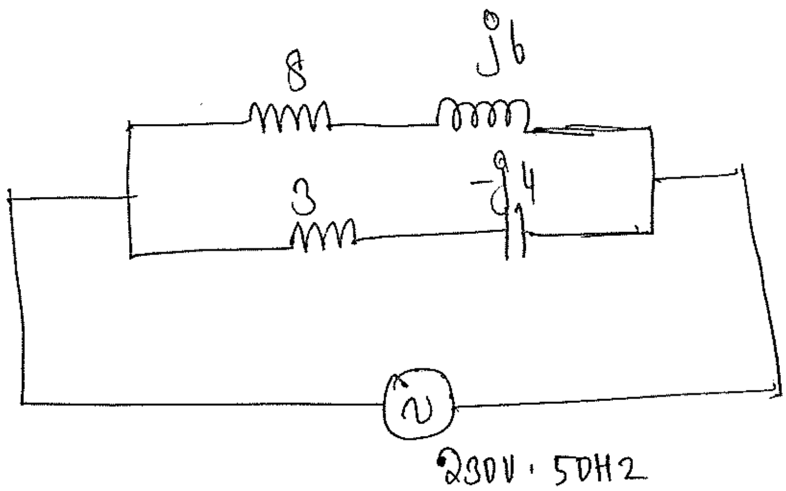
$$\text{Power} = V\,I\,\cos\phi$$

$$= 200 \times 37.73 \times 0.84$$

$$P = 6338.64 \text{ watts}$$

(3) Two impedances $Z_1 = (8+j6)$ and $Z_2 = 3-j4$ are connected in parallel across 230V, 50 Hz supply. Calculate (a) current in each branch (b) Total current of the circuit (c) Circuit P.F and (d) Power taken by the circuit.

Solution:



$$Z_1 = (8+j6)\,\Omega$$

$$Z_2 = (3-j4)\,\Omega$$

Polar form.

$$Z_1 = 10\angle 36.87^\circ\ \Omega$$

$$Z_2 = 5\angle -53.13^\circ\ \Omega$$

Total current $I = \dfrac{V}{Z}$

$$= \frac{230 \angle 0^\circ}{4.47 \angle -26.56^\circ}$$

$$I = 51.45 \angle 26.56^\circ \text{ Amps}$$

Power factor $= \cos\phi$

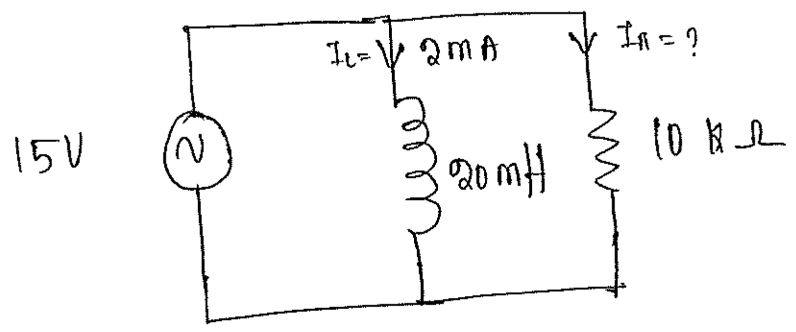
$$= \cos 26.56^\circ$$
$$= 0.894$$

Power $= V I \cos\phi$

$$= 230 \times 51.45 \times 0.894$$

Power = 10579 watts

(4) For the circuit shown in fig. determine (i) circuit frequency (ii) circuit current (iii) circuit impedance.



current flow through resistance R is I_R

$$I_R = \frac{V}{R}$$

$$= \frac{15}{(10 \times 10^3)} = 1.5 \times 10^{-3} A$$

$$\boxed{I_R = 1.5 \, mA}$$

Total current (I) $= I_R + I_L$

$$= 1.5 + 2$$

$$\boxed{I = 3.5 \, mA}$$

Circuit Impedance

$$Z = \frac{V}{I}$$

$$= \frac{15}{(3.5 \times 10^{-3})} = 6000 \, \Omega$$

$$\boxed{Z = 6000 \, \Omega}$$

$$y_2 = \frac{1}{Z_2} = \frac{1}{8-j6}$$

$$y_2 = \frac{1}{8-j6} \times \frac{8+j6}{8+j6}$$

$$= \frac{8+j6}{8^2 - j^2 6^2} = \frac{8+j6}{64+36}$$

$$= \frac{8+j6}{100} = \frac{8}{100} + j\frac{6}{100}$$

$$\boxed{y_2 = 0.08 + j0.06 \ \mho}$$

$$\frac{1}{z} = \frac{1}{z_1} + \frac{1}{z_2}$$

Total admittance $y = y_1 + y_2$.

$$y = 0.06 - j0.08 + 0.08 + j0.06$$

$$\boxed{y = 0.14 - j0.02} \ \mho$$

$$y = G + jB$$

Conductance $G = 0.14 \ \mho$

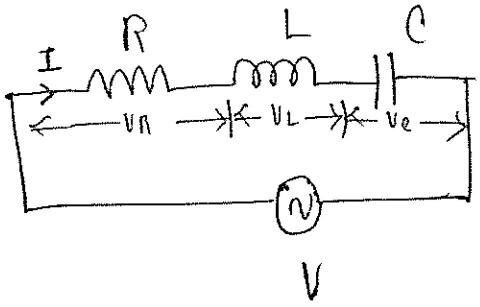
Susceptance $B = 0.02 \ \mho$

(Susceptance + sign for capacitive; − sign for inductive)

RESONANT CIRCUITS

RLC Series Resonance

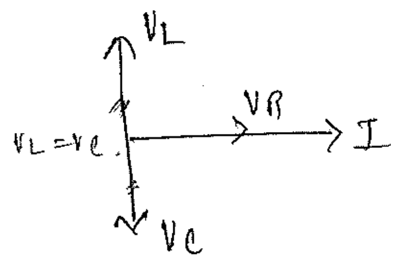
An RLC Series circuit is said to be in Resonance when circuit power factor is unity at $X_L = X_C$



Condition for resonance

$$X_L = X_C$$

Vector diagram



$$Z = \sqrt{R^2 + (X_L - X_C)^2}$$

$$Z = \sqrt{R^2 + (0)^2}$$

$$Z = \sqrt{R^2}.$$

$$Z = R$$

at resonance circuit acts like a Pure resistive circuit. So power factor is unity.

$$P.F = \cos 0^{\circ}$$

$$P.F = 1$$

Resonance frequency (f_r):

The frequency at which resonance occurs is called the resonance frequency.

Q- factor (or) Quality Factor of Series Resonant Circuits.

At resonance the Voltage across L and C is many times greater than Applied Voltage. This Voltage Magnification is called Q factor of Series Resonant Circuit.

$$Q\text{-factor} = \frac{\text{Voltage across } L \text{ (or) } C}{\text{Applied Voltage}}$$

$$= \frac{V_L}{V}$$

$$= \frac{\cancel{I} X_L}{\cancel{I} R}$$

at resonance

$[Z = R]$

$$= \frac{X_L}{R} = \frac{2\pi f_r L}{R}$$

$\left[\text{But } f_r = \frac{1}{2\pi\sqrt{LC}}\right.$

$\left. 2\pi f_r = \frac{1}{\sqrt{LC}}\right]$

$L = \sqrt{L}\,\sqrt{L} = \sqrt{L^2} = L$

$$Q\text{-factor} = \frac{(2\pi f_r)\,L}{R}$$

$$= \frac{\left(\frac{1}{\sqrt{LC}}\right)\cdot L}{R}$$

$$= \frac{L}{\sqrt{LC}} \times \frac{1}{R}$$

$$= \frac{\sqrt{L}\,\cancel{\sqrt{L}}}{\cancel{\sqrt{L}}\,\sqrt{C}} \times \frac{1}{R}$$

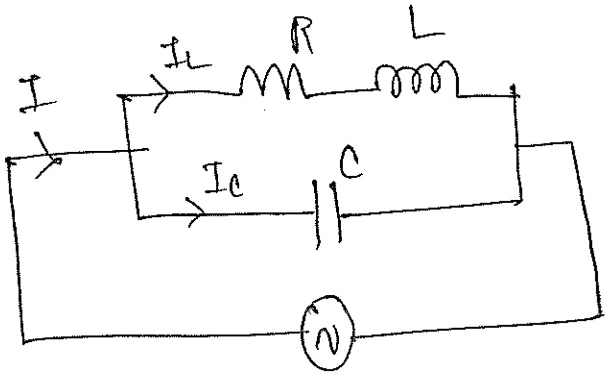
$$2\pi f_0 L = \frac{1}{2\pi f_0 C}$$

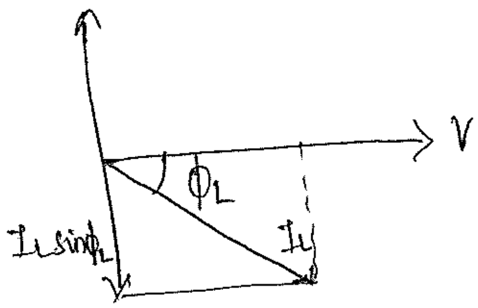
$$f_0^2 = \frac{1}{4\pi^2 LC}$$

$$f_r = \sqrt{\frac{1}{4\pi^2 LC}}$$

$$\boxed{f_r = \frac{1}{2\pi\sqrt{LC}}} \quad Hz.$$

(b) Parallel resonance : Two branch circuit.



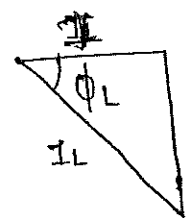


$$f_r = \frac{1}{2\pi}\sqrt{\frac{1}{LC} - \left(\frac{R}{L}\right)^2}$$

(a) circuit

(b) Vector diagram.

Resultant current at resonance.



$$\cos\phi_L = \frac{I}{I_L}$$

$$I = I_L \cos\phi_L$$

[where
$I_L = \frac{V}{Z_L}$
$\cos\phi_L = \frac{R}{Z_L}$]

$$I = \frac{V}{Z_L} \times \frac{R}{Z_L}$$

$$I = \frac{VR}{Z_L^2}$$

Q - factor (or) Quality factor of a Parallel Resonance circuit.

At Parallel resonance, the circulating current between the two branches is many times greater than the supply current. This current magnification is called Q-factor.

$$Q\text{-factor} = \frac{\text{current through } L \text{ (or) } C}{\text{Supply current}}$$

$$= \frac{I_L}{I}$$

$$= \frac{\left(\frac{V}{X_L}\right)}{\left(\frac{VCR}{L}\right)}$$

Where

$$I_L = \frac{V}{X_L}$$

$$I = \frac{V}{(L/CR)} = \frac{VCR}{L}$$

$$= \frac{V}{X_L} \times \frac{L}{VCR}$$

$$= \frac{L}{X_L \; CR}$$

$$f_r = \frac{1}{2\pi\sqrt{LC}}$$

$$2\pi f_r = \frac{1}{\sqrt{LC}}$$

$$\frac{1}{2\pi f_r} = \sqrt{LC}$$

$$= \frac{L}{(2\pi f_r L)\, CR}$$

$$= \frac{1}{2\pi f_r} \times \frac{1}{CR}$$

$$= \sqrt{LC} \times \frac{1}{CR}$$

$$= \sqrt{L}\,\sqrt{C} \times \frac{1}{\sqrt{C}\sqrt{C}\,R} = \frac{\sqrt{L}}{\sqrt{C}} \cdot \frac{1}{R}$$

Problem

(1) A Series circuit with $R = 5\,\Omega$ $L = 20\,mH$ and a Variable capacitor C has an applied Voltage with frequency of 1000 Hz. Find the Value of C for series resonance.

Solution:

$R = 5\,\Omega$

$L = 20\,mH = 20 \times 10^{-3}\,H$

$f = 1000\,Hz$

at resonance $\boxed{X_L = X_C}$

$$2\pi f L = \frac{1}{2\pi f C}$$

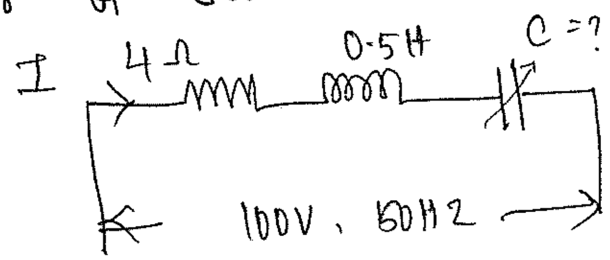
$$C = \frac{1}{4\pi^2 f^2 L}$$

$$= \frac{1}{(4 \times (3.14)^2 \times (1000)^2 \times 20 \times 10^{-3})}$$

$$\boxed{C = 1.27\,\mu F}$$

(2) A Series resonance circuit contains a resistance of 4 ohms and inductance of 0.5 H and a Variable capacitor across 100 V 50 Hz Supply. Find (a) the capacitance for getting resonance (b) the p.d across inductance and capacitance.

(c) Q factor of Series circuit.



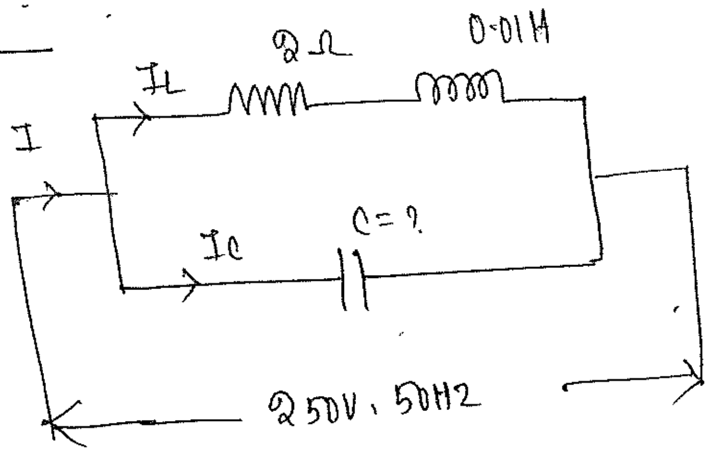
Q factor for series resonance $= \frac{V_L}{V}$

$$= \frac{3925}{100}$$

$$\boxed{Q \text{ factor} = 39.25}$$

(3) An inductive circuit of resistance 2Ω and inductance of 0.01H is connected to a 250V, 50 Hz supply. what capacitance placed in parallel with produce resonance. Find the total current take from the supply and the current in each branch circuits.

Solution.



$I = I_L + I_C$

At resonance

$$f_r = \frac{1}{2\pi}\sqrt{\frac{1}{LC} - \left(\frac{R}{L}\right)^2}$$

$$50 = \frac{1}{2\pi}\sqrt{\frac{1}{LC} - \left(\frac{2}{0.01}\right)^2}$$

$$\sqrt{\frac{1}{0.01C} - \left(\frac{2}{0.01}\right)^2} = 50 \times 2\pi$$

$$\frac{1}{0.01C} - \left(\frac{2}{0.01}\right)^2 = \left(50 \times 2\pi\right)^2$$

$$Z_L = \sqrt{R^2 + X_L^2}$$

$$= \sqrt{2^2 + (3.142)^2}$$

$$Z_L = 3.72\,\Omega$$

$$I_L = \frac{V}{Z_L} = \frac{250}{3.72}$$

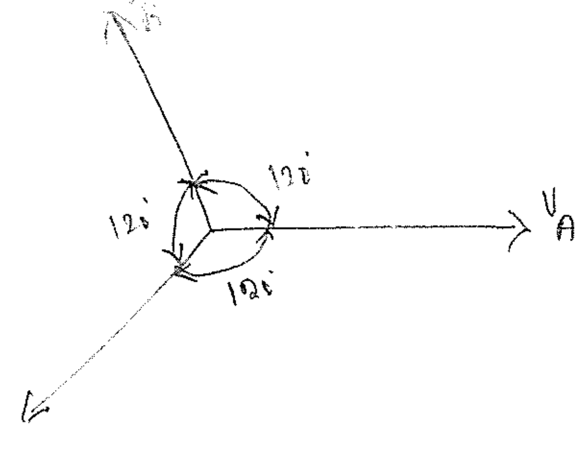
$$I_L = 67.2\,A$$

$$X_C = \frac{1}{2\pi f C} = \frac{1}{(2\pi \times 50 \times 721 \times 10^{-6})}$$

$$X_C = 4.41\,\Omega$$

$$I_C = \frac{V}{X_C} = \frac{250}{4.41}$$

$$I_C = 56.59 \text{ Amps}$$



(Balanced Load)

Advantages of 3ϕ System

① 3ϕ power has a constant magnitude but single phase Power is pulsating one.

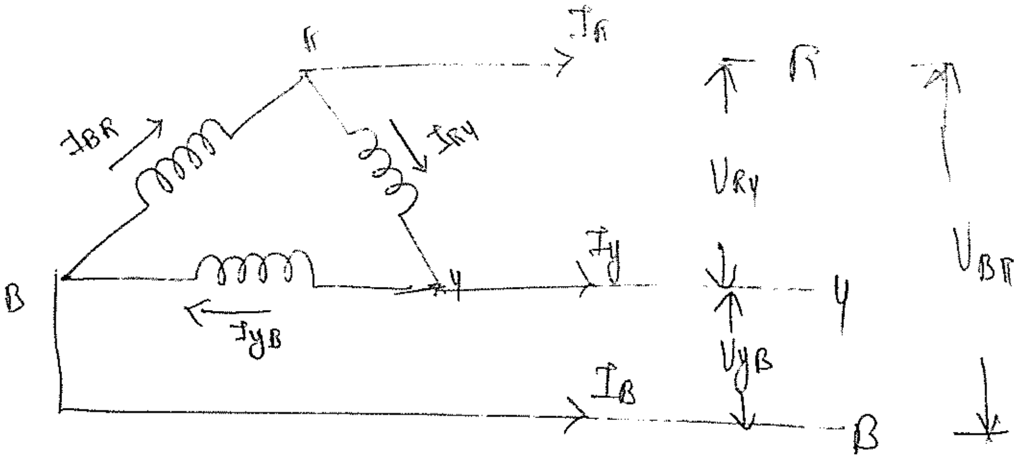
② For same rating 3 phase machines are smaller in size and have better operating characteristic than single phase machines.

③ 3ϕ Induction motors are self starting whereas 1ϕ IM are not self-starting.

④ 3ϕ Motors have better power factor and efficiency over single phase motor.

⑤ Generation, Transmission and Utilisation of power is more economical in 3ϕ system compared to 1ϕ system.

Delta (or) Mesh connection



Line Voltage (V_L) In 3φ the Voltage between any two lines (or) phases is called the line Voltage

Phase Voltage (V_{ph}):

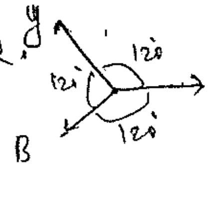
The Voltage between any one line and Neutral is called phase Voltage.

Phase current (I_{ph})

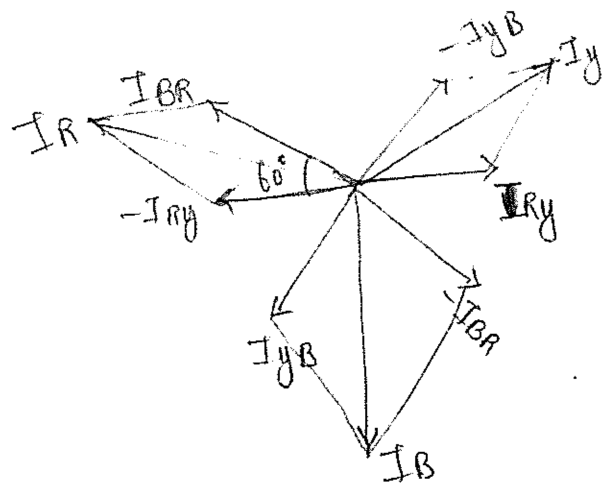
The current flowing in a phase is called the phase current.

Line current (I_L) The current flowing in a line is called the line current.

Balanced Load: In balanced loads the magnitude of load impedance of each phase will be equal and also load impedance angle of each phase will be same.



Vector diagram



Line current and Phase current.

Three phase currents are equal in magnitude but displaced 120° from one another as shown in the Vector diagram.

$$I_{Ry} = I_{yB} = I_{BR} = I_{ph}$$

Similarly 3 lines currents are equal

$$I_R = I_y = I_B = I_L$$

At point 1 apply KCL

$$\vec{I_{BR}} = \vec{I_R} + \vec{I_{Ry}}$$

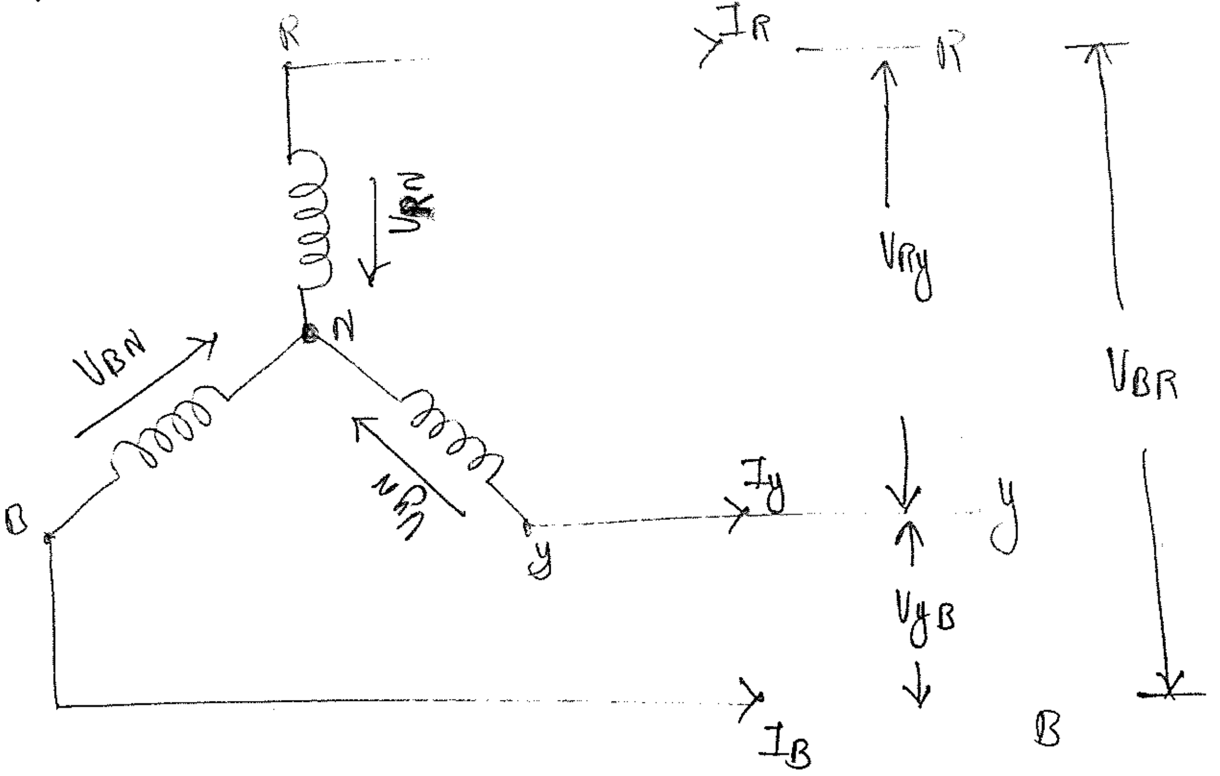
$$\vec{I_R} = \vec{I_{BR}} - \vec{I_{Ry}}$$

From the vector digram.

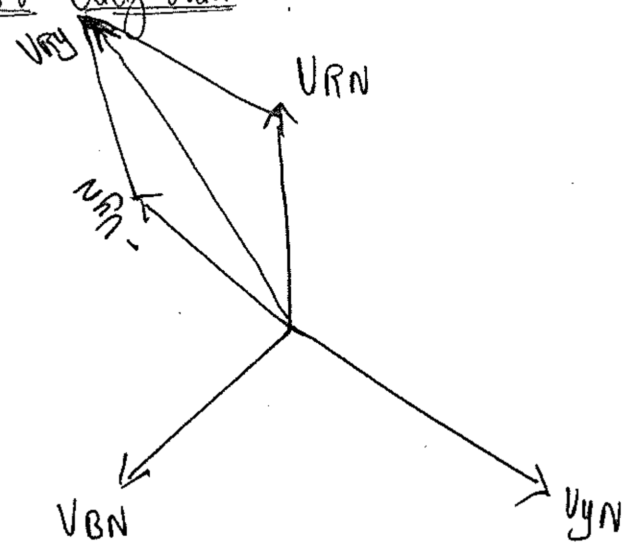
Using law of Parallelogram.

$$I_R = \sqrt{I_{BR}^2 + I_{Ry}^2 + 2 I_{BR} I_{Ry} \cos 60°}$$

VOLTAGES AND CURRENTS IN BALANCED STAR CONNECTION



Vector diagram



Phase Voltages (V_{ph})

$$V_{RN} = V_{YN} = V_{BN} = V_{ph}$$

Line Voltages (V_L)

$$V_{RY} = V_{YB} = V_{BR} = V_L$$

In star connection

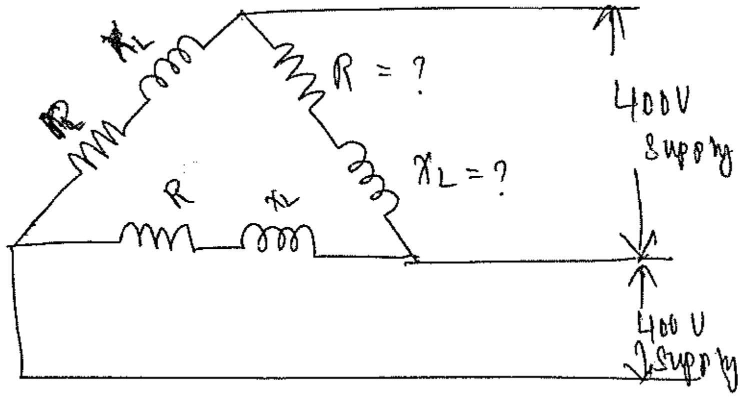
In a balanced star connected 3 phase 4 wire system the current in the neutral is zero

$$\boxed{I_N = 0}$$

Problems:

(1) Three identical impedances are connected in Delta to a 3 phase 400V supply. The line current is 34.65A and the total power taken from the supply is 14.4 kW. Calculate the resistance and reactance values of each impedance.

Solution:



Line Voltage $(V_L) = 400V$

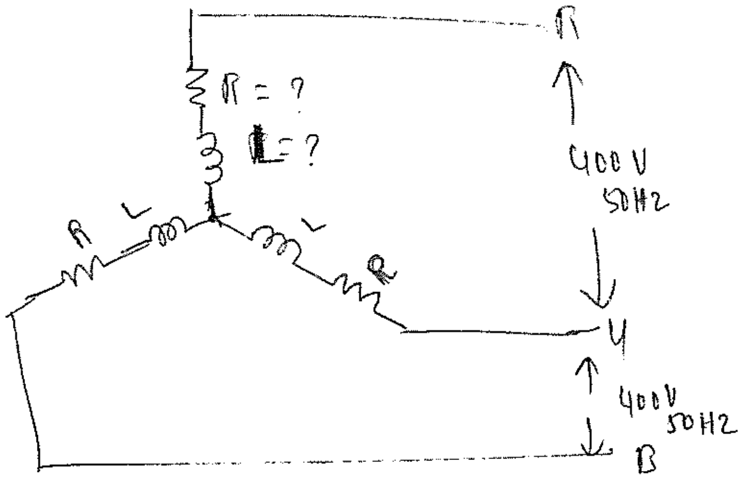
Phase Voltage $(V_{ph}) = V_L = 400V$ (Delta)

Line current $(I_L) = 34.65A$.

$$I_{ph} = \frac{I_L}{\sqrt{3}} = \frac{34.65}{\sqrt{3}} = 20A.$$

(2) Three similar coils are connected in star taken at a Total power of 1.5 kw at a P.F of 0.2 lagging from 3 phase 400V, 50 Hz supply. Calculate Resistance and Inductance of each phase.

Solution



Solution:

Star connection $V_L = 400V$

$V_L = \sqrt{3}\, V_{ph}$.

$I_L = I_{ph}$.

Total power $= 1.5$ kw
$= 1.5 \times 10^3$ watts

Power factor $(\cos\phi) = 0.2$

$f = 50\,Hz$.

$P = \sqrt{3}\, V_L I_L \cos\phi$.

$$I_L = \frac{P}{\sqrt{3}\, V_L \cos\phi} = \frac{1.5 \times 10^3}{(\sqrt{3} \times 400 \times 0.2)}$$

$R_{ph} = 20\ \Omega$

$X_{L_{ph}} = 15\ \Omega$

$V_L = 400\,V$

$f = 50\,Hz$

<u>Impedance per phase</u> $(Z_{ph}) = \sqrt{R_{ph}^2 + X_{L_{ph}}^2}$

$Z_{ph} = \sqrt{20^2 + 15^2}$

$Z_{ph} = 25$ ohms

$V_{ph} = \frac{V_L}{\sqrt{3}} = \frac{400}{\sqrt{3}}$

$V_{ph} = 230.94\,V$

$I_{ph} = \frac{V_{ph}}{Z_{ph}} = \frac{230.94}{25}$

$I_{ph} = 9.24\,A$

<u>In Star</u> $I_L = I_{ph}$

$I_L = 9.24\,A$

43 + 35 = 88   77 − 35 = 42   62

Unit - III

Electrical Machines

Construction, Principle of Operation, Basic equations and applications - D.C generators and D.C Motors - 1ϕ induction Motor - single Phase transformer.

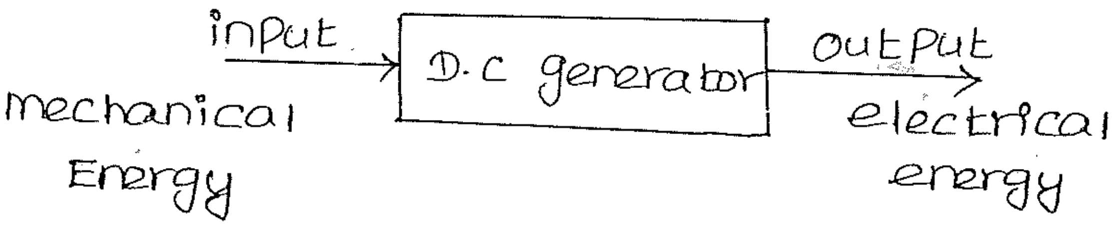
DC Machines

- DC motor
- DC generator

D.C generator:

↳ A generator is a rotating machine which converts mechanical energy into electrical energy.

Principle: Faraday's Law of electromagnetic induction



Faraday's Law:

↳ "whenever a conductor is moved in a magnetic field dynamically induced e.m.f (electro motive force) is produced in the conductor

↳ The direction of induced e.m.f is given by Fleming's right hand rule

major Parts:

1. magnetic Frame (or) yoke
2. Pole, interpoles, windings, Pole shoes
3. Armature
4. Commutator
5. Brushes, bearings and shaft

magnetic Frame (or) yoke:

1. It act as a Protecting cover for the whole machine and provides mechanical support for the poles
2. It carries the magnetic flux Produced by the poles.
3. The yoke is made up of cast iron.

Poles:

Poles consist of,

i) pole cores
ii) Pole shoes
iii) pole coils

Very small machines the Poles are made up of cast iron
larger machines → cast steel

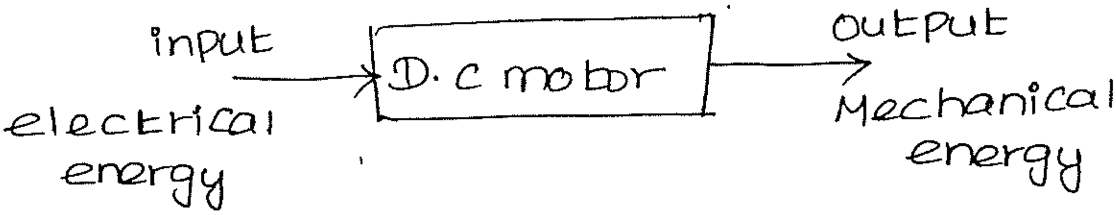
Pole coils are made up of copper wire or strip.

↳ The flux distribution through the pole, airgap, armature core and yoke.

D.C motor

Introduction:

↳ A D.C motor is a machine which converts electrical energy into mechanical energy

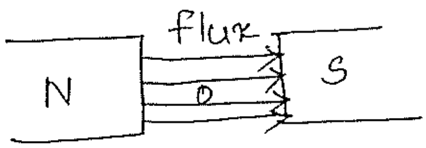


Principle of operation of D.C motor:

↳ "whenever a current carrying conductor is placed in a magnetic field, a mechanical force is produced on the conductor"

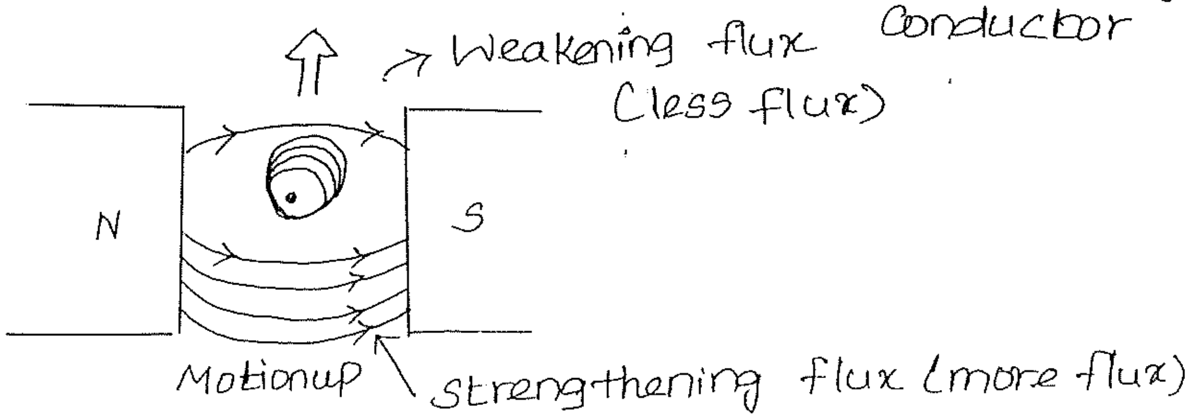
↳ The direction of force is given by Flemings Left hand rule.

↳ The magnetic field between two poles N and S is shown in Figure.



magnetic field

Current carrying conductor



↳ If a current carrying conductor is placed between two magnetic poles as shown in

$\theta = 180°$,

The resultant flux $= -2 \times \frac{\phi_m}{2}$

$= -\phi_m$ (in Fig d)

$\theta = 270°$,

↳ The resultant flux will be zero shown in fig(e)

Thus, variation of resultant flux with θ can be drawn as shown in fig(2).

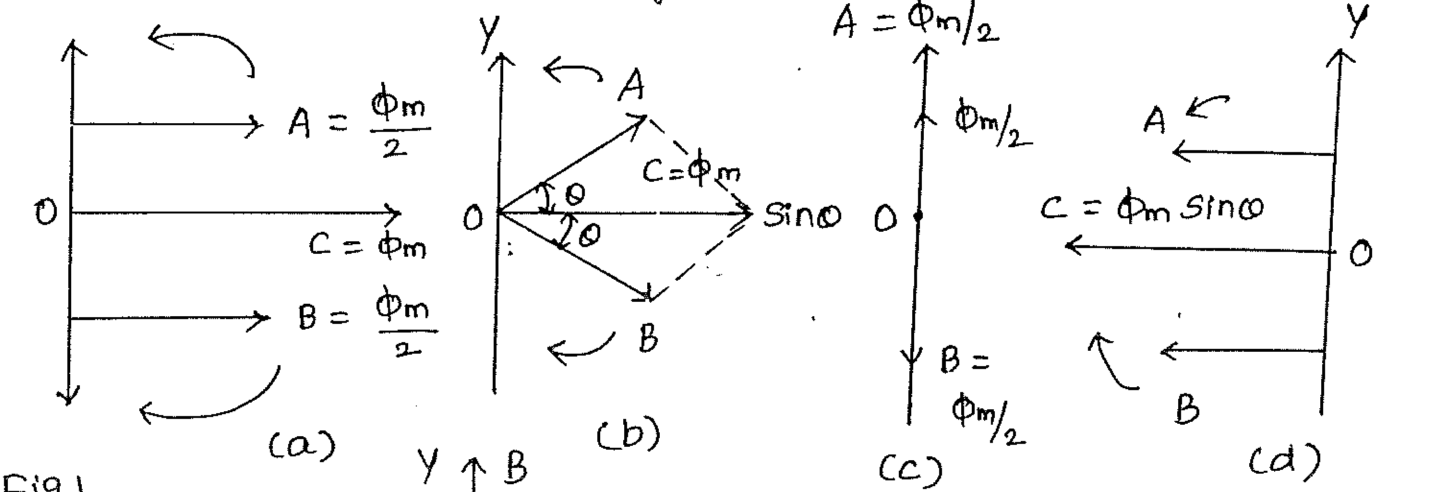
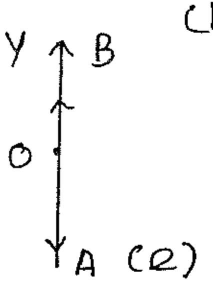


Fig 1



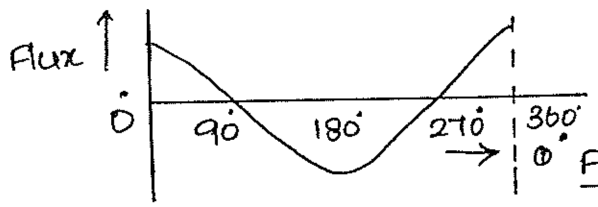
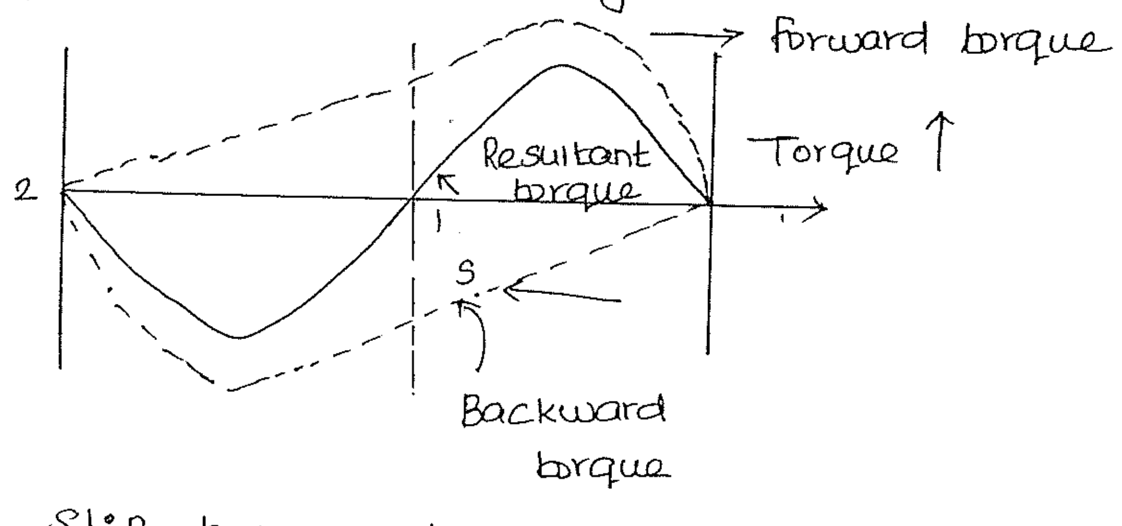


Figure 2

If 's' is the slip of the rotor with respect to forward rotating flux, then the slip of rotor S_b, with respect to back rotating flux will be $(2-s)$.



Slip-torque characteristics

Single Phase transformer:

Introduction:

No rotating Parts ✓

↳ The transformer is a static device used to transfer electrical energy from one circuit to another circuit without changing the frequency.

Working Principle: (Mutual induction)

electromagnetic induction

Construction of transformer:

Primary Winding:

↳ The transformer which, alternating supply is given is called Primary Winding

Secondary Winding

↳ The transformer in which the Load is Connected (energy is received) is called Secondary Winding.

Transformer Core

↳ It magnetically couples the two windings of the transformer.

Laminated Core → Reduce the eddy current Loss

Two types of transformer Core

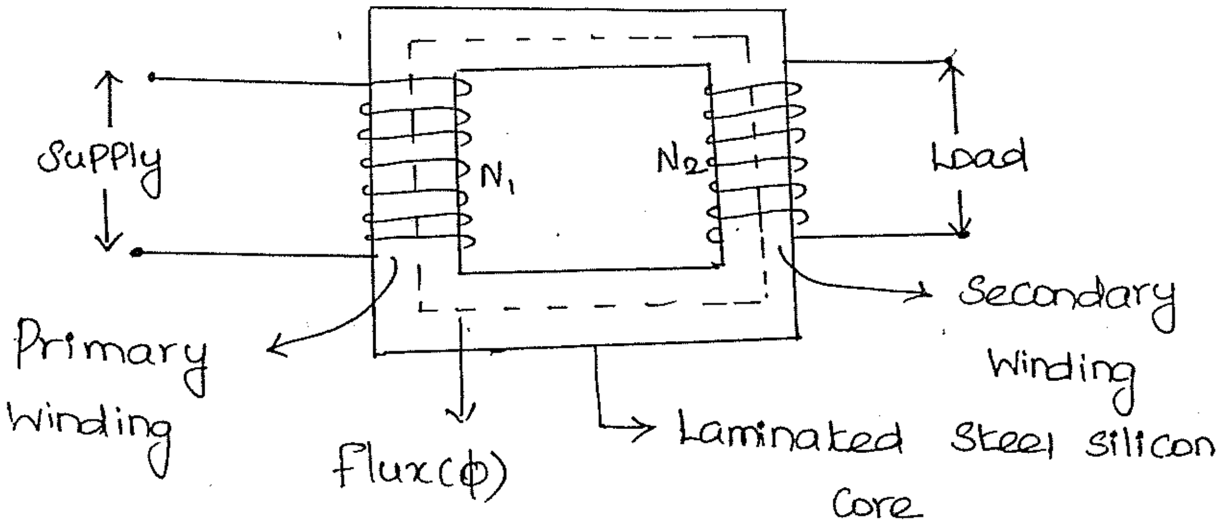
i) Core type

ii) Shell type

Working Principle:

1. The transformer works on the principle of electromagnetic induction

2. The transformer mainly consists of two winding placed on a laminated silicon steel core



3. The transformer works on the principle of mutual induction.

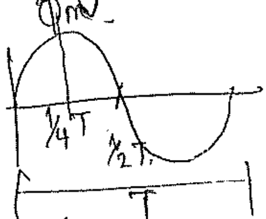
4. When A.C supply is given to primary winding an alternating flux is setup in the core. The alternating flux cuts both the primary and the secondary winding.

5. An emf is induced in the primary winding according to self induction principle.

6. According to Faraday's mutual induction principle an emf is induced in the secondary winding.

7. If we connect a load to the secondary winding. current will through the load.

Average rate of change of flux $= \frac{\phi_m}{1/4f} = \frac{\text{Max value}}{\text{Time}}$ 386



$= 4f\phi_m$ wb/sec

$T = \frac{1}{f}$

Form factor $= \frac{\text{RMS Value}}{\text{Average value}} = 1.11$

Rms value = Form factor × Average value

RMS Value of the emf/~~turn~~ $= 1.11 \times 4f\phi_m$

$= 4.44 f\phi_m$ volts

RMS Value of induced emf in Primary winding,

$E_1 = 4.44 f N_1 \phi_m$

RMS Value of induced emf in Secondary winding,

$E_2 = 4.44 f N_2 \phi_m$

$$\frac{E_1}{N_1} = \frac{E_2}{N_2} = 4.44 f\phi_m$$

$$\frac{E_1}{E_2} = \frac{N_1}{N_2} = 1$$

Applications of transformer:

↳ All electronic circuit use transformer

↳ Power transformer located in Powerplants are used to stepup the generated voltage to a high transmission line.

$$\frac{E_1}{E_2} = \frac{N_1}{N_2} = 1$$

UNIT IV.

SEMICONDUCTOR DEVICES.

BASIC CONCEPT OF SEMICONDUCTORS:

The Solid materials are classified into three types depending on the current carrying capability. They are the conductors, insulators and semiconductors.

CONDUCTORS:

The conductors have large number of free electrons which act as a charge carriers. So, they have high conductivity.

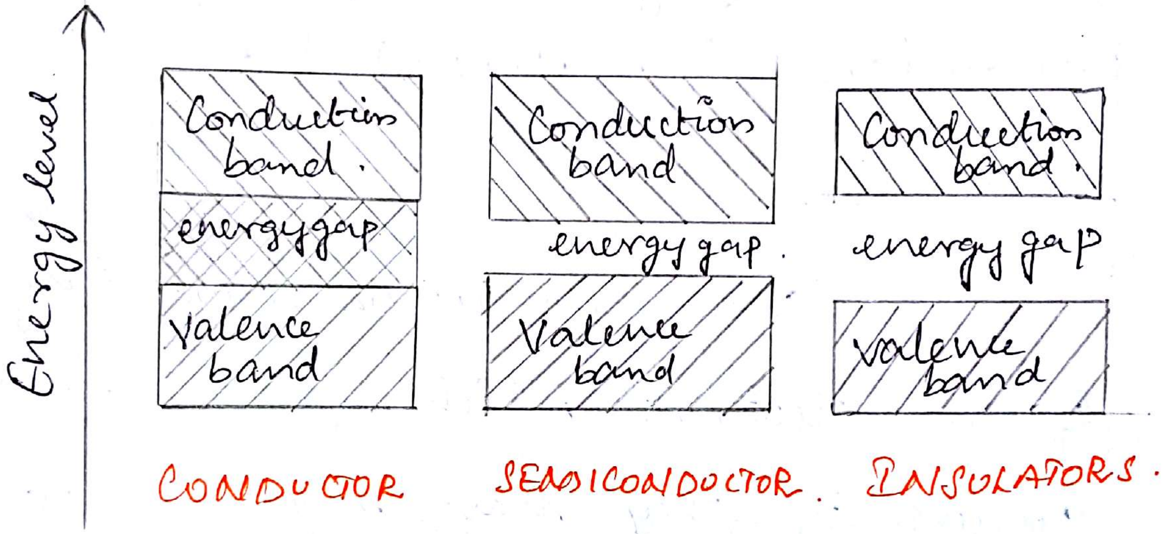
INSULATORS:

They have only few free electrons So, the conductivity is low.

SEMICONDUCTORS:

The semiconductor material has the conductivity between conductors and insulators. These are neither Smart conductors nor Smart insulators. They have only few free electrons because their atoms are tightly bonded in an exceedingly crystalline form are referred to as a crystal lattice. Some of widely used semiconductor material is silicon and germanium.

ENERGY LEVELS :



(a) Energy band diagrams.

From the above diagram, the conductors have forbidden energy gap as zero. The conduction band and the valence band overlap eachother. The large number of valence electrons are available for conduction in room temperature.

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In insulators, the forbidden energy gap is very high [$E_g \approx 4-8$ eV). They have very few valence electrons for conduction. So, conductivity is low.

SEMICONDUCTOR:

In pure semiconductor, the energy gap lies in the range of 0.1-3 eV. By increasing the temperature more electron hole pairs will be created so conductivity gets increased and the resistivity gets decreased.

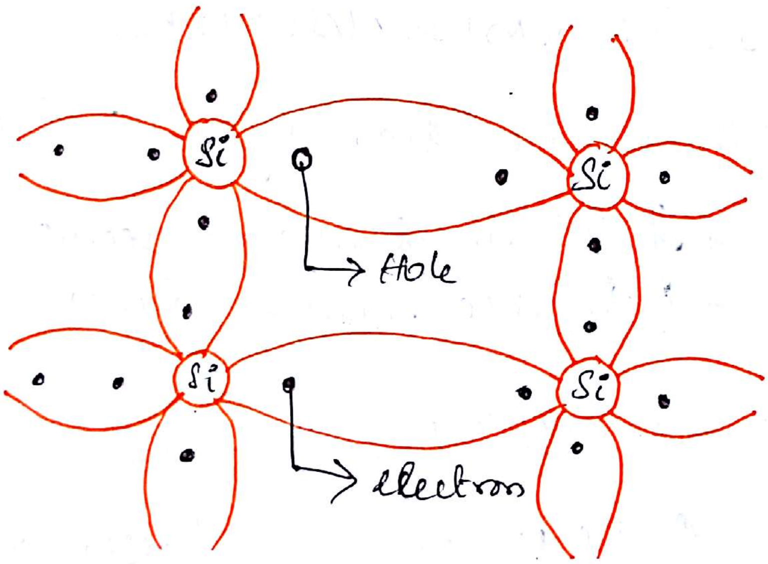
CLASSIFICATION OF SEMICONDUCTORS:

There are two types of semiconductors. They are

* intrinsic semiconductors.
* Extrinsic semiconductors

INTRINSIC SEMICONDUCTOR:

A pure semiconductor is called intrinsic semiconductor. Silicon crystal in its pure form is the example of intrinsic semiconductor because all the atoms in the crystal are silicon atoms. The room temperature is sufficient to make a valence electron to move away from the covalent bond. So, the covalent bond is broken. This broken electron become a free electron to move in the crystal lattice. When an electron breaks a covalent bond and moves away, a vacancy is created in the broken covalent bond. This vacancy is called a 'Hole'. A hole is a positive charge. Whenever a free electron is generated, a hole is created.



EXTRINSIC SEMICONDUCTOR:

The intrinsic semiconductor are used only in the manufacture of heat and light sensitive resistance. Practically,

3

the intrinsic semiconductors material is added with certain specified type of impurities. This process of adding impurities to the semiconductor material is called dopping. Doping is done after the semiconductor material has been refined to a high degree of purity. A doped intrinsic semiconductor is called Extrinsic semiconductor. This extrinsic semiconductor are used for the fabrication of any kind of electronic devices. There are two forms of extrinsic semiconductors. They are.

* N-type Semiconductor
* P-type semiconductor.

N TYPE SEMICONDUCTOR:

The n-type semiconductor material is dopped with pentavalent impurity (ie) it is dopped to have excess electrons. The material used for dopping are Arsenic, Antimony or phosphorus. The impurities are added at very low level with silicon or germanium. In N-type semiconductor, the free electrons are the majority charge carriers and the holes are the minority charge carriers.

P-TYPE SEMICONDUCTOR:-

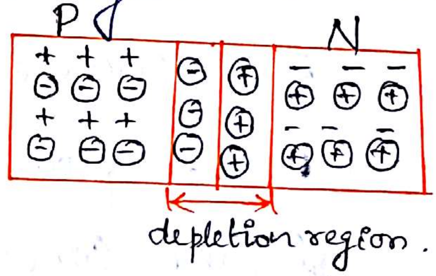
A small amount of trivalent impurities is added to obtain more holes. The semiconductor material added as impurity are aluminium, Boron or Gallium. The impurity atom that accept the electrons from valence band creating holes are called acceptor atoms. The holes are the majority charge carriers and the electrons are the minority carriers.

PN JUNCTION DIODE:

A PN junction is formed by combining P and N type materials. A piece of P type material is kept upon the N type material, the surface where P type & N type material meet is called PN Junction.

At the junction, the free electrons in the N region diffuses across the junction in to the P region. The holes in the P region diffuses across the junction in to the N region

This process of movement of electrons and holes is called diffusion. According to this the electrons and holes recombine with eachother to form a region at the junction. It is called depletion region. When the free electrons move from N type to P type, the donor ions become positively charged. Similarly when the holes move from P type to N type, the acceptor ions become negatively charged. These two charges, on either sides, make a potential across the depletion region is called barrier potential.



DRIFT AND DIFFUSION CURRENT:

The net current flowing through the PN junction diode contains two components. They are
* drift current
* diffusion current.

DRIFT CURRENT:-

When an electric field is applied across the semiconductor material.

the charge carriers attains some energy, and the holes moves towards the negative terminal and the electrons moves towards the positive terminal of the battery. So, due to this effect of movement of charge carriers constitutes a current known as drift current.

DIFFUSION CURRENT:

When no electric field is applied, the charge carriers have the tendency to move from higher concentration region to lower concentration region. Now, the movement of charge carriers produces a current known as diffusion current.

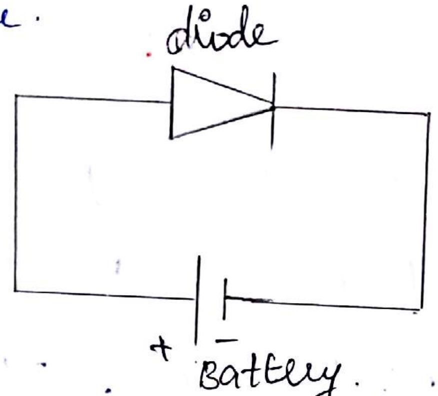
WORKING:

The conduction of any diodes, depends on their biasing. There are two types of biasing

- Forward biasing.
- Reverse biasing.

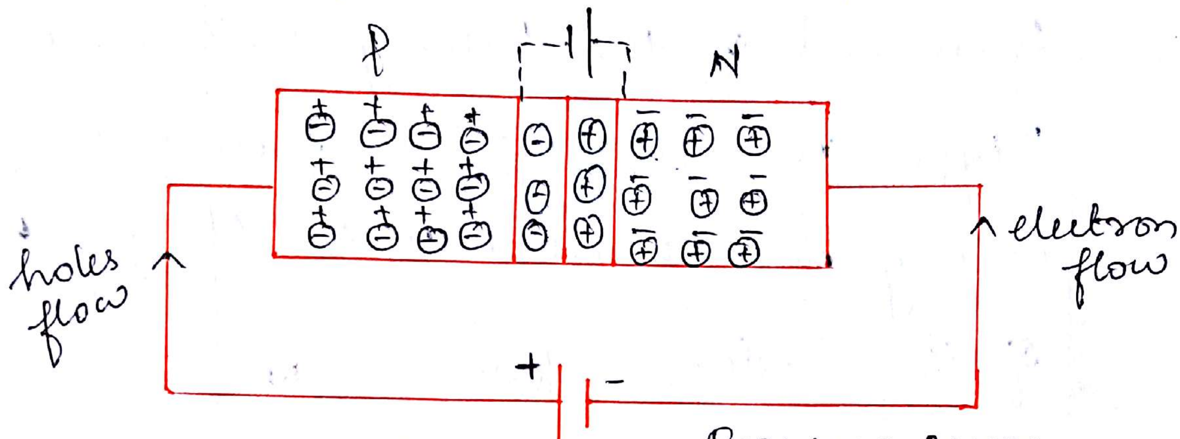
FORWARD BIASING:

In forward biasing, the positive terminal of the battery is connected to the P-type and the negative terminal of the battery is connected to the N type material of the diode.



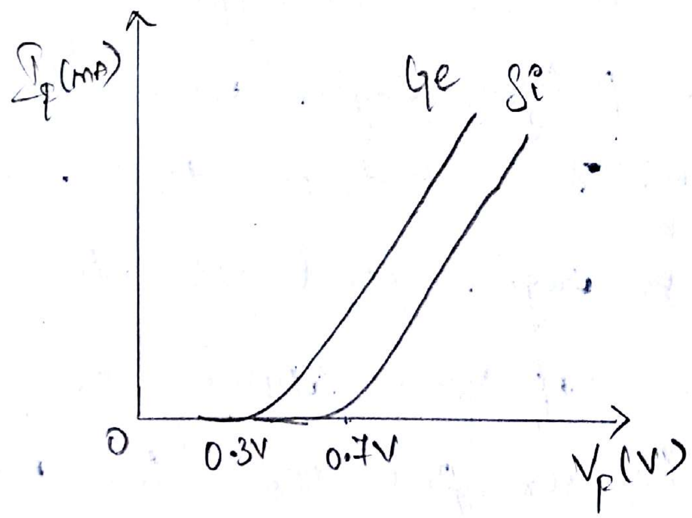
Under the forward bias condition the applied positive potential repels the holes in P type region. The negative potential repels the electrons in N type region. Now the electrons in N type region and the holes in the p type region move towards the junction. This reduces the width of the depletion region and also the barrier potential.

If the applied potential is greater than barrier potential, the majority carriers on both regions move towards the junction. It makes the current flow through the junction. The amount of current flow depends upon the magnitude of applied potential.



PN JUNCTION FORWARD BIASED.

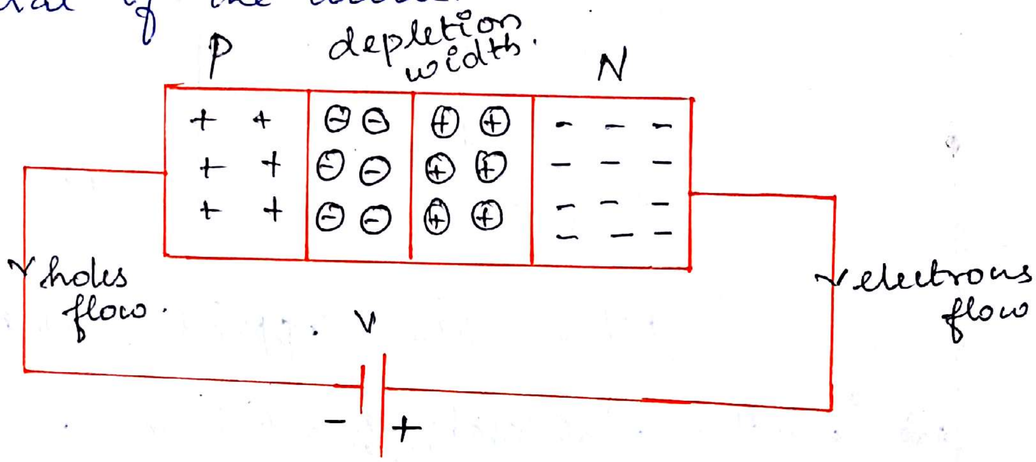
When the applied potential is less than cut in or threshold voltage, the current flow is very low. The cut-in voltage is generally 0.3V for Germanium and 0.7V for silicon diodes respectively. At the cut in voltage, the applied potential overcomes the barrier potential, increases the current rapidly.



VI CHARACTERISTICS.

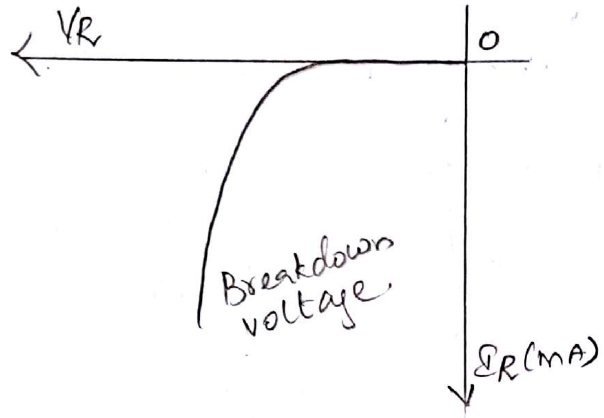
REVERSE BIASING:

In reverse biasing, the positive terminal of the battery is connected to the N type and the negative terminal of the battery is connected to the P-type material of the diode.



Under reverse bias condition, the majority carriers with P and N regions are moved towards the battery respectively. The holes in P type and the electrons in N type regions move to the negative and positive terminals of the battery respectively. Hence the ~~depth~~ width of the depletion region is increased, which prevents the flow of majority carriers through the junction.

When the applied voltage is slowly increased, the majority carriers [electrons] in P region and the minority carriers [holes] in N region make a small amount of current flow through the junction. This current is called "reverse saturation current".



When the applied reverse voltage is further increased, breakdown occurs in the junction. Now large reverse current flow through the junction. The minimum voltage that needs to breakdown occurs in the junction is called "breakdown voltage".

The diode is an unidirectional device. The diode generally permits the current in only one direction. Hence, it is used in rectifiers, clippers, clampers, etc.

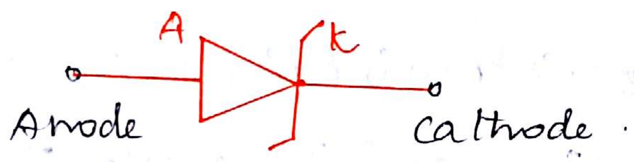
DIODE APPLICATIONS:

* Rectifiers in power supplies.
* Switch in digital logic circuit.

* clamping networks used as DC restorer in TV receivers, and voltage multipliers.

ZENER DIODE:

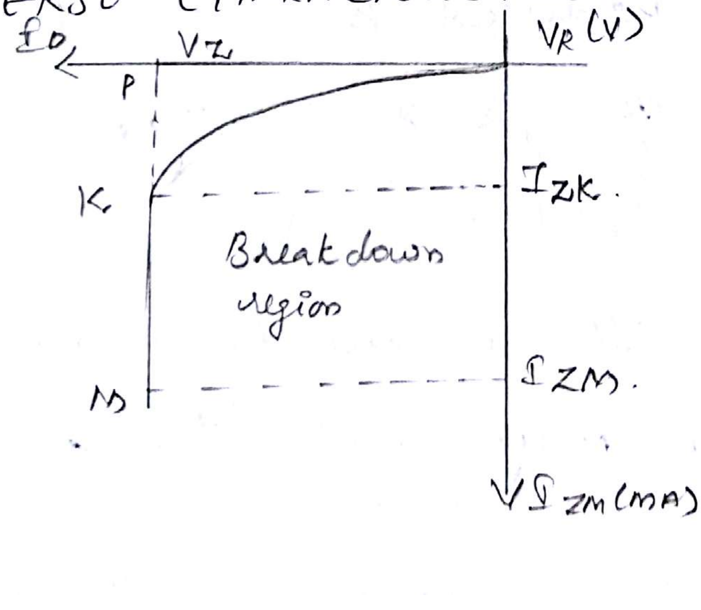
A zener diode is also called as voltage reference, voltage regulator or breakdown diode.



(a) Symbol

The zener diode is a silicon based PN junction device. and it is operated in the reverse breakdown region. The breakdown voltage is adjusted by controlling the doping level.

REVERSE CHARACTERISTICS:



From the reverse characteristics of the zener diode it is noted that the reverse voltage (V_R) is increased, the reverse current (I_Z) or zener current remains negligibly small upto the knee point. (P). At the knee point P, the breakdown occurs. & the zener breakdown voltage V_Z is maintained constant. This is the regulating ability of the zener diode. It maintains an essentially a constant voltage across its terminals over a specified range of zener current.

There is a minimum value of zener current called breakover current ($I_{Z(min)}$) which must be maintained to keep the diode in breakdown region. When the current is reduced below the knee point the voltage changes drastically.

DIODE BREAKDOWN:

The reverse breakdown of a zener diode may occur either due to

Zener breakdown or Avalanche breakdown.

ZENER BREAKDOWN:

Zener breakdown takes place, when both sides of the junctions are very heavily doped and consequently the depletion layer is thin. When a small reverse bias voltage is applied, a very strong electric field is set up across the thin depletion layer. This electric field is enough to break the covalent bonds. Now extremely large number of free charge carriers are produced which constitute the zener current. This process is called zener breakdown. In this process the junction is not damaged. The junction regains its original position when the reverse voltage is removed.

AVALANCHE BREAKDOWN:-

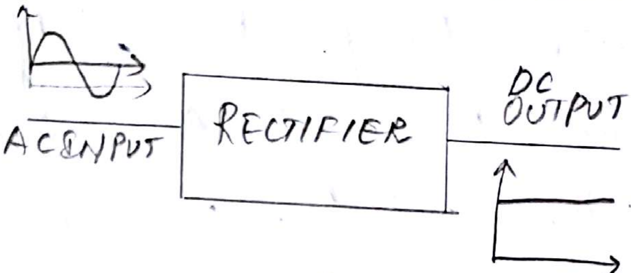
The avalanche breakdown occurs at lightly doped junctions, the width of the depletion layer is large. When the reverse bias voltage is increased, the accelerated free electrons collide with the immobile ions in the depletion region. Due to collision covalent bonds are broken and electron hole pairs are generated. These new carriers again acquire sufficient energy and collide with other ions, thereby generating further electron-hole pairs. This process is cumulative in nature and results in generation of an avalanche charge carriers in a short time. This breakdown occurs at higher reverse voltage levels.

APPLICATIONS OF ZENER DIODE:

* It can be used as a voltage regulator.
* It can be used as a limiter in wave shaping circuits.
* It can be used as a fixed reference voltage in transistor biasing circuits
* It is used for meter protection against damage from accidental over voltage.
* It can be used as a fixed reference voltage in a network for calibrating voltmeters.

RECTIFIER:

Rectifier is an electronic device which convert AC voltage into unidirectional DC voltage. For this, rectifier uses an unidirectional conducting devices such as PN junction diode or vacuum diode.

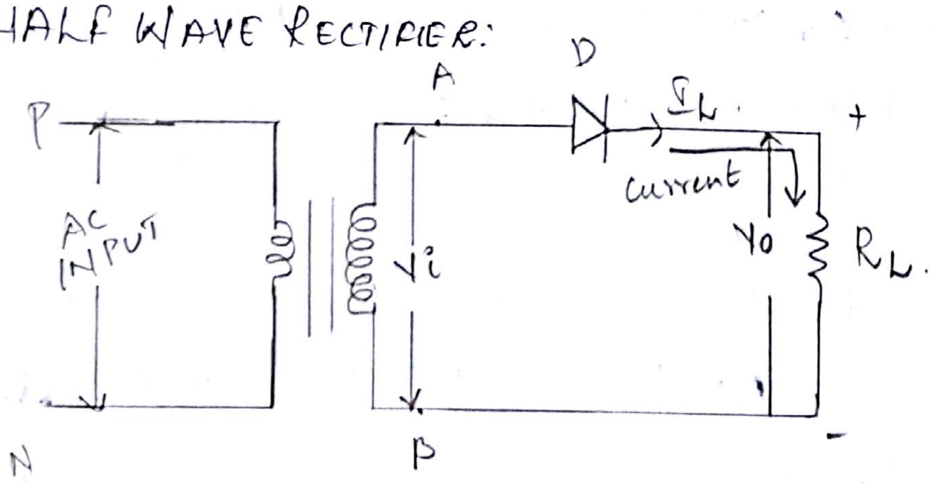


CLASSIFICATION OF RECTIFIERS:

Based on the period of conduction and construction, Rectifiers are classified into the following types.

* Half wave Rectifier
* Full wave Rectifier
* Bridge Rectifier.

HALF WAVE RECTIFIER:



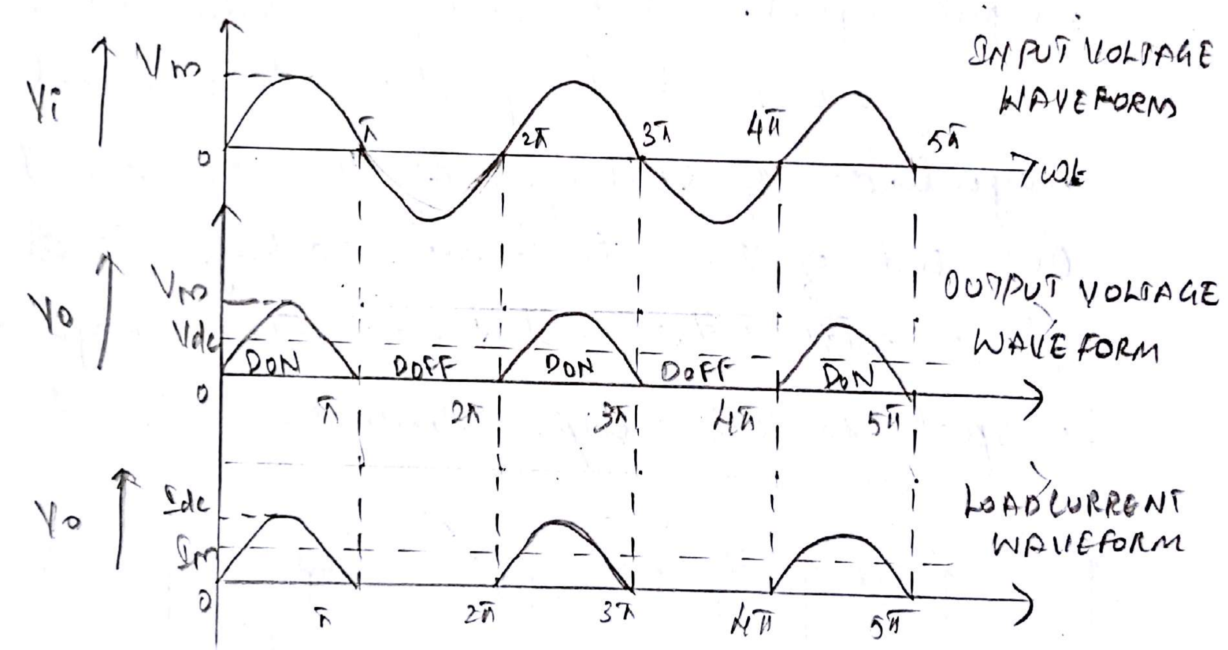
This rectifier converts an AC input voltage into pulsating voltage for only one half cycle of the applied voltage. The circuit contains one diode. So, the output is obtained only for positive half cycle of the input voltage.

During the positive half cycles of the input signal, terminal A is positive with respect to terminal B. Now diode D is forward biased. So, the current flows from from terminal A to B through diode D and load resistance R_L. The input voltage is fully dropped across the load resistance R_L.

During the negative half cycles of the input signal, terminal B is positive with respect to terminal A. Now diode is reverse biased. So, no current flows through the diode and load resistance. The output voltage is zero.

In this circuit, the output contains only the positive half cycle of the input signal. So, it is called as the half wave rectifier.

When an AC voltage is applied to the input of the rectifier, current flows through the load resistance (R_L) only in one direction. Therefore the output across R_L will be DC output voltage. The output is not a steady DC but only a pulsating D.C. It is used for small power applications.



ADVATAGES:

* Circuit is very simple and occupies less space
* Less cost

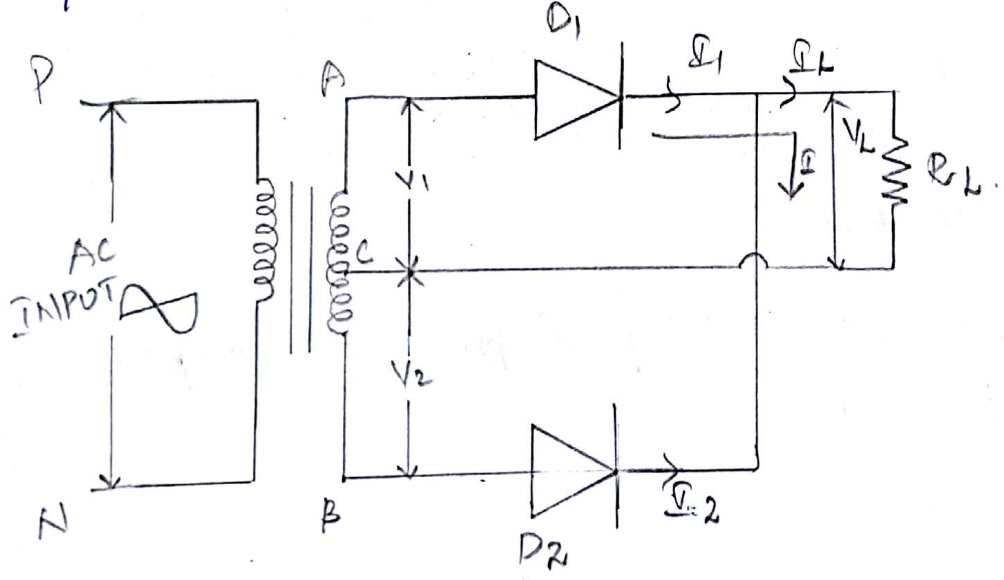
FEATURES :

* Output voltage ($V_{dc} = 0.318\ V_m$)
* Rectification efficiency is low 40.6% only

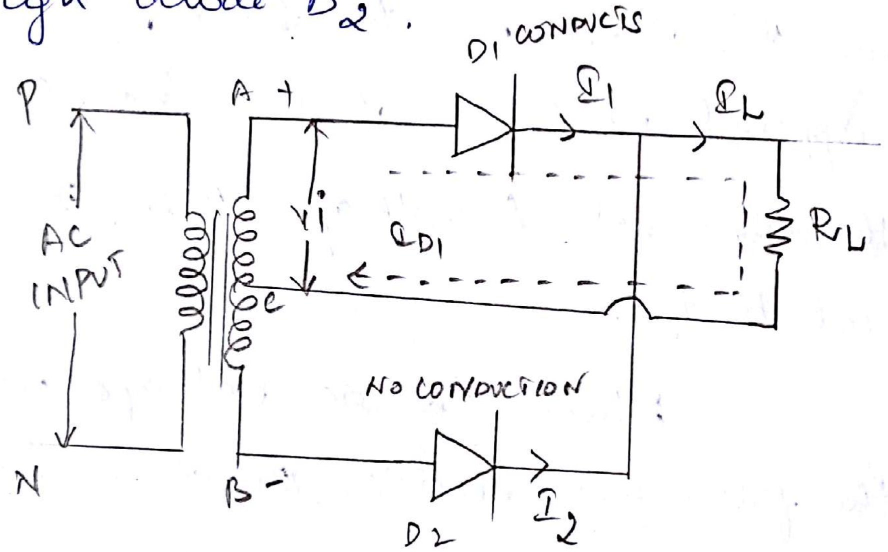
* Ripple factor is high - 1.21.
* DC Saturation of transformer core results in hysteresis loss and production of harmonics, in the power supply.
* Suitable only for very low power applications
* Peak inverse voltage should be equal to V_m

FULL WAVE RECTIFIER:

The full wave rectifier contains two diodes, so they conduct for full cycle of the input signal. This rectifier uses centre tap transformer, which produces two equal magnitude of voltages at the opposite terminal. One end of the terminal voltage is out of phase with other end terminal voltage with respect to centre tap terminal.

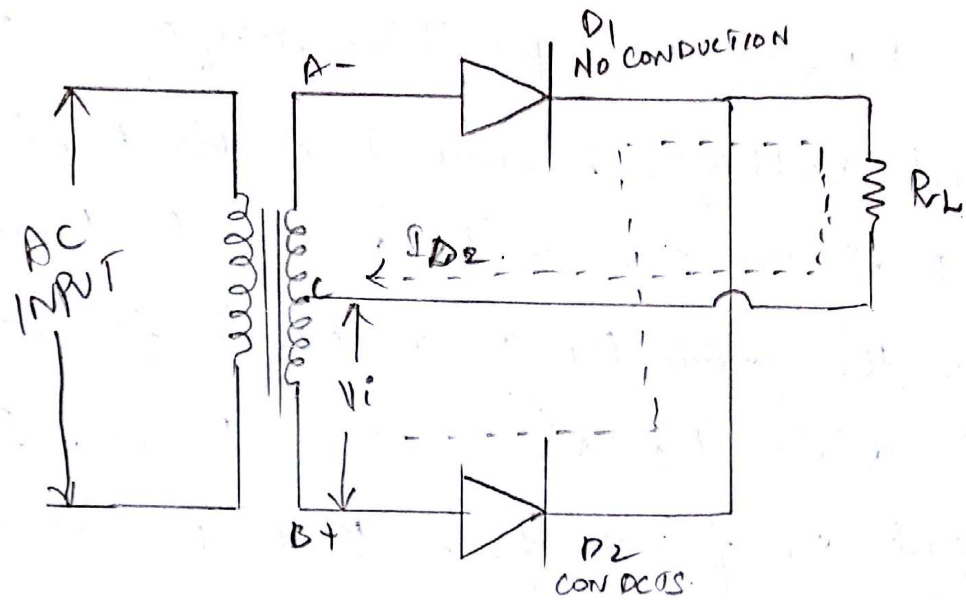


During the positive half cycle of the input voltage, terminal A is positive, and B is negative with respect to terminal C. Now, the diode D_1 conducts in forward bias and diode D_2 is reverse bias. So, the current I_1 flows from the terminal A to the load through diode D_1. No current flows through diode D_2.



During the negative half cycle of the input voltage, terminal B is positive and A is negative with respect to terminal C. Now, the diode D_2 is forward biased and the diode D_1 is reverse biased. So, the current I_2 flows from terminal B to the load through diode D_2.

Scanned by CamScanner



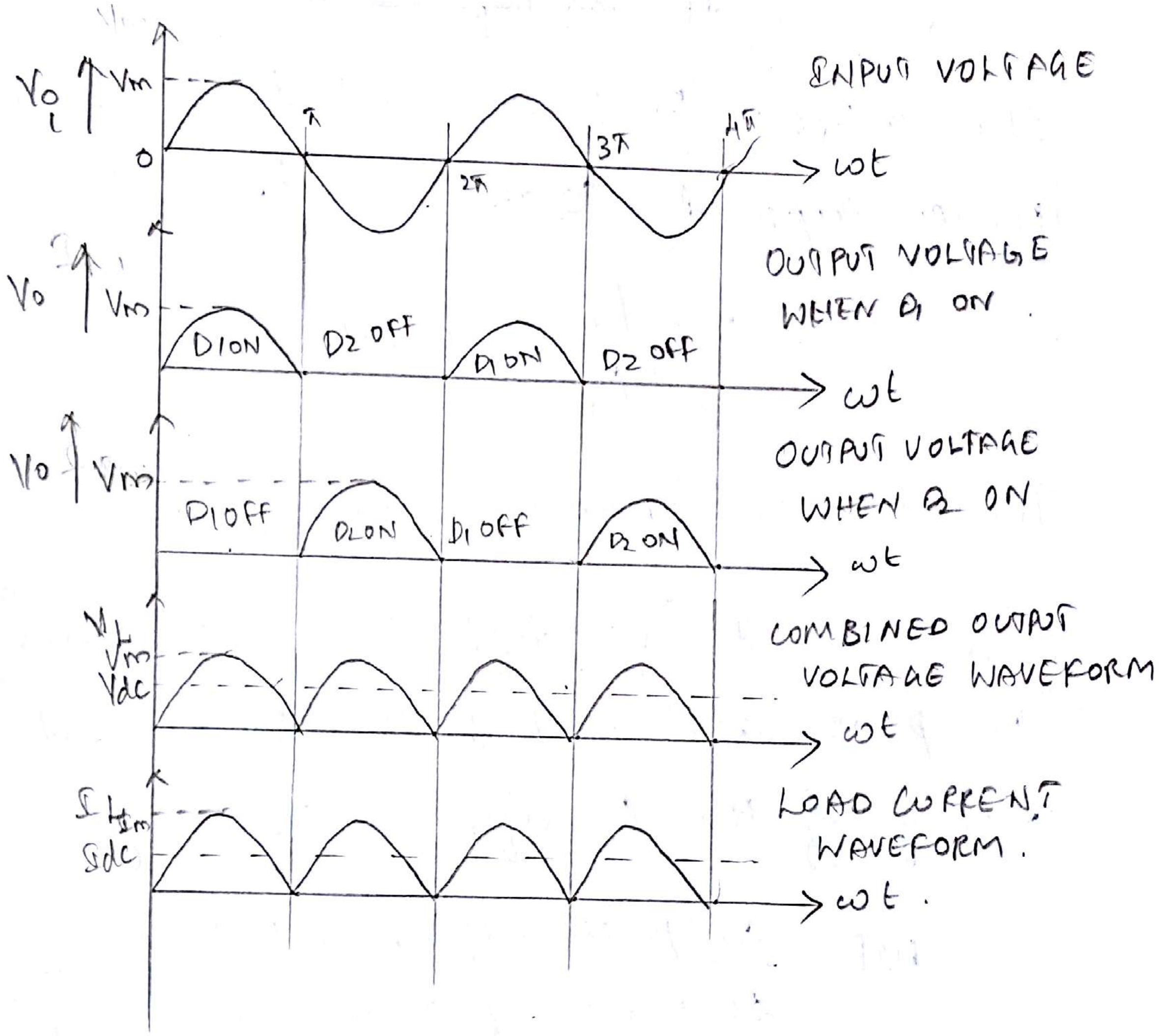
The currents I_1 & I_2 follows the same direction in the load. If the magnitude of applied voltage at terminal A is equal to the terminal B voltage, then current I_1 is equal to I_2.

When an AC voltage is applied to the full wave rectifier D_1 conducts in positive half cycle & D_2 conducts in the negative half cycle. and current flows in same direction in R_L. A pulsating DC is developed across the load resistor R_L.

FEATURES:

* High output voltage, than half wave rectifier
  $V_{dc} = 0.637 V_m$
* Rectification efficiency is high - 81.2%.
* Ripple factor is low - 0.421.

* DC saturation of the core is avoided.
* Peak inverse voltage should be equal to $2V_m$



DISADVANTAGES:

* Cost is high, when compared to half wave rectifiers.
* Requires center tap transformer which is costly.
* Higher PIV rated diodes are required for the operation which is costly.

TERMS RELATED TO RECTIFIER:

RECTIFIER EFFICIENCY (η):

It is defined as the ratio between the output DC power and the input AC power supplied to the circuit.

$$\eta = \frac{P_{dc}}{P_{ac}} \times 100\%.$$

TRANSFORMER UTILIZATION FACTOR [TUF]:

It is defined as the ratio between DC power delivered to the load and AC power rating of the transformer secondary.

$$TUF = \frac{\text{DC power delivered to the load}}{\text{AC rating of the transformer secondary}}.$$

$$= \frac{P_{dc}}{P_{ac(rated)}}.$$

RIPPLE FACTOR:

It is defined as the ratio between the RMS value of the AC component and DC component in the ripple output.

$$\gamma = \sqrt{\left(\frac{I_{rms}}{I_{dc}}\right)^2 - 1}$$

PEAK INVERSE VOLTAGE (PIV) :.

It is defined as the maximum amount of voltage drop across the diode, when it conducts in reverse biasing.

COMPARISON OF RECTIFIERS:

S.No	CHARACTERISTICS	HALF WAVE RECTIFIER	FULL WAVE RECTIFIER.
1.	Average value of load current I_{DC}	$\frac{I_m}{\pi}$	$\frac{2I_m}{\pi}$.
2.	Average value of load voltage (V_{DC})	$\frac{V_m}{\pi}$	$\frac{2V_m}{\pi}$.
3.	RMS value of load current (I_{RMS})	$\frac{I_m}{2}$	$\frac{I_m}{\sqrt{2}}$.
4.	RMS value of load voltage (V_L (RMS))	$\frac{V_m}{2}$	$\frac{V_m}{\sqrt{2}}$.
5.	DC output power (P_{DC})	$\frac{I_m^2}{\pi^2} \cdot R_L$	$\frac{4I_m^2}{\pi^2} \cdot R_L$
6.	Rectifier efficiency (η_{max})	0.406%.	81.2%.
7.	Ripple factor (γ)	1.21.	0.48.
8.	Peak Inverse Voltage (PIV)	V_m	$2V_m$
9.	Transformer utilization factor (TUF)	0.287.	0.693.

BIPOLAR JUNCTION TRANSISTOR:

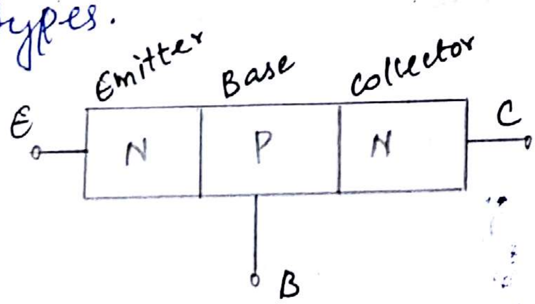
The transistor was developed by Dr. Shockley in bell laboratories in 1951. It is a three terminal, three layer, two junction device whose output voltage and current depends on input voltage and current.

There are two types of transistors.

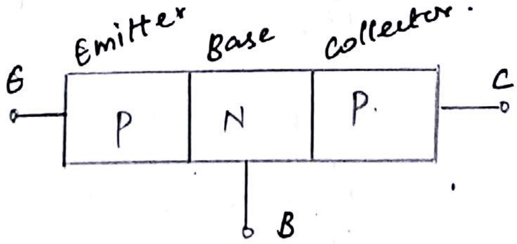
* NPN transistor
* PNP transistor.

TRANSISTOR CONSTRUCTION:

The transistor is basically a silicon or Germanium crystal containing two PN junctions. The junctions are formed by sandwitching either P-type or N-type semiconductor layers between a pair of opposite types.



NPN TRANSISTOR



PNP TRANSISTOR.

The transistors has three regions namely emitter, base and collector. All these regions has terminals labelled as E for emitter, B for base and C for collector.

The transistor has two junctions J_1 as emitter base junction and J_2 as collector base junction.

EMITTER :

This is the first layer of the transistor which is heavily doped. This supplies the charge carriers [electrons or holes] to the other two regions.

BASE :

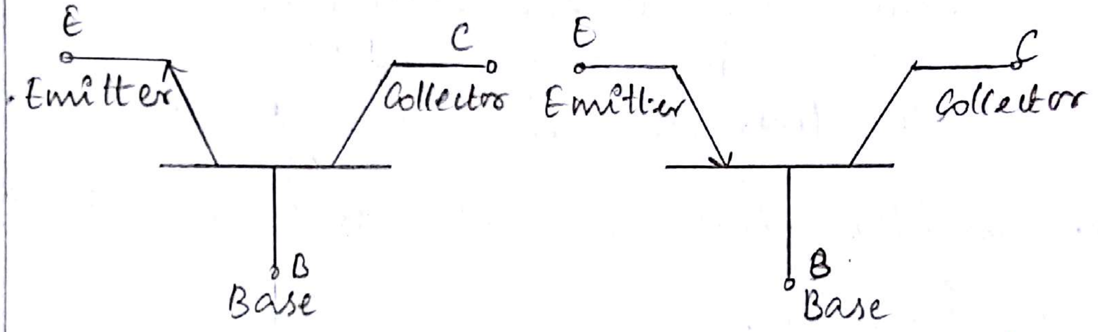
This is the middle region of the transistor. The base of the transistor is lightly doped and small in size (ie) it is a thin layer.

COLLECTOR :

This is the last layer of the transistor which is moderately doped. This collector part of a transistor is larger than the emitter and base. The collector collects the charge carrier supplied by the emitter.

TRANSISTOR SYMBOLS:

When transistor used as circuit element, it is represented as follows.

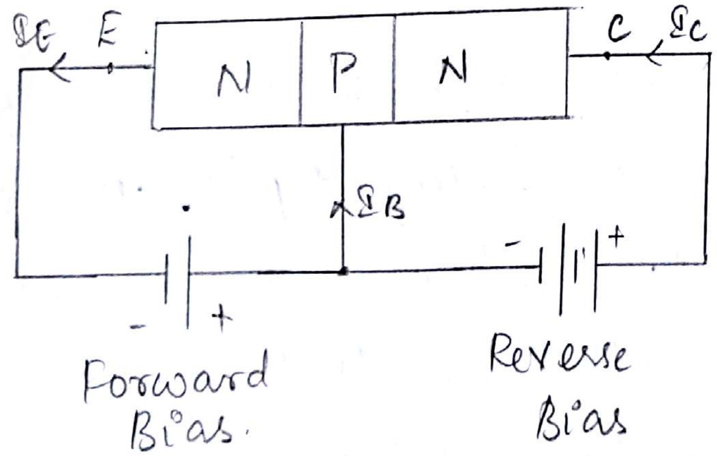


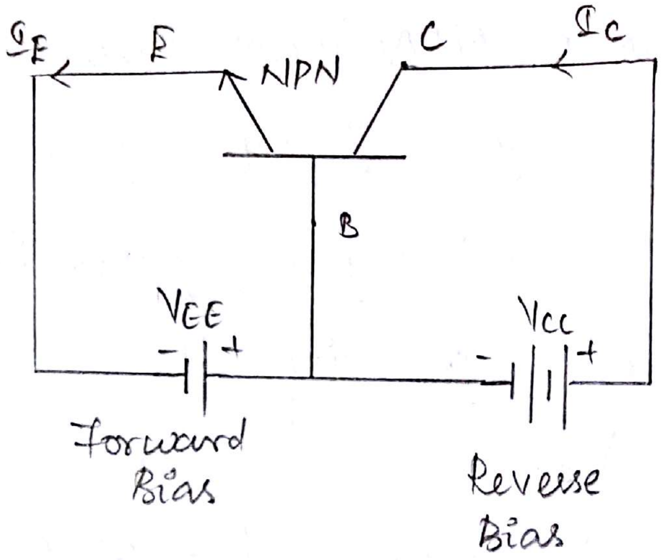
a) Symbol for NPN transistor

b) Symbol for PNP transistor.

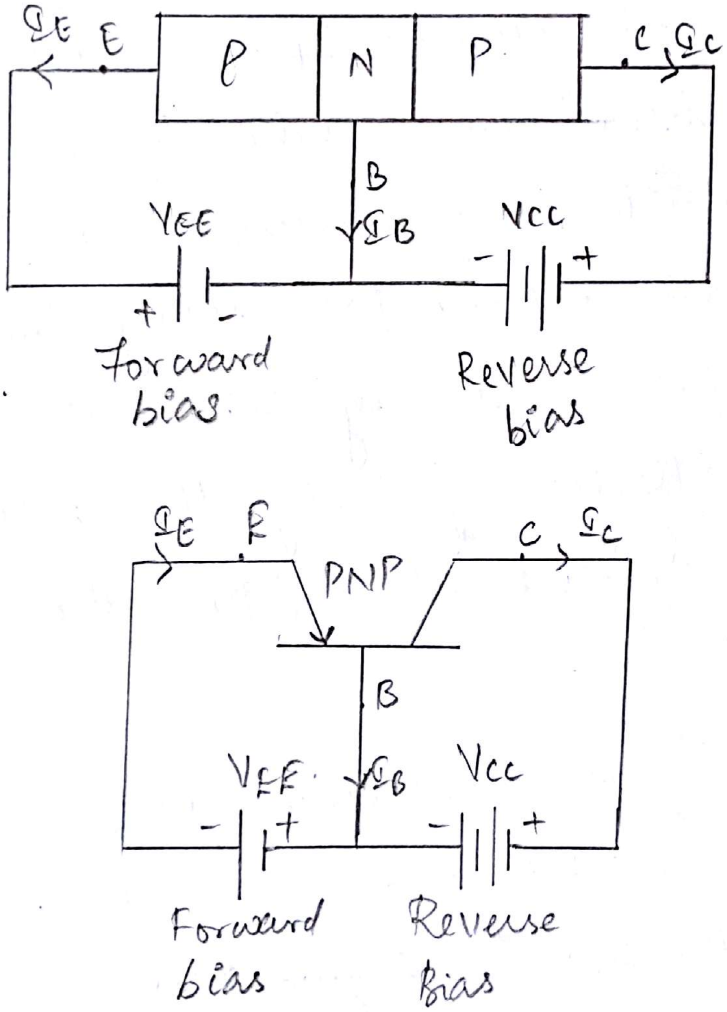
The transistor symbol carriers an arrowhead in the emitter from P-region toward N-region. The arrow head indicates the direction of a conventional current flow in a transistor.

TRANSISTOR BIASING:





(a) Biasing of NPN transistor



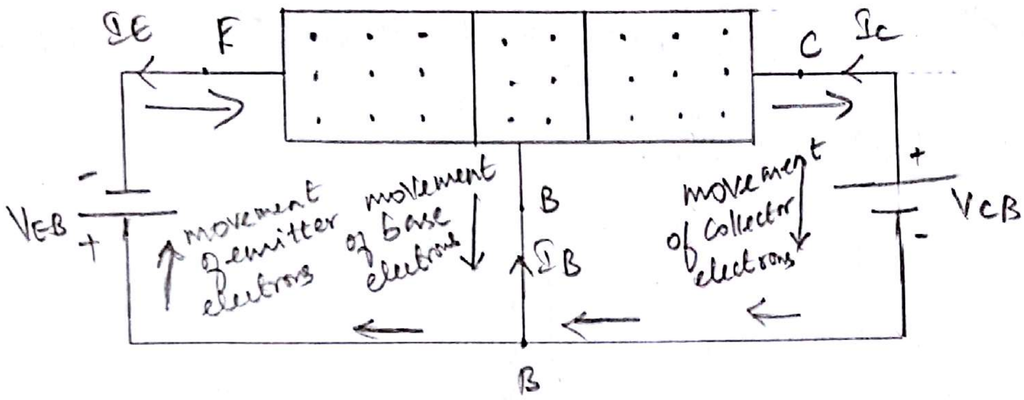
(b) Biasing of PNP transistor

1. OPERATION OF NPN TRANSISTOR:

The emitter-base junction is forward biased by the potential V_{EE}. The collector base junction is reverse biased by potential V_{CC}.

The forward bias potential V_{EE}, causes a lot of electrons from the emitter region to crossover the base region. This produces the emitter current I_E. The base is lightly doped, hence few number of electrons from the emitter, recombines with the holes in the base region, producing the base current I_B. The remaining electrons, move towards the collector region, by the collector base potential V_{CC}, which produces collector current I_C.

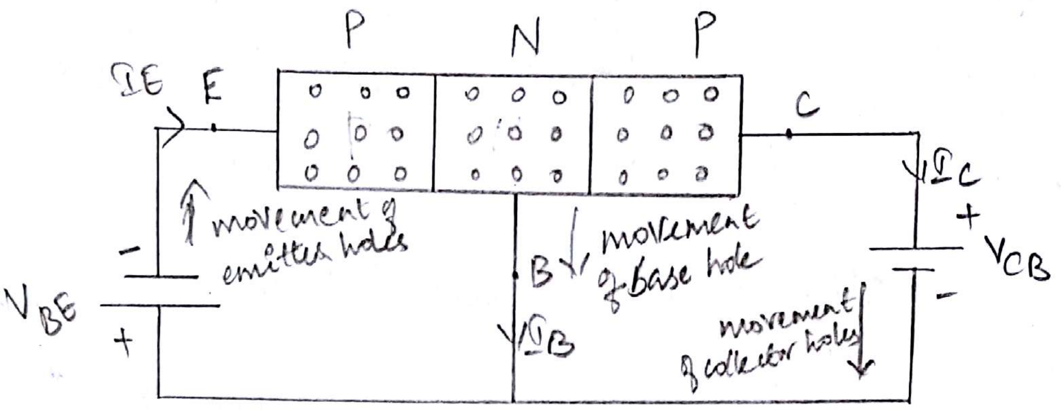
The collector base junction is reverse biased and a small reverse current flows through the region. This is the collector current I_C. The emitter current I_E is equal to base and collector currents. $I_E = I_B + I_C$.



The collector current Ic is also called as the injected current because this current is produced due to electrons injected from the emitter region.

OPERATION OF PNP TRANSISTOR:

The emitter base junction is forward biased and collector base junction is reverse biased. The forward bias causes the holes in the emitter region to flow towards the base region. This constitutes the emitter current IE. The holes after reaching the base region combine with electrons in the base and constitutes the current called the base current IB. The base width is made extremely small and holes do not get sufficient electrons for recombination. Thus most of holes diffuse to the collector regions and constitute the collector current I_C.

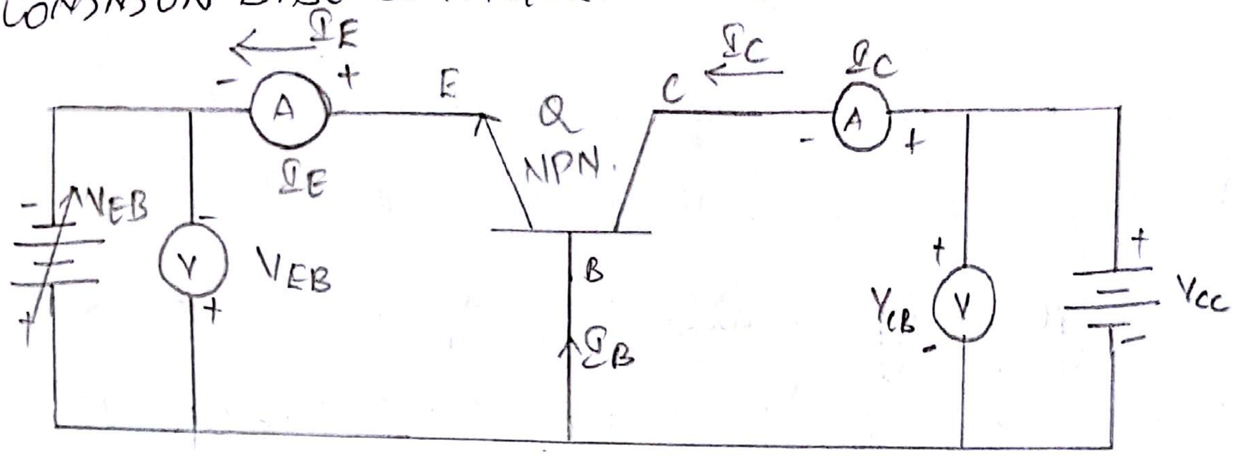


TRANSISTOR CIRCUIT CONFIGURATION:

When a transistor is connected to a circuit, one terminal is connected to the input, one terminal is connected to the output and one terminal is made as common. Depending upon the input, output and common terminals, a transistor can be connected in three configurations. They are

* Common Base (CB) Configuration
* Common Collector (CC) Configuration
* Common ~~Collector~~ Emitter (CE) Configuration

COMMON BASE CONFIGURATION:



(a) Common base NPN transistor circuit.

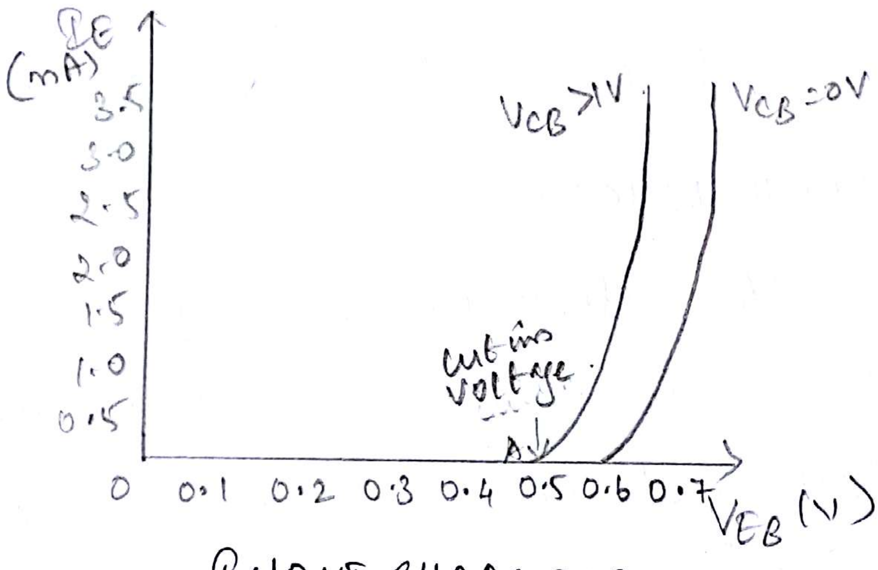
In this configuration, emitter is the input terminal, collector is the output terminal and base is the common terminal.

INPUT CHARACTERISTICS:

To determine the input characteristics, the collector base voltage is kept constant at the zero volt and the emitter current I_E is increased from zero in equal steps by increasing V_{EB}. This is repeated for various fixed values of V_{CB}. A curve is drawn between emitter current and emitter base voltage V_{BE} at constant collector base voltage. V_{CB}.

There exists a threshold voltage also known as offset voltage or cut-in voltage, below which the emitter current is negligibly small. The value of knee cut in voltage is 0.5V for silicon & 0.1V for germanium. The value of input resistance is

$$R_i = \frac{\Delta V_{EB}}{\Delta I_E}.$$



INPUT CHARACTERISTICS.

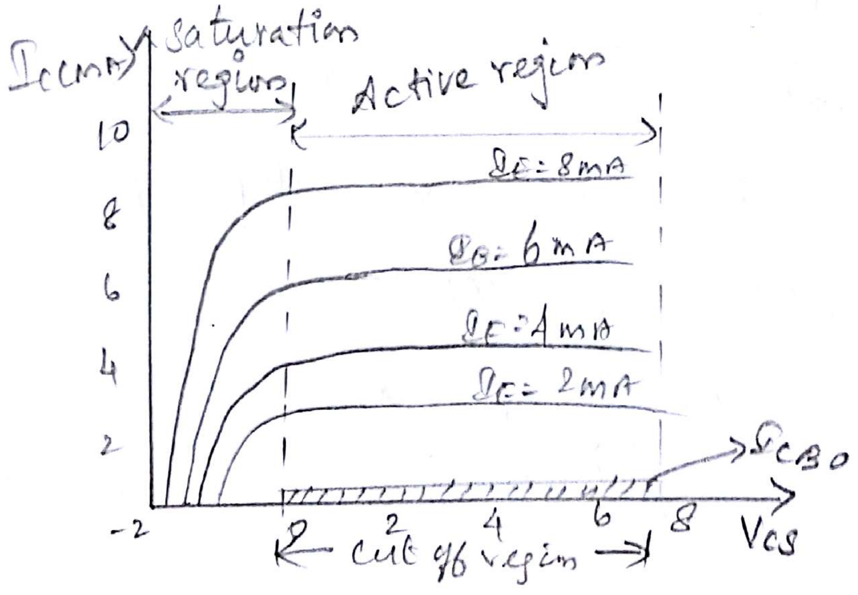
OUTPUT CHARACTERISTICS:

To determine the output characteristics, the emitter current I_E is kept constant by adjusting emitter base voltage V_{EB}. Then V_{CB} is increased in equal steps and collector current is noted. for each value of I_E.

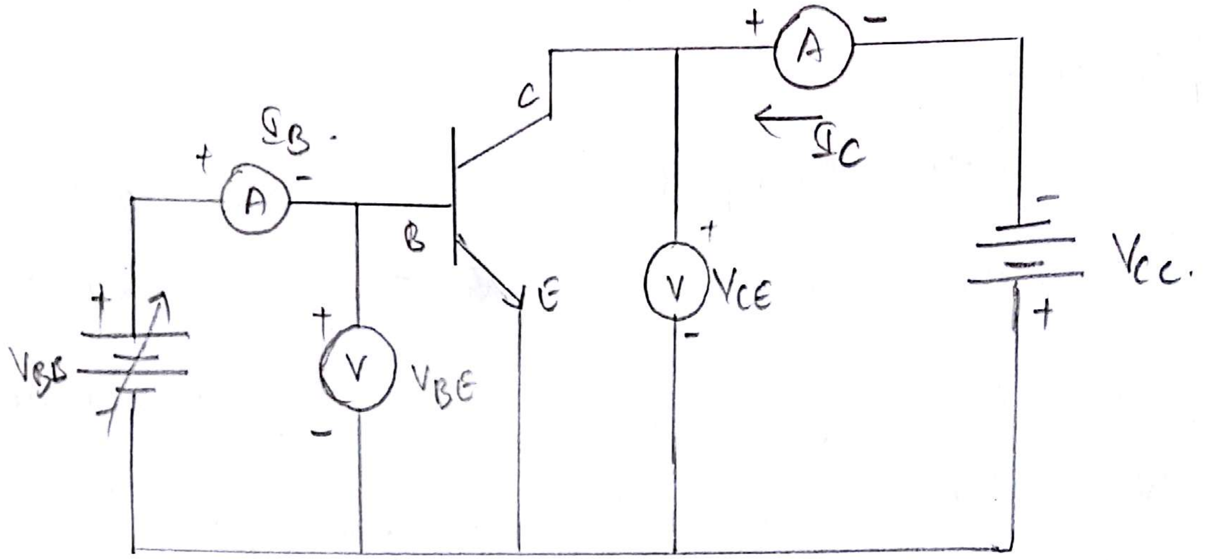
This is repeated for different fixed values of I_E.

The output characteristics of the curve is divided into three regions. namely Saturation region, cut off region and active region. In Saturation region, a small change in V_{CB} results in large value of current. In active region, Collector current is constant and equal to the emitter current. In the cut off region, a small current flows even V_{CB} is zero and emitter current is zero. This is called collector leakage current (I_{CBO}). The value of the output resistance is determined by.

$$R_o = \frac{\Delta V_{CB}}{\Delta I_C}.$$



COMMON EMITTER CONFIGURATION:



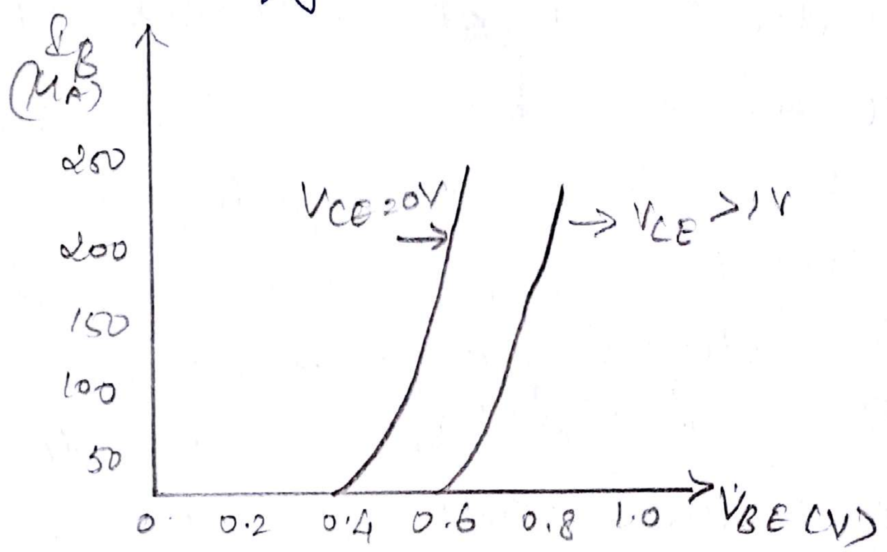
In this configuration, the base is the input terminal, collector is an output terminal and emitter is the common terminal. This is also called as the grounded emitter configuration.

INPUT CHARACTERISTICS:

To determine the input characteristics, the collector to emitter voltage is kept constant at zero volt and base current is increased in steps from zero value by adjusting V_{BE}.

The graph is shown in the figure. There exists a knee voltage as

threshold voltage below which the current 19
is very small. The input resistance of a transistor is high as compared to the common base configuration.



When V_{CE} is increased above 1V, the curve shift downwards. because the width of the depletion region in the base region increases. This reduces the effective base width which in turn reduces the base current. The resistance is calculated by

$$R_i = \frac{\Delta V_{BE}}{\Delta I_B}.$$

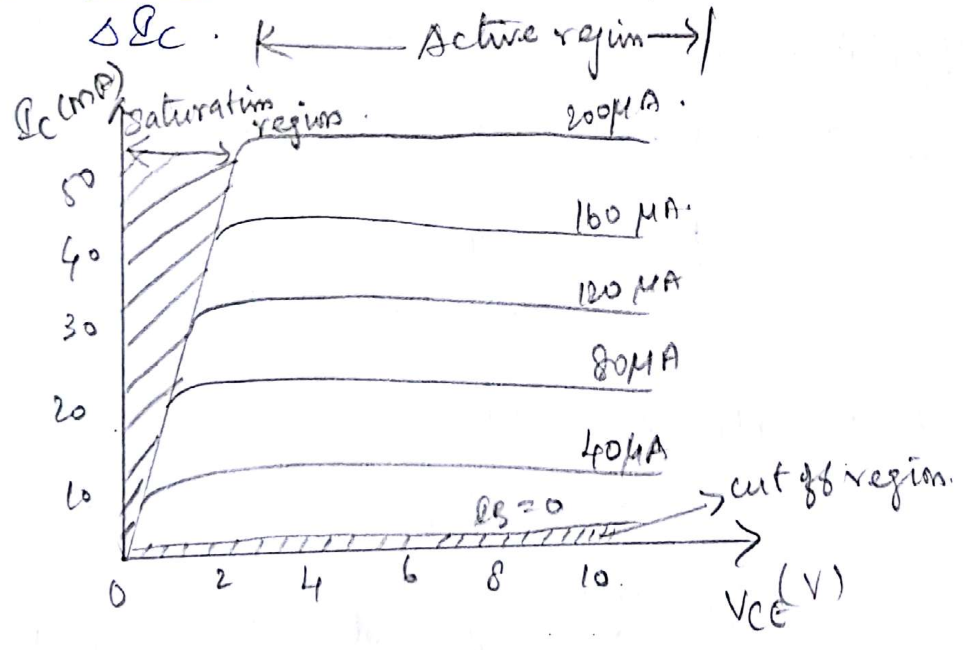
OUTPUT CHARACTERISTICS:

The base current I_B is kept constant by adjusting V_{BE}. The magnitude of

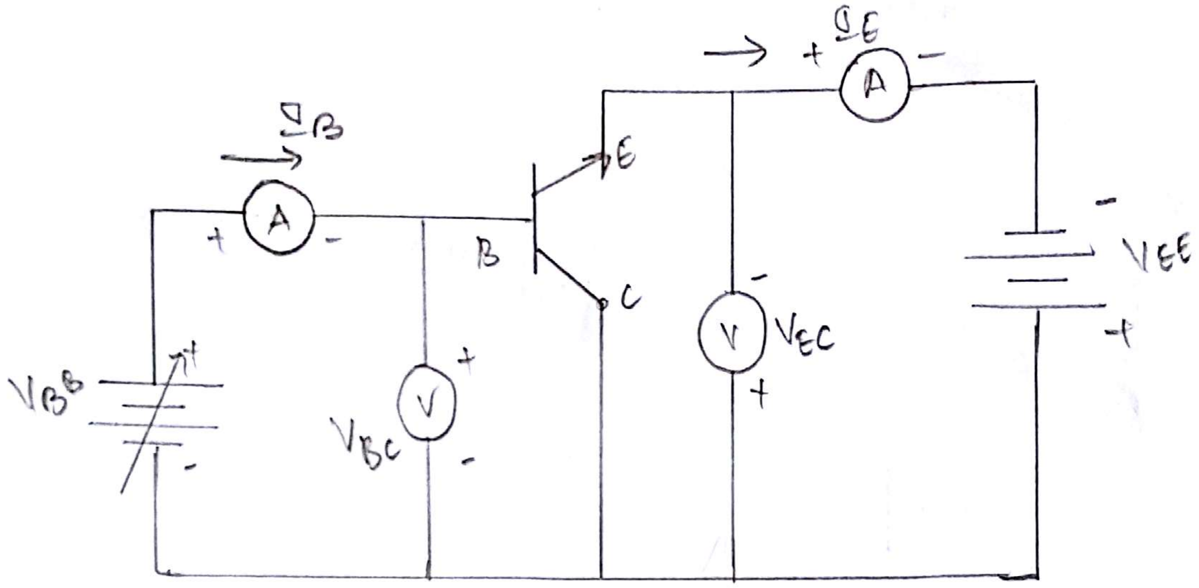
V_{CE} is increased in steps, the value of collector current I_C is noted..

When the V_{CE} is increased, the collector current also increases rapidly. When V_{CE} is increased above zero, the collector current increases rapidly to a saturation value. When V_{CE} is increased further, the collector current increases because of the fact that V_{CE} reduces the base current and hence collector current increases. This phenomenon is called as early effect.

When the base current is zero, a small collector current exists called as leakage current. The ac output resistance is given by $R_o = \frac{\Delta V_{CE}}{\Delta I_C}$.



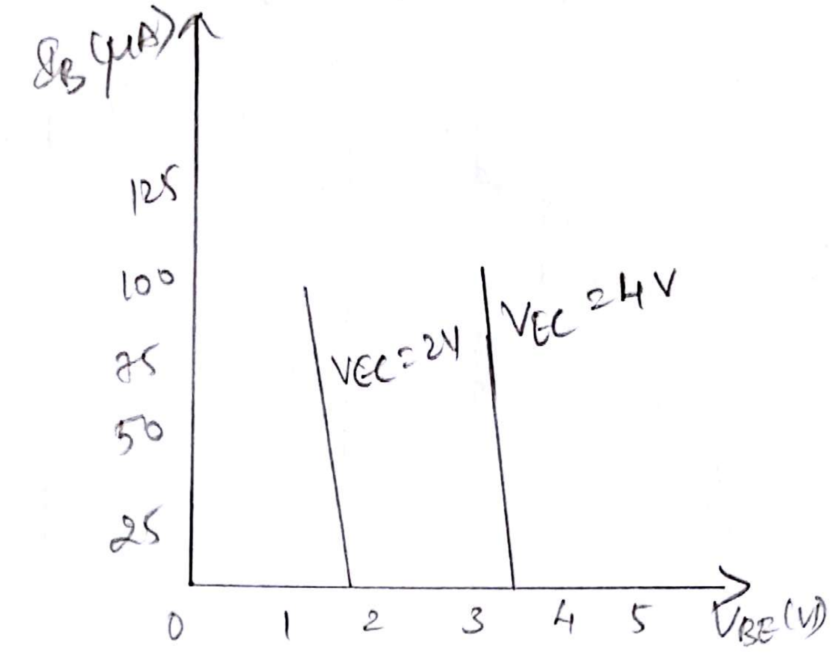
COMMON COLLECTOR CONFIGURATION:



In this configuration, base is the input terminal, emitter is the output terminal and collector is the common terminal.

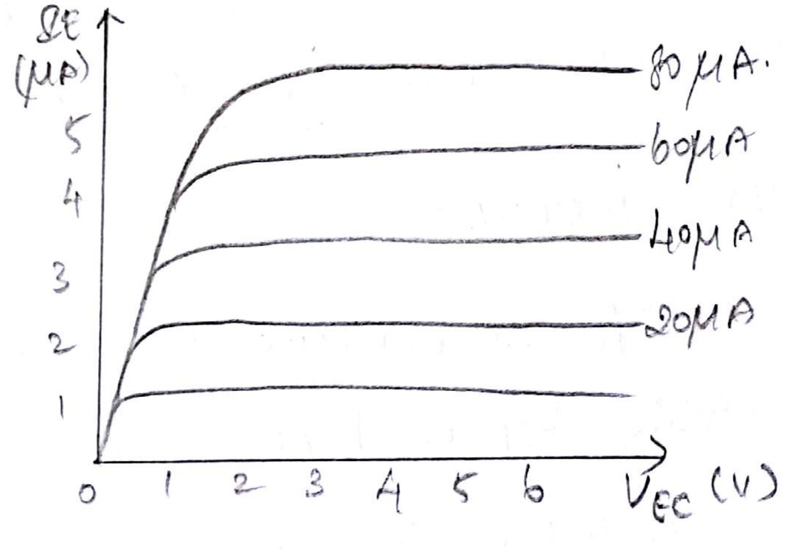
INPUT CHARACTERISTICS:

To determine the input characteristics, V_{CE} is kept constant and V_{BC}, base collector voltage is increased in equal steps and corresponding increase in I_B is noted. This is repeated for different values of V_{EC} and the graph is plotted between I_B & V_{BE} for different values of V_{EC}.



INPUT CHARACTERISTICS of CC.

OUTPUT CHARACTERISTICS :



To determine the output characteristics the reading will be taken between emitter to collector voltage (V_{EC}) and emitter current (I_E) at different fixed values of base current I_B. The output current (I_E) is increased with an increase in input current (I_B).

UNIT - V.

DIGITAL ELECTRONICS.

NUMBER SYSTEM:

Number system is a basis for counting various quantities. the most commonly used number systems are

1. Decimal number system
2. Binary number system
3. Octal number system
4. Hexadecimal number systems.

DECIMAL NUMBER SYSTEM:

The decimal number system uses 0, 1, 2, 3, 4, 5, 6, 7, 8 and 9 numbers. The decimal number system is also known as base 10 system as there are 10 digits. Eg:. 278_{10}

BINARY NUMBER SYSTEM:

The binary number system has only two numbers '0' and '1'. This is also known as base-2 systems as they have only two states 0 or 1. [ON or OFF, open or close State]. Eg:. 1101_2.

OCTAL NUMBER SYSTEM:.

Octal number system has only eight numbers (ie) 0, 1, 2, 3, 4, 5, 6, 7. It has a base of 8. Eg:. 567_8.

HEXADECIMAL NUMBER SYSTEM:

Hexadecimal number system has only sixteen numbers. namely (0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, D, E, F). This is referred as base-16 system. This system makes use of both numerals and alphabets. Eg:. $3FD_{16}$.

CONVERSIONS:

The binary, octal, decimal and hexadecimal numbers are weighted numbers. So, every number system can be converted into any number System. The weight of each number system is represented as follows.

1.

a) Decimal number System:

Number:	2	6	5	9	.	1	5
weight of each digit:	10^3	10^2	10^1	10^0	.	10^{-1}	10^{-2}

b) Binary number System:

Number:	1	0	1	0	.	0	1
weight of each digit:	2^3	2^2	2^1	2^0	.	2^{-1}	2^{-2}

c) Octal number System:

Number:	7	3	4	6	.	3	2
weight of each digit:	8^3	8^2	8^1	8^0	.	8^{-1}	8^{-2}

d) Hexadecimal number System:

Number:	8	A	B	5	.	C	9
weight of each digit:	16^3	16^2	16^1	16^0	.	16^{-1}	16^{-2}

Decimal to Binary Conversion:

The simplest method to convert decimal to binary is to provide progressively the decimal number by 2 until quotient of one is obtained, and writing the reminders in the reverse order gives the binary number.

2	118	
2	59	0
2	29	1
2	14	1
2	7	0
2	3	1
	1	1

$(118)_{10} = (1110110)_2$

Decimal number $(52.625)_{10}$ can be expressed in binary as follows.

First the integer number is converted to binary.

2	52	
2	26	0
2	13	0
2	6	1
2	3	0
	1	1

$(52)_{10} = (110100)_2$

then, fractional number is converted to binary.

$0.625 \times 2 = 1.250$
$0.250 \times 2 = 0.500$
$0.500 \times 2 = 1.000$
$0.000 \times 2 = 0.000.$

Binary to decimal Conversion:

The steps for converting an integer binary number to its equivalent decimal number.

a) Write the binary number.
b) Write the weights under its corresponding binary numbers from right to left.
c) Add the remaining weights to get the equivalent decimal number.

$10101 = 1 \times 2^4 + 0 \times 2^3 + 1 \times 2^2 + 0 \times 2^1 + 1 \times 2^0$
$= 16 + 0 + 4 + 0 + 1.$
$= 21_{10}.$

The steps for converting an fractional binary number to its equivalent decimal number.

a) Write the binary number.

b) Write the weights in negative powers under its corresponding number from left to right.

c) Add the remaining weights to get the equivalent decimal number.

$$110.11 = 1\times2^2 + 1\times2^1 + 0\times2^0 + 1\times2^{-1} + 1\times2^{-2}$$

$$= 4 + 2 + 0 + 0.5 + 0.25$$

$$= 6.75_{10}.$$

Decimal to Octal Conversion:

The Steps for conversion from decimal to octal conversion.

a) Write the decimal number

b) Divide the given decimal number by 8 and take the remainder outside.

c) Continue the same step till remainder is 0.

d) Write the remainder from bottom to top get the octal number.

Convert $(567)_{10}$ to its equivalent octal number.

8	567	
8	70	– 7
8	8	– 6
	1	– 0

$$(567)_{10} = (1067)_8.$$

Convert $(422.26)_{10}$ to its equivalent Octal number.

$$\begin{array}{r|l} 8 & 422 \\ \hline 8 & 52 - 6 \\ \hline & 6 - 4. \end{array}$$

$(422)_{10} = (646)_8$

Take the fractional part from the given number and find the equivalent octal.

	Fractional	Integer
$0.26 \times 8 = 2.08$	0.08	2.
$0.08 \times 8 = 0.64$	0.64	0
$0.64 \times 8 = 5.12$	0.12	5.

$(0.26)_{10} = (205)_8$.

$(422.26)_{10} = (646.205)_8$.

Decimal to Hexadecimal.

The Steps for conversion of decimal to hexadecimal.

a) Write the decimal number.

b) Divide the decimal number by 16 and take the remainder outside.

c) Continue the same until the zero remainder condition.

d) Write the remainder from bottom to top to get the equivalent hexadecimal number.

Convert $(807)_{10}$ to its equivalent hexadecimal number.

16	807	
16	50	– 7
	3	– 2

$(806)_{10} = (327)_{16}$.

Convert $(926.63)_{10}$ to its equivalent hexadecimal number.

16	926	
16	57	– E.
	3	– 9

$(926)_{10} = (39E)_{16}$

Now, take the fraction part and find the equivalent hexadecimal value.

	Fractional	Integer.
$0.63 \times 16 = 10.08$	0.08	A.(10).
$0.08 \times 16 = 1.28$	0.28	1
$0.28 \times 16 = 4.48$	0.48	4.

$(0.63)_{10} = (41A)_{16}$.

$(926.63)_{10} = (39E.41A)_{16}$.

Binary to Octal Conversion:

The steps for conversion of binary to octal number.

a) Write the binary number.

b) Binary number must be arranged in a group of 3 bits from right to left.

c) For fractional number, it is arranged in a group of 3 bit from left to right.

d) If the binary numbers are not completed in the form of 3 digits sufficient zero can be added in the left most side for integer and right most side for the fractional values.

e) Convert the 3 digit binary number to octal number.

Convert a binary number 10110110.10110 to its equivalent octal number.

∴ 10 110 110 . 101 10

10 110 110 . 101 10.

Sufficient zero can be added both at the integer side and also in the fractional part.

010 110 110 . 101 100

Now, convert three digit binary number to its equivalent octal number.

010 110 110 . 101 100

2 6 6 . 5 4.

$(10110110.10110)_2 = (266.54)_8$

Binary to Hexadecimal:

The steps for converting binary to hexadecimal conversion.

a) Write the binary number

b) The binary numbers must be arranged in a group of 4 bit from right to left.

c) For fractional numbers, it must be arranged in a group of 4 bit from left to right.

d) If the binary numbers are not complete in the form of 4 digit.

Sufficient zero can be added in the left most side for an integer and right most side for the fractional values.

e) Convert the 4 digit binary number into a hexadecimal number.

Convert $(11001101)_2$ to its hexadecimal number.

1100	1101	
C	D	$=(CD)_{16}$.

Convert 111110101010.1011101 to its hexadecimal number.

1111 1010 1010 . 1011 101

Sufficient zero should be added to the fractional value to make it 4 digit number.

1111 1010 1010 . 1011 1010.

Now, it can be converted to its equivalent hexadecimal value.

1111	1010	1010	.	1011	1010.
F	A	A	.	B	A.

$(111110101010.1011101)_2 = (FAA.BA)_{16}$

Octal to Binary Conversions:

The weight of the binary number is 2. and the weight of the octal number is 8. So, the weight of octal number is the third power of binary (ie) $2^3 = 8$. Hence, each octal number is converted to its equivalent three digit binary number.

Octal number	Equivalent binary number.
0	000
1	001
2	010
3	011
4	100
5	101
6	110
7.	111.

Convert an octal number 327.64 to its equivalent binary number.

3	2	7	.	6	4.
011	010	111	.	110	100

$(327.64)_8 = (011010111.110100)_2$.

Hexadecimal to binary.

It is the reversal of binary to hexadecimal conversion. The weight of hexadecimal number is 16. and the weight of binary number is 2. (ie)($2^4=16$). Each hexadecimal number is converted into its equivalent 4 digit binary number.

Hexa decimal	Binary number.
0	0000
1	0001
2	0010
3	0011
4	0100
5	0101
6	0110
7	0111
8	1000
9	1001
A	1010
B	1011
C	1100
D	1101
E	1110
F	1111.

Convert hexadecimal 2A5.F9 to its equivalent binary number.

2 A 5 . F 9.

0010 1010 0101 . 1111 1001.

$(2A5.F9)_{16} = (001010100101 . 11111001)_2$.

Octal to hexadecimal:

The steps to convert octal to hexadecimal system.

* Write the given octal number.
* The octal number should be converted to binary equivalent.
* The binary equivalent is converted to hexadecimal value.

Convert $(736)_8$ into its equivalent hexadecimal.

Step 1: Convert octal number to ~~hexa~~ binary equivalent.

7 3 6

↓ ↓ ↓

111 011 110.

Step 2: The binary value is converted to hexadecimal value.

111011110

Zero is added to make it as a four digit number.

0001 1101 1110.

1 D E

$(736)_8 = (000111011110)_2$

$= 1DE$.

$(736)_8 = (1DE)_H$

Hexadecimal to Octal conversion.

The steps to convert hexadecimal value to octal number.

a) Write the given hexadecimal number.

b) Write the equivalent binary equivalent for hexadecimal value.

c) From the derived binary value write the corresponding octal values.

Convert the $(A52)_H$ to octal.

Step 1: Convert hexadecimal to equivalent binary number.

A 5 2

1010 0101 0010

Step 2: Convert binary number to its equivalent octal number.

101	001	010	010
5	1	2	2.

$(A52)_H = (5122)_8$.

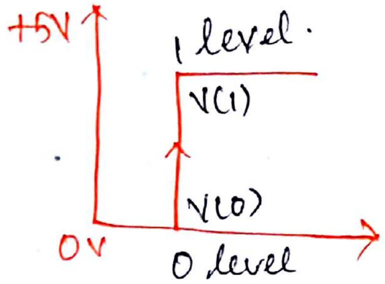
LOGIC GATES:

The digital circuits operates only in the binary mode (ie) 0 or 1. A digital circuit with one or more input pulse voltage but only one output pulse voltage is called as Gate. Gates are also called digital circuits because the input & output signals are either 0 (low) or 1 (high). Gates are called as logic circuits as they are analysed with boolean algebra and the truth table of any gate represents all possible input and output conditions in logic levels.

POSITIVE LOGIC AND NEGATIVE LOGIC:

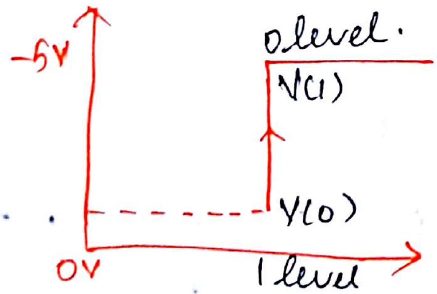
The digital circuit operate on DC voltage. The DC voltage fed to the digital system may be of either polarity of a DC supply.

The positive logic means that '1' stands for the most positive of the two voltage levels. In this 1 = true or high.
0 = low or false.



V(0) = 0 volts denotes 0 level of the logic
V(1) = 5 volts denotes the 1 level of the logic.

The negative logic means that the '1' stands for the most negative of the two voltage levels. In this 0 = high or false
1 = low or true.

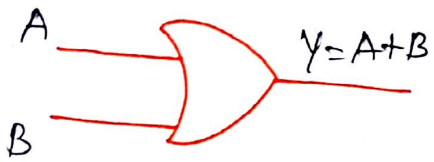


V(0) = 0 volt denotes the 0 level of logic
V(1) = -5 volt denotes 1 level of logic.

Most of the digital system uses the positive logic. (ie) +5V dc represents logic 1 and 0V dc represents logic 0.

OR GATE:

The logical addition is performed by OR gate. This has two independent inputs and only one output. The output is produced with respect to the input.



(a) SYMBOL.

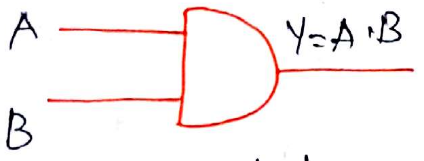
INPUT		OUTPUT
A	B	Y
0	0	0
0	1	1
1	0	1
1	1	1

(b) TRUTH TABLE.

The symbol and truth table of OR gate is shown in the figure above. The OR gate has two inputs and only one output. The output is produced when any one of the input is high. or both of the input is high. We have 2^n combination of input where 'n' is an input.

AND GATE:

The logical multiplication is performed by AND gate. This produces the dot product of the inputs. This may have two or more input signals but only one output signal. The output of the AND gate depend on the input signals.



(a) Symbol.

INPUT		OUTPUT
A	B	Y.
0	0	0
0	1	0
1	0	0
1	1	1

(b) truth table.

The truth table and symbol of the AND gate is shown. The output is high only when both the input is high. The output is low when both input or either of the input is low.

NOT GATE:

This is also known as the invertor gate or complement gate. This gate has one input signal & one output signal.

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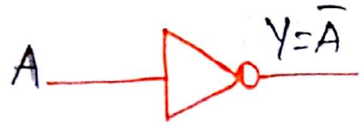


(a) Symbol.

INPUT	OUTPUT
A	$Y=\bar{A}$
0	1
1	0

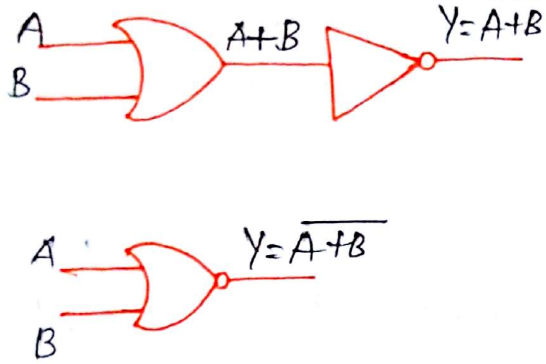
(b) Truth table.

The NOT gate produces the output with respect to the input. In NOT gate, the input A produces the complemented output $\bar{A}$. The symbol and the truth table of NOT gate is shown in the figure above. A small circle on the output side represents the complementary function is called as bubble.

NOR GATE:

The complement of OR gate is NOR gate. A NOT gate followed by an OR gate forms the NOR gate. So, NOR gate is formed by the combination of two gates. (OR & NOT).

The NOR gate may have two or more inputs and a single output.



(a) Symbol

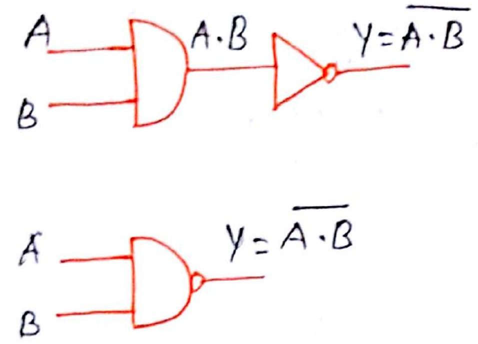
INPUT		OUTPUT
A	B	Y.
0	0	1
0	1	0
1	0	0
1	1	0

(b) Truth table.

The above diagram shows the symbol and the truth table with two inputs and one output. In NOR gate, output is high when both the inputs are loco. and output is low when both the inputs are high.

NAND GATE:

The complement of AND gate is NAND gate. The combination of AND and NOT gate forms the NAND gate. The NAND gate may have more than two inputs and only one output.



(a) Symbol.

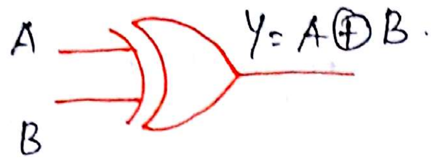
INPUT		OUTPUT.
A	B	Y.
0	0	1
0	1	1
1	0	1
1	1	0

(b) Truth table.

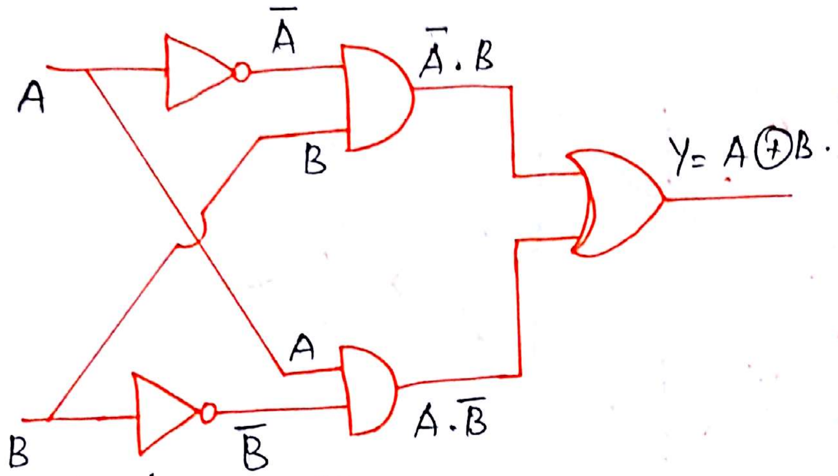
The above diagram shows the two input NAND gate and has a single output. The output of NAND gate is high when anyone of the input is low. The output is low when both of the inputs is high.

Exclusive OR gate [EX-OR gate]:

This is a special type of combinational circuit. This combines several basic logic operations. This contains ~~more~~ two or more inputs and only one output. The inputs A and B produces the output as 'A exclusive B'. ($A \oplus B$) $\bar{A}B + A\bar{B}$. The output is high only In EX-OR gate, the output is high only when both inputs are different. The output is low when both inputs are different.



(a) Symbol



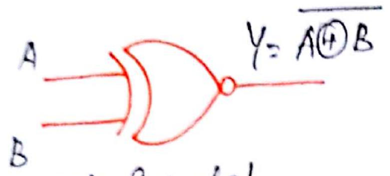
(b) Logic diagram

INPUT		OUTPUT
A	B	Y.
0	0	0
0	1	1
1	0	1
1	1	0

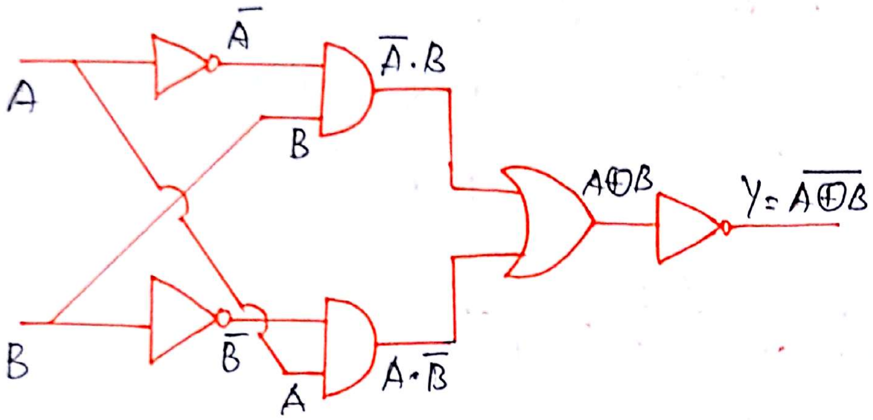
(c) Truth table.

Exclusive NOR gate [EX-NOR gate]:

The complement of EX-OR gate is EX-NOR gate. This gate may contain two or more inputs but only one output. The inputs A and B makes the output. $\overline{A \oplus B}$ (ie) $\overline{\bar{A}B+\bar{B}A}$. The output of the gate is high only when both the inputs are same. The output is low when both inputs are different.



(a) Symbol



(b) Logic diagram.

INPUT		OUTPUT
A	B	Y.
0	0	1
0	1	0
1	0	0
1	1	1

(c) Truth table.

BOOLEAN ALGEBRA:

Boolean algebra is the mathematical technique to solve logic problems. The elements of boolean algebra are '0' and '1'. Boolean Algebra was invented by George Boole in 1854. We have various postulates, laws and theorems in Boolean Algebra.

POSTULATES:

$A+0 = A.$

$A+1 = 1$

$A \cdot (B+C) = A \cdot B + A \cdot C$

$A+\bar{A} = 1$

$A \cdot 0 = 0$

$A \cdot 1 = A.$

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

$A \cdot \bar{A} = 0.$

Theorems:

$A+A = A.$

$A \cdot A = A.$

$A(\bar{A}+B) = AB.$

$(A')' = A \quad [\bar{\bar{A}} = A]$

$A+AB = A.$

$(A+B)(A+\bar{B}) = A.$

$AB + A\bar{B} = A.$

$A \cdot (A+B) = A.$

$A+\bar{A}B = A+B.$

Laws:

a) Commutative law.

$$A+B = B+A.$$

$$A \cdot B = B \cdot A$$

b) Associative law.

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

$$A \cdot (B \cdot C) = (A \cdot B) \cdot C$$

c) Distributive law:

$$A \cdot (B+C) = A \cdot B + A \cdot C$$

$$(A+B) \cdot (C+D) = A \cdot C + B \cdot C + A \cdot D + B \cdot D.$$

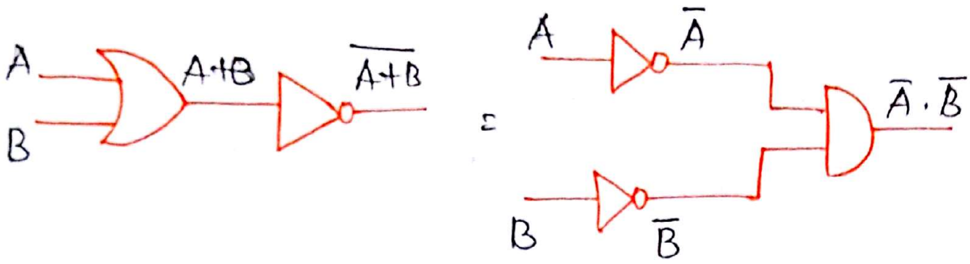
DE-MORGAN'S THEOREM:

This theorem is used for the simplification of Boolean algebra. This has two theorems.

FIRST LAW:

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

The Sum of the complements of the variable is equal to the product of their Complements.



(a) Logic diagram.

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

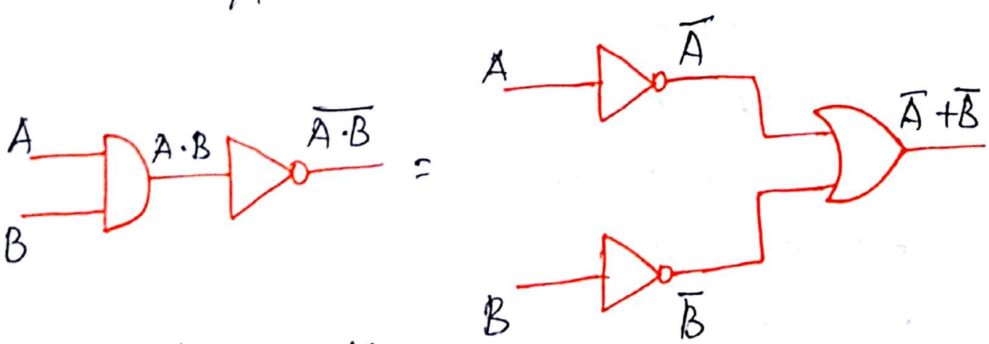
(b) Truth table

From the truth table $\overline{A+B} = \bar{A}\cdot\bar{B}$. is verified.

SECOND LAW:

The complementary product of the variables is equal to the sum of their complements.

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



(a) Logic diagram

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

(b) Truth table.

From the table $\overline{A\cdot B} = \overline{A}+\overline{B}$ is verified.

SIMPLIFICATION OF EXPRESSIONS USING BOOLEAN TECHNIQUES.

1) $Y = AB\overline{C}\,\overline{D} + \overline{A}B\overline{C}\,\overline{D} + \overline{A}BC\overline{D} + ABC\overline{D}$

$= B\overline{C}\,\overline{D}(A+\overline{A}) + BC\overline{D}(A+\overline{A})$

$= B\overline{C}\overline{D} + BC\overline{D}$

$= B\overline{D}\cdot[C+\overline{C}]$

$Y. = B\overline{D}$

2) $Y = AB + A(B+C) + B(B+C)$

$= AB + AB + AC + BB + BC$

$= AB + AC + B + BC$

$= AB + AC + B[1+C]$

$= AB + AC + B$

$= B[A+1] + AC$

$Y = B + AC.$

3) $Y = A\bar{B}D + A\bar{B}\bar{D}$

$= A\bar{B}[D + \bar{D}]$

$Y = A\bar{B}$

4) $Y = (\bar{A}+B)(A+B)$

$= \bar{A}A + \bar{A}B + AB + BB$

$= \bar{A}B + AB + B$

$= B[A+\bar{A}] + B$

$= B + B$

$Y = B.$

ADDERS:.

The mathematical operations such as addition, subtraction, multiplication, division, etc.. are performed in the digital circuits based on the binary adders. There are two types of adders.

a) Half adder

b) Full adder.

There are only four cases in adding two binary digits. They are

$0+0 = 0$

$1+0 = 1$

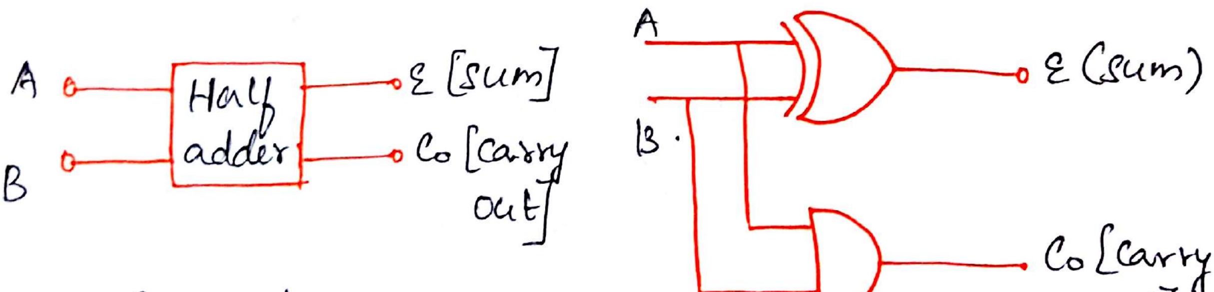
$1+1 = 10_2$ → Sum is 0 and carry is 1

$1+1+1 = 11_2$ → Sum is 1 and carry is 1.

When more than two numbers are to be added, the first two bits are added together and their sum is added to the third bit and so on.

HALF ADDER:

A logic circuit which is used for adding two single bit binary numbers is called as half adder. A & B are the two inputs and sum (S) and carry (c) are the two outputs.



(a) Symbol.

(b) logic diagram

INPUT		OUTPUT	
A	B	S	C_o
0	0	0	0
0	1	1	0
1	0	1	0
1	1	0	1

(c) Truth table.

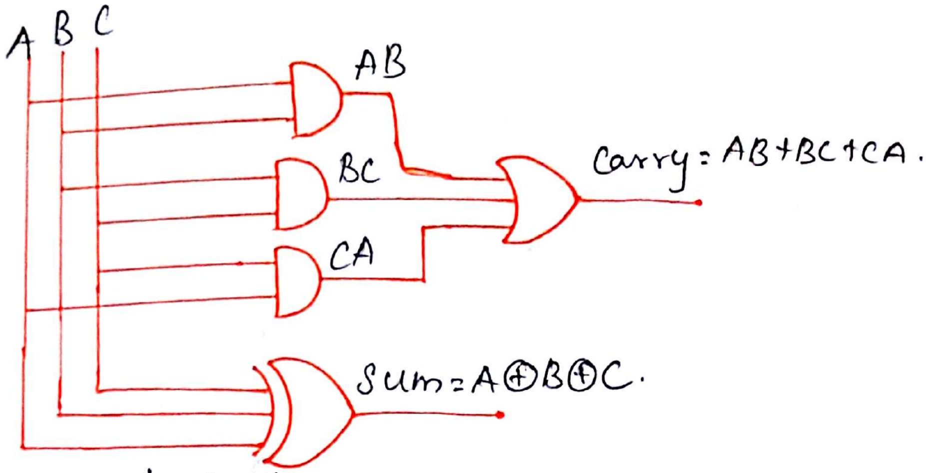
The expression for Sum $S = \bar{A}B + A\bar{B}$

Carry $C_o = AB$.

The EX-OR gate is used to produce the sum & the AND gate is used to produce the carry of the half adder.

FULL ADDER:

A logic circuit that can be used for adding three single bit binary numbers is called full adder. Here A, B & C are the inputs and Sum (S) and Carry (C_o) are the outputs.



(b) Logic diagram.

INPUTS			OUTPUTS.	
A	B	Cin	S	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) truth table.

From the truth table, the expression for Sum and carry are as follows.

$$S = \bar{A}\bar{B}C + \bar{A}B\bar{C} + A\bar{B}\bar{C} + ABC$$

$$S = \bar{A}[\bar{B}C + B\bar{C}] + A[\bar{B}\bar{C} + BC] \rightarrow (I)$$

The value of $\bar{B}\bar{C} + BC$ can be reduced as,

$$\bar{B}\bar{C} + BC = \overline{\overline{\bar{B}\bar{C} + BC}} \quad [\because \bar{\bar{A}} = A]$$

$$= \overline{\overline{(\bar{B}\,\bar{C})}\cdot\overline{(BC)}}$$

$$= \overline{(\overline{\bar{B}}+\overline{\bar{C}})\,(\bar{B}+\bar{C})}$$

$$= \overline{(B+C)\,(\bar{B}+\bar{C})}$$

$$= \overline{B\bar{B}+B\bar{C}+\bar{B}C+C\bar{C}}$$

$$\bar{B}\bar{C}+BC = \overline{B\bar{C}+\bar{B}C} \longrightarrow (II) \quad [\because B\bar{B}=0;\ C\bar{C}=0]$$

Substitute the value of equation (II) in equation (I).

We get, $S = \bar{A}\,[\bar{B}C+B\bar{C}] + A\,[\overline{B\bar{C}+\bar{B}C}]$

$$= \bar{A}\,[B\oplus C] + A\,[\overline{B\oplus C}]$$

$$= A\oplus(B\oplus C)$$

$$S = A\oplus B\oplus C \longrightarrow (III)$$

From the truth table carry is derived as follows.

$$\text{Carry} = \bar{A}BC + A\bar{B}C + AB\bar{C} + ABC$$

$$= \bar{A}BC + A\bar{B}C + AB\bar{C} + ABC + ABC + ABC$$

$$= BC\,[\bar{A}+A] + AC\,[\bar{B}+B]\ AB\,(\bar{C}+C]$$

$[\because ABC + ABC + ABC = ABC]$

$$= BC + AC + AB \quad [\because X+\bar{X}=1]$$

$$C = AB+BC+CA \longrightarrow (IV).$$

The logic diagram for sum and carry is shown in the figure. Three input EX-OR and OR gates are also used in the logic diagram of full adder.

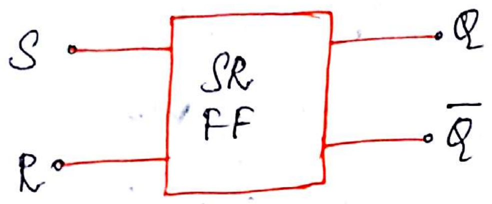
SEQUENTIAL LOGIC CIRCUIT:

A flip flop is a sequential logic device can perform storing the digital data in the form of bits. The output of the sequential logic circuit depends not only on the present state inputs, but also depends on the previous output (memory). Flip flops uses a bistable logic element with one or more inputs and two outputs. A flip flop can store one bit of binary data either '1' or '0'. A flipflop is different from combinational logic circuits because it has internal feedback from the output to its inputs. Flipflop is also known as latch and bistable multivibrator. The flipflops are divided into following types.

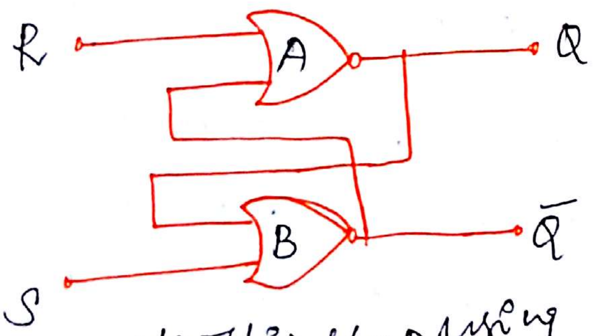
(a) SR flip flop
(b) CSR flipflop
(c) JK flipflop
(d) D flipflop.
(e) T flipflop

SR FLIPFLOPS:

The simplest flipflop is the S.R [Set - Reset] flip flop. S is the set input, R is the Reset input, and Q, $\bar{Q}$ are the output. and the complementary outputs of the flipflop.



(a) Schematic diagram of SR flipflop.



(b) Flip flop using NOR Gate.

INPUT		OUTPUTS.	
R	S.	Q	$\bar{Q}$
0	0	No change	
0	1	1	0
1	0	0	1
1	1	Indeterminate.	

(c) Truth table of SR-flipflop

The circuit diagram of SR flipflop using NOR gates is shown in the figure. We can also used NAND gate in SR flip flop. The working of the SR flipflop is as follows:

a) When input S=0 & R=0; the flipflops remain unchanged. It does not change from its previous value. because there is no setting or resetting value.

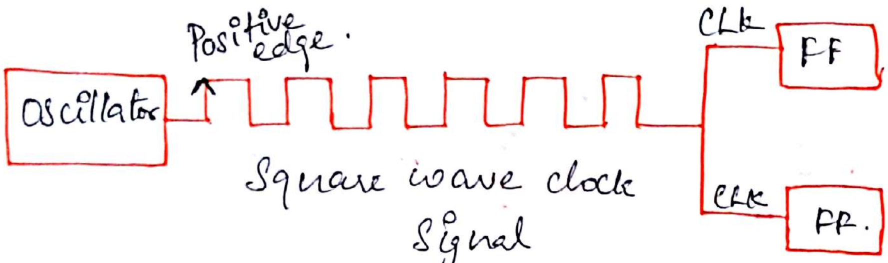
b) When R=0 & S=1; the flip-flop is set (ie) Q = 1 this makes $\bar{Q}$ = 0 & Q = 1. But, when S=1 & R=0 is applied again, there will be no change in the state of the flipflop because it is already set.

c) When R=1 and S=0; the flip flop is reset, (ie) Q = 0 & $\bar{Q}$ = 1. When we apply again there will be no change in the state of the flipflop.

d) When R=1 and S=1; the flip flop does not allow because it requires Q to be compliment of $\bar{Q}$. So, it is an indeterminate stage.

Clocked SR flip flop:

A Clock [CLK] pulse is added to the SR flip flop. The clock pulse is a square wave signal, which is produced from the crystal oscillator. The frequency of the clock pulse determines the speed of operation.



(a) Clock pulse.

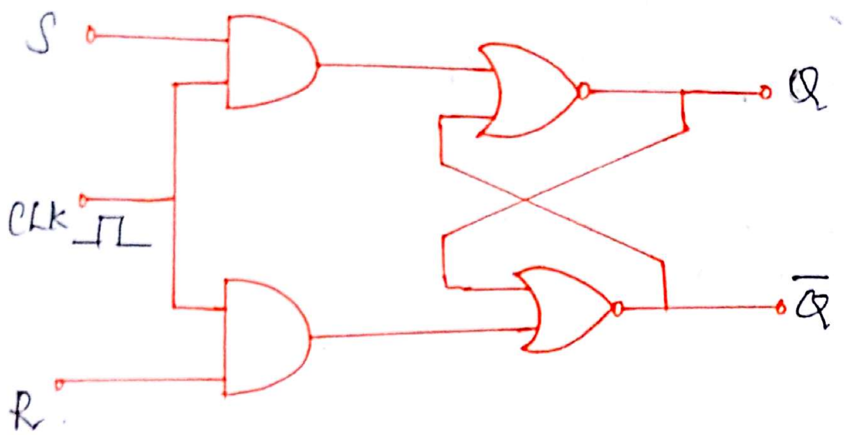
This flipflop is triggered only at the positive edge. of the clock input. The negative edge does not affect the previous state. outputs. Hence, it is called as positive triggered as level triggered flip flop.

The CSR has three inputs S, R and clock and two outputs (Q & $\bar{Q}$). The operation of CSR is as follows:

a) When the clock is low, the output will not change regardless of the conditions of S and R inputs.

b) When the clock input is high, the flip flop will set if R = 0 and S = 1.

c) When the clock is high and R = 1; S = 0, the flip flop will reset.



(b) clocked SR flipflop

INPUT			OUTPUT	
Clk	R	S	Q	$\overline{Q}$
0	0	0	No change	
0	0	1	No change	
0	1	0	No change	
0	1	1	No change	
1	0	0	No change	
1	0	1	1	0
1	1	0	0	1
1	1	1	Indeterminate	

(c) truth table of clocked SR flip-flop.

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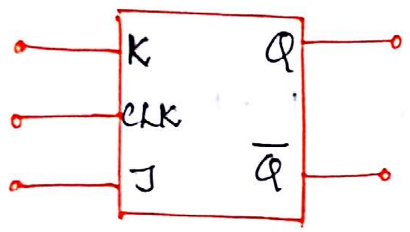
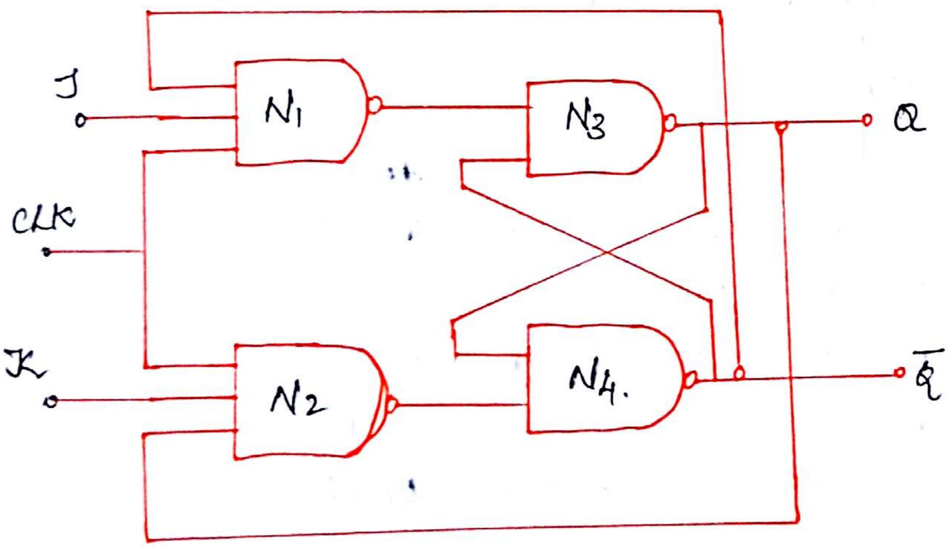
JK FLIP FLOP:

The JK flip flop is advancement of SR flip flop. J is same as S [set] input and K is same as R [Reset] input of the SR flip flop. The major difference is that the J and K inputs both can be high and Q and $\overline{Q}$ are fed back to the pulse-steering NAND gate.



(a) Schematic of JK flipflop



(b) JK flipflop using NAND gates.

The operation of JK flip flop is as follows.

1. When J = K = 0, both the input NAND gates are disabled and the CLK will not change the flip flop states.

2. When J = 0; K = 1; the negative going edge of the clock pulse puts outputs at Q = 0 and $\bar{Q}$ = 1.

3. When J = 1 and K = 0; the negative going edge of the clock pulse puts the Q = 1 and $\bar{Q}$ = 0.

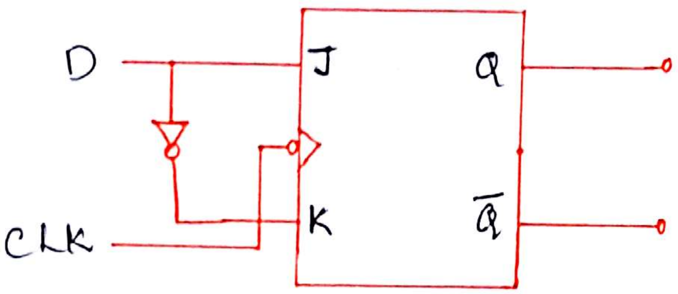
4. When J = 1 and K = 1; the output of the flipflop decides which of the gates N_1 or N_2 is disabled. Therefore the outputs Q and $\bar{Q}$ toggles or alternate with each negative going clock edge.

INPUT			OUTPUT		States.
CLK	J	K	Q	$\bar{Q}$	
0	0	0	0	1	Inactive
0	1	0	0	1	Inactive
0	1	1	0	1	Inactive
1	0	0	0	1	Inactive
1	1	0	0	0	Set.
1	0	1	0	1	Reset.
1	1	1	1	0	toggling
1	1	1	0	1	

Truth table of JK flip flop

D FLIP FLOP:

The D flip-flop is also known as data flip flop. D flip-flops are sequential logic device which are widely used as a temporary memory devices.



(a) D Flip flop.

The signal is applied to J terminal of JK flip flop. The complement of data is then applied to K-terminal. The operation of the D-flip flop is as follows:

1. If D=0 [J=0], then K=1 and the output Q=0, so the flip flop goes to the reset state.
2. If D=1 [J=1], then K=0 and the output Q=1, so the flip flop goes to the set state.

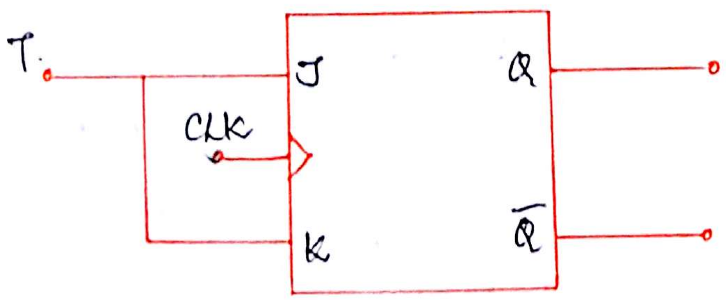
The truth table for this flip-flop indicates that the input is transferred to the output at the end of the clock pulse. The output after clock pulse equals the input at D before the clock pulse. So the transfer of data from input to output is delayed and this D flip flop is also called delayed flip flop.

INPUT	OUTPUT
D	Q
0	0
1	1

Truthtable of D flipflop.

T. FLIPFLOP:

The T flip-flop is also called as Toggle flip flop. This flip flop changes the state with each clock pulse and hence it is called as toggle switch.



T Flip flop.

If J = K = 1, then output is the complement of the previous state. So that the JK flip flop is converted into T-flip flop.

INPUT	OUTPUT	
CLK	T	Q
0	0	no change
0	1	no change
1	0	no change
1	1	$\overline{Q}$

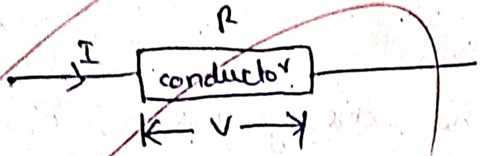
truthtable of T flipflop.

NAME:- PANNURU SAIKUMAR
SUBJECT:- BEEE
SUBJECT CODE:- U18EE101

REGISTER NO:
U19AE076

1 **ohm's law:-**

ohm's law states that at constant temperature the current flow through a conductor is directly proportional to the potential difference between the two ends of the conductor.



$I \propto V$

$V \propto I$

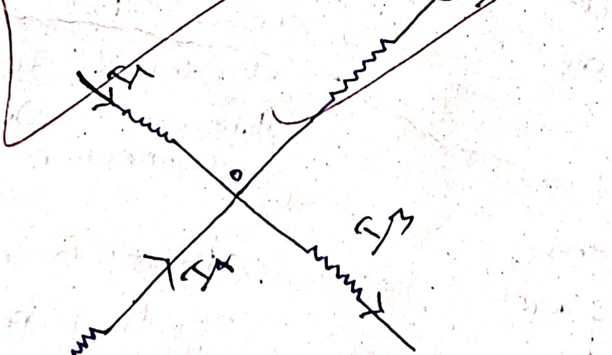
$\boxed{V = IR}$

2 **Kirchoff's current law:-**

The algebraic sum of current flowing towards a junction in an electric circuit is zero

ΣI at junction point $= 0$

Sum of entering current = sum of leaving current



$I_1 + I_2 + I_4 - I_3 = 0$

$\boxed{I_1 + I_2 + I_4 = I_3}$

3 Form factor:-

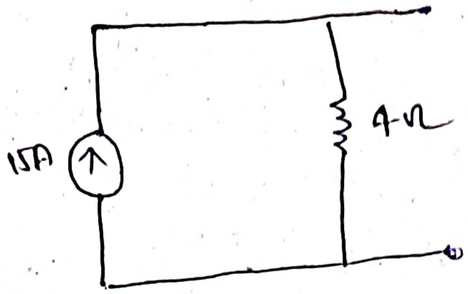
A mathematical factor which compensates for irregularity in the shape of an object, usually the ratio between its volume and that of a regular object of the same breadth and height.

4 Average being the average value, then this current must also transfer the same charge for $t = (\pi/\omega)$. Since average value is the ac value, this charge will be equal to $Q = I_{avg} \times (\pi/\omega)$.

The average value of AC sinusoidal current or voltage is equal to 0.637 times of its peak value.

5

STAR CONNECTION	DELTA CONNECTION
* The terminals of the three branches are connected to a common point. The network formed is known as star connection.	The three branches of the network are connected in such a way that it forms a closed loop known as Delta connection
* The starting and the finishing point ends of the three coils are connected together to a common point known as the neutral point.	There is no neutral point
* line current equal to phase current	line current equals to the root three times of the phase current



Solution:-

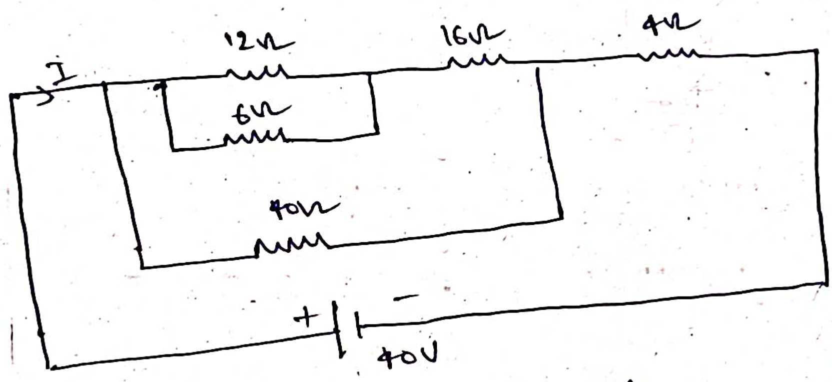
$I = 15A$

$R = 4\Omega$

$V = IR = 15 \times 4$

$V = 60V$

79



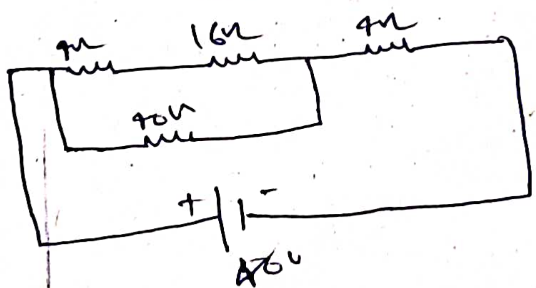
Sol:-

12Ω and 6Ω in parallel

$$R = \frac{R_1 R_2}{R_1 + R_2}$$

$$R = \frac{12 \times 6}{12 + 6}$$

$R = 4\Omega$

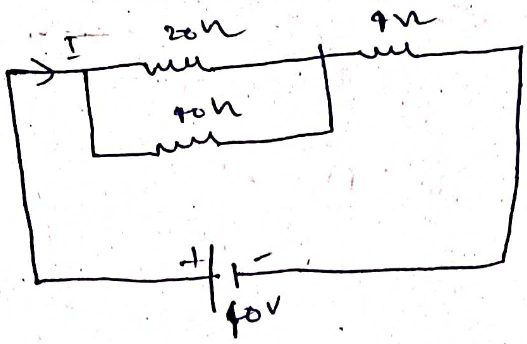


4Ω and 6Ω are ⇒ connected in series

$R = R_1 + R_2$

$= 4\Omega + 16\Omega$

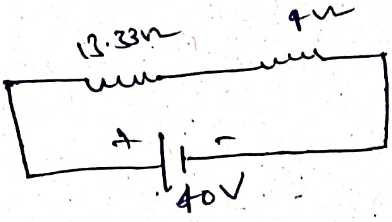
$R = 20\Omega$



⇒ 20Ω and 40Ω are connected in parallel

$$R = \frac{20 \times 40}{20 + 40}$$

$R = 13.33\Omega$



⇒ 13.33Ω and 4Ω are connected in series

$R = 13.33 + 4\Omega$

$R_T = 17.33\Omega$

By ohms law

$V = IR$

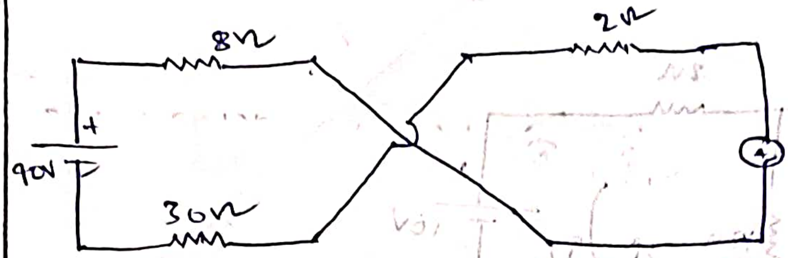
Total (or) equal Resistance $R_T = 17.33\Omega$

$$I = \frac{V}{R}$$

$$= \frac{40}{17.33}$$

$= 2.308$

8 b



Solution

Total Resistance = 8+2+30 = 40Ω

Total voltage = 100+40 = 140V

V = 140V

R = 40Ω

Total current through the circuit (I) = V/R

= 140/40

I = 3.5 Amp

9b STEPS to solve the Nodal Voltage method:-

* convert all voltage source to current sources (source transformation)

* select nodes. Take one of node is a reference node

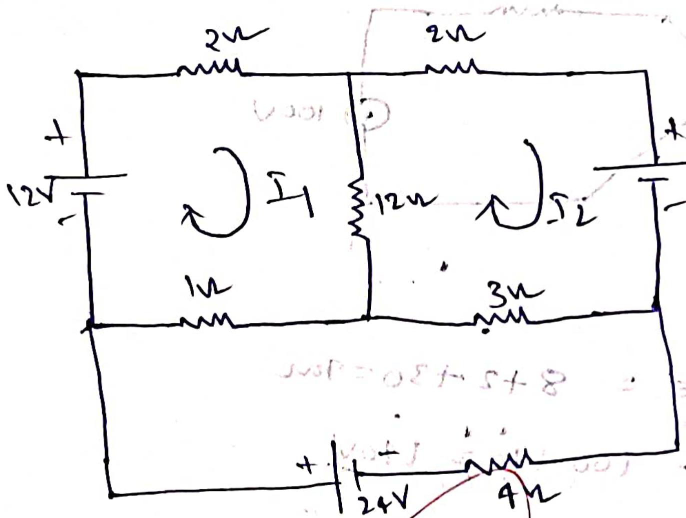
n = no of nodes

* write the equations for each node as per KCL

* Solve the above equations to get the nodal voltages

* calculate the branch current from the values of voltage.

10



Apply KVL at loop 1 :-

$2I_1 + 12(I_1 - I_2) + 1(I_1 - I_3) = 12$

$2I_1 + 12I_1 - 12I_2 + I_1 - I_3 = 12$

$15I_1 - 12I_2 - I_3 = 12$ —①

Apply KVL at loop 2

$2I_2 + 3(I_2 - I_3) + 12(I_2 - I_1) = -10$

$2I_2 + 3I_2 - 3I_3 + 12I_2 - 12I_1 = -10$

$-12I_1 + 17I_2 - 3I_3 = -10$ —②

Apply KVL at loop 3

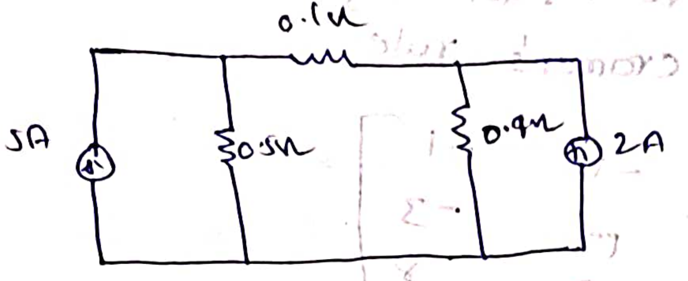
$1(I_3 - I_1) + 3(I_3 - I_2) + 4I_3 = 24$

$I_3 - I_1 + 3I_3 - 3I_2 + 4I_3 = 24$

$-I_1 - 3I_2 + 8I_3 = 24$ —③

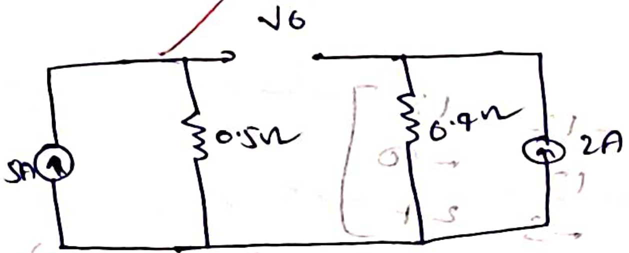
From eq ①, ② and ③

$$\begin{bmatrix} 15 & -12 & -1 \\ -12 & 17 & -3 \\ -1 & -3 & 8 \end{bmatrix} \begin{bmatrix} I_1 \\ I_2 \\ I_3 \end{bmatrix} = \begin{bmatrix} 12 \\ -10 \\ 24 \end{bmatrix}$$



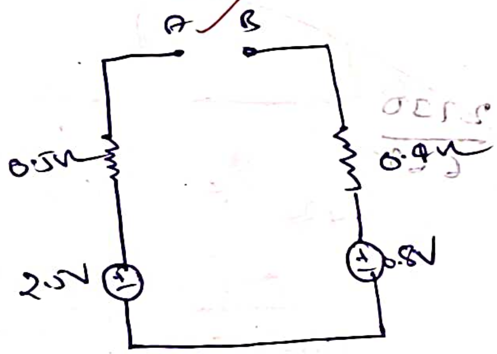
Solution:-

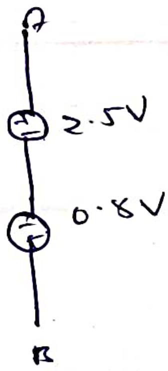
step:-1 To find V_0 = ?



$V_1 = 5 \times 0.5 = 2.5V$

$V_2 = 2 \times 0.4 = 0.8V$





$V_0 = 2.5V - 0.8V$

$V_0 = 1.7V$

current through 4Ω resistor $= I_3$

10 Find I_3 by using cramer's rule

$$\Delta = \begin{bmatrix} 15 & -12 & -1 \\ -12 & 17 & -3 \\ -1 & -3 & 8 \end{bmatrix}$$

$\Delta = 15\ (136-9) + 12\,(-96-3) - 1\ (36+17)$

$\Delta = 1905 + (-1188) - 53$

$\Delta = 664$

$$\Delta I_3 = \begin{bmatrix} 15 & -12 & 12 \\ -12 & 17 & -10 \\ -1 & -3 & 24 \end{bmatrix}$$

$= 15\ (408-30) + 12\ (-288-10) + 12\,(36+17)$

$= 5670 - 3576 + 636$

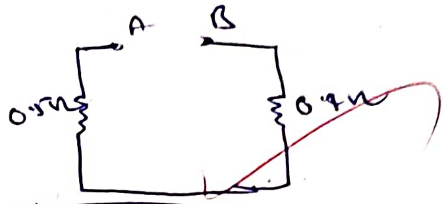
$\Delta I_3 = 2730$

$I_3 = \dfrac{\Delta I_3}{\Delta} = \dfrac{2730}{664}$

$I_3 = 4.11$ Amp

STEP:-2 To find R_{TH} = ?

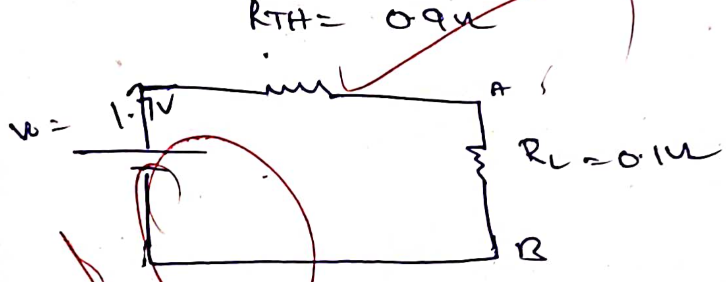
consider only Resistance values



$R_{TH} = 0.9\Omega$

Step:-3 To find I_L = ?

Thevenin's equivalent circuit



$$I_L = \frac{V_0}{R_{TH}+R_L}$$

$$I_L = \frac{1.7}{0.9+0.1}$$

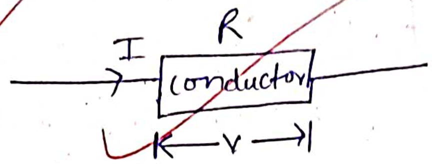
$I_L = 1.7 Amp$

Name : Sunkara Manikanta Subject : BEEE

Reg NO : U19AE093 Subject Code ; U18ESEE101

(1) **Ohm's law :-**

Ohm's law states that at constant temperature the current flow through a conductor is directly proportional to the potential difference between the two Ends of the conductor.



$I \propto V$

$V \propto I$

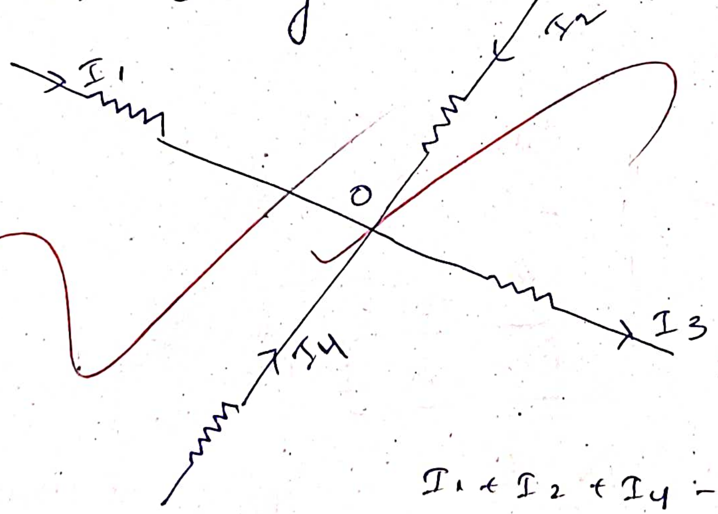
$$\boxed{V = IR}$$

(2A) **Kirchoff's current law :-**

The algebric Sum of current flowing towards a Junction in an Electric Circuit is Zero

ΣI at Junction point o.

Sum of entering current = Sum of leaving current



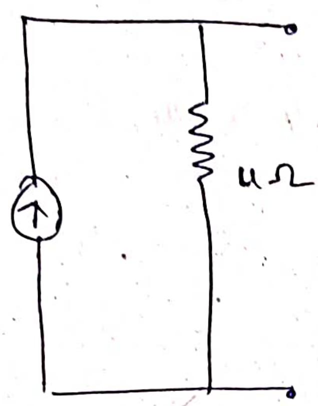
$I_1 + I_2 + I_4 - I_3 = 0$

$$\boxed{I_1 + I_2 + I_4 = I_3.}$$

3A) **Form Factor :-** A mathematical factor which compestate for irregulatity in the shape of an object, usually the ratio between its volume and that of a regular object of the Same breadth and height.

4n.) Average being the average value, then this current must also transfer the same charge for $t = (T/\omega)$. Since average value is the DC value this charge will be equal to $Q = I_{avg} \times (T/\omega)$. The average value of AC sinusoidal current or voltage is equal to 0.637 times of its peak value.

6)



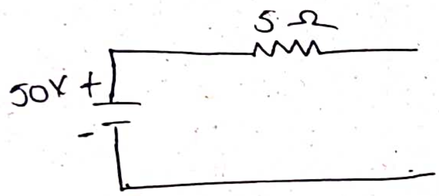
Solution

$I = 15A$

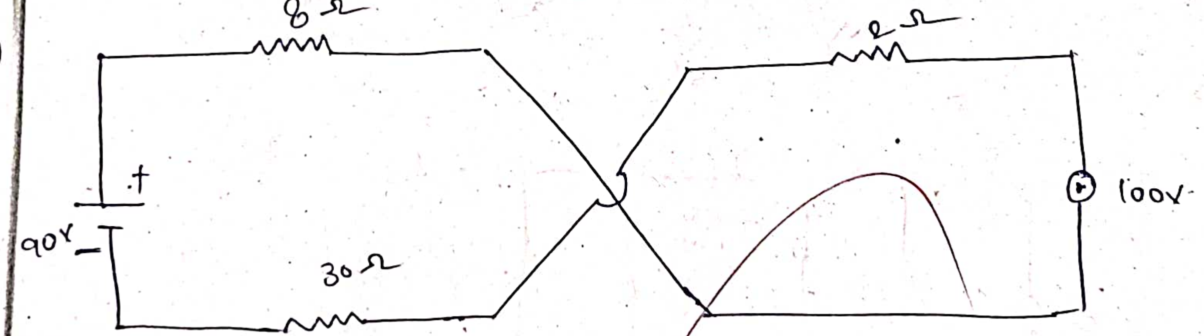
$R = 4\Omega$

$V = IR = 15 \times 4$

$V = 60V.$



8b)



Solution

Total Resistance $= 8 + 2 + 30 = 90\Omega$

Total Voltage $= 100 + 40 = 140V$.

$V = 140V$

$R = 40\Omega$

Total current through the circuit $(I) = V/R$

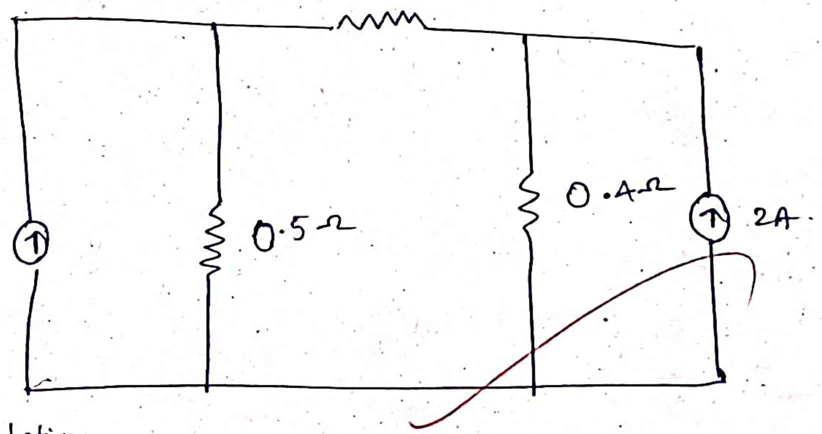
$= 140/40$

$I = 3.5$ Amp.

9b) Steps to solve the Nodal voltage methods:-

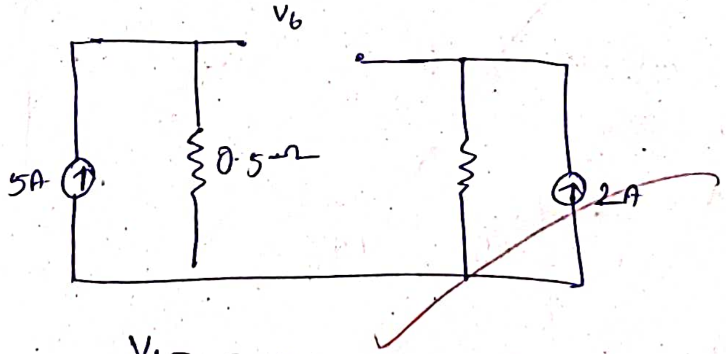
1. convert all voltage source to current sources (source transformation)
2. Select nodes Take one of node is a reference node
   n = no of nodes
3. write the equations for each node as perfect.
4. Solve the above equations to get the nodal voltages.
5. Calculate the branch current from the value of voltage.

12)



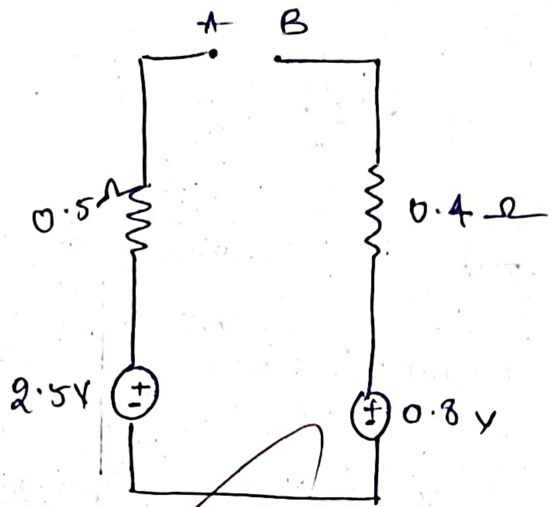
Solution

Step-1 To find $V_o = 1$



$V_1 = 5 \times 0.5 = 2.5V$

$V_2 = 2 \times 0.4 = 08V$

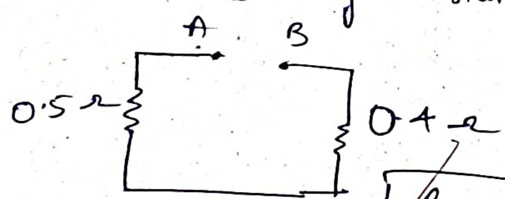


$V_o = 2.5V - 0.8V$

$V_o = 1.7V$

Step-2 to find R_{TH} ?

consider only Resistance Values

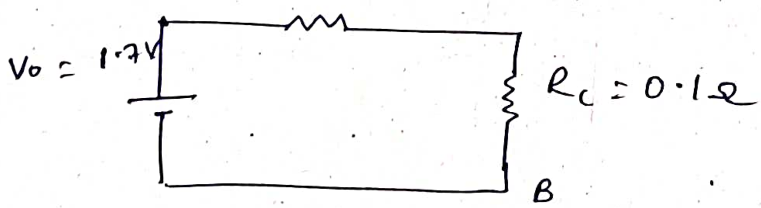


$R_{TH} = 0.9\Omega$

Step:3 To find I_L ?

Thevenin's Equivalent circuit

$R_{TH} = 0.9\Omega$



$I_L = V_o / R_{TH} + R_L \Rightarrow I_L = \frac{1.7}{0.9 + 0.1} \Rightarrow I_L = 1.7 \text{ Amp}$

18-19
9A-I (M)

25
52

Bharath
INSTITUTE OF HIGHER EDUCATION & RESEARCH
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BHARATH INSTITUTE OF SCIENCE & TECHNOLOGY
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INDUSTRIAL BIO TECHNOLOGY

Student Name: PATHAN SAI BABA VALI
Reg No: U19AE077 Sem / Year: I
Sub Code: U18ESEE101
Examination: ... Student Sign: ...

10. (a) Determine the Current through 4 ohm resistor and using Mesh Current Analysis.

A: Apply KVL at node 1 = 12
Apply KVL at node 2 = -10
Apply KVL at node 3 = 24

Current through 4 ohm resistor = 13

13 = 4.11 amps

10 (b) Find Current through 0.4 ohm resistor using the Thevenin's Theorem

A: (2)

$V1 = 2.5$ volt

$V2 = 0.8V$

$V_0 = V_2 - V_1$

$= 2.5V - 0.8V$
$= 1.7V$
$R_{th} = 0.9$ ohm

11.(a) Derive the expression in Current and Voltage in three Phase balanced Circuit in the star Connected System.

In three Phase Circuit the Voltage across the individual coil Called phase Voltage and Voltage between two lines is Called line Voltage.

Current : apply Kirchhoff law

This means balanced star Connected System $I_P = I_l$

Phase Current = line Current

Voltage : $V_l = 3e_P$

line Voltage = root 3 Phase Voltage

11.(b) derive the Expression of AC Current flow through the Pure RL Circuit

Let $V = V_m \sin \omega t$ be the applied Voltage

I = Circuit Current at any instant

R = resistor

V_l = Inductor

F= Frequency

V= Vr+Vl

Tan θ = Xl/r

θ = Tan⁻¹(Xl/r)

is called phase angle and angle between V and L values lies between 0 to 90°.

7.(a) Calculate the equivalent resistance of given circuit.

12 ohm and 16 ohm in Parallel

R= R1R2\ R1+R2 = 40 ohm

2

40 ohm and 60 ohm are Connected in Parallel R=13.33 ohm

13.33 ohm and 40 ohm Series Rr=17.33 oh

V=1r

I = V/r = 2.88 amps

7.(b) Find Equivalent resistance

R= 0.5 ohm

Rr= 1.5 ohm

1.5 ohm and 1.5 ohm are Connected in Parallel

R=0.75 ohm

1 ohm and 0.75 ohm are in Series.

R = 1.75 ohm

Current V = i/r

I = 5.714 amps

8.(a) Write the step by step to solve the procedure of Nodal analysis.

A: → Convert all voltage source to current source.

→ Select one node. Take one of the ref node. N = No. of node.

→ Write the equation for each node as per KCL

→ Solve above equation to get Nodal Voltage

→ Calculate the branch current from value of voltage.

8.(b) Apply KVL and find total current of given value

Total resistance = 8+2+30 = 40

Total Vol = 100+40 = 140

I = V/r

I = 140/40

= 3.5 amps

3

9(a) define reactive Power and true Power and apparent Power.

Reactive Power: Drop voltage and draw current gives the deceptive impression they do dissipate Power. this phantom Power is called reactive Power unit is Volt and amps.

3

True Power: Actual amount of Power being Used in a Circuit unit is measured in Watt.

Apparent Power: the Combination of True and reactive Power is Called apparent Power. The unit is volt and amps.

9(b) Derive the expression of AC Current flowing through the Pure resistive Circuit

$$P = (V_m \sin \omega t)(I_m \sin \omega t)$$

$$P = V_m I_m / 2 \; 2 \sin \omega t$$

$$I = V/r \quad V_m \sin \omega t / r = I_m \sin \omega t$$

where $I_m = V_m / r$ = Peak Value of circuit Current.

1

1. "ohms law State that at Constant te[mperature] the current flowing in a Conductor is directly Proportional to the resistance of th[e] circuit."

2. " Total current or change entering [a] junction or node is exactly equal to th[e] charge leaving the node as it has no other place to go except to leave, as no change is lost within the node.

3. Convert the following current source in[to] an equivalent Voltage Source

$$I = V * R = 60.$$

4. The Ratio of RMS value to average va[lue] of alternating quantity is called Form Factor.

Form Factor = RMS value/ avg value

5. Average value = Area under one complet[e] cycle / Period

Iavg = 2Im/pi

6. **Star Connection:**

- → Connection of winding at one Point.
- → There is a neutral or star Point
- → Line Current is equal to Phase Current

Delta Connection:

- → Winding ends are Connected to each other.
- → No Neutral Point
- → Line voltage is equal to Phase Current.

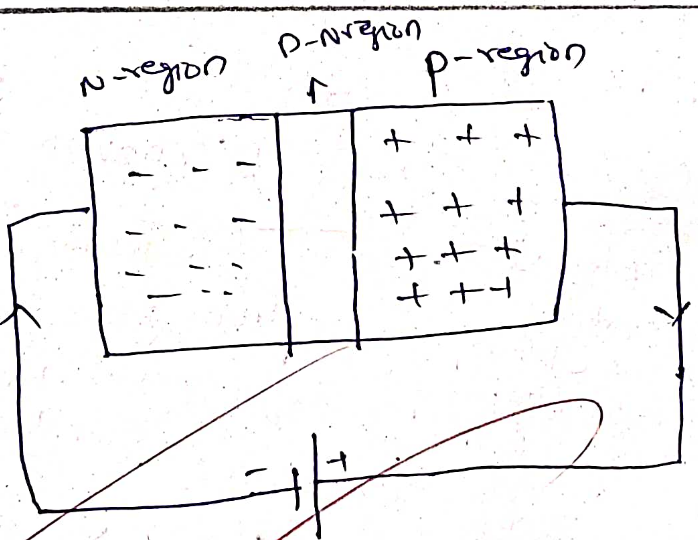
NAME: - Danda Maheshwar reddy Reg no: U19AS007
SUBJECT:- Beee
SUBJECTCODE: - U18ESEE101

(1) Fleming's left hand rule states that when a current - carrying conductor is placed in an external magnetic field, the conductor experiences a force perpendicular to both the field and to the direction of the current flow. It was invented by John Ambrose Fleming.

(2) Types of DC motor:-

Mainly there are two types of DC motors. one is separately Excited DC motor and other is self excited DC motor. The self excited motors are further classified as shunt wound or shunt motor, series wound or series motor and compound wound or compound motor. The dc motor converts electrical power into mechanical power.

(3)



PN junction diode consists of two terminals. positive terminal and negative terminal.

(4) common Base configuration - has voltage gain but no current gain.

common emitter configuration - has both volatge and current gain.

common collector configuration - has current gain no voltage gain.

(5) Applications of zenerdiode:-

* It can be used as a voltage regulator.
* It can be used as a limiter in wave shaping circuit
* It can be used as a fixed reference voltage in transistor biasing circuits
* It is used for meter protection against damage from accidental over voltage
* It can be used as a fixed reference voltage in a network for celibrating voltmeters.

(6)

ADVANTAGES	DISADVANTAGES:
It is universal instrument which can be used for the measurement of AC and DC quantities	These instruments suffer from error due to hysteresis, frequency change and stray losses.
It is very cheap due to simple construction	It is scale is non-uniform and cramped at lower end.

7(b) Torqu
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7(b) Torque equation of DC motor gives the amount and nature of electrical torque Te developed whenever it is taken into service. Basically the performance of DC machine centers around the emf equation and another is torque equation

This equation equally apply for both i.e. generator and motor operation mode of DC machine.

In generator mode of operation the prime mover torque to convert the mechanical energy into electrical energy.

Torque produced in a DC motor is given as

$$T_e = K_a \phi I_a \quad \text{—} (1)$$

where ϕ = Total flux per pole

I_a = Armature current, and

$K_a = (Pz / 2\pi a)$

$F = iLB$

$\phi_t = P\phi$

Magnetic Flux Density B = Total Flux / Area

$= (P\phi / \pi DL)$

wb/m²

Current in each conductor = (I_a / a)

from (2)

$$F = (I_a / a)(P\phi / \pi DL)(L)$$

Torque on single conductor $= FD/2$

$= (I_a P\phi / 2\pi a)$

Total torque $T_e = 2 \times (I_a P\phi / 2\pi a)$

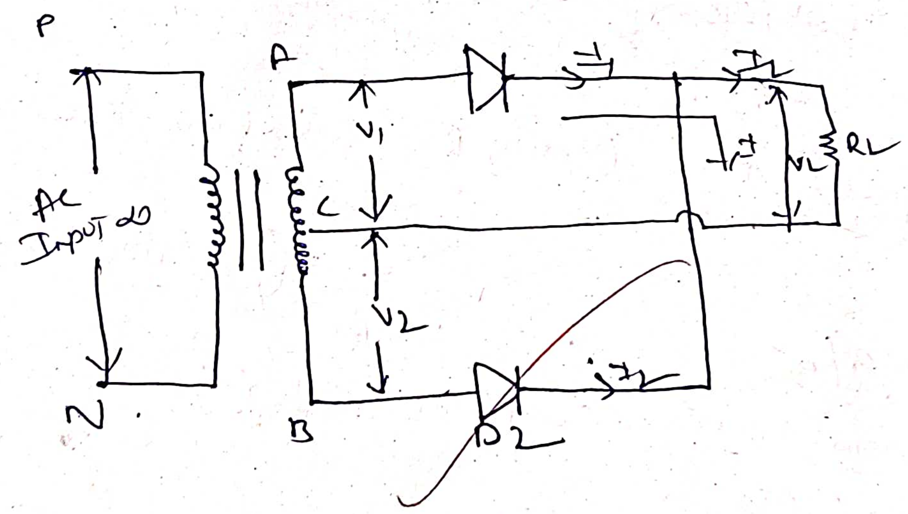
$= (2P/2\pi a)\phi I_a$

$K_a = (2P/2\pi a)$

$$T_e = K_a \phi I_a$$

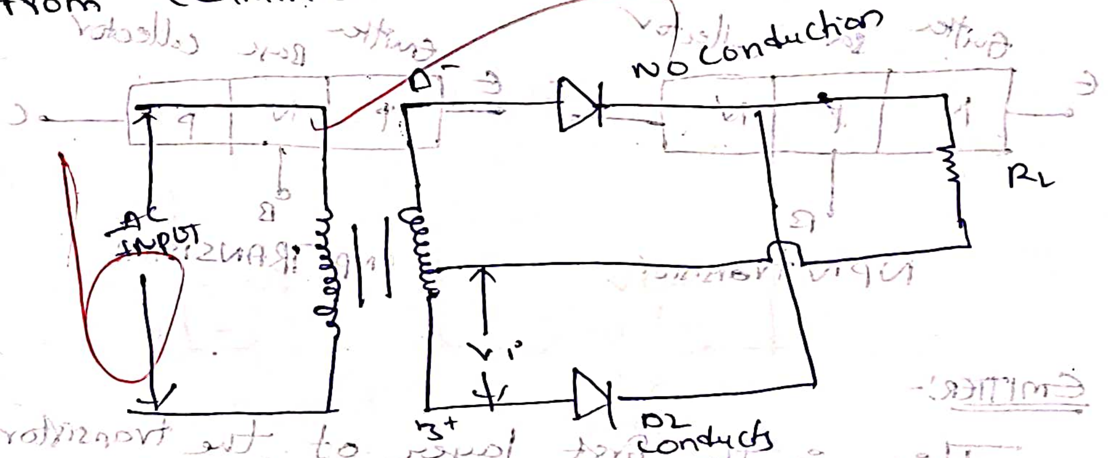
Hence proved.

8(b) FULL WAVE RECTIFIER :- The full wave rectifier contains two diodes, so they conduct for full cycle of the input signal. This rectifier uses centre tap transformer, which produces two equal magnitude of voltages at the opposite terminal. One end of the terminal voltage is one of phase with other end terminal voltage with respect to centre tap terminal



During the positive halfcycle of the input voltage terminal A is positive and B is negative with respect to terminal C. Now, the diode D1 conducts in forward bias and diode D2 is reverse bias. So, the current I_1 flows from the terminal A to the load through diode D1. No current flows through diode D2.

During the negative halfcycle of the input voltage, terminal B is positive and A is negative with respect to terminal C. Now, the diode D2 is forward biased and the diode D1 is reverse biased, so the current I_2 flows from terminal B to the load through diode D2.



The current I_1 & I_2 follows the same direction in the load. If the magnitudes of applied voltage at terminal A is equal to terminal B voltage, then current I_1 is equal to I_2.

(12)

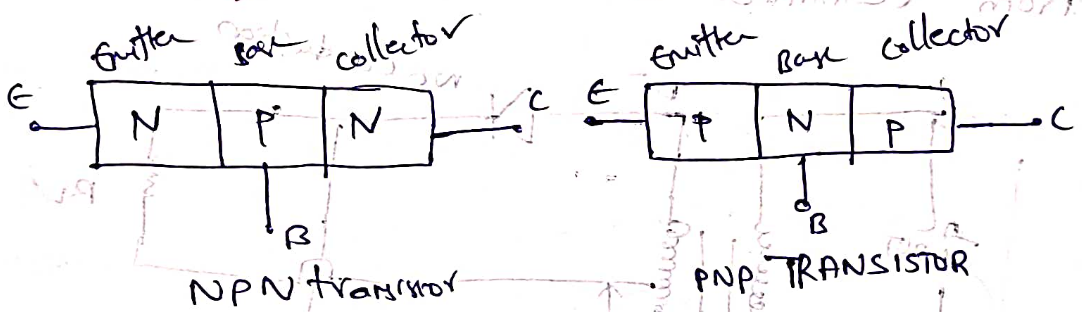
BIPOLAR JUNCTION TRANSISTOR:-

The transistor was developed by Dr. Shockly in bell laboratories in 1951. It is a there terminal, three layer, two junction device whose output voltage and current depends on input voltage, and current.

There are two types of transistor

* NPN transistor
* PNP transistor.

TRANSISTOR CONSTRUCTION:-



EMITTER:-

This is the first layer of the transistor which is heavily doped. This supplies the charge carries [electrons or holes] to the other two regions.

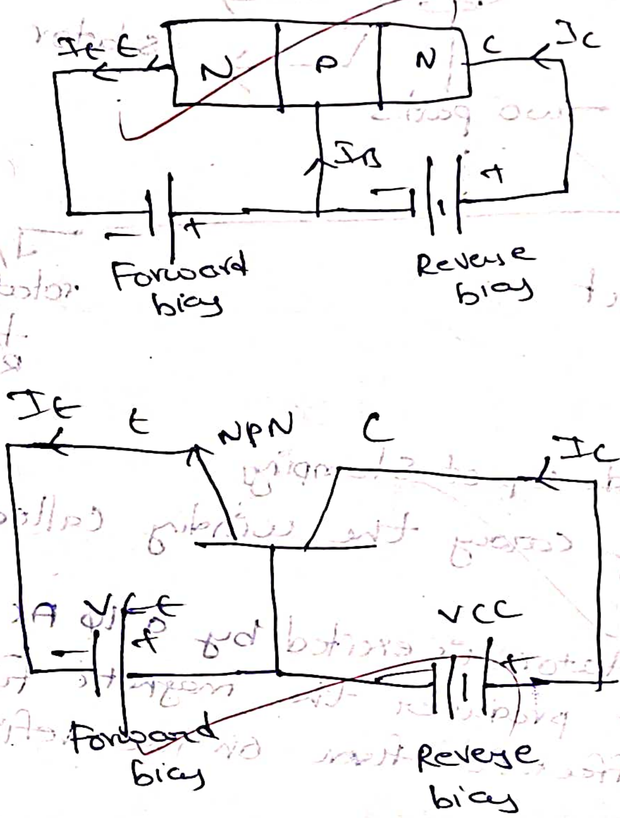
BASE:-

This is the middle region of the transistor. The base of the transistor is lightly doped and small in size (i.e) it is a thin layer.

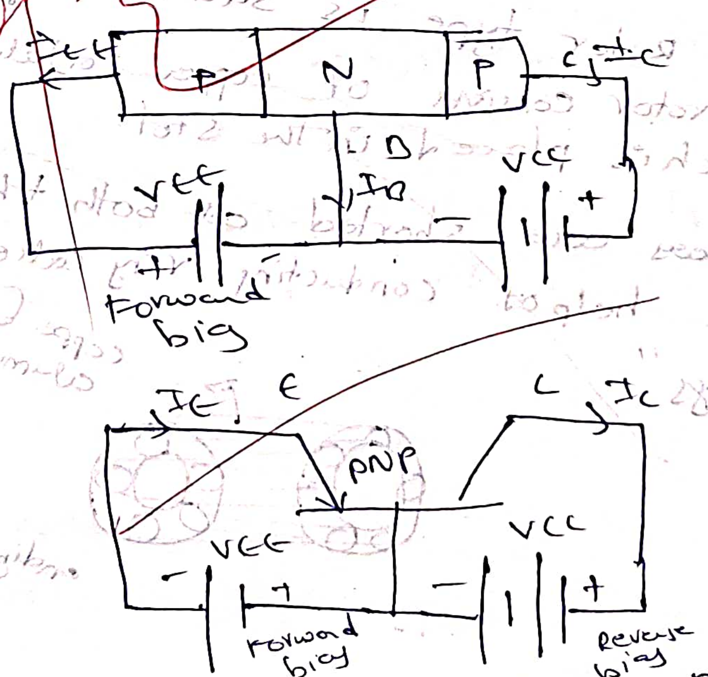
COLLECTOR:-

This is the last layer of the transistor which is moderately doped. This collector part of a transistor is larger than the emitter and base. The collector collects the charge carrier supplied by the emitter.

TRANSISTOR BIASING:-



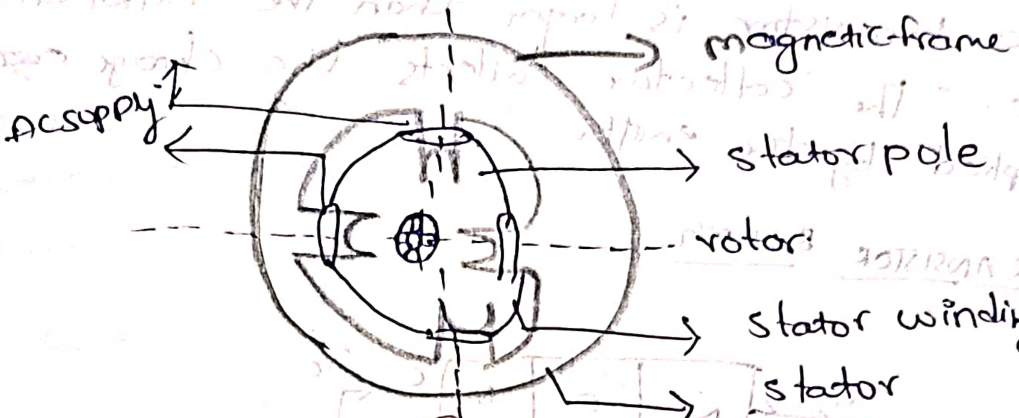
(a) Biasing of NPN transistor



BIASING OF PNP TRANSISTOR.

9(a) SINGLE Phase (1ϕ) induction motor:-

construction:



Two parts

stationary part → stator

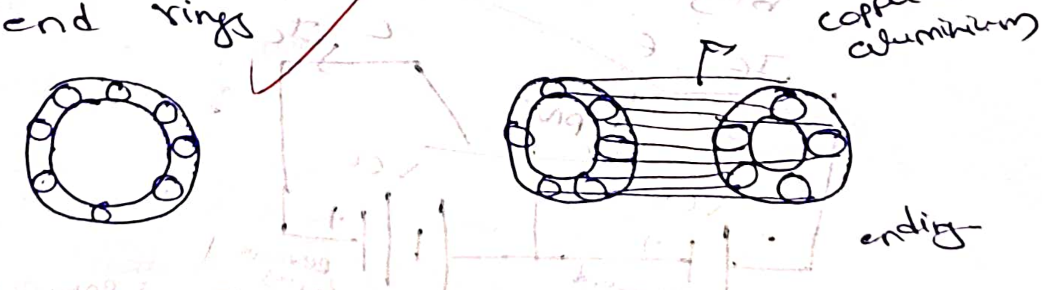
rotating part → Rotor

stator :-

* It is made up of stamping
* Stamping carry the winding called stator winding.
* The stator is excited by a 1ϕ AC supply now stator producer the magnetic field which create effective flux on the definite number of poles

Rotor :-

+ The Rotor type is squirrel cage
* The rotor consists of copper (or) aluminium bar which is placed in the slot.
* The bars are shorted at both the end with the help of conducting ring called "end rings"



12-19 / 10-11 - (4)

32

Student Name: G. P. DEVRAJ ....Date: ....
Reg. No: U19AS008 ....Sem/Year: ....
Sub Code & Name: U18ESEE101
Examination: ....Staff Sign:............Student Sign:..........

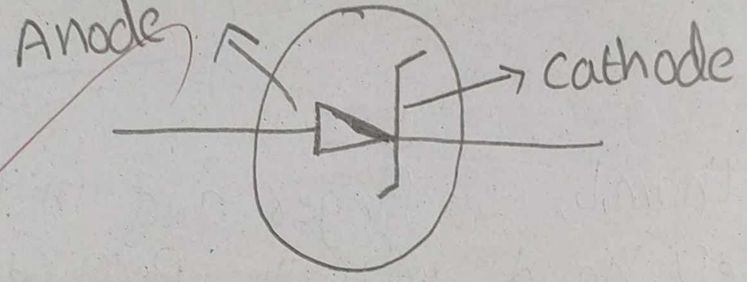
1. The thumb, Fore Finger and middle Finger of left hand mutually Perpendicular directions. Fore finger indicates direction of field flux. Middle finger indicates the direction of current then the thumb Point in the direction of motion of the Conductor.

2. Counter-electromotive Force, also known as back electromotive Force, is the electro motive Force or Voltage that opposes the change in current which induced it.

3. The single Phase motors are simple in Construction cheap in Cost, reliable and easy to repair and maintain. Due to all these advantages, the single phase motor

Fields its application in vaccum cleaners, Fans, washing machines, blowers e.t.c.

4. Forward biasing means putting a Voltage across a diode that allow current to Flow easily, while reverse biasing means putting a Voltage across a diode in the opposite direction. This is useful For changing AC Current to DC Current.

5. 

6. The breakdown Voltage of an insulator is the minimum Voltage that causes a Portion of an insulator to become electrically conductive For diodes. The breakdown Voltage is the minimum reverse Voltage that makes the diode conduct appreciably in reverse. Some devices (such as TRIACS) also have a Forward breakdown voltage.

7(a) Torque Equation of DC Motor:

Force on each conductor $F = BIl$ Newton

here $B \rightarrow$ Average flux density (wb/m^2)

$I \rightarrow$ Current in each conductors

$L \rightarrow$ length of conductor (m)

Torque due to one conductor $= F \times r$ N.m

Total armature torque $T_a = ZFr$ N.m

$= ZBILr$

$r \rightarrow$ radius of armature (m)

$Z \rightarrow$ Total No. of armature Conductors

Now, we know that, $I = \frac{I_a}{A}$ $\boxed{B = \phi/a}$

where a is the cross sectional area of Flux Path at radius

For circular conductor $a = \frac{2\pi r l}{P}$

$$T_a = Z \times \phi/a \times \frac{I_a}{A} \times l \times r$$

$$= Z \times \frac{\phi}{(2\pi r l/P)} \times \frac{I_a}{A} \times l \times r$$

$$= Z\phi \frac{I_a P}{2\pi A} \text{ NM}$$

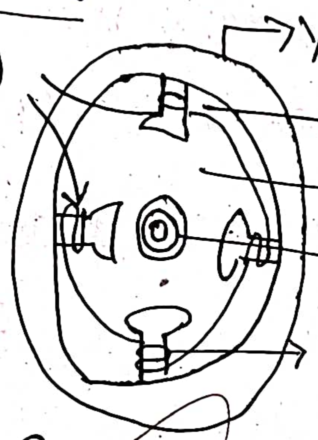
$$T_a = 0.159 Z\phi (P/A) \text{ N.M}$$

For a given DC Motor Z, P.A are Constant

$T_a \propto \phi I_a$ → For Shunt Motor
$T_a \propto I_a^2$ → For Series Motor

8. Single Phase (1ϕ) induction Motor.

Construction:



Construction of a DC Motor

Two Parts

Stationary Part → Stator

Rotatory Part → Rotor

Stator (outer Part)

→ It is made up of stampings
→ Stampings are made up of Silicon steel.
→ The Stamping carry the winding called Stator winding
→ The Stator is excited by a ϕ AC supply now stator produces. The magnetic field which create effective flux on the definite number of Poles.

INTERNAL ASSESSMENT TEST -1

QUESTION PAPER

BHARATH INSTITUTE OF SCIENCE AND TECHNOLOGY

Department of EEE

INTERNAL TEST 1

U18ESEE101Basic Electrical and Electronics Engineering

Date : 14.02.2020

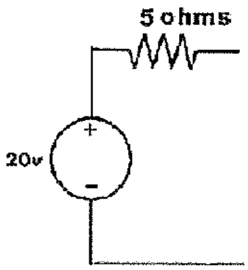
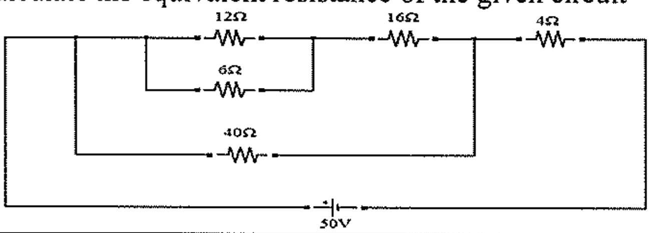
Academic Year / Semester : 2019-2020/EVEN

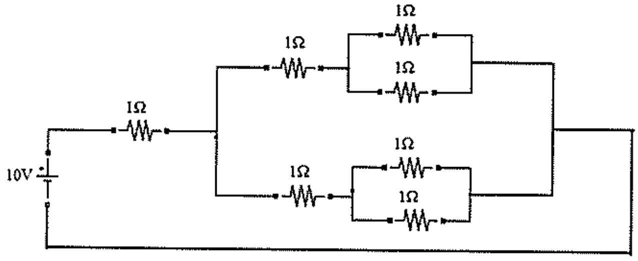
Duration : 1 Hour and 30 Minutes

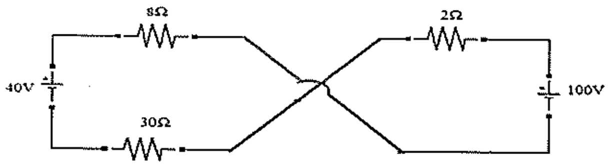
Instructions : Q.no 1-6 Answer all the questions.

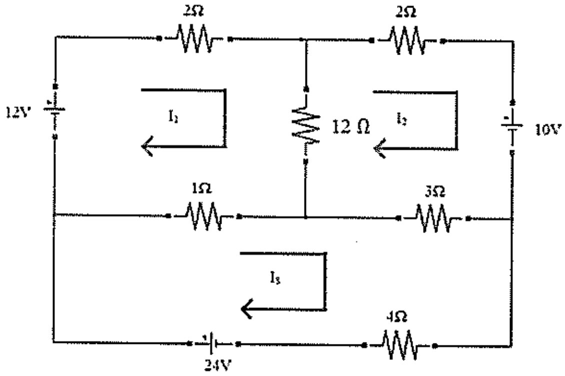
Q.no 7-9 Answer all the questions either a or b.

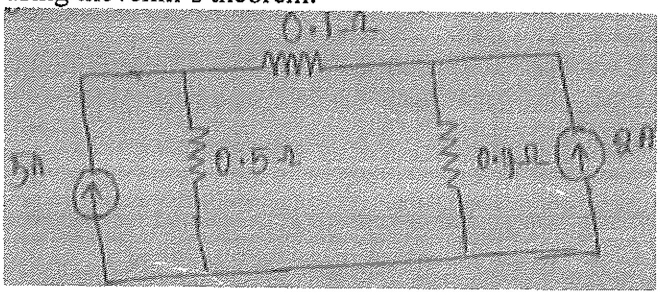
Q.no 10-11Answer all the questions either a or b.

Q.No	Question	Weightage	CO	Bloom's Level
1	State and explain ohm's law.	2	CO1	R
2	State Kirchhoff's current law.	2	CO1	R
3	Convert the following current source into an equivalent voltage source. 	2	CO1	A
4	Define form factor.	2	CO2	R
5	Write the expression for average value of voltage and current in an AC circuits.	2	CO2	U
6	Mention the difference between the star and delta connection.	2	CO2	R
7a.	Calculate the equivalent resistance of the given circuit 	6	CO1	A

<table>
<tr><td>7b.</td><td>Find the equivalent resistance shown in figure.


</td><td>6</td><td>CO1</td><td>A</td></tr>
<tr><td>8a.</td><td>Write the step by step procedure to solve nodal analysis.</td><td>6</td><td>CO1</td><td>U</td></tr>
<tr><td>8b.</td><td>Apply KVL and find the total current of the given circuit.


</td><td>6</td><td>CO1</td><td>U</td></tr>
<tr><td>9a.</td><td>Define the following terms:
Real power, reactive power and apparent power.</td><td>6</td><td>CO2</td><td>R</td></tr>
<tr><td>9b.</td><td>Derive the expression for AC Current flowing through the pure Resistive Circuits.</td><td>6</td><td>CO2</td><td>U</td></tr>
<tr><td>10a.</td><td>Determine the current through 4 ohm resistor by using mesh current analysis shown in figure.


</td><td>10</td><td>CO1</td><td>A</td></tr>
<tr><td>10b.</td><td>Find the current through the 0.1ohm resistor in the fig using thevenin's theorem.


</td><td>10</td><td>CO1</td><td>A</td></tr>
<tr><td>11a.</td><td>Derive the expression voltage and current in a three phase balanced circuits for a star connected system.</td><td>10</td><td>CO2</td><td>U</td></tr>
<tr><td>11b.</td><td>Derive the expression for AC Current flowing through the pure RL Circuits</td><td>10</td><td>CO2</td><td>U</td></tr>
</table>

CO	Weightage
CO1	50
CO2	38
CO3	-
CO4	-
CO5	-
CO6	-
Total	88

Prepared by	Staff Name Ms.S.Dhivya	Signature
Verified by	HoD Dr.A.Manikandan	Signature

INTERNAL ASSESSMENT-1

ANSWER KEY

ANSWER KEY

INTERNAL TEST 1

U18ESEE101 Basic Electric and Electronic Engineering

1. State and explain ohm's law.

"Ohms law state that at constant temperature the current flowing in a conductor is directly proportional to voltage and inversely proportional to the resistance of the circuit"

2. State Kirchhoff's current law.

"Total current or charge entering a junction or node is exactly equal to the charge leaving the node as it has no other place to go except to leave, as no change is lost within the node.

3. Convert the following the current source into an equivalent voltage source.

I=V*R I=60.

4. Define form factor.

The ratio of RMS value to the average value of alternating quantity is called form factor.

Form fac=RMS value/avg value.

5. Write the expression for average value of voltage and current in an AC circuit.

Average value =Area under one complete cycle/period.

I_{avg}=2Im/pi.

6. Mention the difference between star and delta connection.

Star connection:

Connection of winding at one point.

There is a neutral or star point.

Line current is equal to phase current.

Delta connection:

Winding ends are connected to each other.

No neutral point.

Line voltage is equal to phase voltage.

7.a)calculate the equivalent resistance of the given circuit.

12ohm and 16ohm in parallel

R=R1 R2\R1+R2=<u>4ohm</u>

4ohm and 6ohm are connected in series R_T=R1+R2

<u>R_T=20ohm</u>

20ohm and a40ohm are connected in parallel <u>R=13.33ohm</u>

13.33ohm and 4ohm series <u>R_T=17.33ohm</u>

v= I r I =v/r =2.88amps

7.b) find the equivalent resistance.

R = 0.5ohm

R_r =1.5ohm

1.5ohm and 1.5 ohm are connected in parallel

R=0.75Ohm

1ohm and 0.75ohm are in series

R=1.75ohm

Current v=i/r

I=5.714amps

8.a)write the step by step to solve the procedure of nodal analysis

Convert all voltage source to current source

Select one node. Take one of the ref node

N=no. of node

Write the equation for each node as per KCL

Solve above equation to get nodal voltage

Calculate the branch current from value of voltage.

8.b)Apply KVL and find total current of given value

Total resistance = 8+2+30=40

Total vol=100+40=140

I=v/r

I= 140/40=3.5amps.

9.a) Define reactive power and true power and apparent power.

Reactive power: drop voltage and draw current gives the deceptive impression they do dissipate power. This phantom power is called reactive power unit is volt and amps

True power: actual amount of power being used in a circuit unit is measured in watt.

Apparent power: the combination of true and reactive power is called apparent power. The unit is volt and amps

9.b) Derive the expression of AC current flowing through the pure resistive circuit.

P= (Vm sinwt) (Im sinwt)

P= Vm Im/ 2 2sinwt

I = v/r Vm sinwt /r =Im sinwt

Where Im=Vm/r = peak value of circuit current.

10.a) determine the current through 4ohm resistor and using mesh current analysis.

Apply kvl at node 1=12

Apply kvl at node 2=-10

Apply kvl at node 3=24

Current through 4ohm resistor=I_3

I_3=4.11amps.

10.b) find the current through 0.4ohm resistor using the Thevenin s theorem.

V1= 2.5 volt V2=0.8v

V0=2.5v-0.8v = 1.7v.

R_{th}= 0.9ohm

11.a) Derive the expression in current and voltage in three phase balanced circuit in the star connected system.

In three phase circuit the voltage across the individual coil called phase voltage and the voltage between two lines is called line voltage.

Current: apply Kirchhoff law

This means balanced star connected system $I_p = I_l$

Phase current =line current.

Voltage: V_l=3ep

Line voltage =root 3 phase voltage

11.b) Derive the expression of AC current flow through the pure RL circuit.

Let $V = V_m \sin wt$ be the applied voltage

I= circuit current at any instant

R=resistor

V_L= inductor Voltage

F= frequency

$V = V_r + V_L$

Tan $\theta = X_L/r$

$\theta = \tan^{-1}(X_L/r)$ is called phase angle and the angle between V and L values lies between 0to 90deg

________The End ________

INTERNAL ASSESSMENT TEST -1

SAMPLE ANSWER SHEETS

INTERNAL ASSESSMENT
TEST -2
QUESTION PAPER

BHARATH INSTITUTE OF SCIENCE AND TECHNOLOGY
Department of EEE

INTERNAL TEST 2

U18ESEE101- Basic Electrical and Electronics Engineering

Date : 13.03.2020

Academic Year / Semester : 2018-2019/ODD

Duration : 1 Hour and 30 Minutes

Instructions : Q.no 1-6 Answer all the questions.

Q.no 7-9 Answer all the questions either a or b.

Q.no 10-13 Answer all the questions either a or b.

Q.No	Question	Weightage	CO	Bloom's Level
1	Write the Flemings left hand rule.	2	CO3	R
2	Explain the types of D.C. motor.	2	CO3	R
3	Define efficiency of a transformer	2	CO3	R
4	Draw the symbol of PN junction diode and name its terminals.	2	CO4	A
5	Mention the various configurations of BJT.	2	CO4	U
6	What are the applications of zener diode?	2	CO4	U
7a.	What is meant by DC Generator? Explain in detail.	6	CO3	U
7b.	Write the torque equation of DC Motor.	6	CO3	U
8a.	Explain the construction of single phase induction motor.	6	CO3	U
8b.	Explain the working synchronous machines.	6	CO3	U
9a.	Draw the VI characteristics of PN junction diode.	6	CO4	U
9b.	Explain the working of full wave rectifier.	6	CO4	U
10a.	With a neat diagram explain the construction and operating principle of single phase transformer and also mention its types.	10	CO3	U
10b.	Explain the construction and operating principle of DC Motor.	10	CO3	U
11a.	Explain the working of BJT configuration and draw the characteristics.	10	CO4	U
11b.	Explain the working of half wave and Full wave rectifier.	10	CO4	U

CO	Weightage
CO1	-
CO2	-
CO3	50
CO4	38
CO5	-
Total	88

Prepared by	Staff Name Ms.S.Dhivya	Signature
Verified by	HoD Dr.A.Manikandan	Signature

INTERNAL ASSESSMENT-2

ANSWER KEY

ANSWER KEY

INTERNAL TEST 2

U18ESEE101 Basic Electrical and Electronics Engineering

1. Write the fleming's left hand rule.

   Fleming Left Hand Rule

   If the thumb, middle finger and the index finger of the left hand are displaced from each other by an angle of 90°, the middle finger represents the direction of the magnetic field. The index finger represents the direction of the current, and the thumb shows the direction of forces acting on the conductor.

2. Explain the types of D.C, motor.

   TYPES OF DC GENERATORS

   When we grant a space to talk about working principle of Dc generator and construction of Dc generator We touched on Types of Dc generators which need a high attention, as we illustrated Dc generator occupy a privileged position everywhere around us ... in robotics, automobiles, small and also medium application, let's start this thrilling subject.

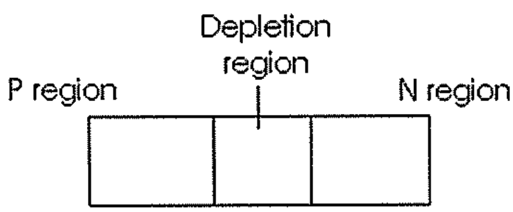
3. Define efficiency of a transformer.

   EFFICIENCY OF TRANSFORMER:

   $\eta = \frac{\text{output}}{\text{input}}$

   $$\eta = \frac{output\ power}{output\ power + losses} \times 100\%$$

4. Define the symbol of PN junction diode and name its terminals.



Positive and negative terminals.

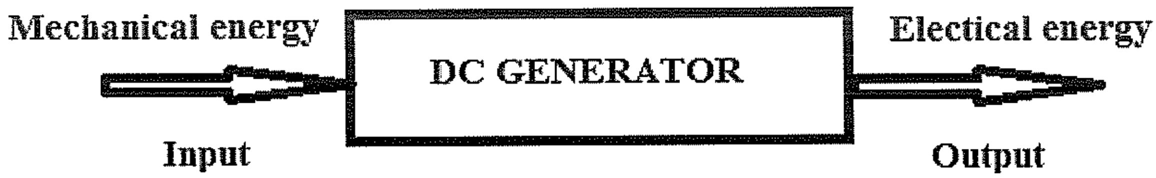
5. Mention the various configurations of BJT.
   Types of Transistor Configuration
   - Common base (CB) configuration
   - Common emitter (CE) configuration
   - Common collector (CC) configuration
6. What are the applications of Zener diode?
   We can classify rectifiers into two types:
   1. Half Wave Rectifier
   2. Full Wave Rectifier
   3. Bridge rectifier

   Clipper circuits
   Clamping circuits

7a. What is meant by DC generator? Explain in detail.

DC GENERATOR

A dc generator is an electrical machine which converts mechanical energy into **direct current electricity**. This energy conversion is based on the principle of production of dynamically induced EMF.



Principle: Faraday's Law of electromagnetic induction

BASIC CONSTRUCTION AND WORKING OF A DC GENERATOR.

Construction of DC machine:

A DC generator can be used as a DC motor without any constructional changes and vice versa is also possible. Thus, a DC generator or a DC motor can be broadly termed as a **DC machine**. These basic constructional details are also valid for the **construction of a DC motor**.

A DC machine consists of two basic parts; stator and rotor.

Basic constructional parts of a DC machine are described below.

1. Magnetic Frame (or) Yoke
2. Poles and pole shoes

3. Field winding
4. Armature core
5.Armature winding
6.Commutator and brushes.

7b. Write the torque equation of DC Motor.

DC motor Torque equation derivation

Since all conductors experience equal force and are equidistant from center, therefore

Total torque = torque on one conductor × total number of conductors

Let

r=average armature radius

L=effective length of each conductor

Z=total number of armature conductors

A=number of parallel paths

Ia =armature current

I=current through each conductor= Ia / A

B=average flux density

Φ=flux per pole

P=number of poles

a=cross-sectional area of flux path per pole at radius r = (2πrL / P)

Force on each conductor = BIL

Torque due to one conductor = BILr

As,

$I = \frac{I_a}{A}$ and $B = \frac{\Phi}{a} = \frac{\Phi}{\left(\frac{2\pi r L}{P}\right)}$

∴ Total armature torque, T_a = (Torque due to one conductor) × (total number of armature conductors)

$$= BILr \times Z$$

$$= \frac{\Phi}{\left(\frac{2\pi r L}{P}\right)} \left(\frac{I_a}{A}\right) Lr\, Z$$

$$= \frac{P\Phi I_a Z}{2\pi A}$$

or $$T_a = 0.159 \Phi I_a Z \left(\frac{P}{A}\right)$$

As Z, P and A are construction features of the machine, therefore are constant.

∴ $T_a \propto \Phi I_a$

Hence, for a given dc motor, torque developed in its armature depends on its flux per pole and armature current taken by it.

- In a dc series motor,
  $\Phi \propto I_a$ ...upto magnetic saturation
  If armature reaction is ignored and flux path reluctance is assumed constant
  Therefore, $T_a \propto I_a^2$

- In a dc shunt motor,
  Φ is practically constant if armature reaction is ignored and flux path reluctance is assumed constant

  Therefore, $T_a \propto I_a$

8a. Explain the construction of single phase induction motor.

Single phase induction motor: The single-phase induction motor is not self-starting. When the motor is connected to a single-phase power supply, the main winding carries an alternating current. It is logical that the least expensive, most reduced upkeep sort engine ought to be utilized most regularly. These are of different types based on their way of starting since these are of not self starting.

Those are split phase, shaded pole and capacitor motors. Again capacitor motors are capacitor start, capacitor run and permanent capacitor motors. Permanent capacitor motor is shown below.

Applications of Single Phase Induction Motor

These are used in low power applications and widely used in domestic applications as well as industrial. And some of those are mentioned below

- Pumps
- Compressors
- Small fans
- Mixers
- Toys
- High speed vacuum cleaners
- Electric shavers
- Drilling machines

8b. Explain the working synchronous machines.

A synchronous machine is an electrical machine whose rotating speed is proportional to the frequency of the alternating current supply and independent of the load.

A rotary electric machine whose rotor rotates in synchronization with a rotating field that has been produced by an AC current flowing through a stator winding, is called a synchronous machine.

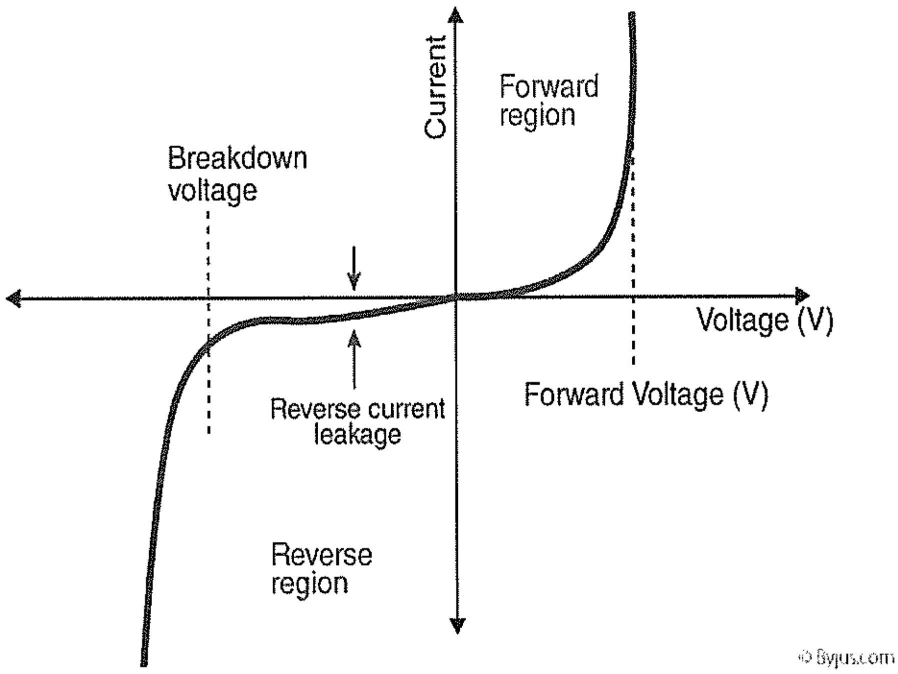
Since the induction motor has no DC field winding, there is no sustained field current in the rotor to provide flux as is the case with a synchronous machine.

A synchronous machine is an electrical machine whose rotating speed is proportional to the frequency of the alternating current supply and independent of the load.

Synchronous Machine constitutes of both synchronous motors as well as synchronous generators.

A synchronous machine is an AC machine whose satisfactory operation depends upon the maintenance of the following relationship.

9a. Draw the VI characteristics of PN junction diode.



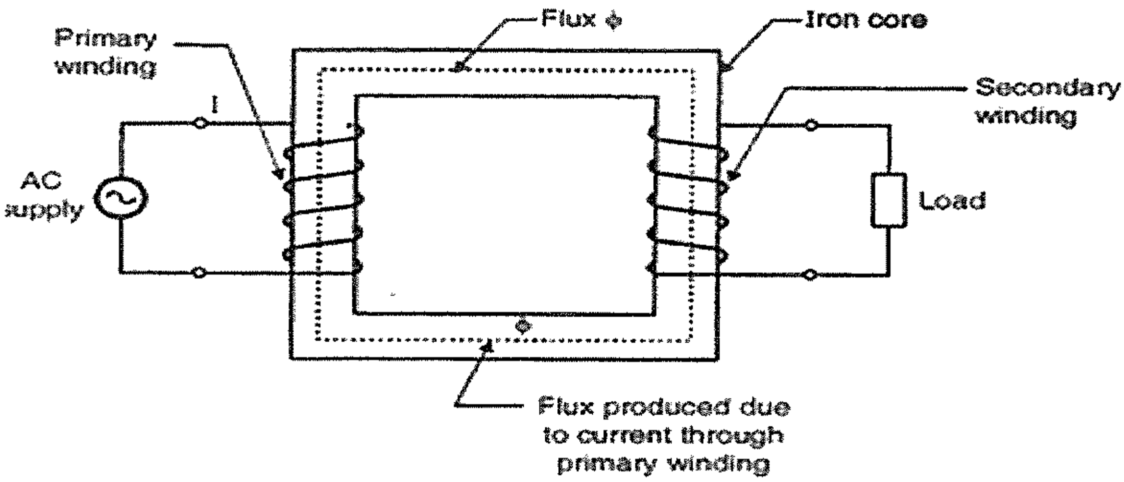
9b. Explain the working of full wave rectifier.

We apply an AC voltage to the input transformer. During the positive half-cycle of the AC voltage, terminal 1 will be positive, centre-tap will be at zero potential and terminal 2 will be negative potential. This will lead to forward bias in diode D_1 and cause current to flow through it. During this time, diode D_2 is in reverse bias and will block current through it.

10a. with a neat diagram explain the construction and operation principle of single phase Single-Phase Transformers

Definition of Transformer

An electrical power transformer is a static device, which transforms electrical energy from one circuit to another without any direct electrical connection. It also performs this with the help of mutual induction between two windings. It can transform power from one circuit to another without changing its frequency, but may be at different voltage levels depending upon the need.



Single Phase Transformer Schematic

Transformer Construction

The three main parts of a transformer are:

Primary Winding: The winding that takes electrical power, and produces magnetic flux when it is connected to an electrical source.

Magnetic Core: This refers to the magnetic flux produced by the primary winding. The flux passes through a low reluctance path linked with secondary winding creating a closed magnetic circuit.

Secondary Winding: The winding that provides the desired output voltage due to mutual induction in the transformer.

WORKING PRINCIPLE OF TRANSFORMER

The working principle of the single phase transformer is based on the Faraday's law of electromagnetic induction. Basically, mutual induction between two or more windings is responsible for transformation action in an electrical transformer.

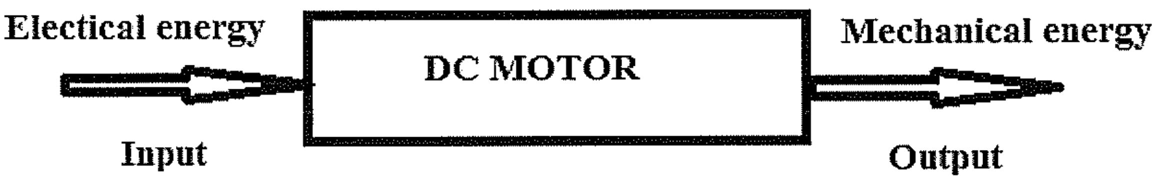
Faraday's Laws of Electromagnetic Induction

According to Faraday's law, "Rate of change of flux linkage with respect to time is directly proportional to the induced EMF in a conductor or coil".

10b. Explain the construction and operating principle of DC Motor.

DC MOTOR

The DC motor is the device which converts the direct current into the mechanical work. It works on the principle of Lorentz Law, which states that **"the current carrying conductor placed in a magnetic and electric field experience a force"**. And that force is called the Lorentz force. The Fleming left-hand rule gives the direction of the force.



The armature coil consists the commutators and brushes. The commutators convert the AC induces in the armature into DC and brushes transfer the current from rotating part of the motor to the stationary external load. The armature is placed between the north and south pole of the permanent or electromagnet.

For simplicity, consider that the armature has only one coil which is placed between the magnetic field shown below in the figure A. When the DC supply is given to the armature coil the current starts flowing through it. This current develops their own field around the coil. Figure B shows the field induces around the coil.

11a. Explain the working of BJT configuration and draw the characteristics.

- Common base (CB) configuration
- Common emitter (CE) configuration
- Common collector (CC) configuration

Common base (CB) configuration

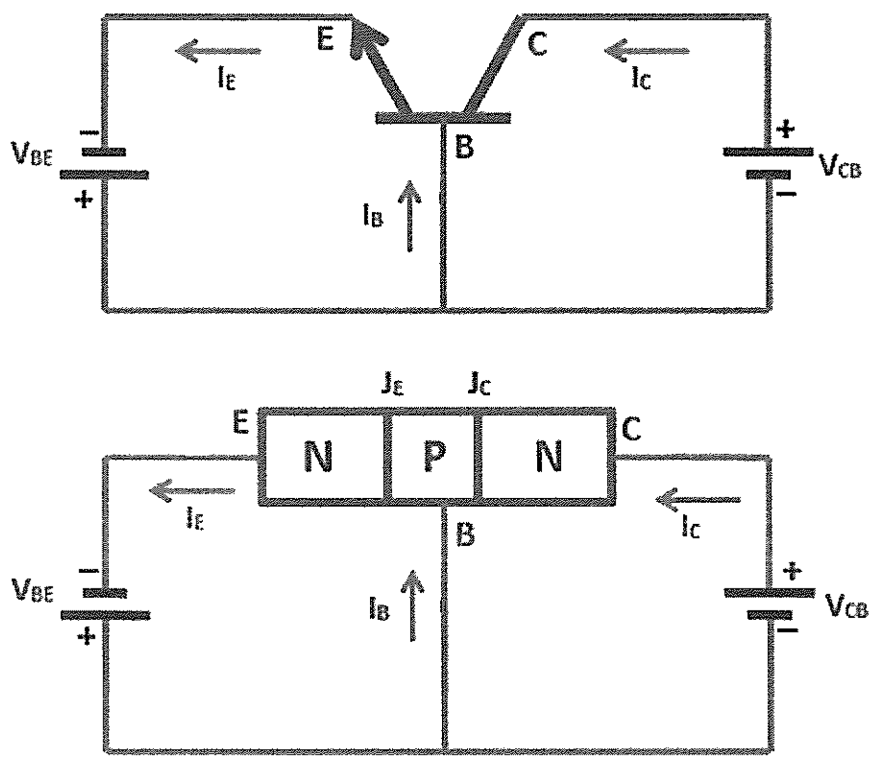
In common base configuration, emitter is the input terminal, collector is the output terminal, and base is the common terminal. The base terminal is grounded in the common base configuration. So the common base configuration is also known as grounded base configuration.

Common emitter (CE) configuration

In common emitter configuration, base is the input terminal, collector is the output terminal, and emitter is the common terminal. The emitter terminal is grounded in the common emitter configuration. So the common emitter configuration is also known as grounded emitter configuration.

Common collector (CC) configuration

In common collector configuration, base is the input terminal, emitter is the output terminal, and collector is the common terminal. The collector terminal is grounded in the common collector configuration. So the common collector configuration is also known as grounded collector configuration.

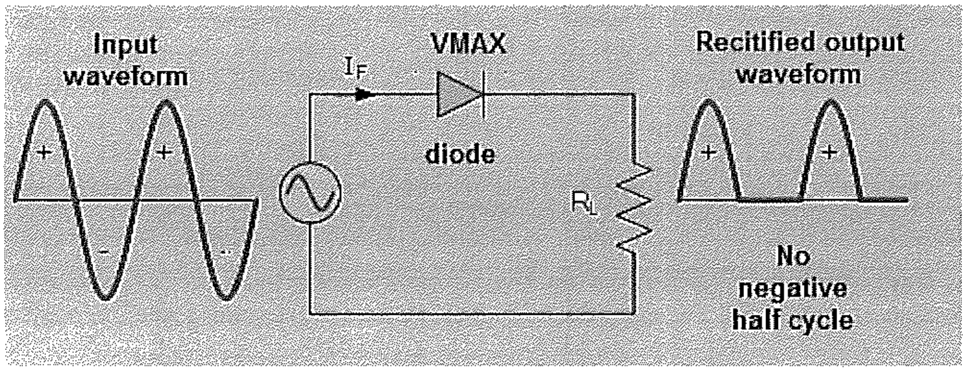


Common base configuration

11b. Explain the working of half wave and full wave rectifier.

Working of Half Wave Rectifier

During the positive half cycle the diode is under forward bias condition and it conducts current to RL (Load resistance). A voltage is developed across the load, which is same as the input AC signal of the positive half cycle.



Half wave Rectifier Working

Alternatively, during the negative half cycle the diode is under reverse bias condition and there is no current flow through the diode. Only the AC input voltage appears across the load and it is the net result which is possible during the positive half cycle. The output voltage pulsates the DC voltage.

Full wave rectifier (refer q.no 9b)

The end

INTERNAL ASSESSMENT TEST -2

SAMPLE ANSWER SHEETS

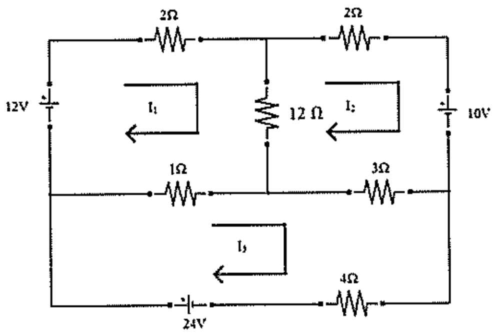
ASSIGNMENT QUESTIONS

Bharath
INSTITUTE OF HIGHER EDUCATION AND RESEARCH
BHARATH INSTITUTE OF SCIENCE AND TECHNOLOGY
No.173, Agharam Road, Selaiyur, Chennai, T.N - 600 073.

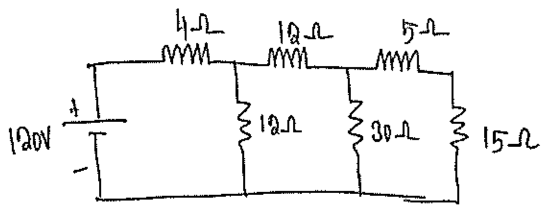
U18ESEE101 BASIC ELECTRICAL AND ELECTRONICS ENGINEERING

ASSIGNMENT-1

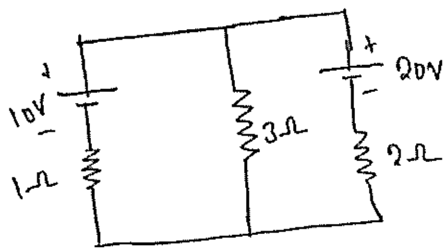
1. Determine the current in the 4Ω branch in the circuit shown in figure.



2. Determine the power delivered to 15Ω resistance using Norton's theorem for the given circuit.



3. Determine the current through 3Ω resistor by using super position theorem for the given circuit.



I·GAUGE INDIAN UNIVERSITY RATING GOLD
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NAAC A
ABET

U18ESEE101 BASIC ELECTRICAL AND ELECTRONICS ENGINEERING

ASSIGNMENT-2

1. Explain in detail about AC Current flowing through pure capacitive circuit.
2. Derive the V&I Expression for RLC circuit.
3. Write short notes about parallel resonance.
4. With a neat diagram explain the Voltage and current Equations in a balanced delta connection.
5. With a neat diagram explain the Voltage and current Equations in a balanced star connection.

SAMPLE ASSIGNMENTS

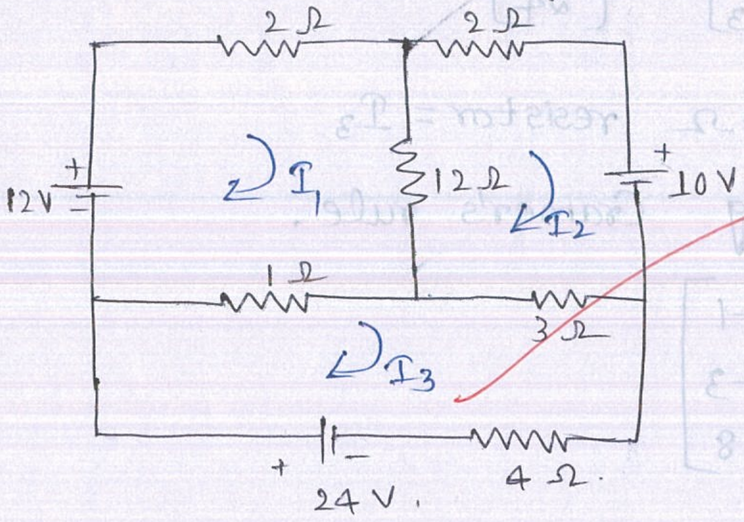
Reg. No: U19AE072 Name: Naveen kumar. R

Basic Electrical and Electronics Engg.

Assignment - 1

10/10 good

1) Determine the current in the 4 Ω branch in the circuit shown in figure.



Sol:-

Apply KVL at LOOP 1

$$2I_1 + 12(I_1 - I_2) + 1(I_1 - I_3) = 12$$

$$2I_1 + 12I_1 - 12I_2 + I_1 - I_3 = 12$$

$$15I_1 - 12I_2 - I_3 = 12 \longrightarrow (1)$$

Apply KVL at LOOP 2

$$2I_2 + 3(I_2 - I_3) + 12(I_2 - I_1) = -10$$

$$2I_2 + 3I_2 - 3I_3 + 12I_2 - 12I_1 = -10$$

$$-12I_2 + 17I_2 - 3I_3 = -10 \longrightarrow (2)$$

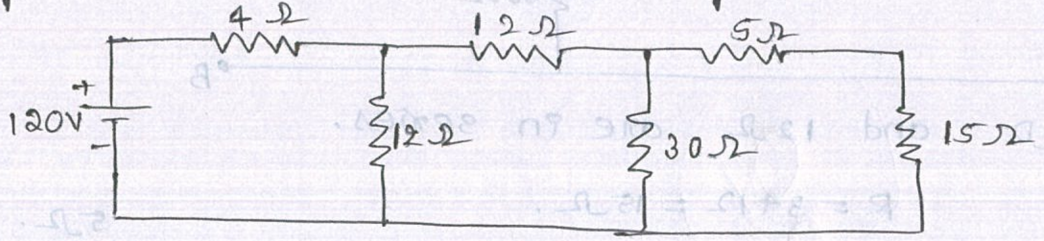
Apply KVL at loop 3

$$1(I_3 - I_1) + 3(I_3 - I_2) + 4I_3 = 24$$

$$I_3 - I_1 + 3I_3 - 3I_2 + 4I_3 = 24$$

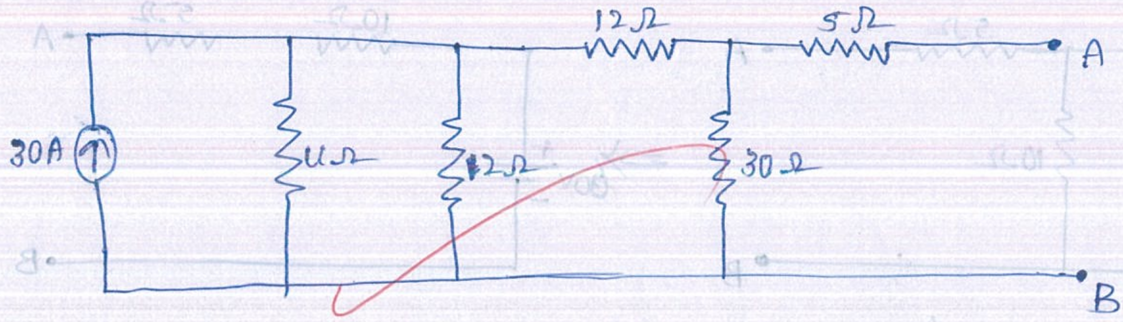
$$-I_1 - 3I_2 + 8I_3 = 24 \longrightarrow (3)$$

2) Determine the power delivered to 15Ω resistance using Norton's theorem for given circuit.



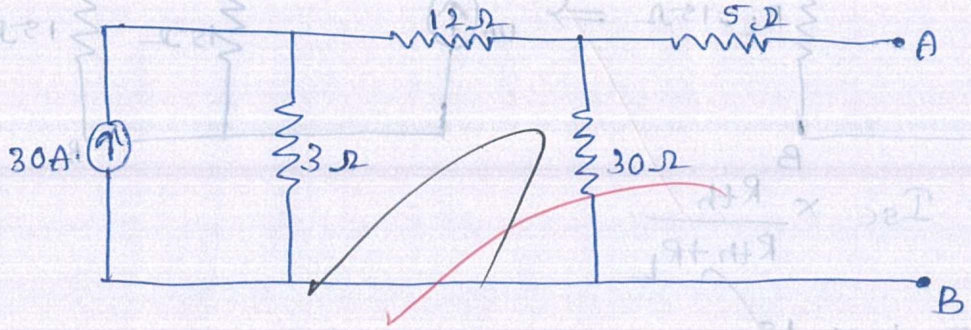
Sol:- The power delivered to 15Ω resistance is to be determined, open circuit. The particular branch. Reduce the circuit by source transformation and resistance reduction.

$I = V/R = 120/4 = 30A$.



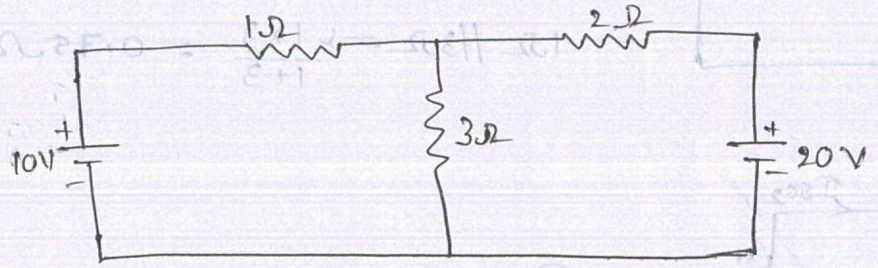
The resistors 4Ω & 12Ω are in parallel

$$R = \frac{4 \times 12}{4+12} = 3\Omega$$



$V = IR = 30 \times 3 = 90V$.

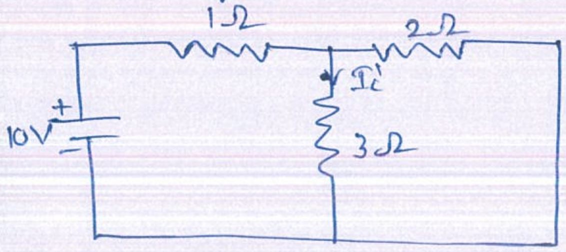
3) Find the current through 3Ω resistor by using super position theorem.



Sol:- Total circuit through load (I_L) = $I_L' + I_L''$

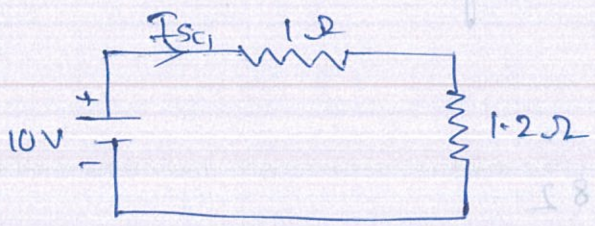
I_L' ⇒ step 1 circuit, I_L'' ⇒ Step 2 circuit.

Step-1:- 10V battery is acting alone and 20V battery is short circuitated.



2Ω and 3Ω are connected in parallel

$$R = 2 \| 3 \Rightarrow \frac{2 \times 3}{2+3} = 1.2\Omega$$



$$\Rightarrow I_{sc_1} = \frac{10}{1+1.2}$$

$$I_{sc_1} = 4.54\ A.$$

By current Division rule,

$$I_L' = 4.54 \times \frac{2}{3+2} = 1.8182\ A$$

$$\boxed{I_L' = 1.8182\ A}$$

Step-2:- 20V battery is acting alone and 10V is short circuited.

BEEE

ASSIGNMENT

NAME: VARSHA . V

REG NO: U19AE103

1) AC THROUGH PURE CAPACITOR

$V = V_m \sin \omega t$

V. good 10/10

A pure capacitor c is connected across a supply voltage of V volts as shown

$$V = V_m \sin \omega t$$

When alternating voltage is given to a capacitor the capacitor is changed in one direction and then in the opposite direction

$$\phi = CV \qquad \phi = \text{charge in columbs}$$

$$\phi = C V_m \sin \omega t$$

Now the current in the circuit is

$$i = \frac{d\phi}{dt}$$

$$i = \frac{d}{dt}\left[C V_m \sin \omega t\right]$$

$$i = C V_m \frac{d}{dt}(\sin \omega t)$$

$$i = C V_m (\omega \cos \omega t)$$

$$i = V_m \cdot \omega c \cos \omega t \qquad \because \left[\omega c = \frac{1}{\frac{1}{\omega c}}\right]$$

$$i = \left[\frac{V_m}{\frac{1}{\omega c}}\right] \cos \omega t \qquad \because \left[\frac{1}{\omega c} = X_e\right]$$

$$i = \frac{V_m}{X_e} \cos \omega t \qquad \because \left[\frac{V_m}{X_e} = I_m\right]$$

[X_e = capacitive inductance]

Power factor $= \cos\phi = \cos 90^\circ = 0$

Power for pure capacitive circuit

$$P = Vi$$

$$= V_m \sin\omega t \quad I_m \sin(\omega t + 90^\circ)$$

$$P = V_m I_m \sin\omega t \ \sin(\omega t + 90^\circ)$$

$$P = V_m I_m \sin\theta \ \sin(\theta + 90^\circ)$$

Instantaneous power $(p) = V_m I_m \sin\theta \ \sin(\theta + 90^\circ)$

$$\text{Average power} = \int_0^{2\pi} \frac{P\,d\theta}{2\pi}$$

$$= \int_0^{2\pi} \frac{V_m I_m \sin\theta \ \sin(\theta+90^\circ)}{2\pi} \cdot d\theta = \frac{V_m I_m}{2\pi} \int_0^{2\pi} \sin\theta \ \sin(\theta+ \cdot d$$

$$= \frac{V_m I_m}{2\pi} \int_0^{2\pi} \frac{(\cos(\theta-(\theta+90) - \cos(\theta+\theta+90^\circ)}{2\pi} d\theta$$

$$= \frac{V_m I_m}{2\pi} \int_0^{2\pi} \frac{(\cos(\theta-\theta+90^\circ) - \cos(2\theta+90^\circ)}{2} d\theta$$

$$P = \frac{V_m I_m}{2\pi \times 2} \int_0^{2\pi} \cos 90^\circ - \cos(2\theta+90^\circ)\, d\theta$$

$$P = \frac{V_m I_m}{4\pi} \int_0^{2\pi} (0 - \cos(2\theta+90^\circ)\, d\theta$$

$$P = -\frac{V_m I_m}{4\pi} \int_0^{2\pi} \cos(2\theta+90^\circ)\, d\theta$$

$$P = -\frac{V_m I_m}{4\pi} \left[\frac{\sin(2\theta+90^\circ)}{2}\right]_0^{2\pi}$$

$$P = -\frac{V_m I_m}{4\pi \times 2} \left[\sin(2\theta+90^\circ)\right]_0^{2\pi}$$

$$P = -\frac{V_m I_m}{8\pi} \left[\sin(2(2\pi)+90) - \sin 2(0)+90\right]$$

Triangle OAD

$$OD = \sqrt{OA^2 + AD^2}$$

$$V = \sqrt{VR^2 + (VL - VC)^2}$$

$$V = \sqrt{(IR)^2 + (IX_L - IX_C)^2}$$

$$V = \sqrt{I^2R^2 + [I(X_L - X_C)]^2}$$

$$V = \sqrt{I^2R^2 + I^2(X_L - X_C)^2}$$

$$V = \sqrt{I^2R^2 + (X_L - X_C)^2}$$

$$V = I\sqrt{R^2 + (X_L - X_C)^2}$$

$$\frac{V}{I} = \sqrt{R^2 + (X_L - X_C)^2}$$

$$\boxed{Z = \sqrt{R^2 + (X_L - X_C)^2}}$$ Impedance RLC circuit

Powerfactor $(\cos\phi) = \frac{OA}{OD}$

$$\cos\phi = \frac{VR}{V} = \frac{IR}{IZ}$$

$$\boxed{\cos\phi = \frac{R}{Z}}$$ Powerfactor

Phase angle

$$\tan\phi = \left(\frac{X_L - X_C}{R}\right)$$

$$\phi = \tan^{-1}\left(\frac{X_L - X_C}{R}\right)$$

Power in RLC series circuit

$$V = V_m \sin\omega t$$

$$i = I_m \sin(\omega t - \phi)$$

$$i = I_m \sin(\omega t + \phi)$$

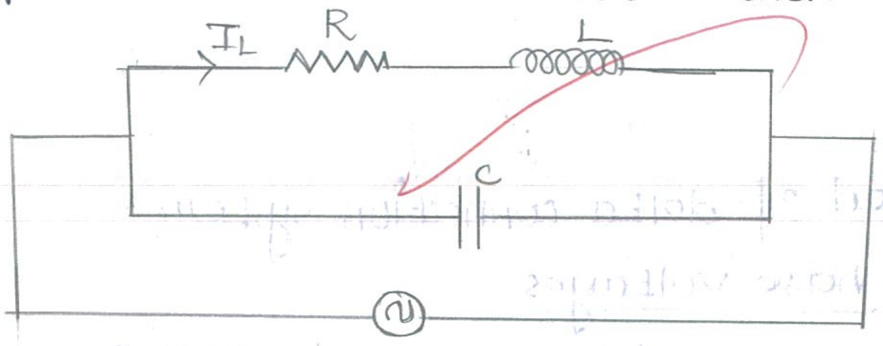
$\because X_L > X_C = RL$ derivative

$\because X_C > X_L = RC$ derivative

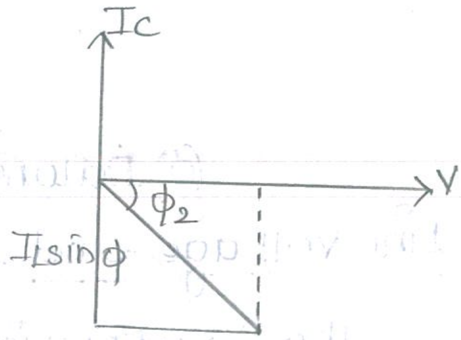
$$f_r = \sqrt{\frac{1}{4\pi^2 LC}}$$

$$\boxed{f_r = \frac{1}{2\pi\sqrt{LC}}}$$

b. parallel Resonance: Two branch circuit



a) circuit



b) vector diagram

Resultant current at resonance

$$\cos\phi_L = \frac{I}{I_L}$$

$$I = I_L \cos\phi_L$$

$$I = \frac{V}{Z_L} \times \frac{R}{Z_L}$$

$$I = \frac{VR}{Z_L^2}$$

$$I = \frac{VR}{L/C}$$

$$\boxed{I = \frac{V}{L/CR}}$$

L/CR is equivalent to impedance and is much larger than actual resistance

so parallel resonant circuit effects maximum impedance and the current minimum

Line current and phase current

Three phase currents are equal in magnitude but displaced 120° from one another as show in the vector diagram

$$I_{Ry} = I_{yB} = I_{BR} = I_{ph}$$

|||ly 3 lines currents are equal

$$I_R = I_y = I_B = I_L$$

At point apply KCL

$$\vec{I_{BR}} = \vec{I_R} + \vec{I_{Ry}}$$

$$\vec{I_R} = \vec{I_{BR}} - \vec{I_{Ry}}$$

From the vector diagram using law of parallelogram

$$I_R = \sqrt{I_{BR}^2 + I_{Ry}^2 + 2 I_{BR} I_{Ry} \cos 60}$$

$$I_L = \sqrt{I_{Ph}^2 + I_{Ph}^2 + 2 I_{Ph} \cdot I_{Ph} \tfrac{1}{2}}$$

$$I_L = \sqrt{I_{Ph}^2 + I_{Ph}^2 + I_{Ph}^2}$$

$$I_L = \sqrt{3 I_{Ph}^2}$$

$$I_L = \sqrt{3}\, I_{ph}$$

|||ly

$$I_y = I_{Ry} - I_{yB}$$

$I_L = \sqrt{3} I_{ph}$ &

$$I_B = I_{yB} - I_{BR}$$

$$I_L = \sqrt{3} I_{ph}$$

Power

Total power = 3x power per phase

$$\boxed{P = 3 V_{ph} I_{ph} \cos\phi} \text{ watts}$$

In Delta

$V_L = V_{ph}$

$I_L = \sqrt{3} I_{ph}$

$I_{ph} = \frac{I_L}{\sqrt{3}}$

$$P = 3 V_L \frac{I_L}{\sqrt{3}} \cos\phi$$

$$P = \sqrt{3}\sqrt{3} V_L \frac{I_L}{\sqrt{3}} \cos\phi$$

$$\boxed{P = \sqrt{3} V_L I_L \cos\phi} \text{ watts}$$

Line current and phase current

In star Line current = phase current

$$I_L = I_{ph}$$

$$I_R = I_y = I_B = I_L$$

From star diagram

$$\vec{V_{Ry}} = \vec{V_{RN}} + \vec{V_{Ny}}$$

$$\vec{V_{Ry}} = \vec{V_{RN}} + (-\vec{V_{yN}})$$

From vector diagram

using law of parallelogram

$$V_{Ry} = \sqrt{V_{RN}^2 + V_{YN}^2 + 2 V_{RN} V_{yN} \cos 60}$$

$$V_L = \sqrt{V_{ph}^2 + V_{ph}^2 + 2 V_{ph} V_{yN} \tfrac{1}{2}}$$

$$V_L = \sqrt{V_{ph}^2 + V_{ph}^2 + V_{ph}^2}$$

$$V_L = \sqrt{3 V_{ph}^2}$$

$$V_L = \sqrt{3} V_{ph}$$

Power

$3 V_{ph} I_{ph} \cos\phi$ watts

$$P = 3 \frac{V_L}{\sqrt{3}} I_L \cos\phi$$

$$= \sqrt{3}\sqrt{3} \frac{V_L}{\sqrt{3}} I_L \cos\phi$$

$$P = \sqrt{3} V_L I_L \cos\phi \text{ watts}$$

$\because$ [In star $I_{ph} = I_L$, $V_{ph} = \frac{V_L}{\sqrt{3}}$]

In star connection

In a balanced star connected to 3 phase 4 wire system the current in the neutral is zero

$$I_N = 0$$

END SEMESTER EXAM QUESTION PAPER

QP CODE: U18ESEE101

Reg. No.									

BHARATH INSTITUTE OF HIGHER EDUCATTION AND RESEARCH
(Declared as deemed to be University under section 3 of UGC act 1956)
173, Agaram Main Road, Selaiyur, Chennai – 600 073, Tamil Nadu

UNIVERSITY EXAMINATIONS - MAY/JUNE 2019

Regulation - 2018

Programme Name	Course Code(s)	Course Title
B.Tech	U18ESEE101	Basic Electrical and Electronics Engineering

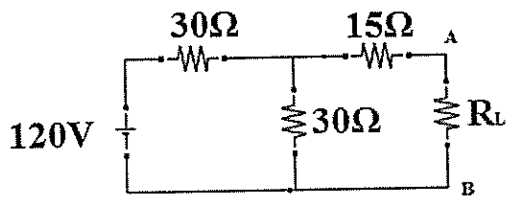
Time: 3 Hours

Max Marks: 100
No. of Pages: 2

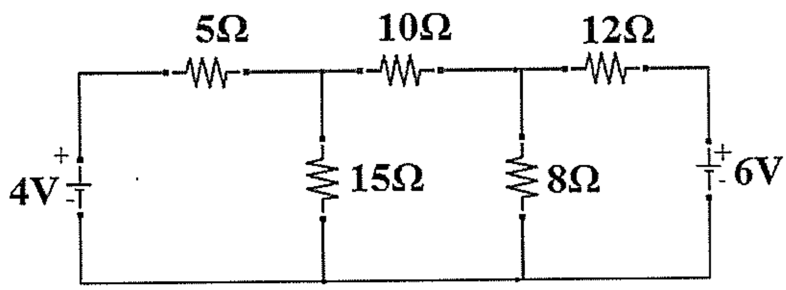
COURSE OUTCOME:

CO1 Students will gain knowledge regarding the various laws and principles associated with electrical systems.
CO2 Students will gain knowledge regarding electrical machines and apply them for practical problems.
CO3 Students will gain knowledge regarding various types' semiconductors.
CO4 Student will gain knowledge digital electronics.
CO5 Student will gain knowledge on electronic systems.
CO6 Students will acquire knowledge in using the concepts in the field of electrical engg. Projects and research.

PART - A Answer All Questions (10 X 2 = 20 MARKS)		BT	CO	Marks
1.	State Ohm's Law.	R	CO1	2
2.	What is source transformation?	U	CO1	2
3.	Draw the Impedance triangle.	An	CO1	2
4.	Define power factor.	R	CO1	2
5.	Write the EMF equation of DC Generator.	R	CO2	2
6.	What is transformation ratio in Transformer?	U	CO2	2
7.	Define break down voltage.	R	CO3	2
8.	What is the function of operational Amplifier?	U	CO5	2
9.	Draw the symbol of EX-OR Gate.	An	CO4	2
10.	What is Registers?	U	CO5	2

PART - B Answer either (a) or (b) from each question (5 X 6 = 30 MARKS)		BT	CO	Marks
11a.	Explain the steps to solve Thevenin's theorem.	U	CO1	6
11b.	Find the value of load resistance and also find the maximum power in the circuit shown in fig. 	E	CO1	6
12a.	Derive Resonant Frequency and Q factor for RLC series resonance circuit	An	CO1	6
12b.	Derive the expression of Line and phase values of current and voltage in Star connected three phase System.	An	CO2	6

13a.	Derive Torque Equation of DC Motor.	An	CO2	6
13b.	Explain the Construction and Connection of Three phase Transformer.	C	CO2	6
14a.	Explain the working of PN junction Diode.	A	CO3	6
14b.	Draw and explain the working of Half wave Rectifier.	An&U	CO3	6
15a.	Draw the symbol and truth table for logic gates.	An&U	CO4	6
15b.	Draw the logic diagram and explain the operation of Full Adder.	An&U	CO5	6

PART – C Answer Any Five Questions (5 X 10 = 50 MARKS)		**BT**	**CO**	**Marks**
16.	Find the current through the 8Ω resistor using Nodal voltage analysis in the Circuits shown in fig. 	E	CO1	10
17.	Convert the phasors Z_1= (8+j6) Ω & Z_2= (3+j4) Ω into polar form and find their product in polar form.	E	CO6	10
18.	Explain the construction and operation of single phase Transformer.	U	CO2	10
19.	Explain the Operation of NPN and PNP transistor.	U	CO3	10
20.	Draw and explain the types of Flip flops.	An&U	CO4	10
21.	Draw and explain the Operation of Shift Registers.	An&U	CO5	10
22.	Three similar coils are connected in Delta taken a total power of 1.5KW at a Power Factor of 0.2 lagging from a phase 400V 50Hz supply. Calculate the resistance and inductance in each phase.	E	CO3	10

Assessment Summary:

COs	Remember	Understand	Apply	Analyze	Evaluate	Create	Total
CO 1	2	2		2	1		7
CO 2	1	2		2		1	6
CO 3	1	2	1	1	1		6
CO4	2	3					5
CO5		4		2			6
CO6					1		1

END SEMESTER EXAM - ANSWER KEY

I-GAUGE INDIAN UNIVERSITY RATINGS GOLD

Bharath INSTITUTE OF HIGHER EDUCATION AND RESEARCH

BHARATH INSTITUTE OF SCIENCE AND TECHNOLOGY

No.173, Agharam Road, Selaiyur, Chennai, T.N - 600 073.

ABET

UNIVERSITY EXAMINATIONS – MAY/JUNE 2019

U18ESEE101 BASIC ELECTRICAL AND ELECTRONICS ENGINEERING

ANSWER KEY

PART – A

1. V=IR
2. The voltage and current sources may be interchanged without affecting the remainder of the circuit this technique is called as source transformation.
3. Impedance Triangle is a right angled triangle whose base, perpendicular and hypotenuse represents Resistance, Reactance and Impedance respectively. It is basically a geometrical representation of circuit impedance.
4. Power factor (PF) is the ratio of working power, measured in kilowatts (kW), to apparent power, measured in kilovolt amperes (kVA).
5. $E_g = \frac{PZ\phi N}{60\,A}$ volts
6. The transformer transformation ratio or transformer turns ratio (K) is the quotient value obtained by dividing the number of turns of the primary winding (N1) and the number of turns of the secondary winding (N2). Then K = N1/N2.
7. When a forward bias is applied current flows in the forward direction and conduction take place. ... The corresponding applied reverse voltage at this point is known as Breakdown Voltage of the PN junction diode. This is also known as Reverse Breakdown Voltage.
8. An operational amplifier is an integrated circuit that can amplify weak electric signals. An operational amplifier has two input pins and one output pin. Its basic role

is to amplify and output the voltage difference between the two input pins.

10.A Register is a collection of flip flops. A flip flop is used to store single bit digital data. For storing a large number of bits, the storage capacity is increased by grouping more than one flip flops. If we want to store an n-bit word, we have to use an n-bit register containing n number of flip flops.

PART – B

1. Find the Thevenin Resistance by removing all voltage sources and load resistor.
   Find the Thevenin Voltage by plugging in the voltages.
   Use the Thevenin Resistance and Voltage to find the current flowing through the load.
2. R_L=30 Ohm, P_{MAX}=30 Watts.

3. $X_L = X_L$

$$X_L = 2\pi f L \ and \ X_C = \frac{1}{2\pi f C}$$

$$2\pi f L = \frac{1}{2\pi f C}$$

$$X_L = 2\pi f L \ and \ X_C = \frac{1}{2\pi f C}$$

$$2\pi f L = \frac{1}{2\pi f C}$$

At resonance $f = f_r$ and on solving above equation we get,

$$\frac{1}{2\pi\sqrt{LC}} = f_r \ H_Z$$

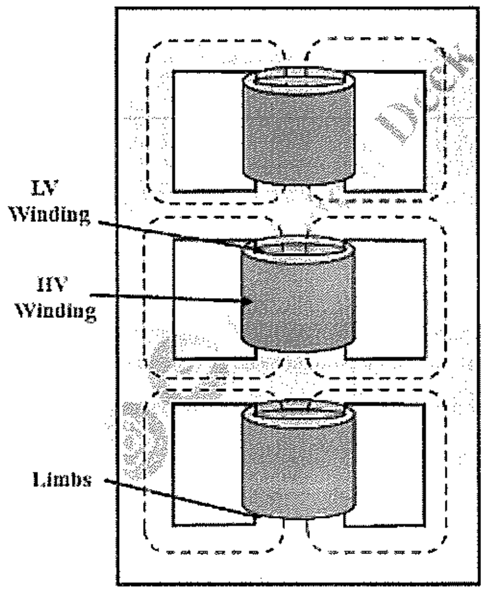
$$\frac{1}{2\pi\sqrt{LC}} = f_r \ H_Z$$

4. $V_R = V_Y = V_B = V_{ph}$
$I_R = I_Y = I_B = I_L = I_{ph}$.

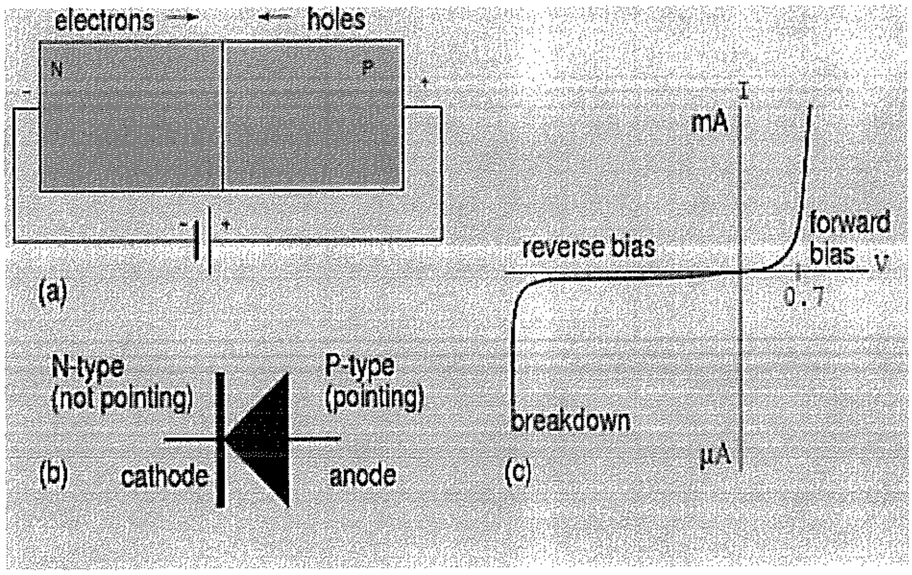
5. Derive Torque Equation of DC Motor.

$$E_b = \frac{\varphi ZNP}{60\ A}$$

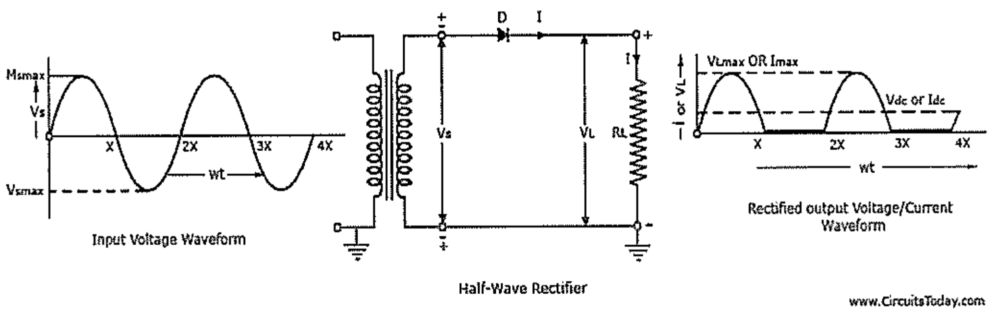
6.Explain the Construction and Connection of Three phase Transformer.



7.Explain the working of PN junction Diode.

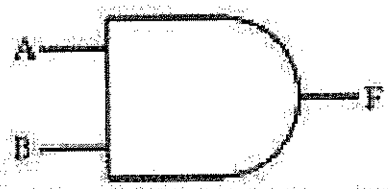
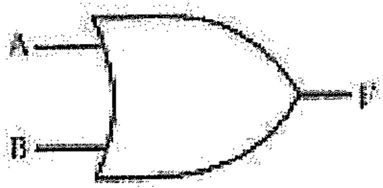
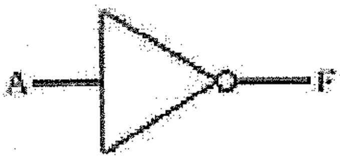
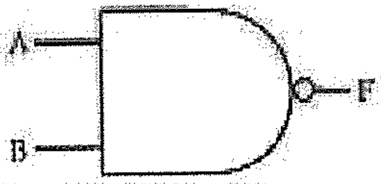
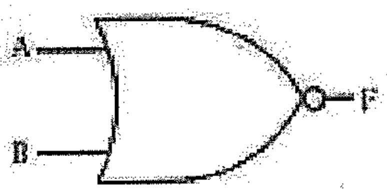


8.Draw and explain the working of Half wave Rectifier.

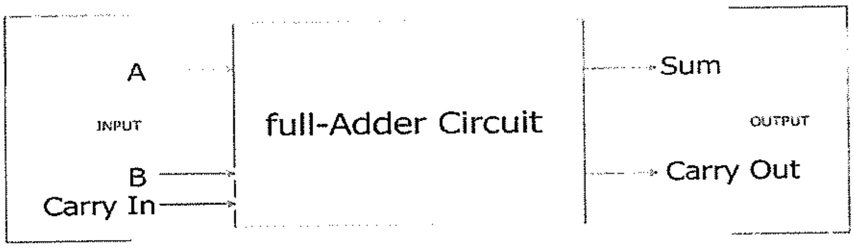


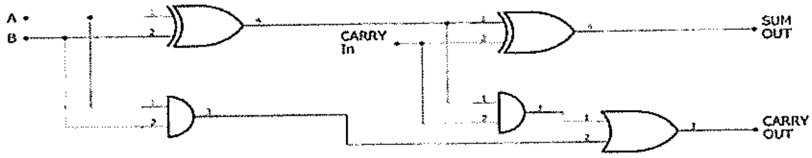
Half-Wave Rectifier

9. Draw the symbol and truth table for logic gates.

Name	Graphic Symbol	Algebraic Function	Truth Table
AND		$F = A \cdot B$ or $F = AB$	A B | F 0 0 | 0 0 1 | 0 1 0 | 0 1 1 | 1
OR		$F = A + B$	A B | F 0 0 | 0 0 1 | 1 1 0 | 1 1 1 | 1
NOT		$F = \bar{A}$ or $F = A'$	A | F 0 | 1 1 | 0
NAND		$F = \overline{(AB)}$	A B | F 0 0 | 1 0 1 | 1 1 0 | 1 1 1 | 0
NOR		$F = \overline{(A + B)}$	A B | F 0 0 | 1 0 1 | 0 1 0 | 0 1 1 | 0

10.Draw the logic diagram and explain the operation of Full Adder





Full-Adder Circuit

PART-C

1. $V_1 = \frac{\Delta V_1}{\Delta} = \frac{1068}{371} = 2.878V$

$V_2 = \frac{\Delta V_2}{\Delta} = \frac{948}{371} = 2.56V$

Current through 8Ω Resistor $I_{8\Omega} = \frac{V_2}{8}$

$= \frac{2.56}{8}$

$I_{8\Omega} = 0.32Amps$

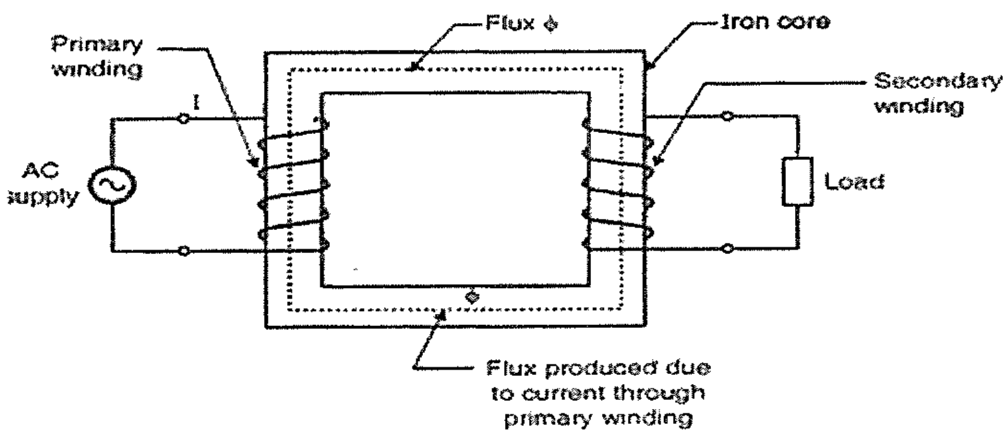
2.

$A = 5 \angle 53.13^\circ$

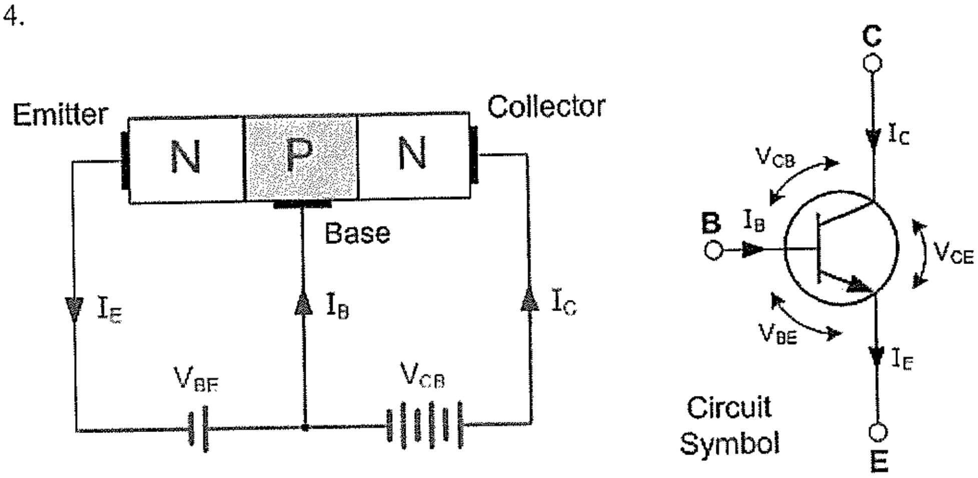
$B = 10 \angle 36.87^\circ$

$AB = 50 \angle 90$

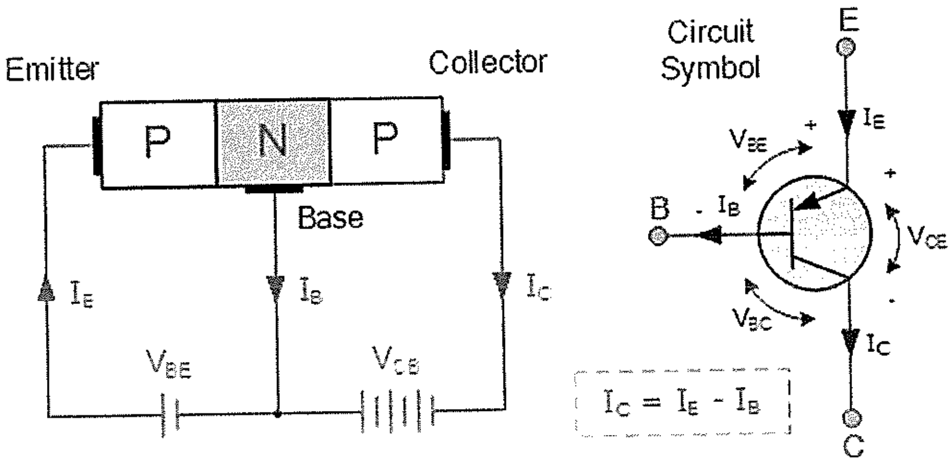
3.



4.



Note: Conventional current flow.

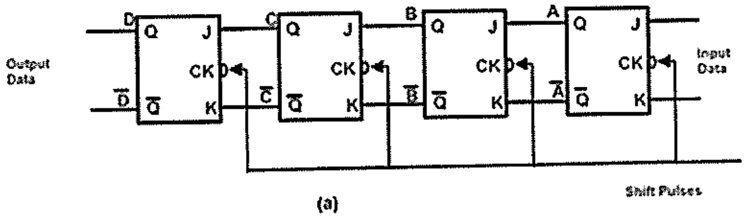


$I_C = I_E - I_B$

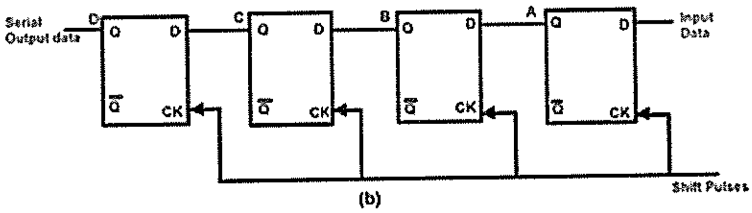
5. **Types of flip-flops:**

- RS Flip Flop.
- JK Flip Flop.
- D Flip Flop.
- T Flip Flop.

6.Shift register



(a)



(b)

7.Iph=10.83A

Vph=230.94v

Zph=21.32ohms

XL=20.89Ω

Rph=4.264Ω

L=66mH

TEXT BOOK & REFERENCE BOOK FOLLOWED

BASIC ELECTRICAL AND ELECTRONICS ENGINEERING

TEXT BOOKS:

1. E. Hughes, "Electrical and Electronics Technology", Pearson, 10th Edition, 2011.
2. K.A.Krishnamurthy and M.R.Raghuveer, `Electrical and Electronics Engineering for Scientists', New Age International Pvt Ltd Publishers, 2011.

REFERENCES:

1. D. P. Kothari and I. J. Nagrath, "Basic Electrical Engineering", Tata McGraw Hill, Third Reprint, 2016.
2. Smarajit Ghosh, Fundamentals of Electrical and Electronics Engineering, Second Edition, PHI Learning, 2007.
3. Jacob Millman and Christos C-Halkias, "Electronic Devices and Circuits", McGraw Higher Ed, 4th Edition, 2015.
4. John Bird, Electrical Circuit Theory &Technology, Taylor & Francis Ltd, 6^{th}, edition.2017.

PREVIOUS YEAR QUESTION PAPERS

QP CODE: U18ESEE101

Reg. No.									

BHARATH INSTITUTE OF HIGHER EDUCATTION AND RESEARCH
(Declared as deemed to be University under section 3 of UGC act 1956)
173, Agaram Main Road, Selaiyur, Chennai – 600 073, Tamil Nadu

UNIVERSITY EXAMINATIONS - NOV/DEC 2018

Regulation – 2018

Programme Name	Course Code(s)	Course Title
B.Tech	U18ESEE101	Basic Electrical and Electronics Engineering

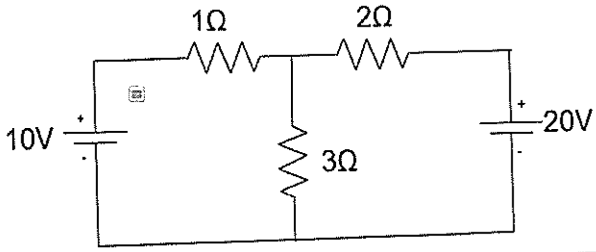
Time: 3 Hours

Max Marks: 100
No. of Pages: 2

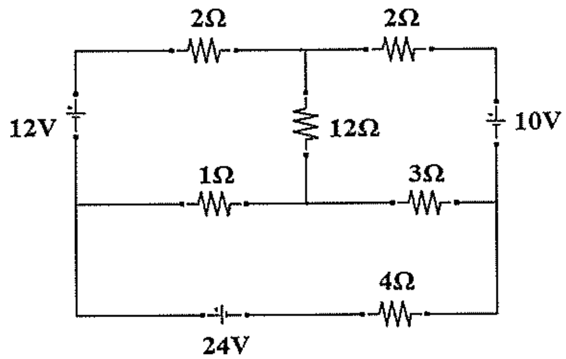
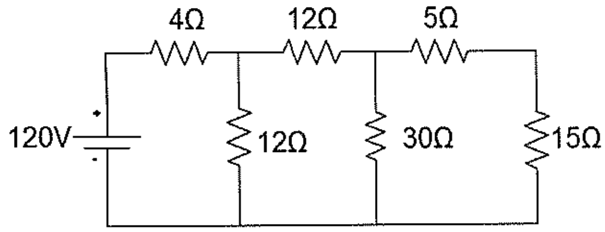
COURSE OUTCOME:

CO1 Students will gain knowledge regarding the various laws and principles associated with electrical systems.
CO2 Students will gain knowledge regarding electrical machines and apply them for practical problems.
CO3 Students will gain knowledge regarding various types' semiconductors.
CO4 Student will gain knowledge digital electronics.
CO5 Student will gain knowledge on electronic systems.
CO6 Students will acquire knowledge in using the concepts in the field of electrical engg. Projects and research.

PART - A	Answer All Questions (10 X 2 = 20 MARKS)	BT	CO	Marks
1.	What are the active and passive elements?	R	CO1	2
2.	State kirchoff's current law.	R	CO1	2
3.	Draw the power triangle.	An	CO1	2
4.	Define form factor.	R	CO1	2
5.	Define all day efficiency.	R	CO2	2
6.	What is transformation ratio in Transformer?	U	CO2	2
7.	What is rectifier?	U	CO3	2
8.	Define drift current?	R	CO5	2
9.	Draw the symbol of Universal logic gates.	An	CO4	2
10.	What are the different types of Flip flops?	U	CO5	2

PART - B	Answer either (a) or (b) from each question (5 X 6 = 30 MARKS)	BT	CO	Marks
11a.	Find the current through the 3Ω resistor shown by using Super position theorem in the circuit shown in fig. 	E	CO1	6
11b.	State and prove Maximum power Transfer theorem.	U	CO1	6
12a.	Derive an expression of power in RL series circuit.	An&U	CO1	6
12b.	Derive the expression of Line current, Line voltage and power in delta Connected three phase circuits.	An&U	CO2	6
13a.	Explain briefly about Types of DC generator.	U	CO2	6

13b.	Derive an EMF Equation of Transformer.	An&U	CO2	6
14a.	Explain the working of Zener Diode.	U	CO3	6
14b.	Draw and Explain the working of Full wave Rectifier.	An&U	CO3	6
15a.	Convert the Following numbers (i)30_{10} to binary number (ii) 10111_2 to Octal Number. (iii)$A8DB_{16}$ to equivalent binary number.	E	CO4	6
15b.	Draw the logic diagram and explain the operation of Half Adder.	An&U	CO5	6

PART - C	**Answer Any Five Questions (5 X 10 = 50 MARKS)**	**BT**	**CO**	**Marks**
16.	Find the current through the 4Ω resistor using Mesh Current analysis in the circuit shown in fig 	U	CO1	10
17.	A series RLC circuit with a resistance of 50 Ω a capacitor of 40 μF and an inductance of 0.1H is connected across 230V, 50Hz supply. Determine the impedance, circuit current, power factor and power consumed of the circuit.	E	CO6	10
18.	Explain briefly the construction and working of DC generator.	U	CO2	10
19.	Explain the Common Base Configuration of BJT and also explain its Input and Output characteristics.	U	CO3	10
20.	Draw and explain the working of Ripple up counter.	An&U	CO4	10
21.	Determine the power delivered to 15 Ω resistance using Norton's theorem for given circuit. 	A & E	CO5	10
22.	Two impedances Z_1= (10+j5) Ω & Z_2= (8+j6) Ω are connected in parallel across voltage of 200V.Find the Branch currents, Total current, power factor and power.	A & E	CO3	10

Assessment Summary:

COs	Remember	Understand	Apply	Analyze	Evaluate	Create	Total
CO 1	3	3		2	1		9
CO 2	1	5		2			8
CO 3	4		1	1	1		7
CO4	1			2	1		4
CO5	1	3	1	1	1		7
CO6		1			1		2

QP CODE: U18ESEE101

Reg. No.									

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UNIVERSITY EXAMINATIONS - MAY/JUNE 2018
Regulation - 2018

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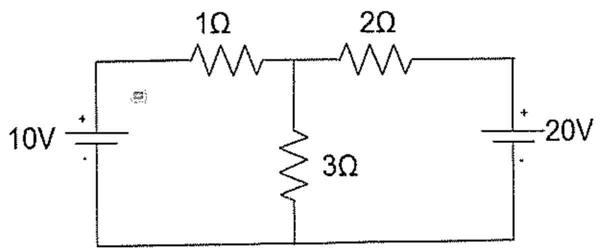
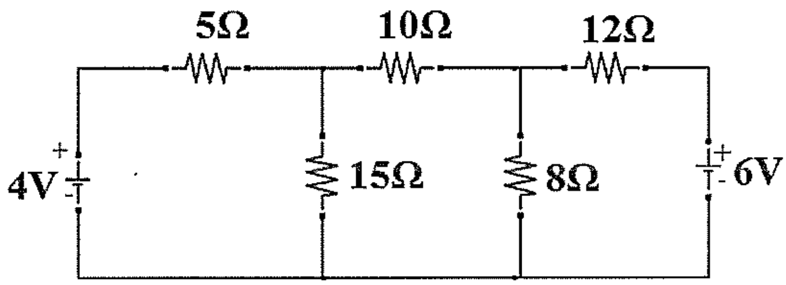
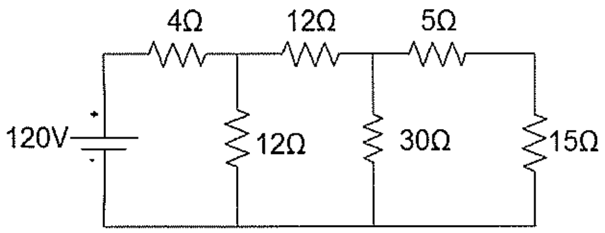
PART - A	Answer All Questions (10 X 2 = 20 MARKS)	BT	CO	Marks
1.	Define Ohms law.	R	CO1	2
2.	State kirchoff's voltage law.	R	CO1	2
3.	Draw the power triangle.	An	CO1	2
4.	Define form factor.	R	CO1	2
5.	Explain mutual induction principle in a transformer.	R	CO2	2
6.	What is transformation ratio in Transformer?	U	CO2	2
7.	What is rectifier?	U	CO3	2
8.	Define drift current?	R	CO5	2
9.	Draw the symbol of Universal logic gates.	An	CO4	2
10.	Draw the logic diagram and truth table of T flipflop?	U	CO5	2

PART - B	Answer either (a) or (b) from each question (5 X 6 = 30 MARKS)	BT	CO	Marks
11a.	Find the current through the 3Ω resistor shown by using Super position theorem in the circuit shown in fig. 	E	CO1	6
11b.	Explain the steps for Thevenin's theorem.	U	CO1	6
12a.	Derive an expression of power in RC series circuit.	An&U	CO1	6
12b.	Derive the expression of Line current, Line voltage and power in delta Connected three phase circuits.	An&U	CO2	6
13a.	Explain briefly about Types of DC generator.	U	CO2	6

13b.	Derive an EMF Equation of Transformer.	An&U	CO2	6
14a.	Explain the working of PN Junction Diode.	U	CO3	6
14b.	Draw and Explain the working of Half wave Rectifier.	An&U	CO3	6
15a.	Convert the Following numbers (i)30_{10} to binary number (ii) 10111_2 to Octal Number. (iii)$A8DB_{16}$ to equivalent binary number.	E	CO4	6
15b.	Draw the logic diagram and explain the operation of Full Adder.	An&U	CO5	6

PART - C Answer Any Five Questions (5 X 10 = 50 MARKS)		BT	CO	Marks
16.	Find the current through the 8Ω resistor using Nodal voltage analysis in the Circuits shown in fig. 	E	CO1	10
17.	A series RLC circuit with a resistance of 50 Ω a capacitor of 40 μF and an inductance of 0.1H is connected across 230V, 50Hz supply. Determine the impedance, circuit current, power factor and power consumed of the circuit.	E	CO6	10
18.	Explain briefly the construction and working of DC generator.	U	CO2	10
19.	Explain the Operation of NPN and PNP transistor.	U	CO3	10
20.	Draw and explain the working of Ripple down counter.	An&U	CO4	10
21.	Determine the power delivered to 15 Ω resistance using Norton's theorem for given circuit. 	A & E	CO5	10
22.	Two impedances Z_1= (10+j5) Ω & Z_2= (8+j6) Ω are connected in parallel across voltage of 200V.Find the Branch currents, Total current, power factor and power.	A & E	CO3	10

Assessment Summary:

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CO 2	1	5		2			8
CO 3	4		1	1	1		7
CO4	1			2	1		4
CO5	1	3	1	1	1		7
CO6		1			1		2

QUESTION BANK

QUESTION BANK

U18ESEE101-BASIC ELECTRICAL AND ELECTRONICS ENGINEERING

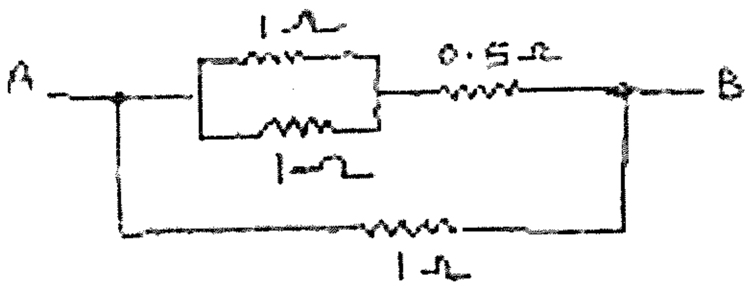
UNIT 1

DC CIRCUITS

PART-A

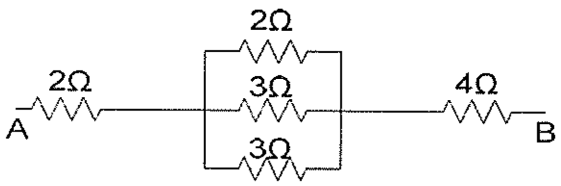
1. What are the classifications of Circuit elements?
2. What is meant by active and passive elements?
3. What is meant by unilateral and bilateral elements?
4. Define Ohms Law.
5. What is a node, a junction and a branch?
6. State voltage division rule.
7. State current division rule.
8. What are dependent and independent sources?
9. What is source transformation?

10).Find the equivalent resistance between A and B in fig.



PART-B

1) Find the resistance between terminals between A and B.

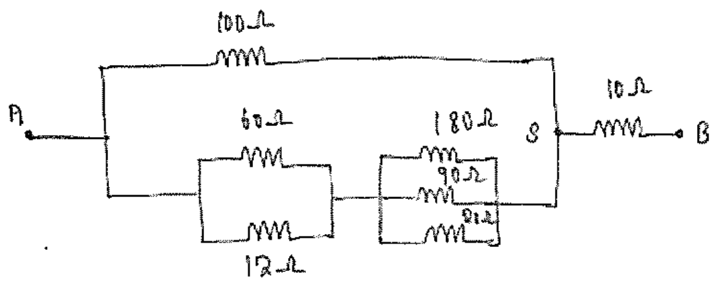


2). Write the steps involved in source transformation with neat diagram.

3). The effective resistance of two resistors connected in series is 100Ω .When connected in parallel, then effective values in 24 Ω. Determine the value of two resistors.

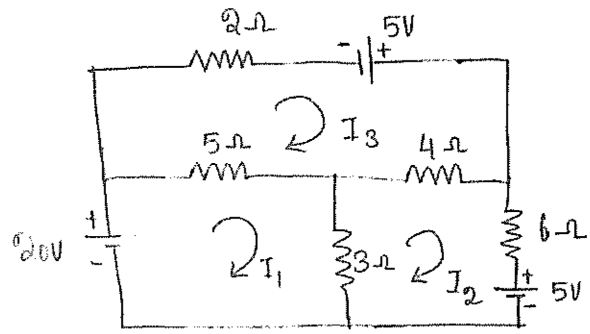
4). Calculate the current and resistance of 50W, 100V electric Lamp.

5).Find the total resistance betweenpoint A and B for given series parallel network.

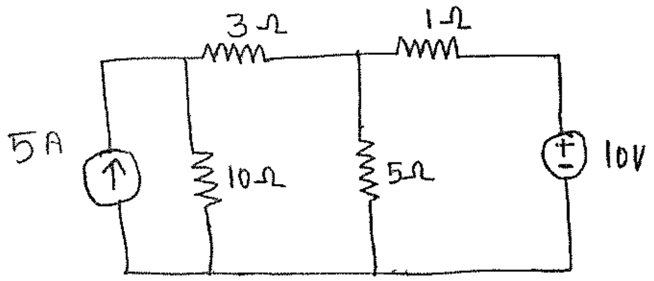


PART-C

1. Write the mesh equations in the circuit shown and determine the mesh currents.



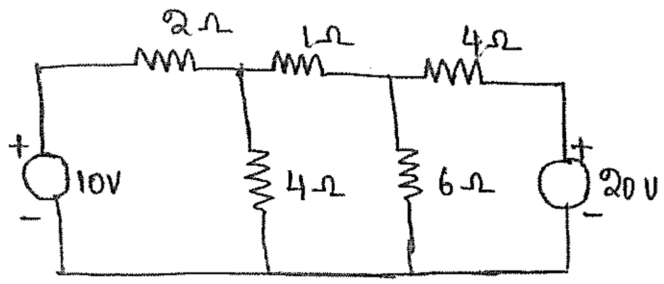
2. Write the nodal equations of the network of fig. and find the voltage potential between nodes.



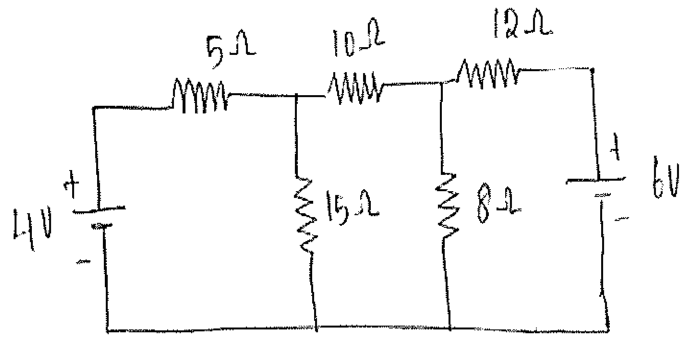
3. (i) Write the steps by step procedure to solve the mesh current analysis .

(ii) Write the steps by step procedure to solve the Nodal voltage analysis.

4. For the circuit shown below fig. (i), calculate the current through the 6Ω resistor; using Mesh current analysis.



5. Find the current through the 8Ω resistor using Nodal voltage analysis in the circuit shown in fig



UNIT-2

AC CIRCUITS

PART A

1. Define line current and phase current.
2. Define line and phase voltage.
3. Give the line and phase values in star connection.
4. Give the line and phase values in delta connection.
5. Write few methods available for measuring in 3-phase load.
6. List the methods used for power measurement with single wattmeter.
7. List the methods for unbalanced star connected load.
8. Write the methods of connections of 3 phase windings?
9. Define Impedance and Admittance.
10. Define power factor.

PART-B

1. Define Average value. Derive an expression to find the average value of an AC sinusoidal current.
2. Define RMS value. Derive an expression to find the RMS value of an AC sinusoidal current.
3. Derive an expression of find the relationship between line and phase current in three phase balanced delta connected system.
4. Derive an expression of find the relationship between line and phase voltage in three phase balanced star connected system.
5. The alternating current passing through a circuit is being by i=141.4 sin 314.2t.What are the values of (a) maximum value of Current (b) RMS value of current (c) the frequency and (d) the instantaneous value of the current when t=0.02 sec.

PART-C

1. Prove that power in RL series circuit is VIcosΦ.

2. A series RLC circuit with a resistance of 50 ohm, a capacitor of 40 micro farad and an inductance of 0.1H is connected across 230V, 50Hz supply. Determine the impedance, circuit current, power factor and power consumed of the circuit.

3. An impedance (6+j8) is connected across 220V, 50 Hz mains in parallel having an impedance of (8-j6) ohm. Calculate (a) the admittance, theconductance and the susceptance of the combined circuit (b) the total current taken from the mains (c) power factor and (d) the total power.

4. Derive an Expression for measuring power in a three phase circuit by two watt meter method for balance load.

5. Three identical coils each having a resistance of 10 Ω and reactance of 10 Ω are connected in delta across 400V three phase supply. Find the line current and the readings on each of the two wattcmeters connected to measure the power.

UNIT-3

ELECTRICAL MACHINES&TRANSFORMERS

PART A

1. State two types of induction motors.
2. How does D.C. motor differ from D.C. generator in construction?
3. What is back emf in D.C. motor?
4. Mention the difference between core and shell type transformers.
5. What is the purpose of laminating the core in a transformer?
6. Define voltage regulation of a transformer.
7. What are the applications of step-up & step-down transformer?
8. How transformers are classified according to their construction?
9. Write down the EMF equation for d.c.generator.
10. Why commutator is employed in d.c.machines?

PART-B

1. List out the various types of DC Generator.
2. Derive the equation for induced EMF of a DC machine.
3. Derive the EMF equation of a transformer.
4. Derive the torque equation of DC motor.
5. Write short notes about auto transformer.

PART-C

1. Explain the construction and operating principle of DC Motor.
2. Explain the construction and principle of operation of single phase induction motor.
3. Explain the construction and principle of operation of a DC generator with neat sketch.

4. With a Neat diagram explain the construction and operating principle of single phase transformer.
5. Draw the V-I characteristics of DC Machines.

UNIT-4

SEMICONDUCTOR DEVICESANDAPPLICATIONS

PART- A

1. What are conductors? Give examples?
2. What are insulators? Give examples?
3. What are the types of Semiconductor?
4. What is Intrinsic Semiconductor?
5. What is Extrinsic Semiconductor?
6. What are the types of Extrinsic Semiconductor?
7. What is P type &N type Semiconductor?
8. What is doping?
9. What is depletion region in PN junction?
10. What is barrier potential?

PART- B

1. Explain intrinsic and extrinsic semiconductors with neat diagrams.
2. Describe the working of a PN junction diode with neat diagrams.
3. Draw the V-I characteristics of a PN junction diode
4. What is a Zener diode? Explain the operation of Zener diode and draw its characteristics.
5. Explain the operation of half wave rectifier with neat sketch and derive the necessaryExpression.

PART- C

1. Explain the operation of Centre tapped full wave rectifier with neat diagram.
2. Explain with a neat diagram how the input and output characteristics of a CEconfiguration can be obtained.
3. Compare the input resistance, output resistance and voltage gain of CB, CC and CE
   Configuration.
4. Explain the working of the CB configuration of a BJT.
5. Explain in detail about small signal CE amplifier.

UNIT-5

DIGITALELECTRONICS

PART- A

1. What is a Logic gate?
2. Which gates are called as the universal gates? What are its advantages?
3. Define combinational logic
4. Explain the design procedure for combinational circuits
5. Define half adder and full adder
6. Define Flip flop.
7. What are the different types of flip-flop?
8. Define registers.
9. Give the comparison between synchronous & Asynchronous counters.
10. Mention the types of Digital to Analog converter

PART-B

1. Draw and explain the operation of AND, OR, NOT, NAND and NOR gates with suitabletruth table.
2. What are universal gates? Explain their principle of working with necessary truth table
3. Explain half adder and full adder.
4. Design a full adder and implement it using logic gates.
5. Write short notes on:

   i). RS-flip flop

   ii). D-flip flop

iii). JK -flip flop

iv). T-flip flop

v). JK-master slave flip flop

PART-C

1. Explain the operation of various types of shift register.
2. Explain in details about Analog Digital and Digital to Analog conversion.
3. Explain the operation of RS flip-flop with logic diagram and truth table.
4. With necessary diagrams explain the functioning of the following:

   i). A/D converter ii). D/A converter
5. Describe the operation of a 4-bit binary, ripple counter.

STUDENTS PERFORMANCE &ATTENDANCE RECORD

Bharath Institute of Science and Technology
STUDENTS PERFORMANCE RECORD
B.Tech -AERONAUTICAL / AEROSPACE ENGINEERING (SEM II)

Course Name: BEEE Course Code: U18ESEE101

Name of the Faculty: Ms.S.Dhivya

S.No	Roll. No	Name	INT - I	INT - II	Assignment	Att %
1	U19AE071	NAREN KANTHAN S R	40	39	9	85
2	U19AE072	NAVEEN KUMAR R	38	40	10	80
3	U19AE073	NUTHAN SURAG K S	37	36	10	79
4	U19AE074	PAMULA VENKATESH	34	34	7	78
5	U19AE075	PANKAJ ADHIKARY	34	35	10	84
6	U19AE076	PANNURU SAIKUMAR	48	40	10	79
7	U19AE077	PATHAN SAI BABA VALI	25	42	10	93
8	U19AE078	PATIL SHIVSHANKAR BAJRANG	43	45	10	91
9	U19AE079	PEDDI BHARGAV	37	A	10	82
10	U19AE080	POKALA SUBBA REDDY	38	39	8	88
11	U19AE081	PRACHI SAVITA	33	37	10	94
12	U19AE082	R PRASHANNA VISHAL	33	30	10	83
13	U19AE083	RAHUL NAYEK	A	43	8	82
14	U19AE084	RAJU KUMAR	A	44	10	90
15	U19AE085	UMAR	32	41	10	91
16	U19AE086	RAWLA RAKESH	36	39	10	81
17	U19AE087	SAFEER B	37	37	10	80
18	U19AE088	MOHIT SATYAM	A	39	10	89
19	U19AE089	SANNAYILA SAI PUNITH	A	36	10	76
20	U19AE090	SANTHOSH D	32	38	10	91
21	U19AE091	SARANYA G	40	45	9	79
22	U19AE092	SARAVANA KUMAR E	37	35	10	80
23	U19AE093	SHAIK LAL ALISHA	44	A	10	78
24	U19AE094	SHAIK NASSER HUSSAIN	37	38	8	84
25	U19AE095	SHIYAM M	36	42	10	80
26	U19AE096	SIMHADRI GANESH	33	36	10	81
27	U19AE097	SIRIGIREDDY VINAY KUMAR REDDY	32	38	10	79
28	U19AE098	P SRIKANTH	A	39	9	80
29	U19AE099	SUNKARA MANIKANTA	30	38	10	93
30	U19AE100	SURYA P	38	39	9	90
31	U19AE101	TELLAKULA HARI VENKATA LAKSHMI	36	39	10	81
32	U19AE102	THIRUMALASETTY MUKESH	30	37	10	91
33	U19AE103	VARSHA V	44	33	10	90
34	U19AE104	VEERANKI KOUSHIK KALYAN	A	39	9	76
35	U19AE105	VEGI S V T NARASIMHA NAIDU	A	36	10	79
36	U19AE106	VELPULA SRINITHA	32	38	10	87

37	U19AE107	VISLAVATH UDAY KIRAN	39	45	10	83
38	U19AE108	YADADHALA BABU REDDY	37	35	10	76
39	U19AE109	YASMEEN	A	38	9	87
40	U19AS001	AERPALLI SRI DURGA PRASAD	38	39	10	91
41	U19AS002	AKANSH JAIN	36	40	9	87
42	U19AS003	ASHON A	38	37	10	78
43	U19AS004	BRISHA `SHARON A	38	44	10	84
44	U19AS005	BUGGA RAHUL RAYAL	40	A	9	81
45	U19AS006	CHADUVU SRI ANUTEJ REDDY	30	38	10	60
46	U19AS007	DANDA MAHESHWAR REDDY	39	40	10	83
47	U19AS008	G P DHEERAJ	A	32	9	85
48	U19AS009	DONEPUDI SHAROON	A	38	10	83
49	U19AS010	ELEENA BASIL	35	38	10	93
50	U19AS011	FARHAT FATMA	37	34	10	91
51	U19AS012	GAIKWAD PRATIK REVANNATH	44	39	10	79
52	U19AS013	GARVA MISHRA A	34	42	8	90
53	U19AS014	GOPIKANNAN M	38	25	10	98
54	U19AS015	JHA HEMANTKUMAR LAIKANT	34	35	9	76
55	U19AS016	KALAPATI GNANA PRASANNAMBIKA	38	38	10	93
56	U19AS017	S KAREENA CHANDINI	35	38	10	81
57	U19AS018	KAVIN R	40	41	9	99
58	U19AS019	KAVIYACHELVAN S	A	39	8	80
59	U19AS020	KIRAN KOUSHIK	A	36	10	89
60	U19AS021	KIRUBHAKARAN M R	32	38	9	80

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COURSE EXIT SURVEY

Bharath Institute of Science and Technology
Student Feedback Report 2019-2020 SEM-2
B.Tech- Aeronautical Engineering | Basic Electrical & Electronics Engineering

S.NO	Registration No	Fluency in English and Clarifying doubts	Class Control	Punctuality	Audibility	Updation of Current trends	Average
1	U19AE002	5	5	3	5	4	4.4
2	U19AE012	5	5	5	5	5	5
3	U19AE018	5	5	5	5	5	5
4	U19AE023	4	4	4	4	4	4
5	U19AE027	4	4	2	4	3	3.4
6	U19AE037	5	5	5	5	5	5
7	U19AE040	5	5	5	5	5	5
8	U19AE046	5	5	5	5	5	5
9	U19AE064	4	4	4	4	4	4
10	U19AE077	5	5	5	5	5	5
11	U19AE096	5	5	5	5	5	5
12	U19AE098	4	4	4	4	4	4
13	U19AE100	5	5	5	5	5	5
14	U19AE103	3	4	3	4	4	3.6
15	U19AE105	5	5	5	5	5	5
16	U19AE107	5	5	5	5	5	5
17	U19AE108	4	3	5	5	3	4
18	U19AE109	5	5	5	5	5	5

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CO ATTAINMENT

Bharath Institute of Science and Technology

STUDENTS PERFORMANCE RECORD

B.Tech -AERONAUTICAL / AEROSPACE ENGINEERING (SEM II

Course Name: BEEE Course Code: U18ESEE101

Name of the Faculty: Ms.S.Dhivya

CO DIRECT ATTAINMENT

		END SEMESTER EXAM									
CO	CO ATTAINMENT AVERAGE FROM ASSESSMENT TEST	MARKS ALLOTTED	MARKS OBTAINED	CO ATTAINMENT AVERAGE FROM END SEMESTER EXAM	DIRECT CO ATTAINMENT	INDIRECT CO ATTAINMENT (OBTAINED FROM EXIT SURVEY)	TOTAL CO ATTAINMENT (%)	TARGET [CLASS AVERAGE] (%)	CO ATTAINMENT GAP [TARGET - ATTAINMENT](%)	Actions Proposed to bridge the Gap (Gap >0)	Modification of Target when achieved(Gap <=0)
CO1	72	20	16	80	77	78	77	73	-4	Target Attained	Target Increased to 76
CO2	72	20	15	75	74	79	75	75	0	Target Attained	Target Increased to 78
CO3	64	20	17	85	77	78	77	75	-2	Target Attained	Target Increased to 78
CO4	68	20	16	80	75	80	76	75	-1	Target Attained	Target Increased to 80
CO5	85	20	16	80	82	75	81	80	-1	Target Attained	Target Increased to 85

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Bharath Institute of Science and Technology
STUDENTS PERFORMANCE RECORD
B.Tech -AERONAUTICAL / AEROSPACE ENGINEERING (SEM II)
Course Name: BEEE Course Code: U18ESEE101
Name of the Faculty: Ms.S.Dhivya

CO INDIRECT ATTAINMENT – SURVEY REPORT

CO	No. of 5's	No. of 4's	No. of 3's	No. of 2's	No. of 1's	CO %
CO1	22	24	13	10	6	78.7
CO2	23	20	17	8	7	80.0
CO3	21	22	16	8	8	78.7
CO4	20	22	18	7	8	80.0
CO5	21	23	17	7	7	81.3
Total	*107*	*111*	*81*	*40*	*36*	

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Bharath Institute of Science and Technology
STUDENTS PERFORMANCE RECORD
B.Tech -AERONAUTICAL / AEROSPACE ENGINEERING (SEM II)

Course Name: BEEE Course Code: U18ESEE101

Name of the Faculty: Ms.S.Dhivya

CO attainment through students Performance

Year	I year	**Semester**	II
Subject code	**U18ESEE101**	**Subject**	Basic Electrical and Electroincs Engineering

	CO1	CO2	CO3	CO4	CO5
Average Mark	75	77	74	74	93
No.of students above av	51	55	48	55	64
Total no. of students	75	75	75	75	75
% CO attainment	68.0	73.3	64.0	73.3	85.3

PO mapping against CO						**Aver. PO attainment**	
	CO1	**CO2**	**CO3**	**CO4**	**CO5**		
PO1	**3**	**3**	**3**	**3**	**3**	**72.3**	
PO2	**3**	**2**	**1**		**2**	**74.3**	
PO3	**1**	**1**		**1**	**2**	**76.5**	
PO4	**1**	**1**		**1**	**1**	**74.3**	
%CO attair	**77**	**75**	**77**	**76**	**81.0**		
All the PO's are above the set value(50%)							

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Bharath Institute of Science and Technology
STUDENTS PERFORMANCE RECORD
B.Tech -AERONAUTICAL / AEROSPACE ENGINEERING (SEM II)

Course Name: BASIC ELECTRICAL AND ELECTRONICS ENGINEERING

Name of the Faculty: Ms.S.Dhivya

Course code:U18ESEE101

CO Attainment Score

S.No	Reg.No	Name	CO Attainment Percentage					
			CO1 %	CO2 %	CO3 %	CO4 %	CO5 %	Average
1	U19AE071	NAREN KANTHAN S R	86	78	78	88	100	86
2	U19AE072	NAVEEN KUMAR R	80	82	85	96	100	89
3	U19AE073	NUTHAN SURAG K S	74	68	82	96	100	84
4	U19AE074	PAMULA VENKATESH	89	82	0	0	100	54
5	U19AE075	PANKAJ ADHIKARY	0	0	69	82	90	48
6	U19AE076	PANNURU SAIKUMAR	86	90	92	71	100	88
7	U19AE077	PATHAN SAI BABA VALI	82	86	76	75	100	84
8	U19AE078	PATIL SHIVSHANKAR BAJRANG	86	68	84	63	100	80
9	U19AE079	PEDDI BHARGAV	65	95	79	73	90	80
10	U19AE080	POKALA SUBBA REDDY	89	64	96	88	100	87
11	U19AE081	PRACHI SAVITA	67	77	96	75	100	83
12	U19AE082	R PRASHANNA VISHAL	88	77	88	76	100	86
13	U19AE083	RAHUL NAYEK	93	74	73	63	100	81
14	U19AE084	RAJU KUMAR	68	86	77	79	100	82
15	U19AE085	UMAR	93	82	83	75	100	87
16	U19AE086	RAWLA RAKESH	82	77	85	79	80	81
17	U19AE087	SAFEER B	68	76	80	80	100	81
18	U19AE088	MOHIT SATYAM	70	80	73	79	100	80
19	U19AE089	SANNAYILA SAI PUNITH	72	86	80	88	100	85
20	U19AE090	SANTHOSH D	78	82	82	88	100	86
21	U19AE091	SARANYA G	82	82	0	0	100	53
22	U19AE092	SARAVANA KUMAR E	80	84	88	83	90	85
23	U19AE093	SHAIK LAL ALISHA	79	91	84	83	100	87
24	U19AE094	SHAIK NASSER HUSSAIN	68	80	68	74	100	78
25	U19AE095	SHIYAM M	0	0	81	71	100	50
26	U19AE096	SIMHADRI GANESH	86	85	68	73	100	82
27	U19AE097	SIRIGIREDDY VINAY KUMAR	72	78	77	77	100	81
28	U19AE098	P SRIKANTH	78	86	68	63	60	71
29	U19AE099	SUNKARA MANIKANTA	89	91	68	75	100	85
30	U19AE100	SURYA P	71	85	86	80	100	84
31	U19AE101	TELLAKULA HARI VENKATA	89	84	88	79	60	80
32	U19AE102	THIRUMALASETTY MUKESH	86	78	73	75	100	82
33	U19AE103	VARSHA V	75	68	80	60	100	77
34	U19AE104	VEERANKI KOUSHIK KALYAN	74	86	63	79	60	72
35	U19AE105	VEGI S V T NARASIMHA NAIDU	89	73	82	75	100	84
36	U19AE106	VELPULA SRINITHA	86	80	63	72	80	76
37	U19AE107	VISLAVATH UDAY KIRAN	89	95	82	88	100	91
38	U19AE108	YADADHALA BABU REDDY	75	78	62	68	60	69
39	U19AE109	YASMEEN	86	86	83	70	100	85
40	U19AS001	AERPALLI SRI DURGA PRASAD	89	82	60	67	100	80
41	U19AS002	AKANSH JAIN	81	91	80	72	80	81
42	U19AS003	ASHON A	86	86	85	78	100	87
43	U19AS004	BRISHA 'SHARON A	84	82	60	78	80	77
44	U19AS005	BUGGA RAHUL RAYAL	0	0	82	79	100	52
45	U19AS006	CHADUVU SRI ANUTEJ REDDY	79	95	60	79	100	83

46	U19AS007	DANDA MAHESHWAR REDDY	74	86	73	79	100	82
47	U19AS008	G P DHEERAJ	86	87	78	88	100	88
48	U19AS009	DONEPUDI SHAROON	75	95	75	80	100	85
49	U19AS010	ELEENA BASIL	93	76	60	78	100	81
50	U19AS011	FARHAT FATMA	89	80	81	76	60	77
51	U19AS012	GAIKWAD PRATIK REVANNATH	78	86	85	78	100	85
52	U19AS013	GARVA MISHRA A	89	80	60	88	60	75
53	U19AS014	GOPIKANNAN M	86	79	80	80	100	85
54	U19AS015	JHA HEMANTKUMAR LAIKANT	82	78	83	71	100	83
55	U19AS016	KALAPATI GNANA	0	0	73	76	80	46
56	U19AS017	S KAREENA CHANDINI	82	85	81	79	100	85
57	U19AS018	KAVIN R	78	77	70	80	100	81
58	U19AS019	KAVIYACHELVAN S	86	78	79	77	60	76
59	U19AS020	KIRAN KOUSHIK	74	80	0	0	100	51
60	U19AS021	KIRUBHAKARAN M R	86	82	81	80	100	86
		AVERAGE:	**76**	**76**	**73**	**74**	**93**	

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