PURNEA COLLEGE OF ENGINEERING
PURNEA

Course File
of
Basic Electrical Engineering
(100201)

2nd Semester EE

Faculty Name:

Mr. Tabish Shanu
Assistant Professor
Department of Electrical Engineering

VISION OF THE INSTITUTE

To consistently strive for excellence in engineering education by producing skilled, trained and knowledge-driven engineers who fit into the current and future requirements of industries, organizations, and society thereby contributing to the sustainable growth of the country.

MISSION OF THE INSTITUTE

M1: To improve teaching-learning process while making the existing curriculum more contemporary and in keeping with the requirements of the industry.

M2: To create an environment for fostering research and development.

M3: To develop students’ soft skills, ethical values, leadership qualities, reasoning and analytical abilities and motivate them to address engineering needs of neighboring areas.

Program Outcomes (PO)

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 analyse 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 modelling 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 teamwork:** 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.

Department of Electrical Engineering

Vision

To produce competent electrical engineers with ethical values addressing the challenges in the field of education, industry, and research for the sustainable growth of nation.

Mission

M1: To create an environment for quality technical education and produce engineers who will contribute meaningfully to the growth and development of the country.

M2: To engage the students in research & development in cutting edge and sustainable technologies.

M3: To develop professional skills, ethical values, and leadership qualities to address the needs of neighbouring areas in terms of engineering and technical support.

PEO

Graduates of the program will be able to:

PEO1: Establish their careers in the field of Electrical Engineering and related areas, providing innovative and effective solutions.

PEO2: Establish themselves as entrepreneur, work in research and development organization and pursue higher education.

PEO3: Manage projects catering to current societal and industrial needs in an ethical manner as a member/leader of multidisciplinary teams.

PSO

Upon satisfactory completion of the program, a student will be able to:

PSO-1: Identify, analyze, and solve real-life problems by applying the knowledge in Electrical Engineering.

PSO-2: Design and develop electrical systems with the help of automation tools to excel in the field of Electrical engineering.

PSO-3: Find solutions to the issues faced by society through engineering and technological innovations while upholding professional ethics and social values.

Institute / College Name :	PURNEA COLLEGE OF ENGINEERING		
Program Name	**B.Tech. (EE – 2nd Sem.)**		
Course Code	100201		
Course Name	BASIC ELECTRICAL ENGINEERING		
Lecture / Tutorial (per week):	3-1-2 (L-T-P)	**Course Credits**	5
Course Coordinator Name	MR. TABISH SHANU		

Course Description

This course covers basic elements of circuit knowledge and AC fundamentals. The course is aimed at teaching the students about the basic and fundamental theorems and devices of Electrical Engineering so that the students can take up higher courses in Electrical Engineering.

Course Outcomes

CO-PO Mapping

CO	Course outcomes	POs/PSOs	CL	Classroom session
CO1	To understand electrical circuit principles, theorems, and time-domain analysis.	PO 1, 2, 3, 4,5,6,8,12 PSO 1,2,3	U	8
CO2	To apply knowledge of AC circuit analysis, power, and phasor representation.	PO 1, 2, 3,4,5,6,7,8,9,10,11,12 PSO 1,2,3	Ap	8
CO3	To analyse magnetic circuits, transformer, and performance of transformer in electrical systems.	PO 1,2,3,4,12 PSO 1,2,3	An	10
CO4	To explain the principles of DC motor, induction motor and synchronous generator.	PO 1, 2, 3,4,5,6,7,8,9,10,11,12 PSO 1,2,3	U	10
CO5	To explain components of LT switchgear, batteries and elementary calculations for energy consumption.	PO 1,2 3,4, 5,6,7,9,10,12 PSO 1,2,3	U	6
				42

Cognitive Level (CL):
R-Remember, U-Understand, Ap- Apply, An-Analyse, E-Evaluate and C-Create

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	3	3	2	2	2	2	0	1	0	0	1	2	3	3	2
CO2	3	3	2	2	1	1	2	1	1	1	1	3	3	3	2
CO3	3	2	2	2	2	2	1	2	1	1	1	2	2	2	3
CO4	3	2	2	3	2	2	1	1	1	1	1	2	3	2	3
CO5	3	3	1	1	2	2	1	0	2	1	0	2	3	2	1
AVERAGE	3	3	2	2	2	2	0	1	0	0	1	2	3	3	2

1-weak, 2-moderate, 3-strong

COURSE OUTCOME TARGET

CO	Target %
CO1	**60%**
CO2	**60%**
CO3	**60%**
CO4	**65%**
CO5	**65%**

PO'S / PSO'S ADDRESSED BY COS & MAPPING STRENGTH WITH COURSE

PO/PSO	CO	No. of Sessions	% of session	Mapping Strength
PO1	CO 1,2,3,4,5	42	100	3
PO2	CO 1,2,3,4,5	42	100	3
PO3	CO 1,2,3,4,5	42	100	3
PO5	CO 1,2,3,4,5	42	100	3
PO6	CO 1,2,3,4,5	42	100	3
PO7	CO 2,3,4,5	34	81	3
PO8	CO 1,2,3,4	36	86	3
PO9	CO 2,3,4,5	34	81	3
PO10	CO 2,3,4,5	34	81	3
PO11	CO 1,2,3,4	36	86	3
PO12	CO 1,2,3,4,5	42	100	3
PSO1	CO 1,2,3,4,5	42	100	3
PSO2	CO 1,2,3,4,5	42	100	3
PSO3	CO 1,2,3,4,5	42	100	3

S. No.	Percentage of Session	Mapping Strength
1	> 70	3
2	30 - 70	2
3	< 30	1

COURSE – PO/PSO MAPPING

BEE	**PO**												**PSO**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
Mapping Strength	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3

Textbooks

TB1: ‘Basic Electrical Engineering' by A. E. Fitzgerald, Fifth Edition, Tata McGraw Hill
TB2: ‘Basic Electrical Engineering’ by Abhijit Chakrabarti, Tata McGraw Hill
TB3: ‘Electric Machines’’ by Ashfaq Hussain, Dhanpat rai & Co.

Reference Books

RB1: 'Fundamental of Electrical Engineering' by Leonard S. Bobrow, Oxford
RB2: 'Fundamentals of Electrical Engineering' by R. Prasad, PHI Publication
RB3: ‘Electrical Engineering Fundamentals’ by Vincent Del Toro, Second Edition

Other readings and relevant websites

S.No.	**Link of Journals, Magazines, websites and Research Papers**
1.	http://nptel.ac.in/courses/108108076/
2.	http://nptel.ac.in/courses/108105053/
3.	https://www.youtube.com/channel/UCBzzSN5VFHL8EHGzVhJNKKQ
4.	http://ieeexplore.ieee.org
5.	https://www.sciencedirect.com

SYLLABUS

Topics
DC CIRCUITS (8 LECTURES) ELECTRICAL CIRCUIT ELEMENTS (R, L AND C), VOLTAGE AND CURRENT SOURCES, KIRCHHOFF CURRENT AND VOLTAGE LAWS, ANALYSIS OF SIMPLE CIRCUITS WITH DC EXCITATION. STAR-DELTA CONVERSION, NETWORK THEOREMS (SUPERPOSITION, THEVENIN, NORTON AND MAXIMUM POWER TRANSFER THEOREMS). TIME-DOMAIN ANALYSIS OF FIRST-ORDER RL AND RC CIRCUITS
AC CIRCUITS (8 LECTURES) REPRESENTATION OF SINUSOIDAL WAVEFORMS, PEAK, RMS AND AVERAGE VALUES (FORM FACTOR AND PEAK FACTOR), IMPEDANCE OF SERIES AND PARALLEL CIRCUIT, PHASOR REPRESENTATION, REAL POWER, REACTIVE POWER, APPARENT POWER, POWER FACTOR, POWER TRIANGLE. ANALYSIS OF SINGLE-PHASE AC CIRCUITS CONSISTING OF R, L, C, RL, RC, RLC COMBINATIONS (SERIES AND PARALLEL), RESONANCE. THREE-PHASE BALANCED CIRCUITS, VOLTAGE AND CURRENT RELATIONS IN STAR AND DELTA CONNECTIONS.
MAGNETIC CIRCUITS: (4 LECTURES) INTRODUCTION, SERIES AND PARALLEL MAGNETIC CIRCUITS, ANALYSIS OF SERIES AND PARALLEL MAGNETIC CIRCUITS.
TRANSFORMERS (6 LECTURES) MAGNETIC MATERIALS, BH CHARACTERISTICS, IDEAL AND PRACTICAL TRANSFORMER, EMF EQUATION, EQUIVALENT CIRCUIT, LOSSES IN TRANSFORMERS, REGULATION AND

EFFICIENCY. AUTO-TRANSFORMER AND THREE-PHASE TRANSFORMER CONNECTIONS.

ELECTRICAL MACHINES (10 LECTURES)

CONSTRUCTION, WORKING, TORQUE-SPEED CHARACTERISTIC AND SPEED CONTROL OF SEPARATELY EXCITED DC MOTOR. GENERATION OF ROTATING MAGNETIC FIELDS, CONSTRUCTION AND WORKING OF A THREE-PHASE INDUCTION MOTOR, SIGNIFICANCE OF TORQUE-SLIP CHARACTERISTIC. LOSS COMPONENTS AND EFFICIENCY, STARTING AND SPEED CONTROL OF INDUCTION MOTOR. CONSTRUCTION AND WORKING OF SYNCHRONOUS GENERATORS.

ELECTRICAL INSTALLATIONS (6 LECTURES)

COMPONENTS OF LT SWITCHGEAR: SWITCH FUSE UNIT (SFU), MCB, ELCB, MCCB, TYPES OF WIRES AND CABLES, EARTHING. TYPES OF BATTERIES, IMPORTANT CHARACTERISTICS FOR BATTERIES. ELEMENTARY CALCULATIONS FOR ENERGY CONSUMPTION, POWER FACTOR IMPROVEMENT AND BATTERY BACKUP.

Time Table

2nd Semester EE
ROOM NO. 103, wef- 29/07/2024

Day/ time	10:00-10:50	10:50-11:40	11:40-12:30	12:30-01:20	01:20-02:00	02:00 to 04:30		
MON		**BEE**			LUNCH BREAK			
TUE			**BEE**					
WED								
THU		**BEE**	**BEE**					
FRI								
SAT			**BEE LAB**					

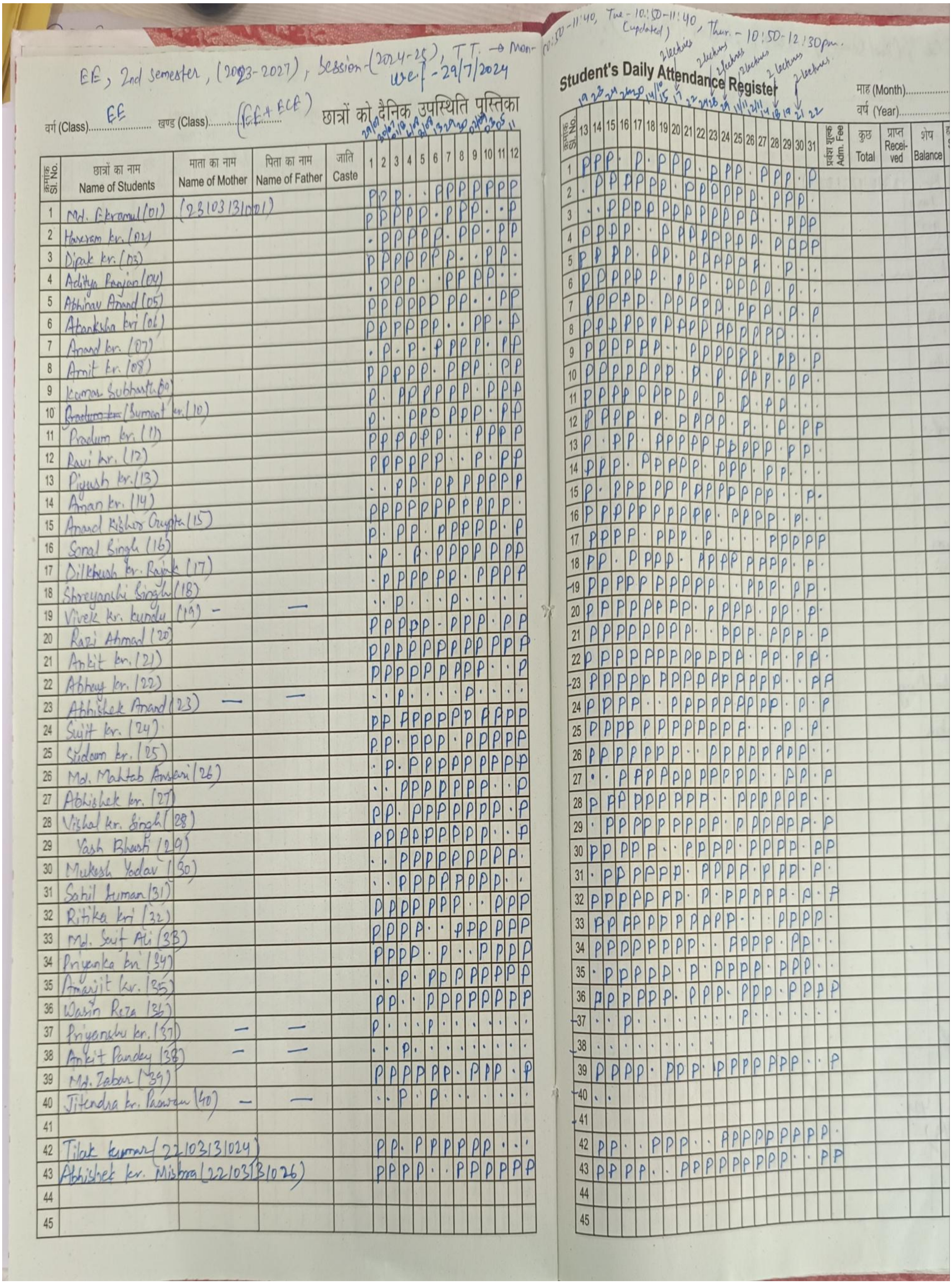
List of Students

Branch- Electrical Engineering

Sl No	Registration No	Name
1	22103131024	TILAK KUMAR
2	22103131026	ABHISHEK KUMAR MISHRA
3	23103131001	MD EKRAMUL
4	23103131002	HARERAM KUMAR
5	23103131003	DIPAK KUMAR
6	23103131004	ADITYA RANJAN
7	23103131005	ABHINAV ANAND
8	23103131006	AKANKSHA KUMARI
9	23103131007	AANAND KUMAR
10	23103131008	AMIT KUMAR
11	23103131009	KUMAR SUBHARTH
12	23103131010	SUMANT KUMAR
13	23103131011	PRADUM KUMAR
14	23103131012	RAVI KUMAR
15	23103131013	PIYUSH KUMAR
16	23103131014	AMAN KUMAR
17	23103131015	ANAND KISHOR GUPTA
18	23103131016	SONAL SINGH
19	23103131017	DILKHUSH KUMAR RAJAK
20	23103131018	SHREYASHI SINGH
21	23103131020	RAZI AHMED
22	23103131021	ANKIT KUMAR
23	23103131022	ABHAY KUMAR
24	23103131024	SUJIT KUMAR
25	23103131025	SUDAM KUMAR
26	23103131026	MD MAHTAB ANSARI
27	23103131027	ABHISHEK KUMAR
28	23103131028	VISHAL KUMAR SINGH
29	23103131029	YASH BHARTI
30	23103131030	MUKESH YADAV
31	23103131031	SAHIL SUMAN
32	23103131032	RITIKA KUMARI

33	**23103131033**	**MD SAIF ALI**
34	**23103131034**	**PRIYANKA KUMARI**
35	**23103131035**	**AMARJIT KUMAR**
36	**23103131036**	**WASIM REZA**
37	**23103131039**	**MD ZABAR**

ATTENDANCE



EE, 2nd semester, (2023-2027), Session-(2024-25), T.T. → Mon- 10:50-11:40, Tue - 10:50-11:40 (updated), Thur. - 10:50-12:30pm.
w.e.f - 29/7/2024

वर्ग (Class) EE खण्ड (Class) (EE + ECE)

छात्रों को दैनिक उपस्थिति पुस्तिका

Student's Daily Attendance Register

माह (Month)

वर्ष (Year)

क्रमांक Sl. No.	छात्रों का नाम Name of Students	माता का नाम Name of Mother	पिता का नाम Name of Father	जाति Caste
1	Md. Ekramul (01)	(23103131001)		
2	Hareram kr. (02)			
3	Dipak kr. (03)			
4	Aditya Ranjan (04)			
5	Abhinav Anand (05)			
6	Akanksha kri (06)			
7	Anand kr. (07)			
8	Amit kr. (08)			
9	Kumar Subhash (09)			
10	~~Pradum kr~~ (Sumant kr. (10)			
11	Pradum kr. (11)			
12	Ravi kr. (12)			
13	Piyush kr. (13)			
14	Aman kr. (14)			
15	Anand Kishor Gupta (15)			
16	Sonal Singh (16)			
17	Dilkhush kr. Rajak (17)			
18	Shreyanshi Singh (18)			
19	Vivek kr. kundu (19)	–	—	
20	Razi Ahmad (20)			
21	Ankit kr. (21)			
22	Abhay kr. (22)			
23	Abhishek Anand (23)	—	—	
24	Sujit kr. (24)			
25	Sudam kr. (25)			
26	Md. Mahtab Ansari (26)			
27	Abhishek kr. (27)			
28	Vishal kr. Singh (28)			
29	Yash Bharti (29)			
30	Mukesh Yadav (30)			
31	Sahil Suman (31)			
32	Ritika kri (32)			
33	Md. Saif Ali (33)			
34	Priyanka kri (34)			
35	Amarjit kr. (35)			
36	Wasim Reza (36)			
37	Priyanshu kr. (37)	—	—	
38	Ankit Pandey (38)	—	—	
39	Md. Zabar (39)			
40	Jitendra kr. Paswan (40)	—	—	
41				
42	Tilak kumar (22103131024)			
43	Abhishek kr. Mishra (22103131026)			
44				
45				

LECTURE PLAN

Lecture Number	Topics	Web Links for video lectures	Text Book / Reference Book / Other reading material	Page numbers of Text Book(s)
1-3	**Introduction**			
	Electrical Elements and their Classification, KCL, KVL equation and node voltage method.	https://www.youtube.com/watch?v=rLUyP6g1VNI&list=PL425060D3C78350E1	**TB2, RB3**	47-52
4-5	**D.C. Circuits**			
	D.C circuits steady state analysis with independent and dependent sources, Series and parallel circuits, Star delta conversion.	https://www.youtube.com/watch?v=VKSoHdJ67jQ&index=3&list=PL425060D3C78350E1	**TB2, RB3**	52-72
6-8	**Network Theorems**			
	Superposition theorem, Thevenin's theorem, Norton's theorem, Maximum Power Transfer Theorem.	https://www.youtube.com/watch?v=bnjiLg4xfh8	**TB2, RB1**	99-130
9-10	**A.C Circuits**			
	Common signals and their waveform, R.M.S and Average value, form factor and Peak factor of sinusoidal wave.	https://www.youtube.com/watch?v=EyHljBaE7xw	**TB2, RB1**	201-246
11-12	**Impedance & A.C. Power**			
	Impedance of series and parallel circuits, Phasor diagram, Power, Power factor, Power triangle, Coupled circuits, Resonance and Q-factor.	https://www.youtube.com/watch?v=Fvj_pZCWV_4	**TB2, RB1**	247-274
13-14	**A.C. Network Theorems**			
	Superposition, Thevenin's and Norton's, Maximum power transfer theorem for A.C circuits.	https://www.youtube.com/watch?v=cpwMPTFPFKM	**TB2, RB1**	247-274
15-16	**3-Phase A.C. Circuits**			
	Phase Star delta, line and phase relation, Power relation, Analysis of balanced and unbalanced 3-phase circuits.	https://www.youtube.com/watch?v=tp_y60TqtWY	**TB2, RB3**	301-329
17-20	**Magnetic circuits**			
	Introduction, Series & Parallel magnetic circuits. Analysis of Linear and nonlinear magnetic circuits. Energy storage, A.C. excitation. Eddy current and hysteresis losses.	https://www.youtube.com/watch?v=RxbJo2kDRxE	**TB2, RB2**	1-68
21-23	**TRANSFORMERS**			
	MAGNETIC MATERIALS, BH CHARACTERISTICS, IDEAL AND PRACTICAL TRANSFORMER, EMF EQUATION, EQUIVALENT CIRCUIT.	https://www.youtube.com/watch?v=LPcQYXjPdIQ&list=PLp6ek2hDcoNCANsWM2mw3qi0387BhfLyV	**TB3**	1-68
24-26	**THREE PHASE TRANSFORMERS**			

	LOSSES IN TRANSFORMERS, REGULATION AND EFFICIENCY. AUTO-TRANSFORMER AND THREE-PHASE TRANSFORMER CONNECTIONS.	https://www.youtube.com/watch?v=LPcQYXjPdIQ&list=PLp6ek2hDcoNCANsWM2mw3qi0387BhfLyV	**TB3**	69-166
27-30	**Electrical machines**			
	CONSTRUCTION, WORKING, TORQUE-SPEED CHARACTERISTIC AND SPEED CONTROL OF SEPARATELY EXCITED DC MOTOR.	https://www.youtube.com/watch?v=LPcQYXjPdIQ&list=PLp6ek2hDcoNCANsWM2mw3qi0387BhfLyV	**TB3**	493-548
31-36	**3 phase induction motor**			
	GENERATION OF ROTATING MAGNETIC FIELDS, CONSTRUCTION AND WORKING OF A THREE-PHASE INDUCTION MOTOR, SIGNIFICANCE OF TORQUE-SLIP CHARACTERISTIC. LOSS COMPONENTS AND EFFICIENCY, STARTING AND SPEED CONTROL OF INDUCTION MOTOR. CONSTRUCTION AND WORKING OF SYNCHRONOUS GENERATORS.	https://www.youtube.com/watch?v=LPcQYXjPdIQ&list=PLp6ek2hDcoNCANsWM2mw3qi0387BhfLyV	**TB3**	303-406
37-39	**Electrical installations**			
	COMPONENTS OF LT SWITCHGEAR: SWITCH FUSE UNIT (SFU), MCB, ELCB, MCCB, TYPES OF WIRES AND CABLES, EARTHING.	https://www.youtube.com/watch?v=2lDQh9HWsJQ&list=PLmpjYYaZvRxRmDRuxTVHBIj4JEQ7k9qy9	**TB3**	30-43
40-42	**Batteries**			
	TYPES OF BATTERIES, IMPORTANT CHARACTERISTICS FOR BATTERIES. ELEMENTARY CALCULATIONS FOR ENERGY CONSUMPTION, POWER FACTOR IMPROVEMENT AND BATTERY BACKUP.	https://www.youtube.com/watch?v=iihYXx79QiE	**TB3**	100-120

LECTURE PLAN

Topics	**Lecture**	**CO covered**
DC CIRCUITS	**1-8**	
R, L AND C ELEMENTS, VOLTAGE AND CURRENT SOURCES	1	CO1
KIRCHHOFF CURRENT AND VOLTAGE LAWS	2	CO1
ANALYSIS OF SIMPLE CIRCUITS WITH DC EXCITATION.	3	CO1
ANALYSIS OF SIMPLE CIRCUITS WITH DC EXCITATION.	4	CO1
STAR-DELTA CONVERSION	5	CO1
NETWORK THEOREMS (SUPERPOSITION, THEVENIN)	6	CO1
NORTON AND MAXIMUM POWER TRANSFER THEOREMS	7	CO1
TIME-DOMAIN ANALYSIS OF FIRST-ORDER RL AND RC	8	CO1

CIRCUITS		
AC CIRCUITS	**9-16**	
REPRESENTATION OF SINUSOIDAL WAVEFORMS	9	CO2
PEAK, RMS AND AVERAGE VALUES	10	CO2
IMPEDANCE OF SERIES AND PARALLEL CIRCUIT	11	CO2
PHASOR REPRESENTATION, REAL POWER, REACTIVE POWER, APPARENT POWER	12	CO2
POWER FACTOR, POWER TRIANGLE.	13	CO2
ANALYSIS OF SINGLE-PHASE AC CIRCUITS CONSISTING OF R, L, C, RL, RC, RLC COMBINATIONS	14	CO2
RESONANCE. THREE-PHASE BALANCED CIRCUITS, VOLTAGE AND CURRENT RELATIONS IN STAR AND DELTA CONNECTIONS.	15	CO2
RESONANCE. THREE-PHASE BALANCED CIRCUITS, VOLTAGE AND CURRENT RELATIONS IN STAR AND DELTA CONNECTIONS.	16	CO2
MAGNETIC CIRCUITS:	**17-20**	
INTRODUCTION	17	CO3
SERIES AND PARALLEL MAGNETIC CIRCUITS	18	CO3
ANALYSIS OF SERIES AND PARALLEL MAGNETIC CIRCUITS.	19	CO3
ANALYSIS OF SERIES AND PARALLEL MAGNETIC CIRCUITS.	20	CO3
TRANSFORMERS	**21-26**	
MAGNETIC MATERIALS, BH CHARACTERISTICS	21	CO3
IDEAL AND PRACTICAL TRANSFORMER, EMF EQUATION	22	CO3
EQUIVALENT CIRCUIT	23	CO3
LOSSES IN TRANSFORMERS	24	CO3
REGULATION AND EFFICIENCY	25	CO3
AUTO-TRANSFORMER AND THREE-PHASE TRANSFORMER CONNECTIONS	26	CO3
ELECTRICAL MACHINES	**27-36**	
CONSTRUCTION, WORKING	27	CO4
TORQUE-SPEED CHARACTERISTIC	28	CO4
SPEED CONTROL OF SEPARATELY EXCITED DC MOTOR	29	CO4
GENERATION OF ROTATING MAGNETIC FIELDS	30	CO4
CONSTRUCTION AND WORKING OF A THREE-PHASE INDUCTION MOTOR	31	CO4
CONSTRUCTION AND WORKING OF A THREE-PHASE INDUCTION MOTOR	32	CO4
SIGNIFICANCE OF TORQUE-SLIP CHARACTERISTIC	33	CO4
LOSS COMPONENTS AND EFFICIENCY	34	CO4
STARTING AND SPEED CONTROL OF INDUCTION MOTOR	35	CO4

CONSTRUCTION AND WORKING OF SYNCHRONOUS GENERATORS.	36	CO4
ELECTRICAL INSTALLATIONS	**37-42**	
COMPONENTS OF LT SWITCHGEAR: SWITCH FUSE UNIT (SFU)	37	CO5
MCB, ELCB, MCCB, TYPES OF WIRES AND CABLES	38	CO5
EARTHING. TYPES OF BATTERIES	39	CO5
IMPORTANT CHARACTERISTICS FOR BATTERIES	40	CO5
ELEMENTARY CALCULATIONS FOR ENERGY CONSUMPTION	41	CO5
POWER FACTOR IMPROVEMENT AND BATTERY BACKUP	42	CO5

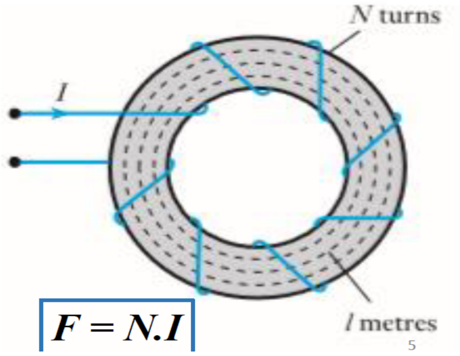
- **LECTURE NOTES**

INTRODUCTION

- A **magnetic circuit** is made up of one or more **closed loop** paths containing a **magnetic flux** ϕ (= **magnetic** field/**flux density** B × **cross-sectional area** A).
- The **flux** is usually **generated** by **permanent magnets** or **electromagnets** and confined to a **path** by **magnetic cores** consisting of **ferromagnetic materials** like **iron**, although there **may be air gaps** or other materials in the path.
- Magnetic circuits are employed to efficiently channel magnetic fields in many **devices** such as **electric motors, generators, transformers, relays, solenoids, loudspeakers, hard disks, MRI machines**.

Magnetomotive force (*mmf*)

- In an **electric circuit**, the **current** is **induced** due to the existence of an **electromotive force** (***emf E***, **battery voltage**). By analogy, we say that in a **magnetic circuit** the **magnetic flux** is **induced** due to the existence of a **magnetomotive force** (***mmf F***) caused by a **current flowing through one or more turns of coil**.
- The value of the ***mmf F*** is **proportional** to the **current** flowing through the coil and to the **number of turns** in the **coil**, and is expressed in units of "**ampere-turns**" or just **amperes** (number of turns is dimensionless).



$$\boxed{F = N.I}$$

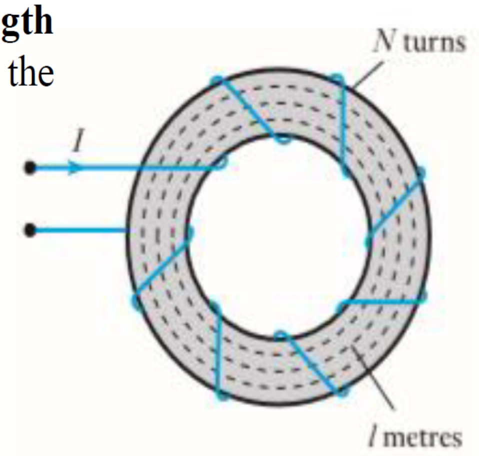
Magnetic field strength/intensity (*H*)

- The **magnetomotive force per unit length** of the magnetic circuit is termed the **magnetic field strength/intensity** (***H***).

$$H = \frac{F}{l}$$

where, $F = NI$ amperes

where l is the length of the magnetic circuit or flux loop



- **Units** of H are **ampere-turns per metre** (At/m) or just **ampere per metre** (A/m)

$$\boxed{H = \frac{NI}{l} \text{ amperes per metre}}$$

Permeability of free space μ_0 (magnetic constant)

The permeability of free space or non-magnetic materials is

$$\boxed{\mu_0 = \frac{B}{H} \quad \text{for a vaccum and non-magnetic materials}}$$

$$\boxed{\mu_0 = 4\pi * 10^{-7} \ H/m}$$ (The **units** of $\boldsymbol{\mu_0}$ are H/m **(Henry per meter))**

where $\boldsymbol{B}$ (= ϕ/A) is the **magnetic flux density** (units of Tesla, T),

$\boldsymbol{A}$ is the **cross-sectional area** through which the flux passes,

$\boldsymbol{\phi}$ is the **magnetic flux** (units of Weber (Wb)) and

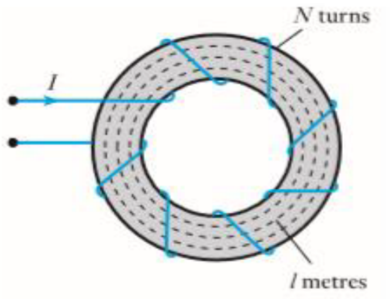
$\boldsymbol{H}$ is the **magnetic field strength** (units A/m).

Reluctance *S*

It is the opposition that a magnetic circuit offers to the passage of magnetic flux through it (**ratio of *mmf* applied to the flux induced**).

$$\phi = BA \qquad (1)$$

$$mmf,\ F = Hl \qquad (2)$$



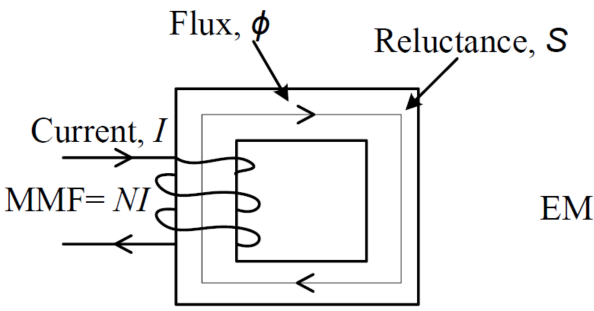
Dividing (1) by (2),

$$\frac{\phi}{F} = \frac{BA}{Hl} = \frac{\mu_0 \mu_r HA}{Hl} = \mu_0 \mu_r \frac{A}{l}$$

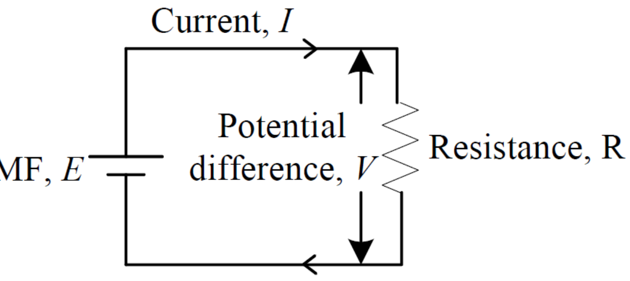
Thus, $\boxed{\boldsymbol{S = F/\phi = l/(\mu A)}}$, where $\mu = \mu_0 \mu_r$ (S has units of A/Wb)

The **inverse of reluctance** is known as **permeance** (ease of flux passage)

MAGNETIC CIRCUIT ANALOGY WITH ELECTRICAL CIRCUIT



Magnetic circuit



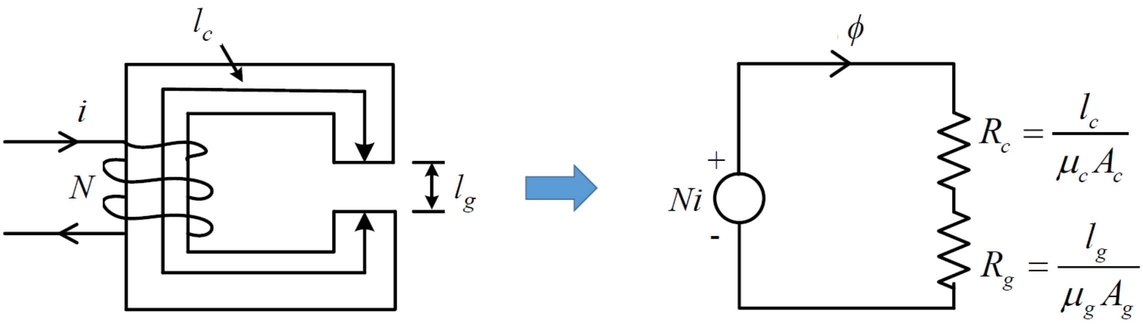
Analogous electrical circuit

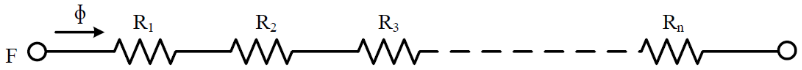
Magnetic Circuit Analogy with Electrical Circuit

S.No	Magnetic circuit quantity	Electrical circuit quantity
1	Magnetic flux density ***B*** (T = Wb/m^2)	Current density ***J*** (A/m^2)
2	Magnetic flux ***ϕ*** (Wb)	Current ***I*** (A)
3	Magnetic field intensity ***H*** (A/m)	Electric field intensity ***E*** (V/m)
4	m.m.f. ***F*** (A)	e.m.f. ***E*** (V)
5	Reluctance ***S*** (A/Wb)	Resistance ***R*** (Ω = V/A)
6	Permeance (H = Wb/A)	Conductance (S = A/V)
7	Permeability ***μ*** (H/m)	Conductivity ***σ*** (S/m)

Series Connection in Magnetic Circuit

The applied *mmf* is equal to the sum of the *mmf*s dropped across each series element, while the flux through each series element is the same.





$$\boxed{F=\phi R_{eq}=\phi\left(R_1+R_2+R_3+........+R_n\right)}$$ (R_i denote reluctances)

B-H Curve

- The ***B-H*** or **magnetization curve** gives the **relation** between **flux density *B*** and **field intensity *H***.
- It is **not a straight line** (as naively expected from the relation $B = \mu H$) and is actually **non-linear** as the permeability ***μ*** typically **depends** on the applied field strength ***H***.
- The complete ***B-H* curve** is usually described as a **hysteresis loop**. The **area** contained **within** a hysteresis **loop** indicates the **energy required** to perform the '**magnetize - demagnetize**' process.

Types of Batteries and Their Applications

written by: Umair Mirza • edited by: KennethSleight • updated: 8/29/2011

A battery is a source of electrical energy, which is provided by one or more electrochemical cells of the battery after conversion of stored chemical energy. In today's life, batteries play an important part as many household and industrial appliances use batteries as their power source.

Types of Batteries

Batteries can be divided into two major categories, primary batteries and secondary batteries. A primary battery is a disposable kind of battery.

Once used, it cannot be recharged. Secondary batteries are rechargeable batteries. Once empty, it can be recharged again. This charging and discharging can happen many times depending on the battery type. Alkaline batteries, Mercury batteries, Silver-Oxide batteries, and Zinc carbon batteries are examples of primary batteries whereas Lead-Acid batteries and Lithium batteries fall into the secondary battery's category.

Alkaline Batteries

Alkaline batteries are non-rechargeable, high energy density, batteries that have a long life span. This battery obtained its name because the electrolyte used in it is alkaline (potassium hydroxide). The chemical composition features zinc powder as an anode and manganese dioxide as the cathode with potassium hydroxide as the electrolyte.

The chemical reactions are:

$Zn\ (s) + 2OH^-\ (aq) \rightarrow ZnO\ (s) + H_2O\ (l) + 2e^-$

$2MnO_2\ (s) + H_2O\ (l) + 2e^- \rightarrow Mn_2O_3\ (s) + 2OH^-\ (aq)$

If we compare the capacity of an alkaline cell with a zinc-chloride cell of same size, the former can provide about four to five times more energy under equal load conditions. The supply voltage level decreases over time so the minimum required voltage level for a particular load may not match the supplied voltage level and thus results in no operation. But the rate of decline of alkaline batteries is lower than the Leclanche cell, thus longer life. The typical values of voltage and current supplied by a single alkaline cell are 1.5V and 700mA respectively. These batteries are distributed in various standard cylindrical shapes.

Applications

Alkaline batteries are the most common type of batteries used in the world with major consumption in the US, UK and Switzerland. Designed for long lasting performance, these can be found in remote controls, clocks, and radios. The high run time makes alkaline batteries ideal for digital cameras, hand held games, MP3 players etc.

Zinc-Carbon Batteries

Zinc-Carbon batteries are also known as dry cells (as the nature of electrolyte used in these cells is dry), which come in a composition of a carbon rod (cathode) surrounded by a mixture of carbon powder and manganese dioxide (to increase the conductivity). This whole combination is packed in a zinc container acting as the anode. The electrolyte is a mixture of ammonium chloride and zinc chloride. The typical voltage value is a little less than 1.5V. These batteries are durable and have longer lives. Zinc-Carbon batteries can be used effectively at moderate temperature but do not work well at low temperatures.

Applications

These general purpose batteries are available for lower prices which is why many electronic devices are sold with these batteries included free. The basic use is in low power drain applications such as flash lights, remote controsl, toys, and table clocks.

Lead-Acid Batteries

Lead-acid batteries are the rechargeable kind of batteries invented in the 1980s. These large, heavyweight batteries find the major application in automobiles as these fulfill the high current requirements of the heavy motors. The composition of Lead-Acid battery changes in charged and discharged states.

A combination of Pb (negative) and PbO_2 (positive) as electrodes with H_2SO_4 as electrolyte in charged form and $PbSO_4$ and water in discharged form.

Applications

The major application of lead acid battery is in starting, lightning, and ignition systems(SLI) of automobiles. Its other form, wet cell battery is used as backup power supply for high end servers, personal computers, telephone exchanges, and in off grid homes with inverters. Portable emergency lights also use lead acid batteries.

Mercury Batteries

Mercury batteries are non-rechargeable batteries that contain mercuric oxide with manganese dioxide. They are deep discharge batteries and voltage level does not fall below 1.35V until 5% energy level is reached. These batteries are less popular because of low output voltage. Furthermore, mercury is toxic and can cause hazards for humans.

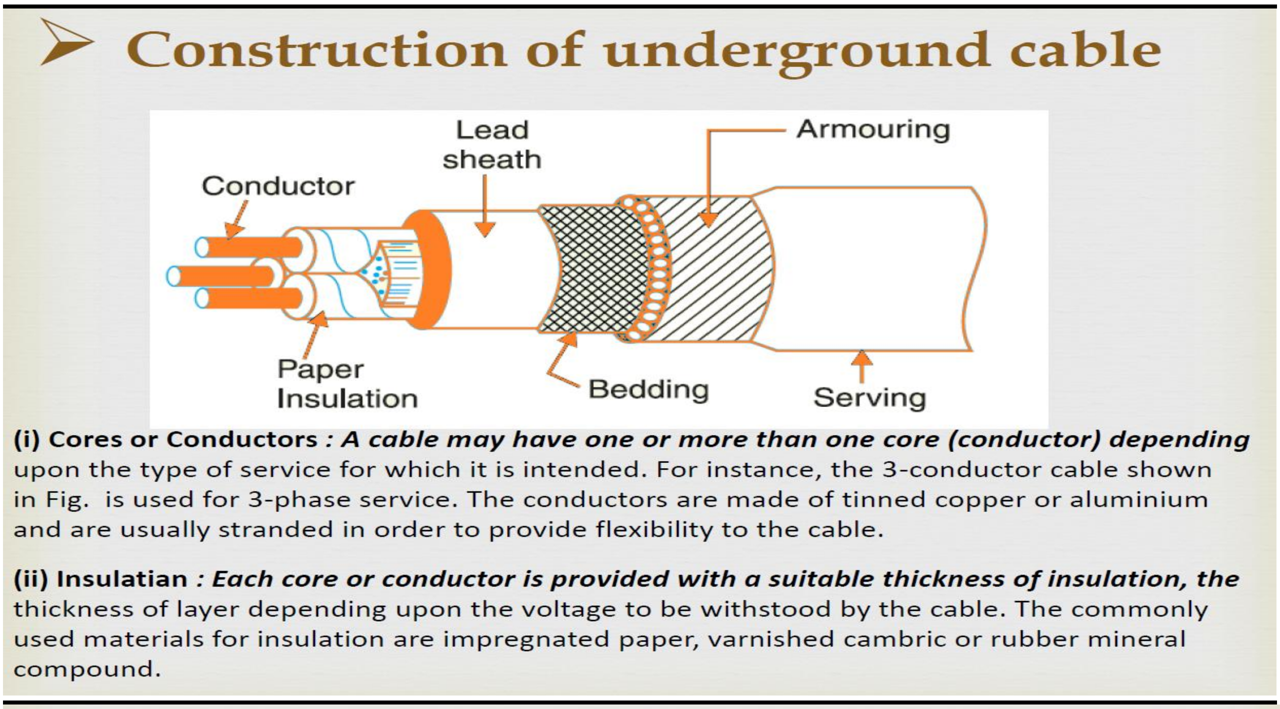
Applications

The flat discharge curve makes this battery useful for photographic light meters and electronic devices such as to run the real-time clock of CPU.

Lithium and Silver Oxide Batteries

Lithium batteries are rechargeable (secondary) batteries, where lithium in its pure ion compound form is used. Depending on the design and chemical compounds used, lithium batteries can produce voltages from 1.5 Volts to 3.7 Volts. The most common type of lithium battery used in consumer applications uses manganese dioxide as cathode and metallic lithium as anode. Compared to ordinary zinc–carbon batteries or alkaline batteries, the voltage production of lithium cell is twice from them.

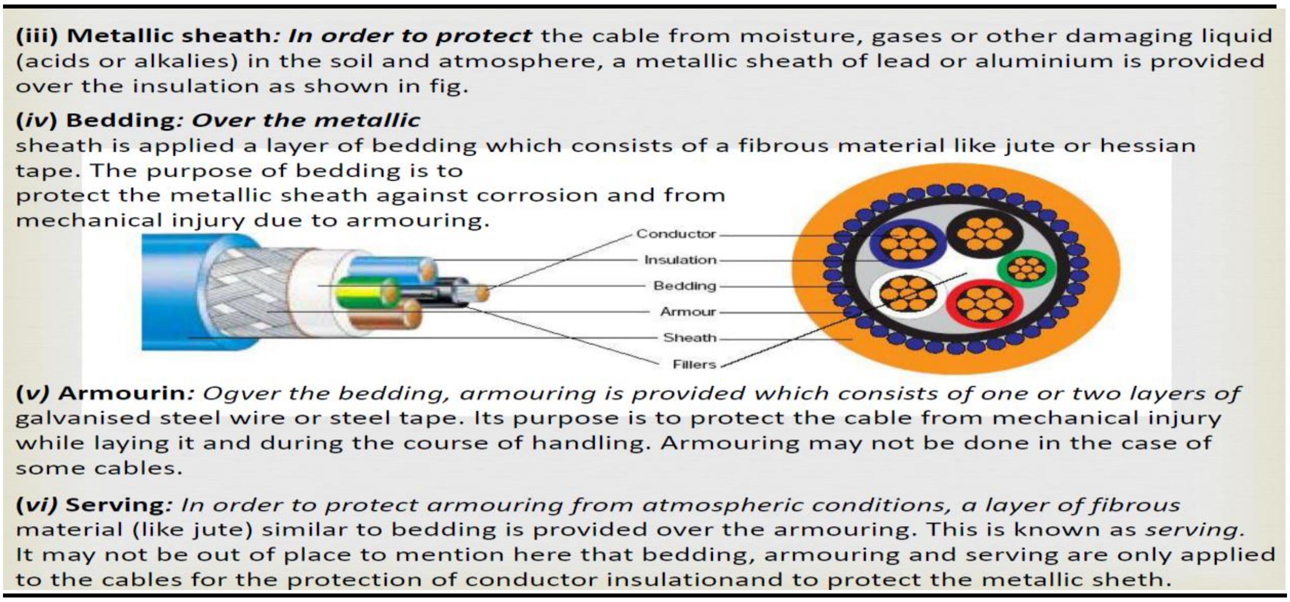
Silver oxide batteries are expensive, small to large sized primary cells that offer better run time than alkaline batteries. They are usually suitable for powering low-current electrical devices.They use silver oxide as positive



➢ Construction of underground cable

(i) Cores or Conductors : ***A cable may have one or more than one core (conductor) depending*** upon the type of service for which it is intended. For instance, the 3-conductor cable shown in Fig. is used for 3-phase service. The conductors are made of tinned copper or aluminium and are usually stranded in order to provide flexibility to the cable.

(ii) Insulatian : ***Each core or conductor is provided with a suitable thickness of insulation, the*** thickness of layer depending upon the voltage to be withstood by the cable. The commonly used materials for insulation are impregnated paper, varnished cambric or rubber mineral compound.

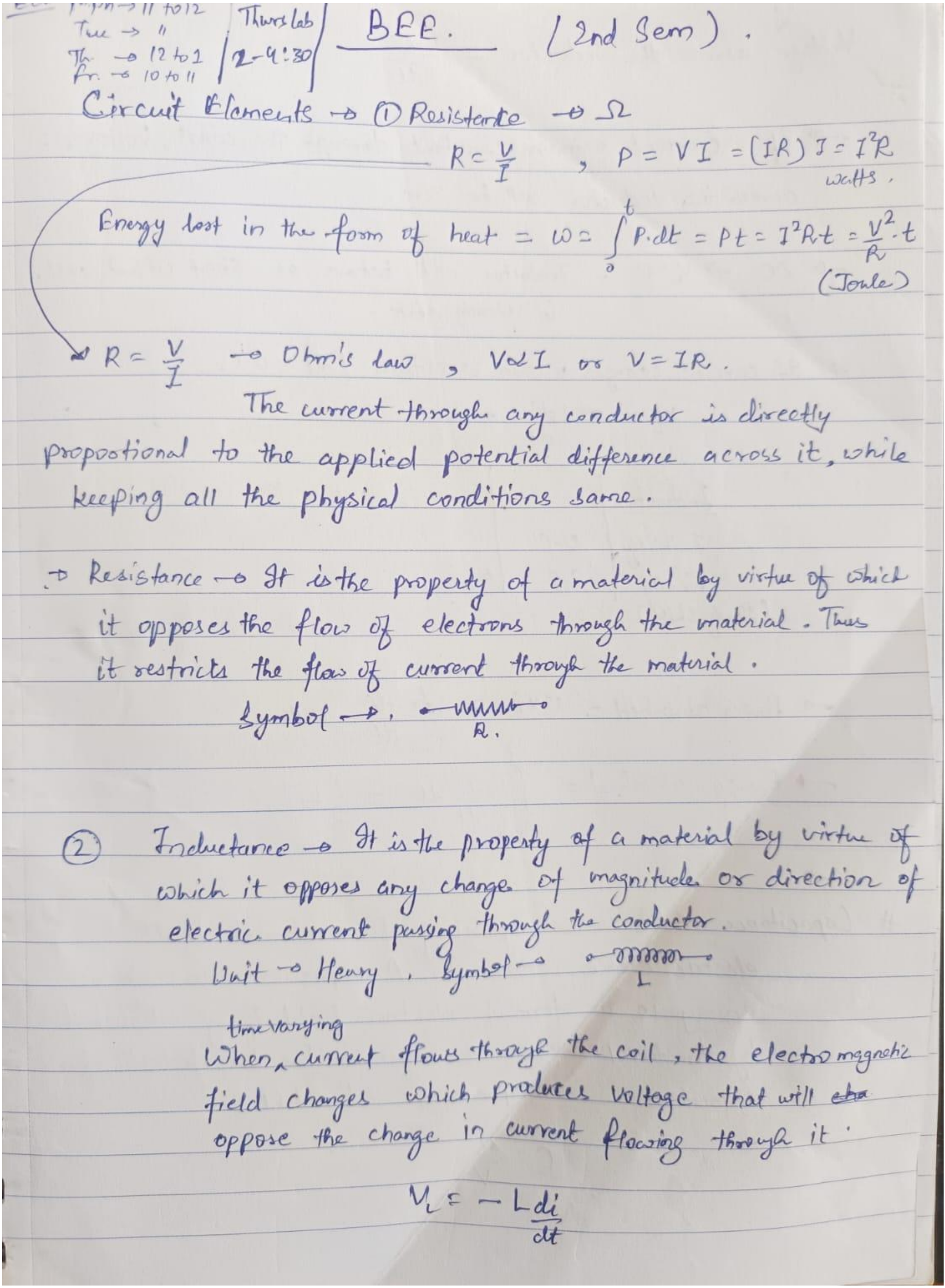


(iii) Metallic sheath*:* ***In order to protect*** the cable from moisture, gases or other damaging liquid (acids or alkalies) in the soil and atmosphere, a metallic sheath of lead or aluminium is provided over the insulation as shown in fig.

(iv)* Bedding:** ***Over the metallic sheath is applied a layer of bedding which consists of a fibrous material like jute or hessian tape. The purpose of bedding is to protect the metallic sheath against corrosion and from mechanical injury due to armouring.

(*v*) Armourin*:* *Ogver the bedding, armouring is provided which consists of one or two layers of* galvanised steel wire or steel tape. Its purpose is to protect the cable from mechanical injury while laying it and during the course of handling. Armouring may not be done in the case of some cables.

(*vi*) Serving*:* *In order to protect armouring from atmospheric conditions, a layer of fibrous* material (like jute) similar to bedding is provided over the armouring. This is known as *serving*. It may not be out of place to mention here that bedding, armouring and serving are only applied to the cables for the protection of conductor insulationand to protect the metallic sheth.



→ 11 to 12
Tue → 11
Th → 12 to 1
Fr. → 10 to 11

Thurs lab
2-4:30

BEE. (2nd Sem).

Circuit Elements → ① Resistance → Ω

$R = \frac{V}{I}$, $P = VI = (IR)I = I^2R$ watts.

Energy lost in the form of heat = $W = \int_0^t P.dt = Pt = I^2Rt = \frac{V^2}{R}.t$ (Joule)

$R = \frac{V}{I}$ → Ohm's law , $V \propto I$ or $V = IR$.

The current through any conductor is directly propootional to the applied potential difference across it, while keeping all the physical conditions same.

→ Resistance → It is the property of a material by virtue of which it opposes the flow of electrons through the material. Thus it restricts the flow of current through the material.

Symbol → , R.

② Inductance → It is the property of a material by virtue of which it opposes any change of magnitude or direction of electric current passing through the conductor.

Unit → Henry , Symbol → L

When time varying current flows through the coil, the electromagnetic field changes which produces voltage that will ~~cha~~ oppose the change in current flowing through it.

$$V_L = -L\frac{di}{dt}$$

Voltage across the inductor $= L\frac{di}{dt}$

→ If current remains constant through the condr, voltage across the inductor will be zero.

→ DC → $V_L = 0$, Inductor will behave as Short circuit coil. in steady state.

→ If current changes within zero time $(dt \approx 0)$.

$$V_L = L\frac{di}{dt} = \infty .$$

Inductor	
Initially	O.C
Finally (Steady state)	S.C

→ Power absorbed $= v \times i = Li\frac{di}{dt}$ watts.

→ Energy absorbed $= \int_0^t Li\frac{di}{dt}\,dt = \frac{1}{2}Li^2$

→

Capacitance → It is the capability of an element to store electric charge within it. A capacitor stores electric energy in the form of electric field being established by the two polarities of charges on the two electrodes of a capacitor.

Capacitance → Farad (F)

$$C = \frac{q}{V}$$

ie, $i = C\frac{dv}{dt}$, $\left[i = \frac{dq}{dt} \right]$

$q = Cv$ / $i = \frac{dq}{dt}$

$\frac{dq}{dt} = \frac{d(Cv)}{dt}$

$i = C\frac{dv}{dt}$

$p = vi = vC\frac{dv}{dt}$

$$\omega = \int_0^t p \cdot dt = \int_0^t vC\frac{dv}{dt}\,dt = \frac{1}{2}Cv^2$$

Capacitor	→
Initially	S.C
finally (steady state)	O.C

Eg. 1) The strength of current in 1H inductor changes at a rate of 1A/sec. Find the voltage across it. and determine the magnitude of energy stored in the inductor after 2 sec.

⇒ $L = 1H$, $\frac{di}{dt} = 1A/s$, $v = L\frac{di}{dt} = 1 \times 1 = 1V$, $\omega = \frac{1}{2}Li^2 = \frac{1}{2} \times 1 \times 2^2$

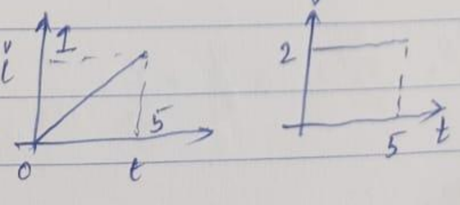
$= 2J$.

Eg 2. A capacitor has a capacitance of 5uf. Calculate the stored energy in it. if a d.c voltage of 100v is applied across it.

⇒ $V = 100$ Volts , $C = 5 \times 10^{-6} F$, $\omega = \frac{1}{2}CV^2 = \frac{1}{2} \times 5 \times 10^{-6} \times (100)^2$.

$= 2.5 \times 10^{-2}$ Joule.

Eg.



$\frac{di}{dt} = \frac{\cdot 1}{5 \times 10^{-3}} = 0.2$ kA/sec. , V = 2v.

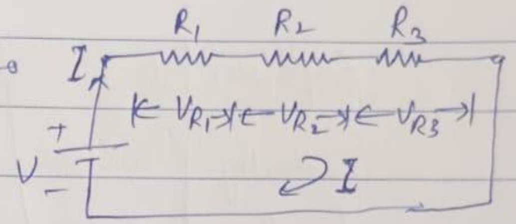
Current & voltage profile of a inductor is shown, find out the ~~voltage~~ across it inductance ? ~~to~~ $v = L\frac{di}{dt}$, L = 10mH.

Eg: A 50uf cap. is charged to retain 10mJ of energy by a constant charging current of 1A. Determine the voltage across the cap.

→ $W = \frac{1}{2}CV^2$, $V = \sqrt{\frac{2W}{C}}$, $V = 20V$.

Series & Parallel →

① Resistance → ⓐ Series → Connection



$$V = V_{R_1} + V_{R_2} + V_{R_3}$$

$$IR = IR_1 + IR_2 + IR_3$$

$$R = R_1 + R_2 + R_3$$

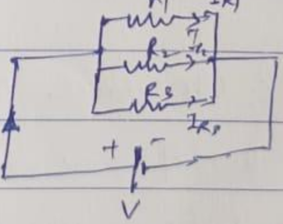
→ Equivalent resistance is the sum of individual resistances.

Also, $I = \frac{V}{R_1 + R_2 + R_3}$ A, $P = I^2R_1 + I^2R_2 + I^2R_3$

$= I^2(R_1 + R_2 + R_3)$

or, $P = I(V_{R_1} + V_{R_2} + V_{R_3})$

ⓑ Parallel connection:—



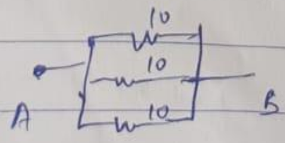
$$V = I_{R_1} \cdot R_1 = I_{R_2} R_2 = I_{R_3} R_3$$

$I = I_{R_1} + I_{R_2} + I_{R_3} = \frac{V}{R_1} + \frac{V}{R_2} + \frac{V}{R_3} = \frac{V}{R}$, $\therefore \frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$

$\downarrow$ Req.

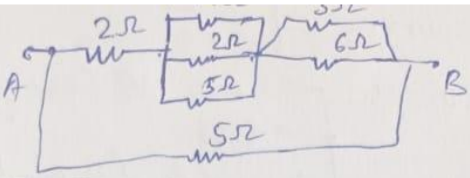
$P = P_{R_1} + P_{R_2} + P_{R_3} = I_{R_1}^2 R_1 + I_{R_2}^2 R_2 + I_{R_3}^2 R_3 = \frac{V^2}{R_1} + \frac{V^2}{R_2} + \frac{V^2}{R_3}$.

e.g.



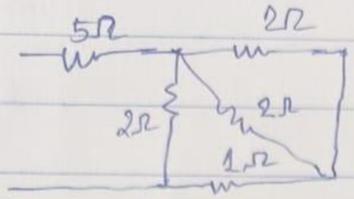
$R_{eq} = \frac{10}{3} = 3.33$.

e.g.



$R_{eq} = 2.39\Omega$.

e.g.:

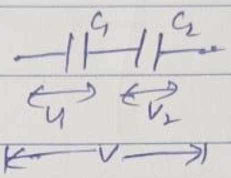


$R_{eq} = 6\Omega$.

Inductor. ⓐ series ⓑ Parallel → same.

$L = L_1 + L_2$ $\quad L_{eq} = \frac{L_1L_2}{L_1+L_2}$.

Capacitor :- ⓐ Series



, $C_{eq} = \frac{C_1C_2}{C_1+C_2}$.

$v = V_1 + V_2$

$\frac{1}{C}\int i\,dt = \frac{1}{C_1}\int i\,dt + \frac{1}{C_2}\int i\,dt \Rightarrow \frac{1}{C} = \frac{1}{C_1} + \frac{1}{C_2}$

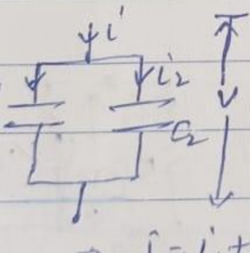
$q = CV$

$\int i\,dt = CV$.

$\boxed{\Rightarrow V = \frac{1}{C}\int i\,dt}$

d

ⓑ Parallel →



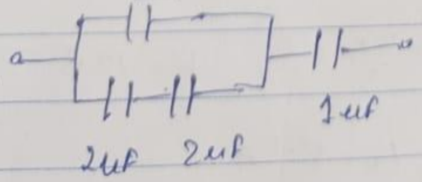
$i = i_1 + i_2$ $\quad \to q = CV$.

$\frac{dq}{dt} = i = C\frac{dv}{dt}$.

$\Rightarrow i = i_1 + i_2$.

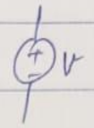
$C\frac{dv}{dt} = C_1\frac{dv}{dt} + C_2\frac{dv}{dt} \Rightarrow C = C_1 + C_2$.

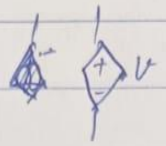
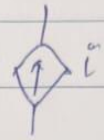
eg.-6.



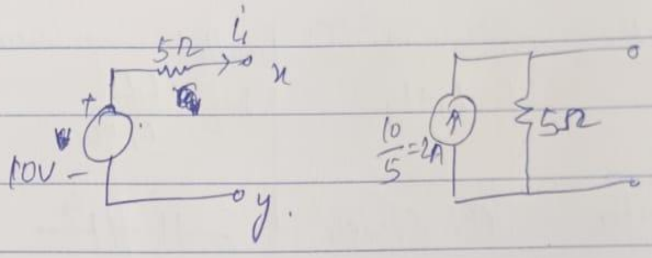
$C_{eq} = \frac{3}{4}$ uF.

Energy Sources →
- Independent sources
  - VS
  - CS
- Dependent sources
  - VS (Dependent voltage source)
  - CS (Dependent current source)

IVS →  ICS → 

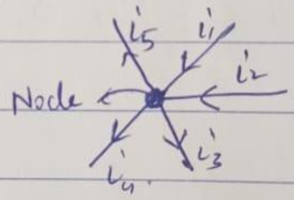
DVS →  DCS 

Source Transformation →

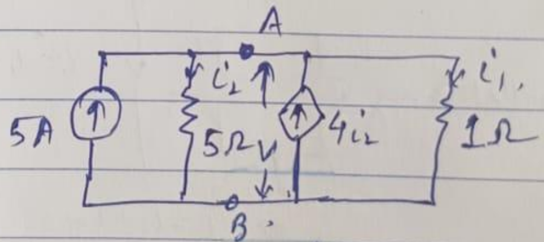


KCL :- The algebraic sum of currents at any node of a circuit is zero.

$i_1 + i_2 - i_3 - i_4 - i_5 = 0$.



Q. Find i_1 & i_2 →



KCL at node A ⇒ $i_2 + i_1 = 5 + 4i_2$.

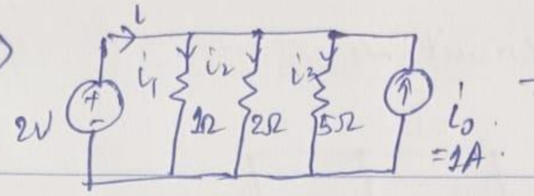
$i_1 - 3i_2 = 5$

$i_1 = \frac{V}{1}$, $i_2 = \frac{V}{5}$.

$V - \frac{3V}{5} = 5$, $V = 12.5$

$i_1 = 12.5A$, $i_2 = 2.5A$.

Q)



→ ~~[illegible]~~ KCL ⇒ $i + i_0 = i_1 + i_2 + i_3$.

$i_1 = 2A$, $i_2 = 1A$, $i_3 = \frac{2}{5} A = 0.4A$.

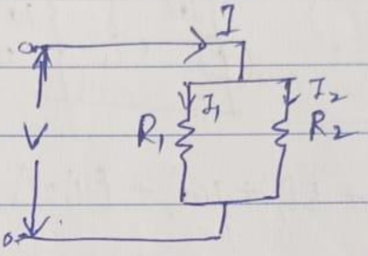
$i = 2 + 1 + 0.4 - 1 = \underline{\underline{2.4A}}$,

Find current through 2V source & total power absorbed by ~~each~~ resistors.

$P = P_1 + P_2 + P_3 = i_1^2 R_1 + i_2^2 R_2 + i_3^2 R_3$

$= \cancel{2.0}\ 4 + 2 + 0.8 = 6.8 W$.

Current division :-



$$R_{eq} = \frac{R_1 R_2}{R_1 + R_2}$$

$$I_1 = I \cdot \frac{R_2}{R_1 + R_2}, \quad I_2 = I \cdot \frac{R_1}{R_1 + R_2}$$

$$I_1 = \frac{V}{R_1}$$

$$V = I R_{eq}.$$

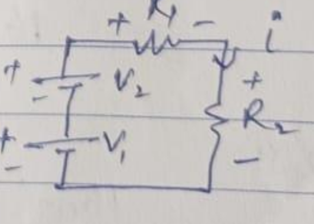
$$V = I \times \frac{R_1 R_2}{R_1 + R_2}$$

$$I_1 = \frac{I \times \left(\frac{\cancel{R_1} R_2}{R_1 + R_2}\right)}{\cancel{R_1}}$$

KVL :- The algebraic sum of voltages (or voltage drops) in any closed path of network that is transversed in a single direction is zero.

eg.

$$KVL \to 0 \quad -V_1 - V_2 + iR_1 + iR_2 = 0.$$

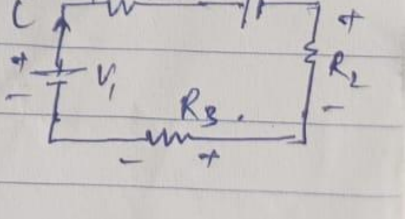


$$i = \frac{V_1 + V_2}{R_1 + R_2}.$$

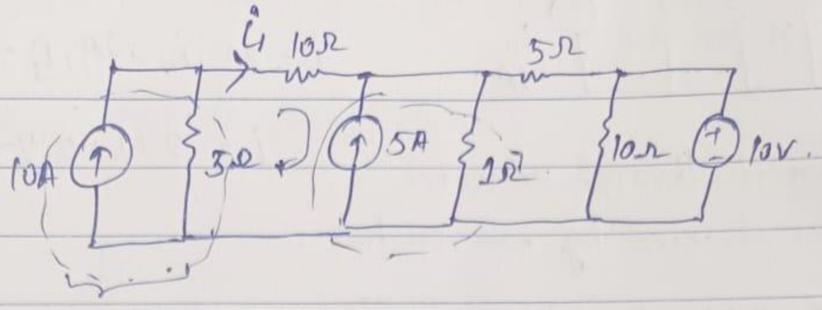
eg. →

$$-V_1 + iR_1 + V_2 + iR_2 + iR_3 = 0$$

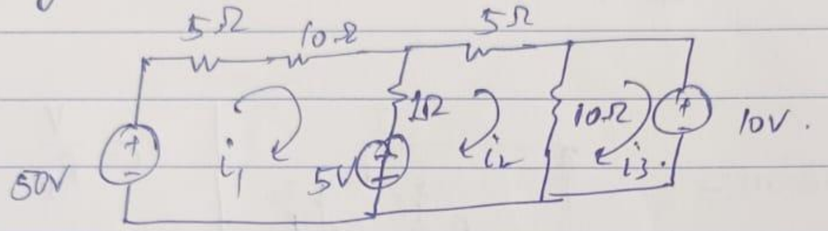
$$i = \frac{(V_1 - V_2)}{R_1 + R_2 + R_3}$$



Q) Find out current i_1 in the circuit —:



Using source transformation:-



$16i_1 - i_2 = 45$ ✓

$16i_2 - i_1 - 10(i_2 - 1) =$

$26i_2 - 9i_1 = 5$ ✓

$26(\cancel{45}\ 16i_1 - 45) - 9i_1 = 5$

$407i_1 = 1175$

$i_1 = 2.89A$

$$-50 + 5i_1 + 10i_1 + (i_1 - i_2) + 5 = 0.$$

$$\Rightarrow \quad 16i_1 - i_2 = 45 \quad \text{—(I)}.$$

$$-5 + (i_2 - i_1) + 5i_2 + 10(i_2 - i_3) = 0.$$

$$16i_2 - i_1 - 10i_3 = 5 \quad \text{—(II)}.$$

$$10(i_3 - i_2) + 10 = 0, \quad 10(i_3 - i_2) = -10 \quad \text{—(III)}.$$

$$i_3 - i_2 = -1.$$

$$\boxed{i_3 = i_2 - 1}$$

$$16i_2 - i_1 - 10(i_2 - 1) = 5$$

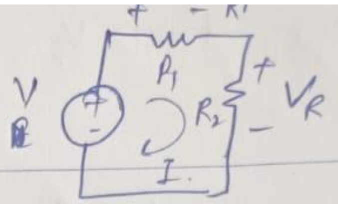
$$\Rightarrow \quad 6\cdot\ i_1 - 6i_2 = 5 \quad \text{—(IV)}.$$

from (I) & (IV)

$16i_1 - i_2 = 45$

$i_1 - 6i_2 = 5$ $\quad i_1 = 2.79A,\ i_2 = -0.37A$

Voltage division in series :-

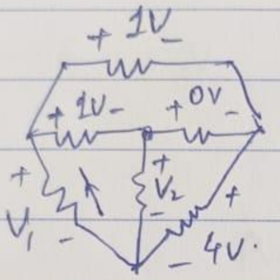


$$I = \frac{V}{R_1+R_2}.$$

$$V_{R_1} = IR_1 = \cancel{V} R_1 \left(\frac{V}{R_1+R_2}\right)$$

$$V_{R_2} = IR_2 = R_2 \cdot \left(\frac{V}{R_1+R_2}\right)$$

Q).



Find V_1 & V_2 using KVL.

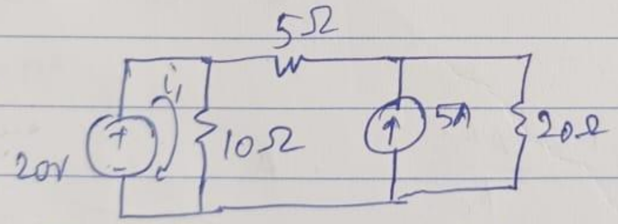
$-V_1 + 1 + 0 + 4 = 0$

$V_1 = 5$

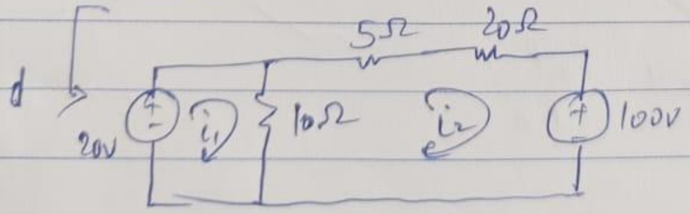
$-V_1 + 1 + V_2 = 0$, $V_2 = V_1 \mp 1$ V.

$V_2 = \cancel{9}4$ ✓

Q)



Power loss across 5Ω resistor.



$20 = (i_1 - i_2)10$

$i_1 - i_2 = 2$ —①.

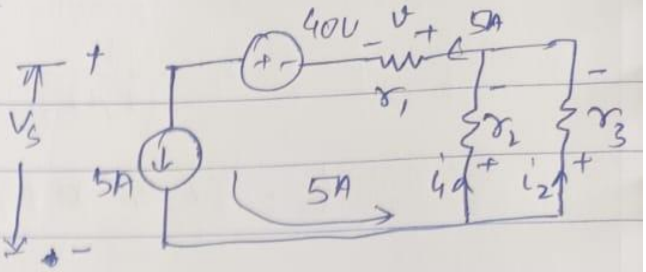
$25 i_2 + 10 + (i_2 - i_1) \times 10 = 0.$

$35 i_2 - 10 i_1 = -100.$

$i_2 = -3.2A.$

$$P = (3.2)^2 \times 5 = 51.2w.$$

Q) Find V_s , $r_1 = 2\Omega$, $r_2 = 1\Omega$, $r_3 = 5\Omega$



$$i_1 = 5 \times \frac{5}{5+1}$$

$$i_1 = \frac{25}{6}$$

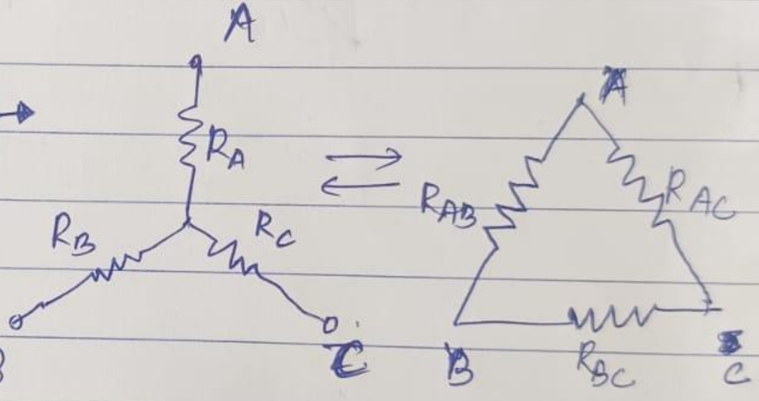
$v = 5 \times 2 = 10V.$

[illegible] =

KVL → $\frac{25}{6} \times 1 + 10 - 40 + V_s = 0.$

$V_s = 30 - 4.16 = 25.84V$

Star Delta Connection :→



Star to Delta →

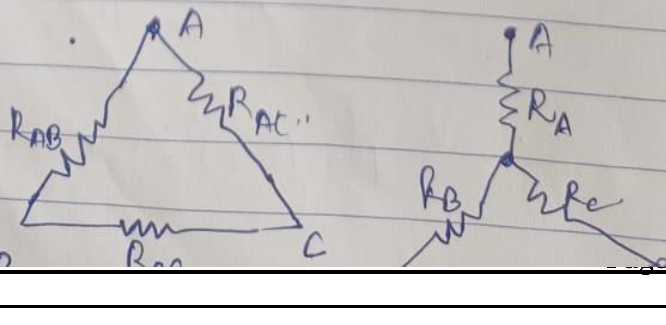
$$R_{AB} = R_A + R_B + \frac{R_A R_B}{R_C}.$$

, R.

$$R_{BC} = R_B + R_C + \frac{R_B R_C}{R_A}$$

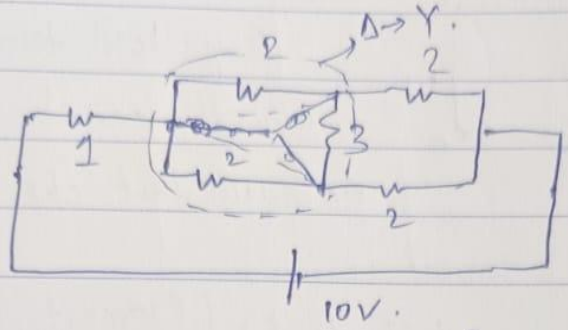
$$R_{AC} = R_A + R_C + \frac{R_A R_C}{R_B}.$$

Delta to Star :-



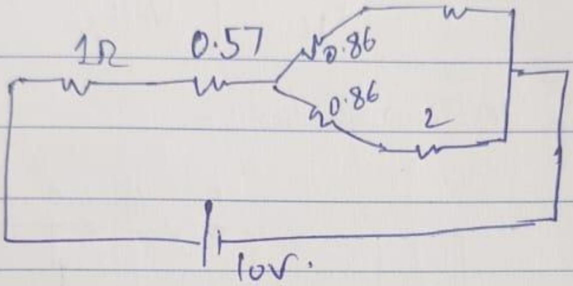
$$R_A = \frac{R_{AB} \cdot R_{AC}}{R_{AB} + R_{BC} + R_{AC}}, \quad R_B = \frac{R_{AB} \cdot R_{BC}}{R_{AB} + R_{BC} + R_{CA}}, \quad R_C = \frac{R_{BC} \cdot R_{AC}}{R_{AB} + R_{BC} + R_{AC}}$$

Q).



Find I.

$I = 3.33A$

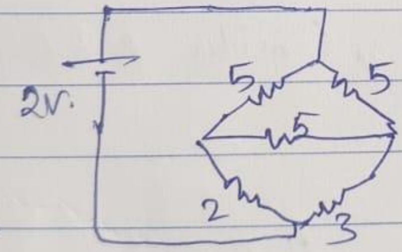


$Req = \frac{2.86}{2} + 0.57 + 1$

$Req = 1.43 + 0.57 + 1 = 3$

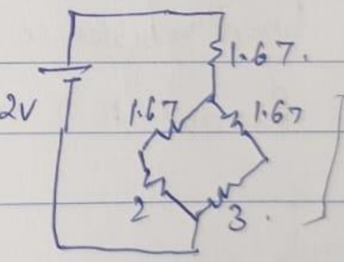
$Req = 3\Omega$.

Q).



Find I.

⇒



$Req = 3.725\Omega$,

$1.67 + \frac{4.67 \times 3.67}{4.67 + 3.67}$

$I = \frac{2}{3.725} = 0.54A$.

D to Star:- $\frac{5 \times 5}{5+5+5} = \frac{\cancel{25}^{5}}{\cancel{15}_{3}}$

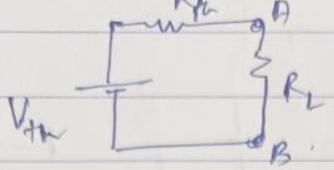
$= 1.67$

Network Theorems.

Thvenin's Theorem :-

$I_L = \left(\frac{V_{oc}}{R_{Th}+R_L}\right) \cdot A$

$V_{th} \to V_{oc}$

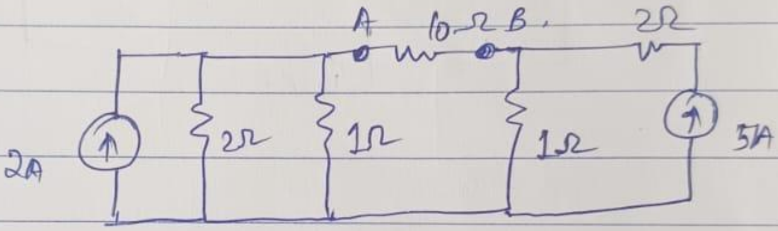


Any two terminal bilateral d.c network can be replaced by an equivalent ckt. consisting of a voltage source & a series resistor

(To find R_{th}) [Current source → O.C
Voltage source → S.C

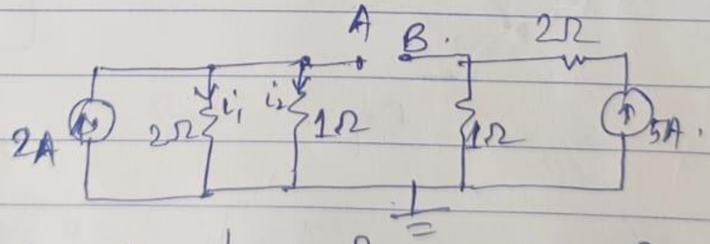
Current.

Eg. Power loss in 10 Ω resistor :-



Load resistance → 10Ω, Consider A & B-points

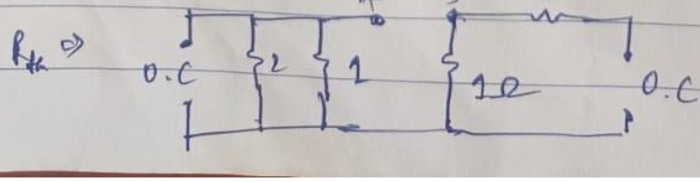
Remove 10Ω resistor.



$i_1 = 2 \times \frac{1}{3} = \frac{2}{3}$, $V_{2\Omega} = \frac{2}{3} \times 2 = \frac{4}{3} = 1.33V$

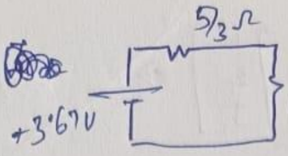
$V_B = 1 \times 5 = 5V.$

$V_A - V_B = V_{Th} = 5 - 1.33 = -3.67V.$



$1 + \frac{1 \times 2}{1+2} = 1 + \frac{2}{3}$

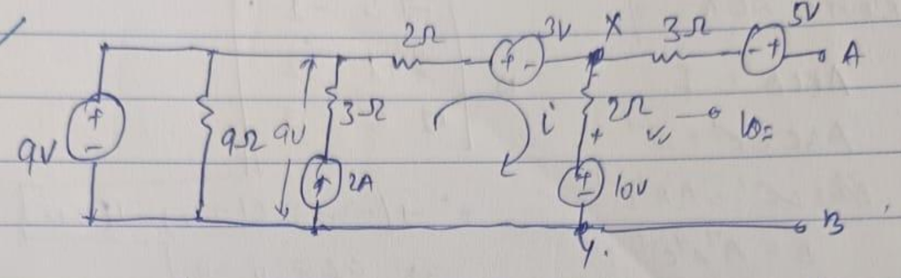
$= \frac{5}{\;}$

1 

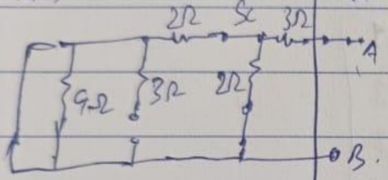
$\Rightarrow I = \frac{3.67}{\frac{5}{3}+10} = 0.315A$ Ans

Q. Obtain Thevenin's equivalent ckt across AB.

Mid Sem



$R_{th} \Rightarrow$

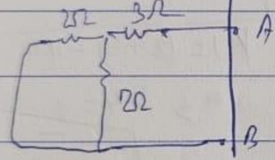


$-9 + 2i + 3 + 2i + 10 = 0.$

$+4i = -4, \quad i = -1A$

$V_{2Ω} = 2 \times -1 = -2V.$

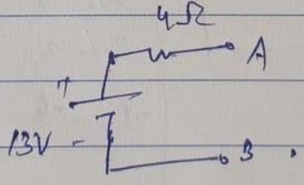
$V_{xy} = 10-2 = 8V.$

⇒ 

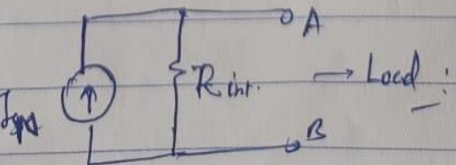
$V_{AB} = 8+5 = 13V.$

$V_{th} = 13V.$

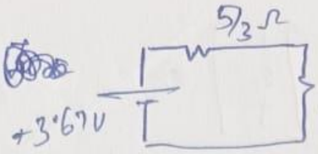
$R_{th} = 4Ω.$ ✓



NORTON Theorem :- A linear bilateral network can be replaced by an equivalent ckt consisting of a current source in parallel with a resistance.



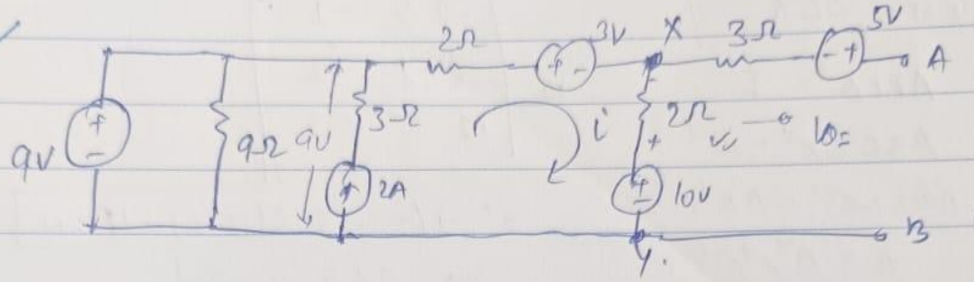
$I_N \rightarrow I_{sc}.$

1 

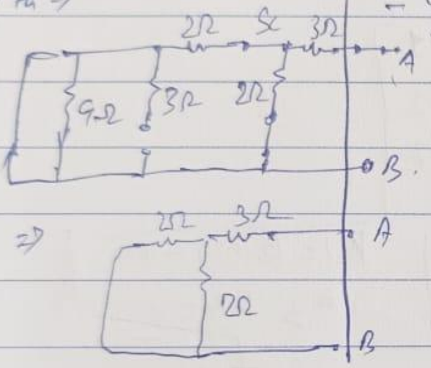
$\Rightarrow I = \frac{3.67}{\frac{5}{3}+10} = 0.315A$ Ans

Mid Sem

Q) Obtain Thevenin's equivalent ckt across AB.



$R_{th} \Rightarrow$



$R_{th} = 4\Omega$. ✓

$-9 + 2i + 3 + 2i + 10 = 0$.

$+4i = -4$, $i = -1A$

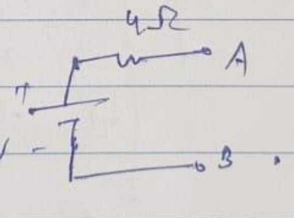
$V_{2\Omega} = 2 \times -1$

$= -2V$.

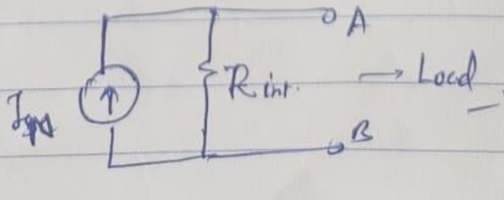
$V_{XY} = 10 - 2 = 8V$.

$V_{AB} = 8 + 5 = 13V$.

$V_{th} = 13V$.



NORTON Theorem :- A linear bilateral network can be replaced by an equivalent ckt consisting of a current source in parallel with a resistance.

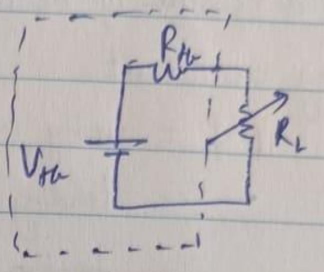


$I_N \rightarrow I_{sc}$.

lectures → 1 2 1 3

Notes

Max. Power Transfer theorem :- A resistive load being connected to a dc network receives maximum power when the load resistance is equal to the internal resistance of the source network.



$$P_L = I^2 R_L$$

$$= \left(\frac{V_0}{R_{th}+R_L}\right)^2 \times R_L$$

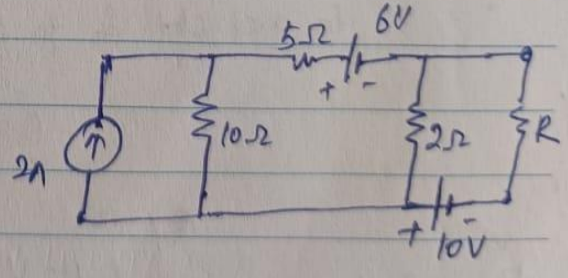
$$\frac{dP_L}{dR_L} \Rightarrow \quad \frac{dP}{dR_L} = 0 \;, \quad R_{th} = R_L$$

$$P_{max} = \frac{V_0^2}{(R_{th}+R_{th})^2} \times R_{th} = \frac{V_0^2}{4R_{th}}.$$

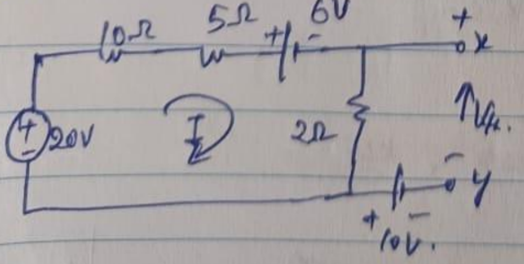
Total power supplied $= 2 \times \frac{V_0^2}{4R_{th}} = \frac{V_0^2}{2R_{th}}$, $2 = \frac{P_{max}}{P} \times 100$

$= 50\%$

Q). Find R & max. power transfer in ckt.



Sol^n:



$$-20+6+I(10+5+2) = 0 \;, \quad I = \frac{14}{17} A.$$

$V_{th} = 10 + \frac{14}{17} \times 2 = 11.65V$, $R_{th} = \frac{30}{17} = 1.765$

$R = R_{th}$ $P_{max.} = \frac{V_{th}^2}{4R} = \frac{11.65^2}{4 \times 1.765} = 19.22W$; $\therefore R = R_{th} = 1.765\Omega$.

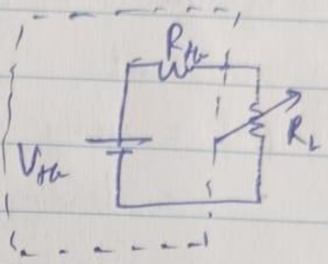
lecture → 1 2 1 3

Notes

Max. Power Transfer theorem :- A resistive load being connected to a dc network receives maximum power when the load resistance is equal to the internal resistance of the source network.

$P_L = I^2 R_L$

$= \left(\frac{V_0}{R_{th}+R_L}\right)^2 \times R_L$



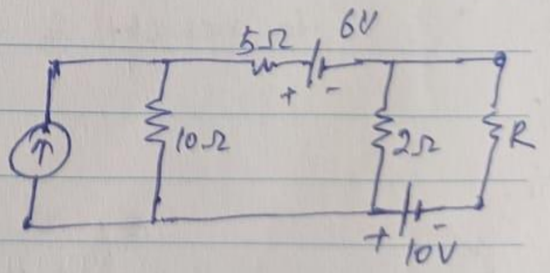
$\frac{dP_L}{dR_L} \Rightarrow \qquad \frac{dP}{dR_L} = 0 \;, \quad R_{th} = R_L$

$P_{max} = \frac{V_0^2}{(R_{th}+R_{th})^2} \times R_{th} = \frac{V_0^2}{4R_{th}}$.

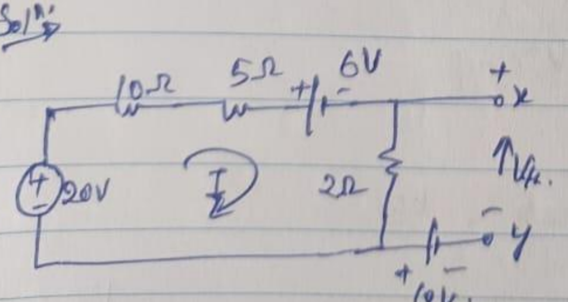
Total power supplied $= 2 \times \frac{V_0^2}{4R_{th}} = \frac{V_0^2}{2R_{th}}$, $\eta = \frac{P_{max}}{P} \times 100$

$= 50\%$

Q). Find R & max. power transfer in ckt.



Sol^n ⇒



$-20 + 6 + I(10+5+2) = 0 \;, \quad I = \frac{14}{17}$ A.

$V_{th} = 10 + \frac{14}{17} \times 2 = 11.65V$, $\quad R_{th} = \frac{30}{17} = 1.765$

$R_L = R_{th} \quad P_{max.} = \frac{V_{th}^2}{4R} = \frac{11.65^2}{4 \times 1.765} = 19.22W$. $\quad \therefore R = R_{th} = 1.765\Omega$.

Module-2

*

Notes

Power factor:→ The term (cosφ) in the expression of $P = VI\cos\varphi$ is called as p.f.

It is the cosine of the angle between the voltage & current in any a.c circuit.

p.f = unity → in case of resistive ckt.
= leading → in case of capacitive ckt.
= ~~leading~~ lagging → in case of inductive ckt.

① Apparent → VI is called as apparent power.
symbol → S

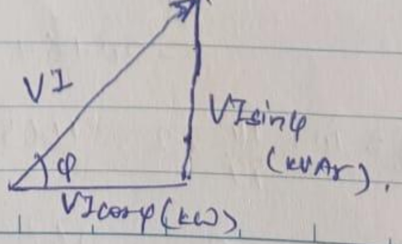
② Reactive power → the pdt. of rms voltage and current with the sine of the angle b/w them is called as reactive power in a.c ckt. & is denoted by Q, the unit being VAR

$$Q = VI\sin\varphi$$

Q

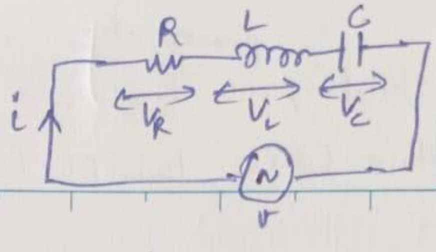
③ Active power → $P = VI\cos\varphi$, kW.

→ Power triangle:→



① Series RLC ckt. →

Notes



Reactance in comple

→ $X_L = j\omega L$

⇒ $X_C = \frac{1}{j\omega C}$

$$V = IR + jIX_L + I \cdot \frac{1}{j\omega C}$$

$$\Rightarrow V = I\left[R + j\overset{\omega L}{\cancel{X}_L} + \frac{1}{j\omega C}\right]$$

$$V = IZ = I\left[R + j\omega L + \frac{1}{j\omega C}\right]$$

$$\rightarrow \quad \Rightarrow Z = R + j\left[\omega L - \frac{1}{\omega C}\right]$$

$$\Rightarrow \sqrt{R^2 + \left(\omega L - \frac{1}{\omega C}\right)^2} \angle \tan^{-1} \frac{(\omega L) - \left(\frac{1}{\omega C}\right)}{R}$$

$$i = \frac{V}{Z} = \frac{V}{\sqrt{R^2 + \left(\omega L - \frac{1}{\omega C}\right)^2}} \angle -\tan^{-1} \frac{\left(\omega L - \frac{1}{\omega C}\right)}{R}$$

$$\theta = -\tan^{-1}\left(\frac{\omega L - \frac{1}{\omega C}}{R}\right)$$

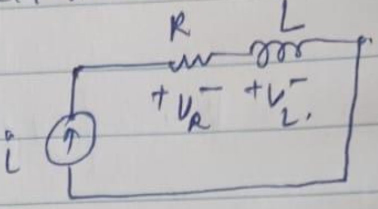
* $|Z| \Rightarrow$ for (R,L) & (RC)

phasors etc

Teach about pure R, L & C ~~not~~ connected to a voltage source · then (RL, RC) → phasors.

Notes

Time domain analysis of a 1st order RL ckt :→ (Series)



$i = I_m \sin\omega t$

$v_R = iR = RI_m \sin\omega t$

$V_L = L\frac{di}{dt} = L\frac{d}{dt}(I_m \sin\omega t) = \omega L I_m \cos\omega t$

$V_L = \omega L I_m \sin(\omega t + 90)$

$V = V_R + V_L = RI_m \sin\omega t + \omega L I_m \sin(\omega t + 90)$.

$V = V_m \sin(\omega t + \theta) = RI_m \sin\omega t + \omega L I_m \sin(\omega t + 90)$

$V_m = \sqrt{(RI_m)^2 + (\omega L I_m)^2}$

$= I_m\sqrt{R^2 + (\omega L)^2} = I_m Z$.

$\theta = \tan^{-1}\left(\frac{\omega L}{R}\right)$

*

$Z = R + j\omega L$

$Z = \sqrt{R^2 + (\omega L)^2} \angle \tan^{-1}\left(\frac{\omega L}{R}\right)$

$I_m = \frac{V_m}{Z} = \frac{V_m}{(R + j\omega L) \angle \tan^{-1}\left(\frac{\omega L}{R}\right)}$

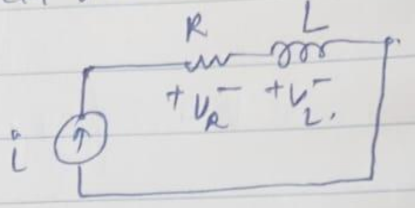
$= \frac{V_m}{(R + j\omega L)} \angle -\tan^{-1}\left(\frac{\omega L}{R}\right)$

* $|Z| \Rightarrow$ for (R, L) & (RC)

Notes

Teach about pure R, L & C ~~not~~ connected to a voltage source (phasors etc) · then (RL, RC) → phasors.

Time domain analysis of a 1st order RL ckt :→ (Series)



$$i = I_m \sin\omega t$$

$$v_R = iR = RI_m \sin\omega t$$

$$V_L = L\frac{di}{dt} = L\frac{d}{dt}(I_m \sin\omega t) = \omega L I_m \cos\omega t$$

$$V_L = \omega L I_m \sin(\omega t + 90)$$

$$V = V_R + V_L = RI_m \sin\omega t + \omega L I_m \sin(\omega t + 90).$$

$$V = V_m \sin(\omega t + \theta) = RI_m \sin\omega t + \omega L I_m \sin(\omega t + 90)$$

$$V_m = \sqrt{(RI_m)^2 + (\omega L I_m)^2}$$

$$= I_m\sqrt{R^2 + (\omega L)^2} = I_m Z.$$

*

$$\theta = \tan^{-1}\left(\frac{\omega L}{R}\right)$$

$$Z = R + j\omega L$$

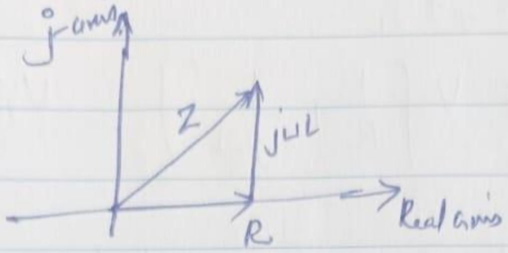
$$Z = \sqrt{R^2 + (\omega L)^2} \angle \tan^{-1}\left(\frac{\omega L}{R}\right)$$

$$I_m = \frac{V_m}{Z} = \frac{V_m}{(R + j\omega L) \angle \tan^{-1}\left(\frac{\omega L}{R}\right)}$$

$$= \frac{V_m}{(R + j\omega L)} \angle -\tan^{-1}\left(\frac{\omega L}{R}\right)$$

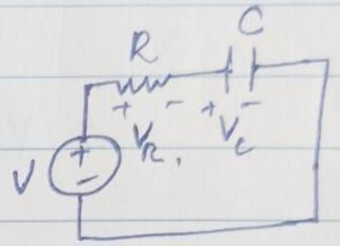
$$I = \frac{V}{R+j\omega L} \angle -\tan^{-1}\left(\frac{\omega L}{R}\right)$$

Notes



(Series)

Time domain analysis of RC ckt :-



$v = V_m \sin\omega t$

$$V = I\left(R + \frac{1}{j\omega C}\right) = I\left(R - \frac{j}{\omega C}\right) = IZ.$$

$$\Rightarrow Z = R - \frac{j}{\omega C} = \sqrt{R^2 + \left(\frac{1}{\omega C}\right)^2} \angle -\tan^{-1} \frac{1}{\omega RC}.$$

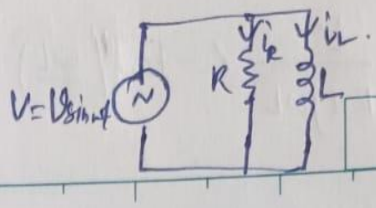
$$I = \frac{V}{Z} = \frac{V}{\sqrt{R^2 + \left(\frac{1}{\omega C}\right)^2} \angle -\tan^{-1} \frac{1}{\omega RC}}$$

$$\Rightarrow I = \frac{V}{\sqrt{R^2 + \left(\frac{1}{\omega C}\right)^2}} \angle \tan^{-1} \frac{1}{\omega RC}$$

[illegible]

*. See 1 page back

Parallel R-L →.



Notes

$$I = I_R + I_L$$

$$= V\left[\frac{1}{R} + \frac{1}{j\omega L}\right] = VY$$

$Y = G + jB$, G = conductance

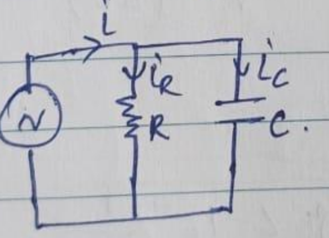
B = Inductive susceptance

$$\therefore Y = \frac{1}{R} + \frac{1}{j\omega L} = \frac{1}{R} - j\frac{1}{\omega L}$$

$$\theta = \tan^{-1}\left[\frac{-1/\omega L}{1/R}\right] = \tan^{-1}\left(\frac{-R}{\omega L}\right)$$

~~$i = i_R + i_L = \frac{V_m}{R}\cos\omega t$~~

RC →



$v = V_m \sin\omega t$.

$I_R = \frac{V}{R}$, $I_C = \frac{V}{1/j\omega C}$, $I = I_R + I_C$

$$I = V\left[\frac{1}{R} + \frac{1}{1/j\omega C}\right]$$

$$I = V\left[\frac{1}{R} + j\omega C\right] = V[G + jB]$$

$$\theta = \tan^{-1}\left(\frac{\omega C}{1/R}\right)$$

or, $\theta = \tan^{-1}(\omega RC)$

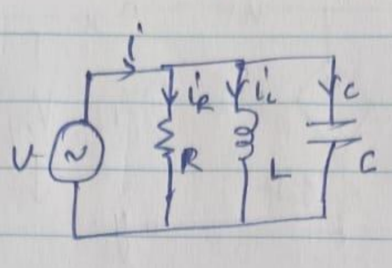
$$i = i_R + i_C$$

$$= v + C\,dv = \underline{V_m \sin\omega t} + \omega C V_m \cos\omega t$$

Notes

$$i = \sqrt{\left(\frac{1}{R}\right)^2 + (\omega C)^2}\ V_m \sin(\omega t + \theta).$$

Parallel RLC →.



$$Y = \frac{1}{R} + \left(\frac{1}{j\omega L} + j\omega C\right)$$

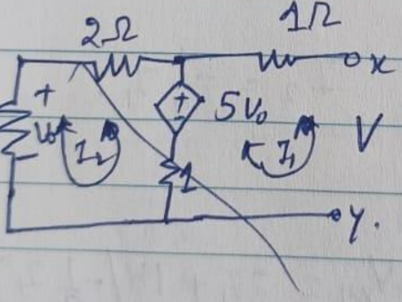
$$= \frac{1}{R} + j\left(\omega C - \frac{1}{j\omega L}\right)$$

$$i = i_R + i_L + i_C = \frac{V}{R} + \frac{1}{L}\int v\,dt + C\frac{dv}{dt}$$

$$= \frac{V_m \sin \omega t}{R} - \frac{V_m}{\omega L}\cos \omega t + \omega C V_m \cos \omega t.$$

$$\tan\theta = \frac{\left(\omega C - \frac{1}{\omega L}\right)}{1/R},.$$

Q



~~$V_0 = -3I_2$~~

~~$\therefore (I_1 - I_2) - 5V_0 + I_1 + V_{xy} = 0.$~~

~~$V_{xy} = -I_2 + 5 \times 3I_2 \pm 2I_1$~~

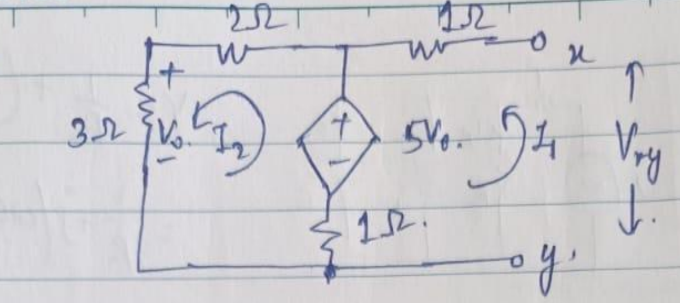
~~$V_{xy} = 14I_2 - 2I_1$~~

~~$-3I_2 \pm 2I$~~

Dependent Source Numericals.

Notes

Q)



Find R_{int} ⇒ ?

$\boxed{V_0 = 3I_2}$

$$-V_{xy} + I_1 + 5V_0 + (I_1 - I_2) = 0.$$

$$\Rightarrow V_{xy} = 2I_1 + 14I_2 \quad -①.$$

$$-5V_0 + 5I_2 + (I_2 - I_1) = 0.$$

$$\Rightarrow -15I_2 + 5I_2 + I_2 - I_1 = 0.$$

$$\Rightarrow -9I_2 \mp I_1 = 0.$$

$$I_2 = -\frac{1}{9}I_1.$$

~~$V_0 = 3\times\left(-\frac{1}{9}I_1\right)$~~.

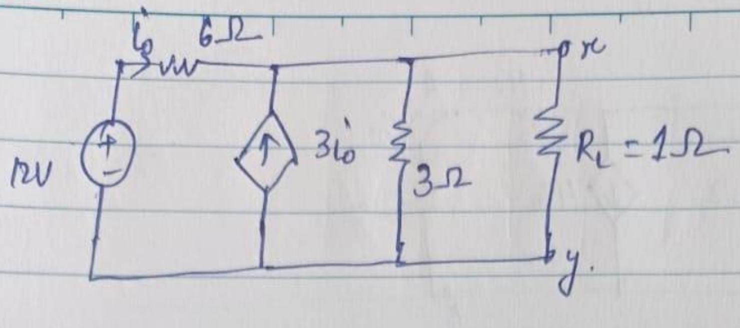
⇒

$$V_{xy} = 2I_1 + 14\left(-\frac{1}{9}I_1\right).$$

$$\Rightarrow V_{xy} = 2I_1 - 1.56I_1.$$

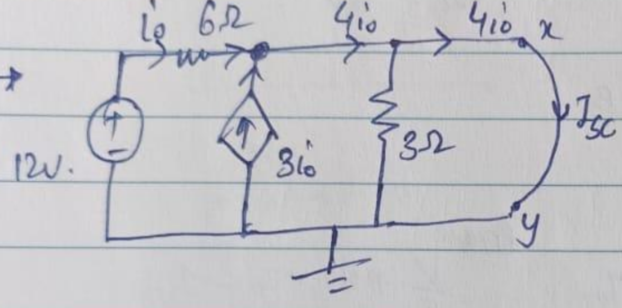
$$\Rightarrow \frac{V_{xy}}{I_1} = R_{int} = 0.44\Omega.$$

Q) Find the current through R_L, using Norton's theorem –



Find, I_{sc}, V_{oc}, $\frac{V_{oc}}{I_{sc}} = R_{int}$, → Norton's ckt.

→

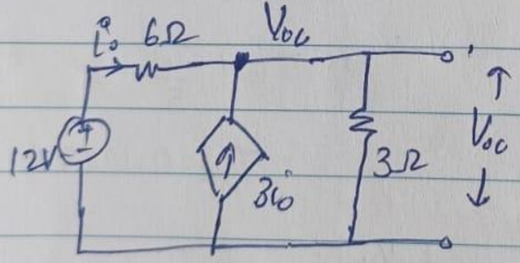


→ $I_{sc} = 4i_0$

$i_0 = \frac{12}{6} = 2A$.

$I_{sc} = 4\times2 = 8A$,

V_{oc} →.



$\frac{V_{oc}}{3} = 3i_0 + i_0 = 4i_0$

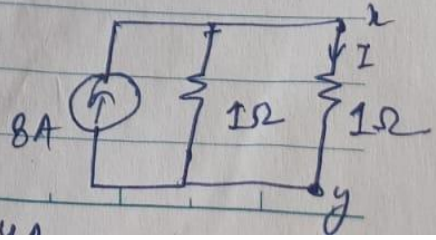
$\frac{V_{oc}}{3} = 4\times\left(\frac{V_{oc}-12}{6}\right)$

$i_0 = \frac{12-V_{oc}}{6}$.

$\frac{V_{oc}}{3} = 4\times\left(\frac{12-V_{oc}}{6}\right)$

$V_{oc} = 8V$.

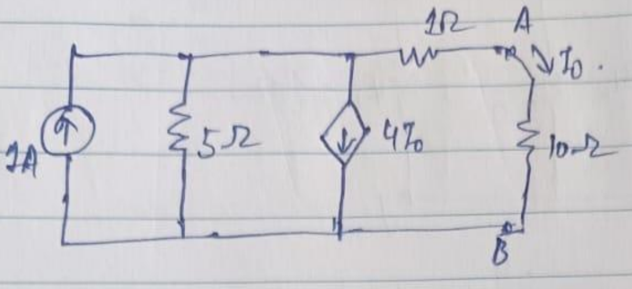
→ $R_{int} = \frac{V_{oc}}{I_{sc}} = \frac{8}{8} = 1\Omega$. →

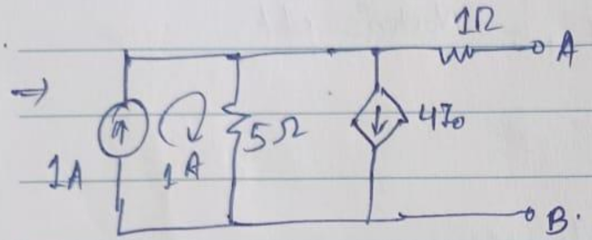


$I = 8$

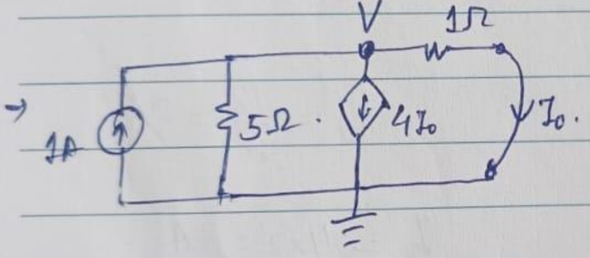
Q) Find power loss in 10Ω resistor :-
Using Norton's theorem :-

Notes





$V_{oc} = 5V$



~~I_o~~

$\frac{V}{5} + 4I_o + I_o = 1.$

$5I_o + \frac{V}{5} = 1.$

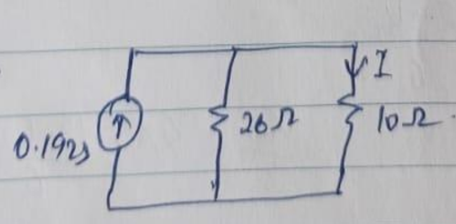
$I_o = \frac{V}{1} = V$

$\Rightarrow 5I_o + \frac{I_o}{5} = 1.$

$I_o = 0.1923 A.$

$R_{int.} = \frac{V_{oc}}{I_o} = \frac{5}{0.1923} = 26Ω.$

Norton ckt :-

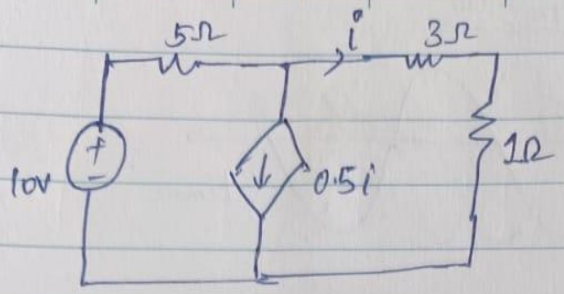


$\Rightarrow I = 0.1923 \times \frac{26}{26+10}$

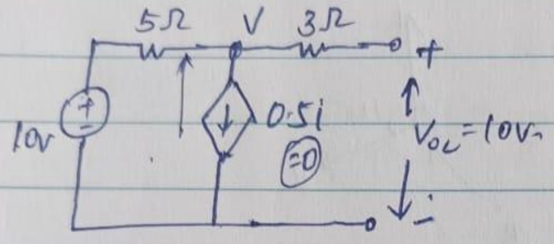
$I = 0.14A$

Power loss = $(0.14)^2 \times 10 = 0.195W.$

Q). Find the current in 1Ω resistor using Norton's theorem:-

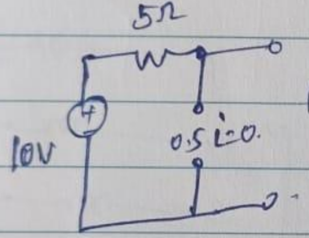


⇒

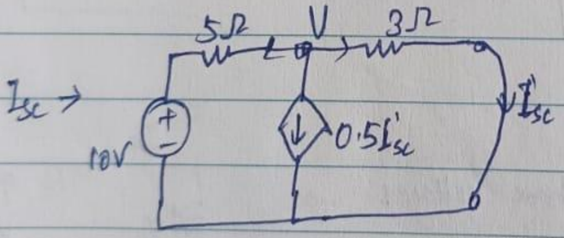


~~10/5~~ $V_{oc} = 10V$.

⇒



$10V = V_{oc}$.



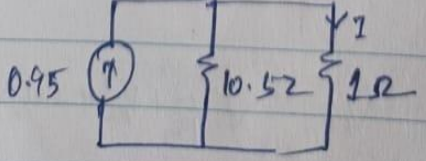
$V = 3 i_{sc}$

$$\frac{V-10}{5} + 0.5 I_{sc} + I_{sc} = 0.$$

$\Rightarrow \; 2.1 I_{sc} = 2.$

$I_{sc} = 0.95A$.

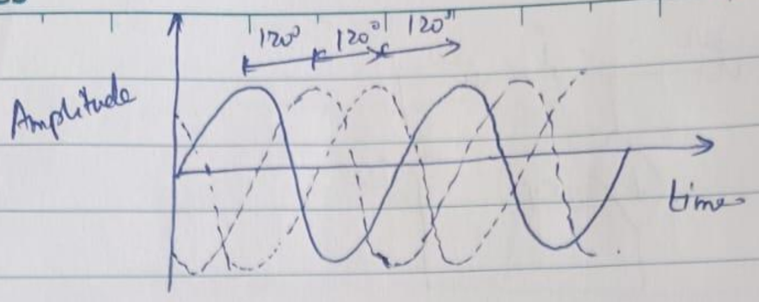
$$R_{int} = \frac{V_{oc}}{I_{sc}} = \frac{10}{0.95} = 10.52\,\Omega.$$



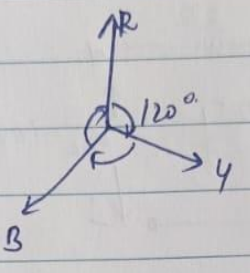
$$I = 0.95 \times \frac{10.52}{11.52}$$

$I = 0.86A$. ✓

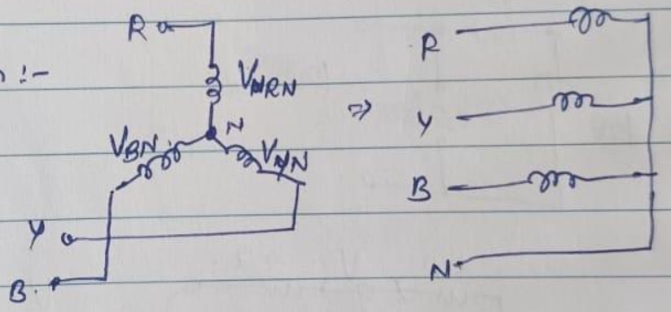
Three Phase circuit :-



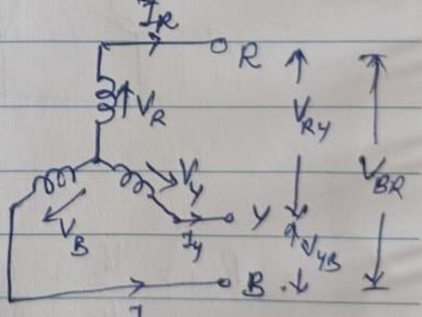
$V_R = V\angle 0°$
$V_Y = V\angle -120°$
$V_B = V\angle +120°$

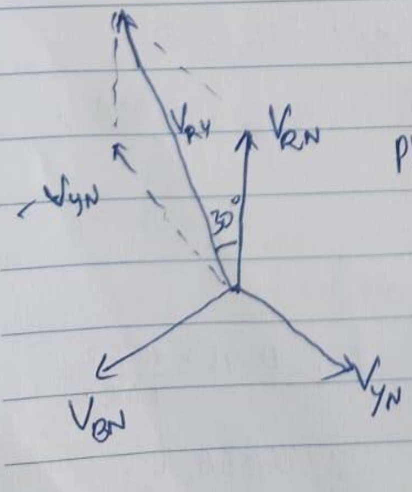


3φ Star connection :-



Relationship b/w line & phase voltages →





Phase voltage.

↳ $|V_{RN}| = |V_{YN}| = |V_{BN}| = V_{ph}$:

$V_{RY} = V_{RN} - V_{YN}$ → line voltage

$V_{RY} = \sqrt{V_{ph}^2 + V_{ph}^2 + 2V_{ph}V_{ph}\cos 60°}$

$V_{RY} = \sqrt{3}\, V_{ph}$ → Star

$\boxed{I_L = I_{ph}}$ ve

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

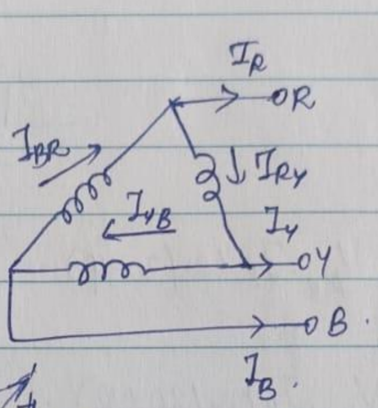
Power → $P = 3\underbrace{V_{Ph} I_{Ph} \cos\varphi}. = \sqrt{3}\, V_L I_L \cos\varphi \cdot (kW)$

Notes

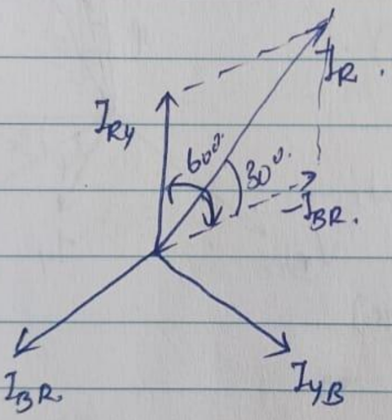
$Q = \sqrt{3}\, V_L I_L \sin\varphi$, $S = \sqrt{P^2+Q^2} = \sqrt{3}\, V_L I_L (kVA)$.

kVAR.

Delta Connection :-



$V_L = V_{Ph}$.



$I_R = I_{BR} - I_{RY}$.

$I_{RY} = I_{RY} - I_{YB}$.

$I_B = I_{YB} - I_{BR}$.

$|I_{RY}| = |I_{YB}| = |I_{BR}| = I_{Ph}$.

$I_R = \sqrt{I_{Ph}^2 + I_{Ph}^2 + 2 I_{Ph}^2 \cos(60^\circ)} = \sqrt{3}\, I_{Ph}$.

$I_R = I_Y = I_B = I_L = \sqrt{3}\, I_{Ph}$.

Power per phase = $V_{Ph} I_{Ph} \cos\varphi$

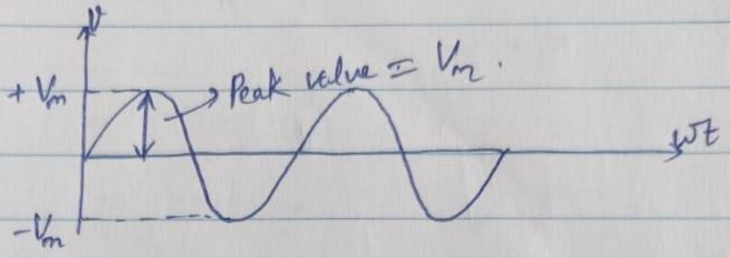
Power in 3φ = $3 V_{Ph} I_{Ph} \cos\varphi = \sqrt{3}\, V_L I_L \cos\varphi$ (kW)

$Q = \sqrt{3}\, V_L I_L \sin\varphi$ kVAR , $S = \sqrt{P^2+Q^2}$

Peak, Rms, Average of sine wave :-

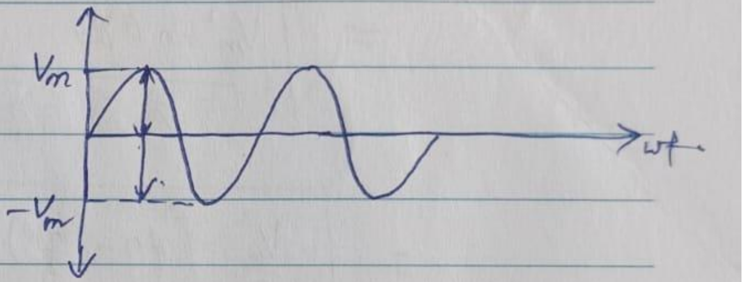
Notes

① Peak value :- $v = V_m \sin \omega t$ (Sine wave).



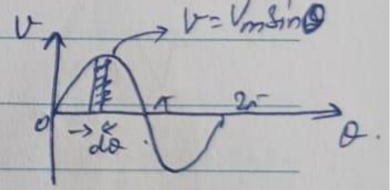
② Peak to peak :-

$v = V_m \sin \omega t$



Peak to peak = $2V_m$.

③ Average value :- $v = V_m \sin \omega t$.



$$\text{Average value} = \frac{\text{Area in half cyle.}}{\text{Time period of half cycle}}$$

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

$$= \frac{V_m}{\pi}\left[-\cos\theta\right]_0^{\pi} = \frac{-V_m}{\pi}\left[-1-1\right] = \frac{2V_m}{\pi}$$

Average value = $\frac{2V_m}{\pi}$ ✓

④ Rms → $= \sqrt{\frac{\text{Area of full cycle of squared wave}}{\text{Full cycle base.}}}$

Notes

$$V_{rms} = \sqrt{\frac{\text{Area of half cycle squared wave}}{\text{Half -cycle base.}}}$$

$$= \sqrt{\frac{\int_0^{\pi} v^2 d\theta}{\pi}}$$

$$= \sqrt{\frac{\int_0^{\pi} V_m^2 \sin^2\theta \, d\theta}{\pi}} = \sqrt{\int_0^{\pi} V_m^2 \cdot \left(\frac{1-\cos 2\theta}{2}\right) d\theta}$$

$$= \sqrt{\frac{\frac{V_m^2}{2} \cdot \int_0^{\pi} \left(\theta - \frac{\sin 2\theta}{2}\right) \Big|_0^{\pi}}{\pi}} = \sqrt{\frac{V_m^2}{2\pi} \times \pi}$$

$$V_{\substack{Rms \\ value}} = \frac{V_m}{\sqrt{2}}$$

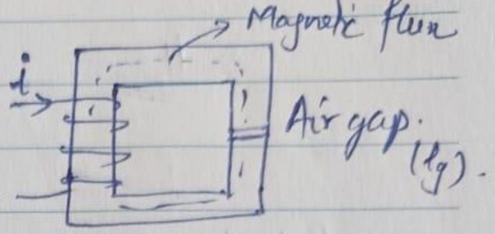
form factor → $= \frac{\text{Rms value.}}{\text{Average value}} = \frac{V_m/\sqrt{2}}{2V_m/\pi} = \frac{\pi}{2\sqrt{2}} = 1.11$

Peak Factor → $= \frac{\text{Max. value}}{\text{Rms value}} = \frac{V_m \times \sqrt{2}}{V_m} = 1.414.$

* Magnetic Circuit :-

Notes

- A closed restricted path in which magnetic flux is established is known as magnetic circuit.



$l_c \rightarrow$ core length

$\mu_0 \Rightarrow$ air gap permeability.

Area $\rightarrow A_g$.

$l_g \Rightarrow$ Air gap length.

$i = I_m \sin \omega t$, $\varphi = \varphi_m \sin \omega t$.

φ = flux = $\frac{\text{mmf}}{\text{Reluctance}}$, analogy current = $\frac{\text{emf}}{R}$.

$\downarrow$
SI unit Wb (weber)

MMF = Flux × reluctance

$\rightarrow f = NI$
$\downarrow$
mmf.

Relative permeability = $\mu_r = \frac{\mu}{\mu_0}$.

Magnetic flux density (B) $\Rightarrow$ $B = \varphi/A$, $\varphi \Rightarrow$ flux $\rightarrow$ Wb
$A \Rightarrow$ Area $\Rightarrow m^2$.

$B \Rightarrow \frac{Wb}{m^2}$ unit $\Rightarrow$ Tesla (T)

$B = \mu H$
$\hookrightarrow$ Magnetic field strength.

$B = \mu_0 \mu_r H \; . \quad \therefore = \mu_0 H \; , \quad H = \frac{B}{\mu_0}$

Notes

$H = \frac{mmf}{length} = \frac{NI}{l}$ in AT/m.

~~H~~ =

Analogy.

mmf ⇒ emf
$\phi \rightarrow$ current

Reluctance $= S = \frac{mmf}{\phi} = \frac{AT}{Wb}$ → SI unit.

$$B = \frac{\phi}{A} \; , \quad \phi = B \cdot A \; , \quad B = \mu_0 \mu_r H .$$

$$\downarrow$$

$$\phi = \mu_0 \mu_r H A$$

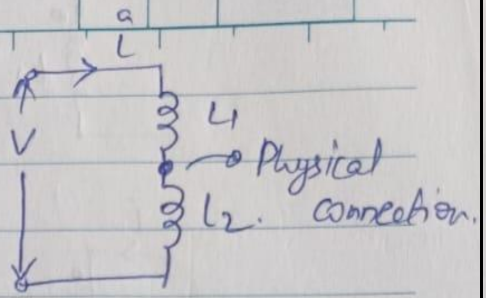
$$= \mu_0 \mu_r \cdot \left(\frac{F}{l}\right) \cdot A . \qquad ; H = \frac{NI}{l} = \frac{F}{l}$$

$$\boxed{\cancel{\phi = \frac{F}{S} \; , \; S = \frac{F}{\phi} = NI}}$$

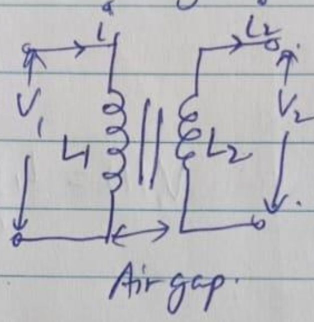
Permeance $= \frac{1}{Reluctance} \; \therefore = \frac{1}{S} = \frac{\mu_0 \mu_r A}{l}$.

Electrical Coupling →

① Electrical coupling →



② Magnetically coupled or magnetic coupling →.



No physical connection.

Mutual induction is responsible for magnetic coupling.

Co-efficient of coupling → (K), $K = \frac{M}{\sqrt{L_1 L_2}}$.

M → Mutual inductance.
L_1 → Self inductance of coil L_1.
L_2 ⇒ " " " L_2.

K = 1, max; it means entire flux of one coil is linked with other coil. There is no leakage flux.

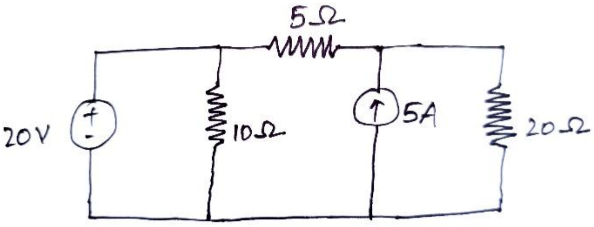
$M = k\sqrt{L_1 L_2}$, $0 \le k \le 1$.

LIST OF WEEK STUDENTS

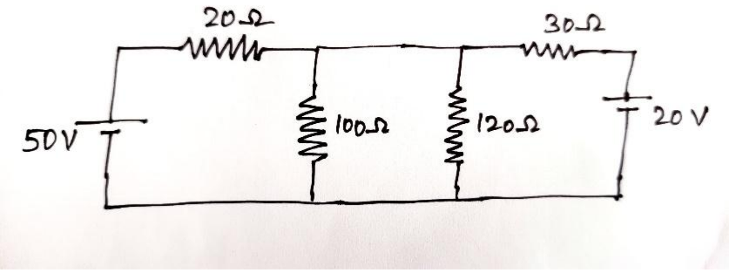
Sl No	Registration No	Name	Mid Term Marks (20)
1	22103131024	TILAK KUMAR	3
2	22103131026	ABHISHEK KUMAR MISHRA	3
3	23103131017	DILKHUSH KUMAR RAJAK	2
4	23103131018	SHREYASHI SINGH	4
5	23103131032	RITIKA KUMARI	4
6	23103131039	MD ZABAR	2

Assignment-I (CO1)

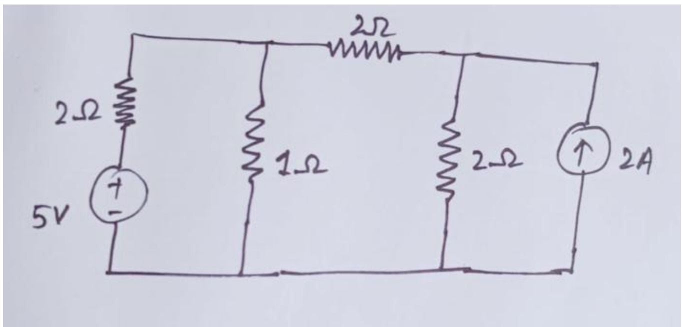
1. Find the power loss in 5Ω resistor.



2. Using nodal analysis find the current through 100Ω resistor.



3. Find the current in 1Ω resistor.



4. Write down the statement of Thevenin's theorem and Norton's theorem. Also write the steps to be followed in these theorems.

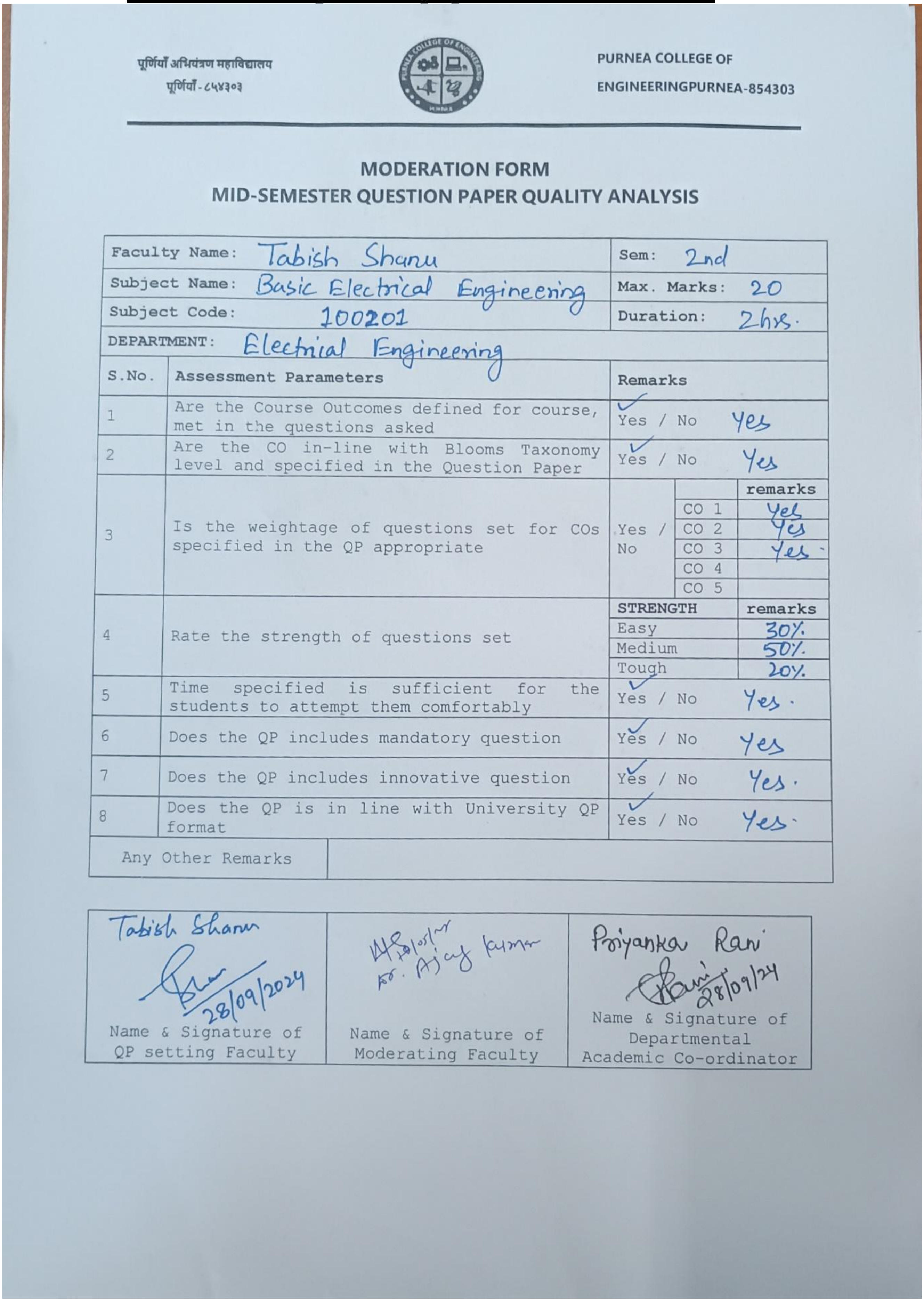
5. What is maximum power transfer theorem? Derive the condition of maximum power transfer.

Assignment-II (CO2)

1. What is the reactance of 1H inductor (f=50Hz).
2. A inductor of 20mH offers a reactance of 100 Ω .Determine the supply frequency.
3. A R-L series circuit has resistance of 20Ω and inductance of 0.02H. If the net impedance of he given circuit is 40∠Φ Ω, find Φ and frequency of supply.

4. A series circuit hs a resistance of 4 Ω and inductance of 0.01H. Find the impedance at 100Hz and 500Hz.
5. A 50Hz sinusoidal voltage v=311sinωt is applied to a RL series circuit. If the resistance is 5Ω and inductance is 0.02H. Calculate the rms current and phase angle.

Mid Semester question paper moderation form



पूर्णियाँ अभियंत्रण महाविद्यालय
पूर्णियाँ - ८५४३०३

PURNEA COLLEGE OF
ENGINEERINGPURNEA-854303

MODERATION FORM
MID-SEMESTER QUESTION PAPER QUALITY ANALYSIS

Faculty Name: Tabish Shanu	**Sem:** 2nd
Subject Name: Basic Electrical Engineering	**Max. Marks:** 20
Subject Code: 100201	**Duration:** 2hrs.
DEPARTMENT: Electrical Engineering	

S.No.	**Assessment Parameters**	**Remarks**	
1	Are the Course Outcomes defined for course, met in the questions asked	[✓ Yes] / No	Yes
2	Are the CO in-line with Blooms Taxonomy level and specified in the Question Paper	[✓ Yes] / No	Yes
3	Is the weightage of questions set for COs specified in the QP appropriate	Yes / No	**remarks** CO 1: Yes CO 2: Yes CO 3: Yes. CO 4: CO 5:
4	Rate the strength of questions set	**STRENGTH** Easy Medium Tough	**remarks** 30% 50% 20%
5	Time specified is sufficient for the students to attempt them comfortably	[✓ Yes] / No	Yes.
6	Does the QP includes mandatory question	[✓ Yes] / No	Yes
7	Does the QP includes innovative question	[✓ Yes] / No	Yes.
8	Does the QP is in line with University QP format	[✓ Yes] / No	Yes.
	Any Other Remarks		

Tabish Shanu 28/09/2024 Name & Signature of QP setting Faculty	Dr. Ajay Kumar Name & Signature of Moderating Faculty	Priyanka Rani Rani 28/09/24 Name & Signature of Departmental Academic Co-ordinator

पूर्णियाँ अभियंत्रण महाविद्यालय
पूर्णियाँ – ८५४३०३

PURNEA COLLEGE OF ENGINEERING
PURNEA-854303

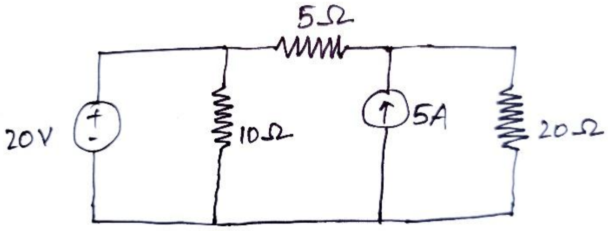
Mid-Semester Examination, October 2024

Duration: 2 Hrs Semester: 2nd (EE) Date: 04/10/2024 Time: 10:30-12:30pm Full
Marks: 20 Subject: BEE (100101) Session-2024-25 Batch- 2023-27

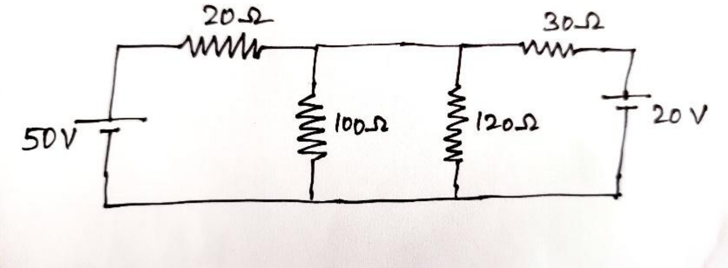
CO1	To understand electrical circuit principles, theorems, and time-domain analysis.
CO2	To apply knowledge of AC circuit analysis, power, and phasor representation
CO3	To analyse magnetic circuits, transformer, and performance of transformer in electrical systems.
CO4	To explain the principles of DC motor, induction motor and synchronous generator
CO5	To explain components of LT switchgear, batteries and elementary calculations for energy consumption.

(***Answer any four question. Each question carries five marks.***)

1. Find the power loss in 5Ω resistor. **CO1**

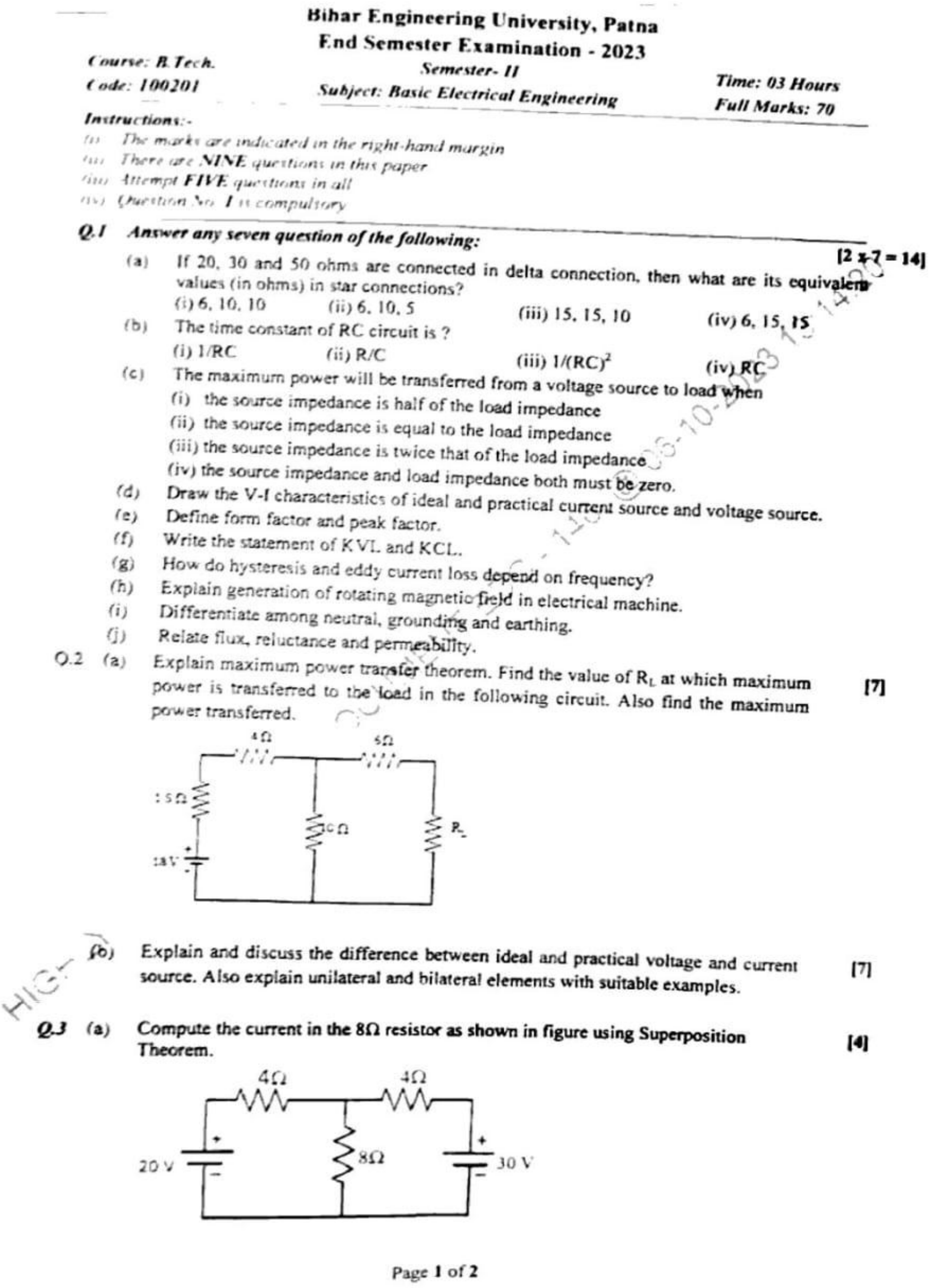


2. Using nodal analysis find the current through 100Ω resistor. **CO1**



3. Write down the statement of Thevenin’s theorem and Norton’s theorem. Also write the steps to be followed in these theorems. **CO1**
4. What is maximum power transfer theorem? Derive the condition of maximum power transfer.
   CO1
5. A R-L series circuit has resistance of 20Ω and inductance of 0.02H. If the net impedance of he given circuit is 40∠Φ Ω, find Φ and frequency of supply. **CO2**
6. A 50Hz sinusoidal voltage v=311sinωt is applied to a RL series circuit. If the resistance is 5Ω and inductance is 0.02H. Calculate the rms current and phase angle. **CO2**
7. Explain the working principle of transformer with the help of neat diagrams and equations. **CO3**

University question papers



Bihar Engineering University, Patna
End Semester Examination - 2023

Course: B.Tech.
Code: 100201
Semester- II
Subject: Basic Electrical Engineering
Time: 03 Hours
Full Marks: 70

Instructions:-
(i) The marks are indicated in the right-hand margin
*(ii) There are **NINE** questions in this paper*
*(iii) Attempt **FIVE** questions in all*
*(iv) Question No. **1** is compultory*

Q.1 Answer any seven question of the following: **[2 x 7 = 14]**

(a) If 20, 30 and 50 ohms are connected in delta connection, then what are its equivalent values (in ohms) in star connections?
(i) 6, 10, 10 (ii) 6, 10, 5 (iii) 15, 15, 10 (iv) 6, 15, 15

(b) The time constant of RC circuit is ?
(i) 1/RC (ii) R/C (iii) $1/(RC)^2$ (iv) RC

(c) The maximum power will be transferred from a voltage source to load when
(i) the source impedance is half of the load impedance
(ii) the source impedance is equal to the load impedance
(iii) the source impedance is twice that of the load impedance
(iv) the source impedance and load impedance both must be zero.

(d) Draw the V-I characteristics of ideal and practical current source and voltage source.

(e) Define form factor and peak factor.

(f) Write the statement of KVL and KCL.

(g) How do hysteresis and eddy current loss depend on frequency?

(h) Explain generation of rotating magnetic field in electrical machine.

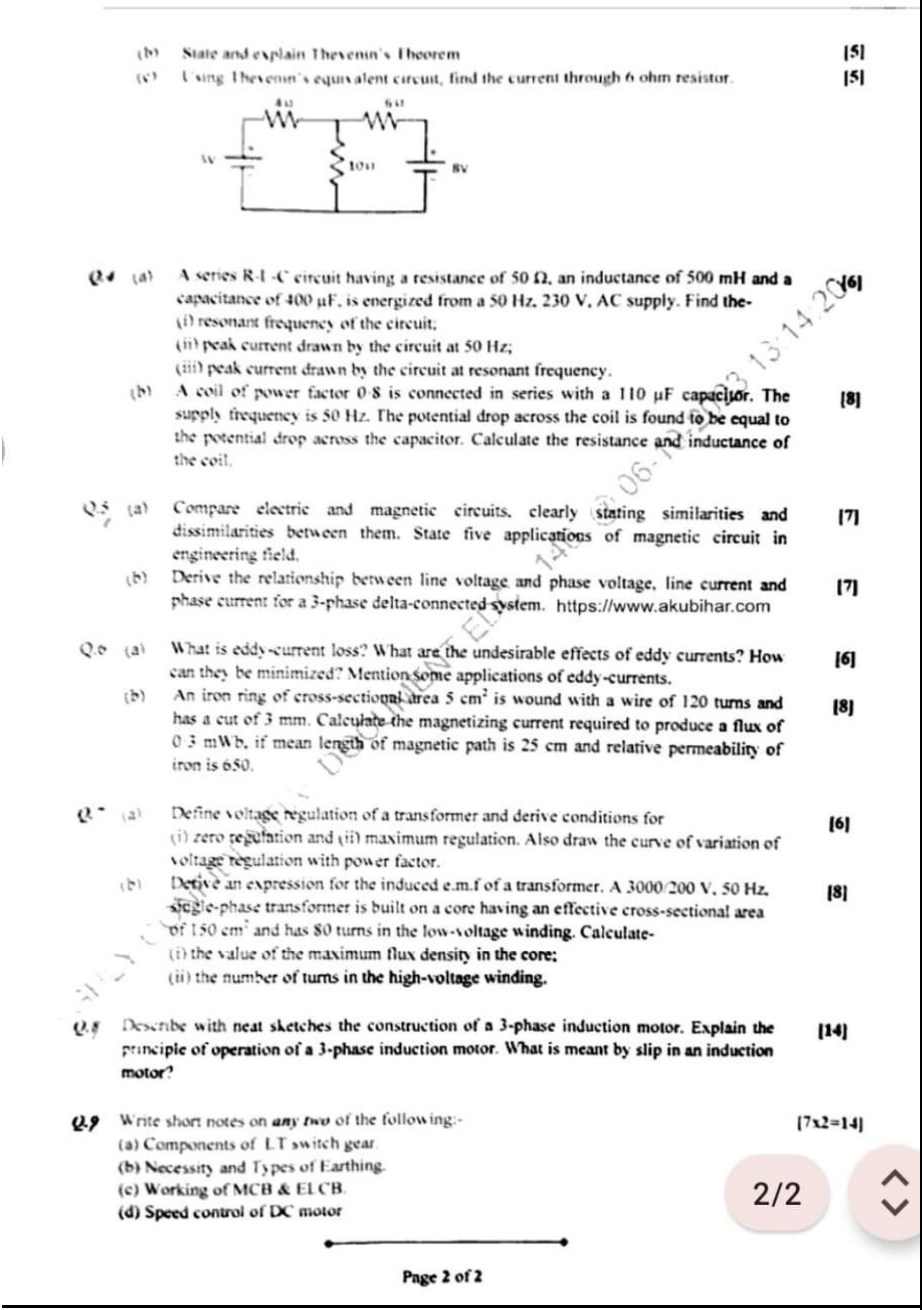
(i) Differentiate among neutral, grounding and earthing.

(j) Relate flux, reluctance and permeability.

Q.2 (a) Explain maximum power transfer theorem. Find the value of R_L at which maximum power is transferred to the load in the following circuit. Also find the maximum power transferred. **[7]**

(b) Explain and discuss the difference between ideal and practical voltage and current source. Also explain unilateral and bilateral elements with suitable examples. [7]

***Q.3* (a) Compute the current in the 8Ω resistor as shown in figure using Superposition Theorem. [4]**



(b) State and explain Thevenin's Theorem **[5]**

(c) Using Thevenin's equivalent circuit, find the current through 6 ohm resistor. **[5]**

Q.4 (a) A series R-L-C circuit having a resistance of 50 Ω, an inductance of 500 mH and a capacitance of 400 μF, is energized from a 50 Hz, 230 V, AC supply. Find the- **[6]**
(i) resonant frequency of the circuit;
(ii) peak current drawn by the circuit at 50 Hz;
(iii) peak current drawn by the circuit at resonant frequency.

(b) A coil of power factor 0·8 is connected in series with a 110 μF capacitor. The supply frequency is 50 Hz. The potential drop across the coil is found to be equal to the potential drop across the capacitor. Calculate the resistance and inductance of the coil. **[8]**

Q.5 (a) Compare electric and magnetic circuits, clearly stating similarities and dissimilarities between them. State five applications of magnetic circuit in engineering field. **[7]**

(b) Derive the relationship between line voltage and phase voltage, line current and phase current for a 3-phase delta-connected system. **[7]**

Q.6 (a) What is eddy-current loss? What are the undesirable effects of eddy currents? How can they be minimized? Mention some applications of eddy-currents. **[6]**

(b) An iron ring of cross-sectional area 5 cm^2 is wound with a wire of 120 turns and has a cut of 3 mm. Calculate the magnetizing current required to produce a flux of 0·3 mWb, if mean length of magnetic path is 25 cm and relative permeability of iron is 650. **[8]**

Q.7 (a) Define voltage regulation of a transformer and derive conditions for (i) zero regulation and (ii) maximum regulation. Also draw the curve of variation of voltage regulation with power factor. **[6]**

(b) Derive an expression for the induced e.m.f of a transformer. A 3000/200 V, 50 Hz, single-phase transformer is built on a core having an effective cross-sectional area of 150 cm^2 and has 80 turns in the low-voltage winding. Calculate- **[8]**
(i) the value of the maximum flux density in the core;
(ii) the number of turns in the high-voltage winding.

Q.8 Describe with neat sketches the construction of a 3-phase induction motor. Explain the principle of operation of a 3-phase induction motor. What is meant by slip in an induction motor? **[14]**

Q.9 Write short notes on ***any two*** of the following:- **[7x2=14]**
(a) Components of LT switch gear.
(b) Necessity and Types of Earthing.
(c) Working of MCB & ELCB.
(d) Speed control of DC motor

Page 2 of 2

Code : 100201

B.Tech 2nd Semester Exam., 2021

(New Course)

BASIC ELECTRICAL ENGINEERING

Time : 3 hours *Full Marks* : 70

Instructions :

(i) The marks are indicated in the right-hand margin.

*(ii) There are **NINE** questions in this paper.*

*(iii) Attempt **FIVE** questions in all.*

*(iv) Question No. **1** is compulsory.*

1. Choose the correct answer of the following (any *seven*) : 2×7=14

(a) Lamps in street lighting are all connected in

[✓ *(i)* series]

[✓ *(ii)* parallel]

(iii) series-parallel

(iv) end-end

(b) The rotor slots in a 3-phase induction motor are kept inclined. This phenomenon is known as

[✓ *(i)* skewing]

(ii) crawling

[✓ *(iii)* cogging]

(iv) hardening

(c) An alternator with higher value of SCR has

(i) poor voltage regulation and lower stability limit

(ii) better voltage regulation and higher stability limit

(iii) poor voltage regulation and higher stability limit

[✓ *(iv)* better voltage regulation and lower stability limit]

(d) If the flux of a DC motor approaches zero, its speed will

[✓ *(i)* approach infinity]

(ii) approach zero

(iii) remain unchanged

(iv) between zero and infinity

(e) The core flux of a practical transformer with a resistive load

[✓ *(i)* is strictly constant with load changes]

(ii) increases linearly with load

(iii) increases as the square root of the load

(iv) decreases with increase in load

(f) A transformer has a percentage resistance of 2% and percentage reactance of 4%. What are its voltage regulations at 0·8 lagging and 0·8 leading respectively?

(i) 4·8% and –0·6%

(ii) 3·2% and –1·6%

(iii) 1·6% and –3·2%

(iv) 4% and –0·8%

(g) Higher the *Q* of a series circuit, narrower its

(i) pass band

(ii) resonance curve

(iii) bandwidth

(iv) All of the above

(h) A 10 mH inductor carries a sinusoidal current of 1 A r.m.s. at a frequency of 50 Hz. The average power dissipated by the inductor is

(i) 0 W

(ii) 0·25 W

[✓ *(iii)* 0·5 W]

(iv) 1 W

(i) Which of the following statements is incorrect?

(i) Resistance is a passive element.

(ii) Inductor is a passive element.

(iii) Current source is a passive element.

(iv) Voltage source is an active element.

(j) Which of the following is *not* bilateral element?

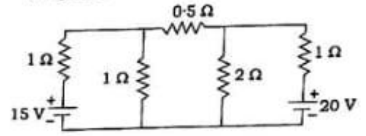
(i) Constant current source

(ii) Resistor

(iii) Inductor

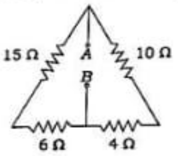
(iv) Capacitor

2. *(a)* Find the current through each resistor of the following circuit using nodal analysis : 4



(b) Explain the concept of superposition theorem applied to the electric circuit by taking a 3-element *T*-network and two batteries. 6

(c) Find the equivalent resistance between points *A* and *B* in the following circuit : 4



3. *(a)* An iron cored coil draws 2 A at 0·5 p.f. lag against a 50 Hz, 100 V supply. Iron core being then removed, the voltage applied being 50 V, the current rises to 5 A at 0·78 lag. Find the inductance of each case. 6

(b) A resistance of 10 Ω, an inductance of 150 mH and a capacitor of 100 μF are connected across a 50 V, 50 Hz source. Find the branch currents and total current. Draw the phasor diagram. 4

(c) Discuss the effect of resistance of RLC series circuit on the frequency response curve. 4

4. *(a)* An iron ring 8 cm mean diameter is made up of round iron diameter 1 cm and permeability of 900 has an air gap of 2 mm wide. It consists of winding with 400 turns carrying a current of 3·5 A. Determine—

(i) MMF;
(ii) total reluctance;
(iii) the flux;
(iv) flux density in ring. 4

(b) Give the comparison between electric circuit and magnetic circuit. 4

(c) Explain the experimental method of obtaining hysteresis loop of magnetic circuit. 6

5. *(a)* The open-circuit and short-circuit tests on a 10 kVA, 125/250 V, 50 Hz single-phase transformer gave the following results :
OC test : 125 V, 0·6 A, 50 W on LV side
SC test : 15 V, 30 A, 100 W on HV side
Calculate *(i)* copper loss on full load, *(ii)* full-load efficiency at 0·8 leading p.f., *(iii)* half-load efficiency at 0·8 leading p.f. and *(iv)* voltage regulation at full load, 0·9 leading p.f. 8

(b) Explain the various three-phase transformer connections with neat circuit and phasor diagrams. 6

6. *(a)* Draw the speed-torque characteristics of DC shunt motors and series motors. 4

(b) Explain the constructional details of alternators. 4

(c) The lap wound armature of a 4-pole DC shunt motor has 600 armature turns and it takes 100 Amps when running at 600 r.p.m. The flux per pole is 100 mWb. Calculate the gross mechanical torque developed and the net power output if the torque lost in friction, windage and core losses is 60 N-m. 6

7. *(a)* A 4-pole, 50 Hz, 3-phase induction motor running on full load develops a useful torque of 200 N-m when the rotor e.m.f. makes 120 complete cycles per minute. If the mechanical torque lost in friction and rotor core loss is 15 N-m, calculate the—

(i) shaft power output;

(ii) rotor copper losses;
(iii) stator input;
(iv) motor efficiency. 4

(b) Differentiate the principle of operation of induction and synchronous motors. 4

(c) Draw the speed-torque characteristics of an induction motor. 3

(d) List the various types of DC generators and draw their electrical circuits. 3

8. *(a)* Define cold ranking ampere and specific power in batteries. 6

(b) Describe the various devices used to improve the system power factor. 4

(c) Explain the various types of earthing systems. 4

9. *(a)* Explain maximum power transfer theorem applied in a DC network. 7

(b) Why a DC series motor cannot be started on no load? Explain your answer with the help of basic speed-torque equation and necessary diagrams. 7

* * *

Code : 100201

B.Tech 2nd Semester Exam., 2022

(New Course)

BASIC ELECTRICAL ENGINEERING

Time : 3 hours *Full Marks* : 70

Instructions :

(i) The marks are indicated in the right-hand margin.

(ii) There are ***NINE*** *questions in this paper.*

(iii) Attempt ***FIVE*** *questions in all.*

(iv) Question No. ***1*** *is compulsory.*

1. Short answer-type questions (any *seven*) : 2×7=14

(a) State and explain Kirchhoff's laws with an example.

(b) Which winding (LV or HV) should be kept open while conducting OC test? Justify your answer.

(c) Assume that the given transformer has the following name plate ratings :

40 kVA, 440 V/11 kV, 50 Hz

What do these numbers imply?

(d) What is a commutator in d.c. machine?

(e) What is meant by linear network? Explain *R*, *L* and *C* as linear elements.

(f) Differentiate among real, reactive and apparent powers.

(g) Calculate maximum value and r.m.s. value of $v = 10\sin\omega t - 17{\cdot}3\cos\omega t$.

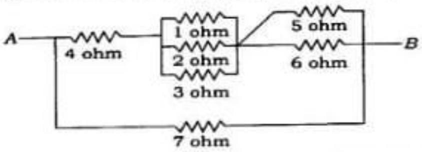
(h) A 250 V bulb passes a current of 0·3 A. Calculate the power in the lamp.

(i) Define unilateral and bilateral elements.

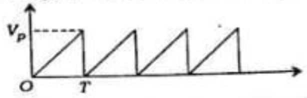
(j) Give some applications of three-phase induction motor.

2. *(a)* An a.c. current varying sinusoidal with frequency 50 Hz has r.m.s. value 20 A. Write equation for instantaneous value and find this value 0·0125 seconds after passing through maximum value. 7

(b) Calculate the resistance between *A* and *B* from the figure given below : 7



3. *(a)* Explain the r.m.s. value. Solve the V_{rms} value of given waveform in the figure : 6



(b) Two coils, connected in series-aiding fashion, have a total inductance of 250 mH. When connected in a series-opposing configuration, the coils have a total inductance of 150 mH. If the inductance of one coil (L_1) is three times the other, then find L_1, L_2 and *M*. What is the coupling coefficient? 8

4. *(a)* Explain the principle of transformer action. 7

(b) A series circuit consists of a resistance of 4 Ω, an inductance of 500 mH and a variable capacitance connected across a 100 V, 50 Hz supply. Calculate the capacitance requires for producing a series resonance condition, and the voltages generated across both the inductor and the capacitor at the point of resonance. 7

5. *(a)* Define parallel resonance. Calculate at resonance the resultant current and quality factor in terms of the parameters of a circuit. 6

(b) Explain the advantages of rotating field-type alternator. 8

6. A 3-phase, 6-pole, star-connected alternator revolves at 1000 r.p.m. The stator has 90 slots and 8 conductors per slot. The flux per pole is 0·05 Wb. Calculate the voltage generated, if $K_w = 0{\cdot}96$. 14

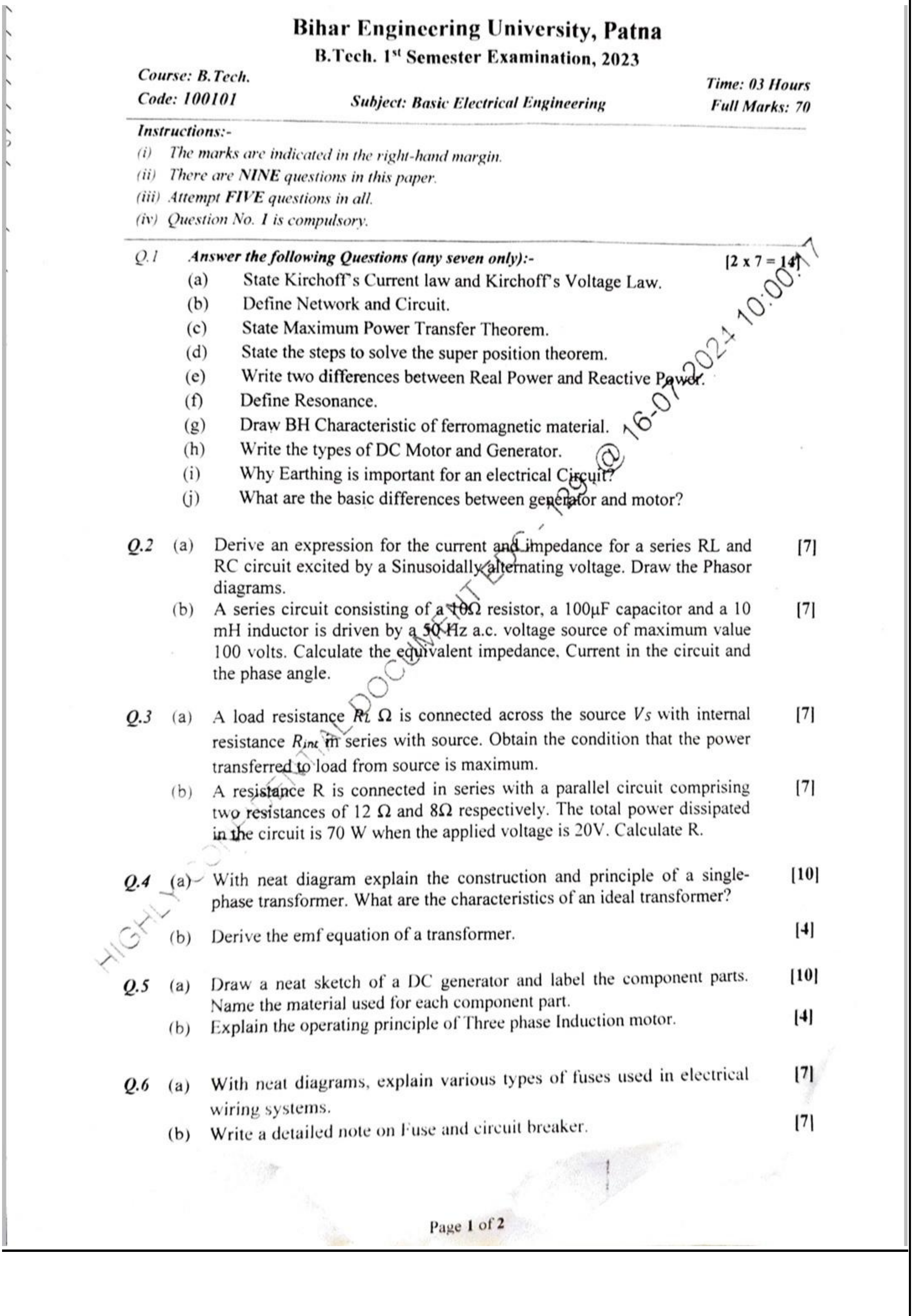
7. *(a)* Explain the principle of operation of d.c. motor. https://www.akubihar.com 6

(b) A balanced star-connected load of $(8 + j6)\,\Omega$ per phase is connected to a balanced 3-phase, 400 V supply. Find the line current, power factor, power and total volt-amperes. 8

8. A 6-pole alternator runs at 1000 r.p.m., and supplies power to a 4-pole, 3-phase induction motor. The frequency of rotor of induction motor is 2 Hz. Determine the slip and speed of the motor. 14

9. Two coils, *X* of 12000 turns and *Y* of 15000 turns, lie in parallel planes so that 45% of the flux produced by coil *X* links coil *Y*. A current of 5 A in *X* produces 0·05 Wb while the same current in *Y* produces 0·075 Wb. Calculate *(a)* the mutual inductance, *(b)* the coupling coefficient and *(c)* the percentage of flux produced by coil *Y* and linking with coil *X*. 14

* * *



Bihar Engineering University, Patna

B.Tech. 1st Semester Examination, 2023

Course: B.Tech.
Code: 100101 *Subject: Basic Electrical Engineering*
Time: 03 Hours
Full Marks: 70

Instructions:-

(i) The marks are indicated in the right-hand margin.
*(ii) There are **NINE** questions in this paper.*
*(iii) Attempt **FIVE** questions in all.*
*(iv) Question No. **1** is compulsory.*

Q.1 ***Answer the following Questions (any seven only):-*** **[2 x 7 = 14]**

(a) State Kirchoff's Current law and Kirchoff's Voltage Law.
(b) Define Network and Circuit.
(c) State Maximum Power Transfer Theorem.
(d) State the steps to solve the super position theorem.
(e) Write two differences between Real Power and Reactive Power.
(f) Define Resonance.
(g) Draw BH Characteristic of ferromagnetic material.
(h) Write the types of DC Motor and Generator.
(i) Why Earthing is important for an electrical Circuit?
(j) What are the basic differences between generator and motor?

Q.2 (a) Derive an expression for the current and impedance for a series RL and RC circuit excited by a Sinusoidally alternating voltage. Draw the Phasor diagrams. **[7]**

(b) A series circuit consisting of a 10Ω resistor, a 100μF capacitor and a 10 mH inductor is driven by a 50 Hz a.c. voltage source of maximum value 100 volts. Calculate the equivalent impedance, Current in the circuit and the phase angle. **[7]**

Q.3 (a) A load resistance R_L Ω is connected across the source V_S with internal resistance R_{int} in series with source. Obtain the condition that the power transferred to load from source is maximum. **[7]**

(b) A resistance R is connected in series with a parallel circuit comprising two resistances of 12 Ω and 8Ω respectively. The total power dissipated in the circuit is 70 W when the applied voltage is 20V. Calculate R. **[7]**

Q.4 (a) With neat diagram explain the construction and principle of a single-phase transformer. What are the characteristics of an ideal transformer? **[10]**

(b) Derive the emf equation of a transformer. **[4]**

Q.5 (a) Draw a neat sketch of a DC generator and label the component parts. Name the material used for each component part. **[10]**

(b) Explain the operating principle of Three phase Induction motor. **[4]**

Q.6 (a) With neat diagrams, explain various types of fuses used in electrical wiring systems. **[7]**

(b) Write a detailed note on Fuse and circuit breaker. **[7]**

Q.7 (a) State and Explain Thevenin's Theorem for a DC Circuit. Write applications, advantages and limitations of Thevenin's Theorem. **[10]**

(b) State Norton's theorem. **[4]**

Q.8 A three single phase balanced load connected in three phase three wires star form, with the help of phasor diagram, obtain the relationship between line and phase quantities of voltage and current. **[14]**

Q.9 Write short notes on ***any two*** of the following:- **[7×2=14]**

(a) Batteries and its types and application
(b) Losses in Transformer
(c) differences between Balanced, Unbalanced and Faulty Electrical Systems
(d) Working and application of Synchronous generator

◆

LIST OF WEEK STUDENTS			
Sl No	**Registration No**	**Name**	**Mid Term Marks (20)**
1	22103131024	TILAK KUMAR	3
2	22103131026	ABHISHEK KUMAR MISHRA	3
3	23103131017	DILKHUSH KUMAR RAJAK	2
4	23103131018	SHREYASHI SINGH	4
5	23103131032	RITIKA KUMARI	4
6	23103131039	MD ZABAR	2

CO ATTAINMENT THROUGH MID SEMESTER EXAM

CO		CO1	CO1	CO1	CO1	CO2	CO2	CO3	Total Marks
QUES		**1**	**2**	**3**	**4**	**5**	**6**	**7**	
Max mark	**Reg. No.**	**5**	**5**	**5**	**5**	**5**	**5**	**5**	**20**
22103131024	**TILAK KUMAR**	**1**		**1**	**1**				**3**
22103131026	**ABHISHEK KUMAR MISHRA**		**1**	**1**	**1**				**3**
23103131001	**MD EKRAMUL**	**5**	**5**	**4**		**5**			**19**
23103131002	**HARERAM KUMAR**	**3**	**2**	**4**	**1**				**10**
23103131003	**DIPAK KUMAR**	**2**	**4**	**5**		**5**			**18**
23103131004	**ADITYA RANJAN**	**3**	**5**	**5**			**4**		**17**
23103131005	**ABHINAV ANAND**			**3**		**2**			**5**
23103131006	**AKANKSHA KUMARI**	**5**	**2**						**7**
23103131007	**AANAND KUMAR**	**3**	**5**						**8**
23103131008	**AMIT KUMAR**	**4**	**5**	**4**	**5**				**18**
23103131009	**KUMAR SUBHARTH**		**5**	**4**		**4**	**4**		**17**
23103131010	**SUMANT KUMAR**	**2**	**1**	**4**		**2**			**9**
23103131011	**PRADUM KUMAR**	**4**			**2**	**5**	**3**		**14**
23103131012	**RAVI KUMAR**			**4**	**3**	**5**	**4**		**16**
23103131013	**PIYUSH KUMAR**		**5**	**5**	**5**		**5**		**20**
23103131014	**AMAN KUMAR**	**5**	**5**	**5**	**5**				**20**
23103131015	**ANAND KISHOR GUPTA**	**5**	**5**			**5**	**5**		**20**
23103131016	**SONAL SINGH**	**4**	**5**	**5**	**4**				**18**
23103131017	**DILKHUSH KUMAR RAJAK**	**2**							**2**
23103131018	**SHREYASHI SINGH**	**1**	**3**						**4**
23103131020	**RAZI AHMED**	**4**			**3**	**4**	**4**		**15**
23103131021	**ANKIT KUMAR**	**5**	**4**			**4**	**4**		**17**
23103131022	**ABHAY KUMAR**	**5**	**5**			**5**	**5**		**20**
23103131024	**SUJIT KUMAR**	**1**		**4**		**5**	**3**		**13**
23103131025	**SUDAM KUMAR**		**4**	**5**	**2**	**4**			**15**
23103131026	**MD MAHTAB ANSARI**	**5**	**5**			**5**	**5**		**20**
23103131027	**ABHISHEK KUMAR**			**4**	**1**	**1**			**6**

23103131028	**VISHAL KUMAR SINGH**		5			1	2		**8**
23103131029	**YASH BHARTI**	2	2	2	1				**7**
23103131030	**MUKESH YADAV**	2	3			3	3		**11**
23103131031	**SAHIL SUMAN**	5		5	5				**15**
23103131032	**RITIKA KUMARI**			4					**4**
23103131033	**MD SAIF ALI**	5	5	5	4				**19**
23103131034	**PRIYANKA KUMARI**	5		2	2				**9**
23103131035	**AMARJIT KUMAR**	4	3	3	2				**12**
23103131036	**WASIM REZA**	5	5		5	5			**20**
23103131039	**MD ZABAR**				1			1	**2**
Average Marks									

CO ATTAINMENT THROUGH ASSIGNMENT

Max mark	**Reg. No.**	Assignment marks (5)
22103131024	**TILAK KUMAR**	5
22103131026	**ABHISHEK KUMAR MISHRA**	5
23103131001	**MD EKRAMUL**	4
23103131002	**HARERAM KUMAR**	5
23103131003	**DIPAK KUMAR**	4
23103131004	**ADITYA RANJAN**	5
23103131005	**ABHINAV ANAND**	5
23103131006	**AKANKSHA KUMARI**	5
23103131007	**AANAND KUMAR**	5
23103131008	**AMIT KUMAR**	4
23103131009	**KUMAR SUBHARTH**	5
23103131010	**SUMANT KUMAR**	5
23103131011	**PRADUM KUMAR**	5
23103131012	**RAVI KUMAR**	4
23103131013	**PIYUSH KUMAR**	4
23103131014	**AMAN KUMAR**	3
23103131015	**ANAND KISHOR GUPTA**	4

23103131016	SONAL SINGH	4
23103131017	DILKHUSH KUMAR RAJAK	5
23103131018	SHREYASHI SINGH	5
23103131020	RAZI AHMED	5
23103131021	ANKIT KUMAR	4
23103131022	ABHAY KUMAR	3
23103131024	SUJIT KUMAR	5
23103131025	SUDAM KUMAR	5
23103131026	MD MAHTAB ANSARI	4
23103131027	ABHISHEK KUMAR	5
23103131028	VISHAL KUMAR SINGH	5
23103131029	YASH BHARTI	5
23103131030	MUKESH YADAV	4
23103131031	SAHIL SUMAN	5
23103131032	RITIKA KUMARI	5
23103131033	MD SAIF ALI	4
23103131034	PRIYANKA KUMARI	5
23103131035	AMARJIT KUMAR	5
23103131036	WASIM REZA	4
23103131039	MD ZABAR	5
Average Marks		

CO ATTAINMENT THROUGH ATTENDANCE

Name	Reg. No.	Attendance Marks (5)
22103131024	TILAK KUMAR	5
22103131026	ABHISHEK KUMAR MISHRA	5
23103131001	MD EKRAMUL	4
23103131002	HARERAM KUMAR	4
23103131003	DIPAK KUMAR	5
23103131004	ADITYA RANJAN	4
23103131005	ABHINAV ANAND	5

23103131006	**AKANKSHA KUMARI**	5
23103131007	**AANAND KUMAR**	5
23103131008	**AMIT KUMAR**	4
23103131009	**KUMAR SUBHARTH**	4
23103131010	**SUMANT KUMAR**	5
23103131011	**PRADUM KUMAR**	4
23103131012	**RAVI KUMAR**	5
23103131013	**PIYUSH KUMAR**	3
23103131014	**AMAN KUMAR**	4
23103131015	**ANAND KISHOR GUPTA**	3
23103131016	**SONAL SINGH**	4
23103131017	**DILKHUSH KUMAR RAJAK**	5
23103131018	**SHREYASHI SINGH**	5
23103131020	**RAZI AHMED**	4
23103131021	**ANKIT KUMAR**	5
23103131022	**ABHAY KUMAR**	4
23103131024	**SUJIT KUMAR**	5
23103131025	**SUDAM KUMAR**	4
23103131026	**MD MAHTAB ANSARI**	3
23103131027	**ABHISHEK KUMAR**	5
23103131028	**VISHAL KUMAR SINGH**	4
23103131029	**YASH BHARTI**	5
23103131030	**MUKESH YADAV**	5
23103131031	**SAHIL SUMAN**	4
23103131032	**RITIKA KUMARI**	5
23103131033	**MD SAIF ALI**	4
23103131034	**PRIYANKA KUMARI**	5
23103131035	**AMARJIT KUMAR**	5
23103131036	**WASIM REZA**	3
23103131039	**MD ZABAR**	5
Average Marks		

CO Attainment Analysis

CLASS AVERAGE IN CONTINUOUS INTERNAL EVALUATION				
CO	**Mid Term Exam (20)**	**Assignment (5)**	**Attendance (5)**	**Class Average(%)**
CO1	9.1	2.3	4.4	57.44%
CO2	3.3	2.3	4.6	57.97%
CO3	0.0	0.0	4.6	46.18%
CO4	0.0	0.0	4.6	91.82%
CO5	0.0	0.0	4.6	91.82%

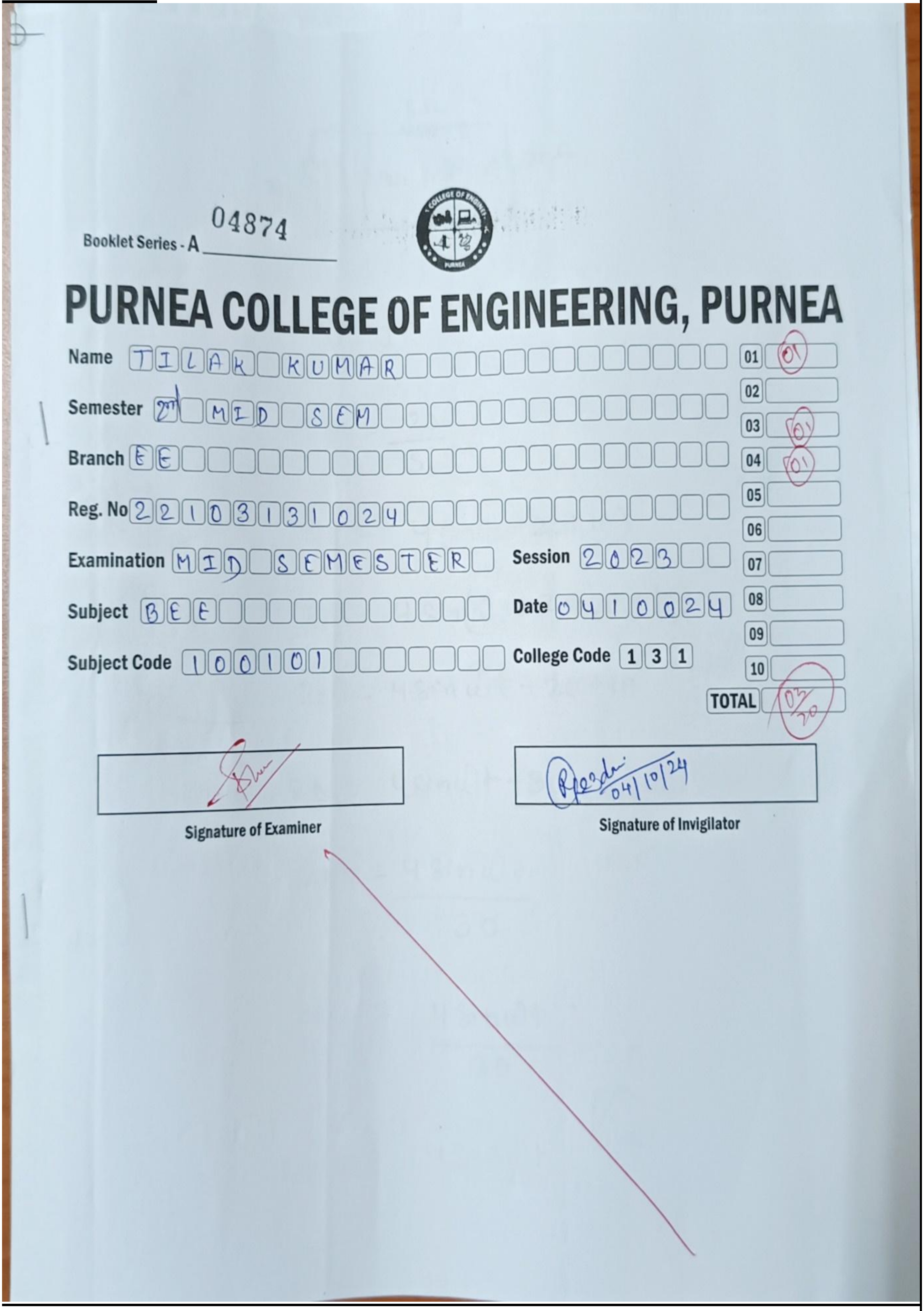
Direct CO Attainment			
(30% of Continuous internal evaluation + 70 % of end semester exam)			
CO	**CIE (Class Avg. %)**	**ESE (Class Avg. %) (Same Value Assumed for all Cos)**	**Direct CO Attained (.30 OF CIE + .70 OF ESE)**
CO1	57.44%	52.78%	**54.18%**
CO2	57.97%	52.78%	**54.34%**
CO3	46.18%	52.78%	**50.80%**
CO4	91.82%	52.78%	**64.49%**
CO5	91.82%	52.78%	**64.49%**
Total CO Attainment			
(90% of Direct CO Attainment + 10 % of Indirect CO Attainment)			
CO	**Direct attained CO %**	**Indirectly Attained CO % (Course End Survey)**	**Total CO Attained%**
CO1	**54.18%**	70.81%	55.84%
CO2	**54.34%**	70.27%	55.93%
CO3	**50.80%**	82.16%	53.94%
CO4	**64.49%**	85.95%	66.64%
CO5	**64.49%**	85.95%	66.64%

Direct PO/PSO Attainment														
PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
2.00	2.00	2.00	2.00	2.00	2.00	2.00	0.00	0.00	0.00	0.00	2.00	2.00	2.00	2.00

Course target status

CO attainment					
CO	Target %	Attained %	Attainment gap (%)	Action Proposed to bridge the gap	Modification of target where achieved
CO1	**60.00%**	**55.84%**	**4.16%**	**Defined**	**60.00%**
CO2	**60%**	**55.93%**	**4%**	**Defined**	**60%**
CO3	**60%**	**53.94%**	**6%**	**Defined**	**60%**
CO4	**65%**	**66.64%**	**-2%**	**Attained**	**70%**
CO5	**65%**	**66.64%**	**-2%**	**Attained**	**70%**

Weak Student



Booklet Series - A 04874

PURNEA COLLEGE OF ENGINEERING, PURNEA

Name TILAK KUMAR

Semester 2nd MID SEM

Branch EE

Reg. No 22103131024

Examination MID SEMESTER

Session 2023

Subject BEE

Date 04100024

Subject Code 100101

College Code 131

01	01
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03	01
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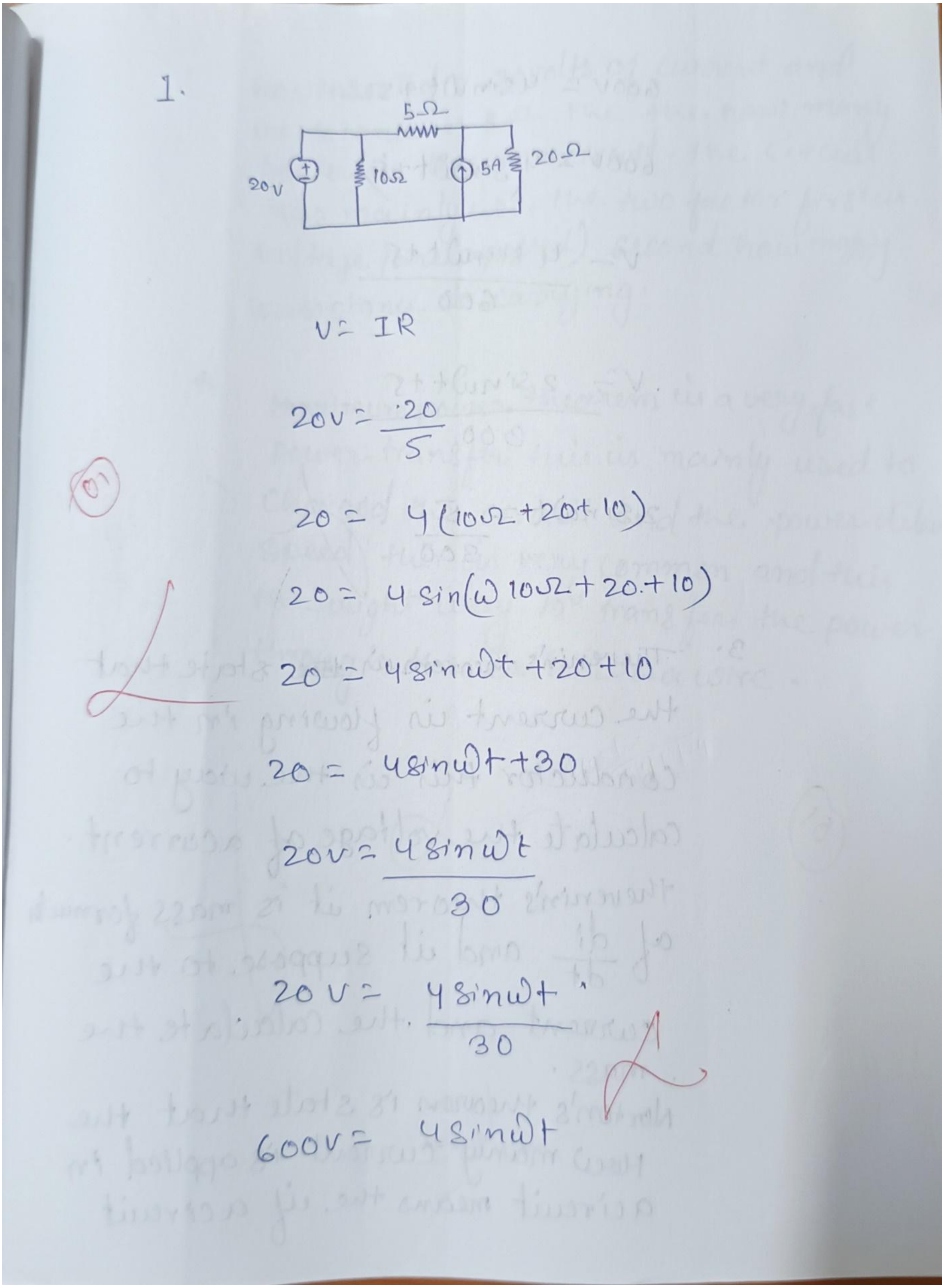
TOTAL	02/20

Signature of Examiner

04/10/24

Signature of Invigilator



1.

$V = IR$

$20V = \frac{20}{5}$

01

$20 = 4(10\Omega + 20 + 10)$

$20 = 4\sin(\omega 10\Omega + 20. + 10)$

$20 = 4\sin\omega t + 20 + 10$

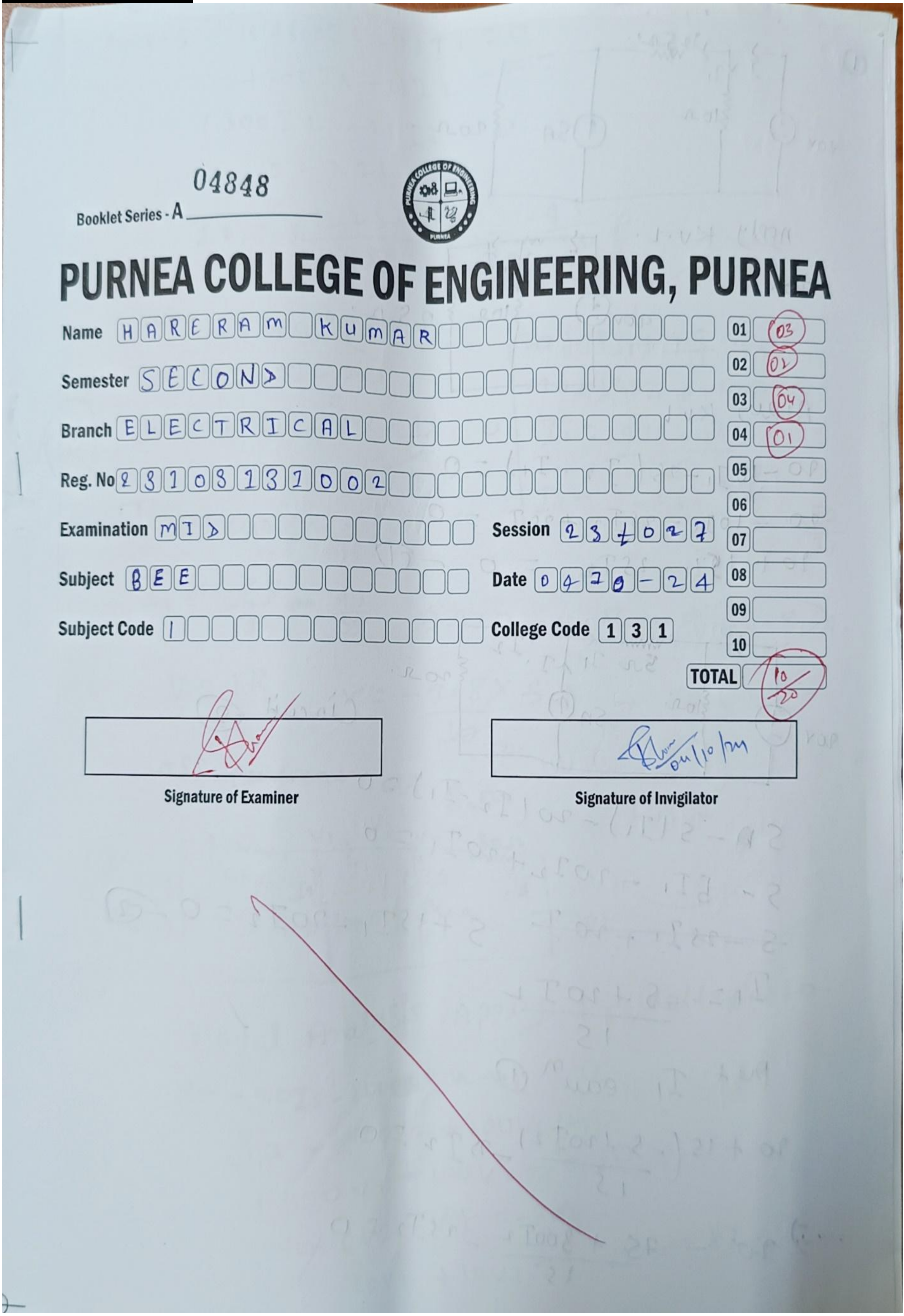
$20 = 4\sin\omega t + 30$

$20V = \frac{4\sin\omega t}{30}$

$20V = \frac{4\sin\omega t}{30}$

$600V = 4\sin\omega t$

Mediocre Student



04848
Booklet Series - A

PURNEA COLLEGE OF ENGINEERING, PURNEA

Name: HARERAM KUMAR
Semester: SECOND
Branch: ELECTRICAL
Reg. No: 23103131002
Examination: MID
Session: 23t027
Subject: BEE
Date: 0410-24
Subject Code: 1
College Code: 131

01	03
02	02
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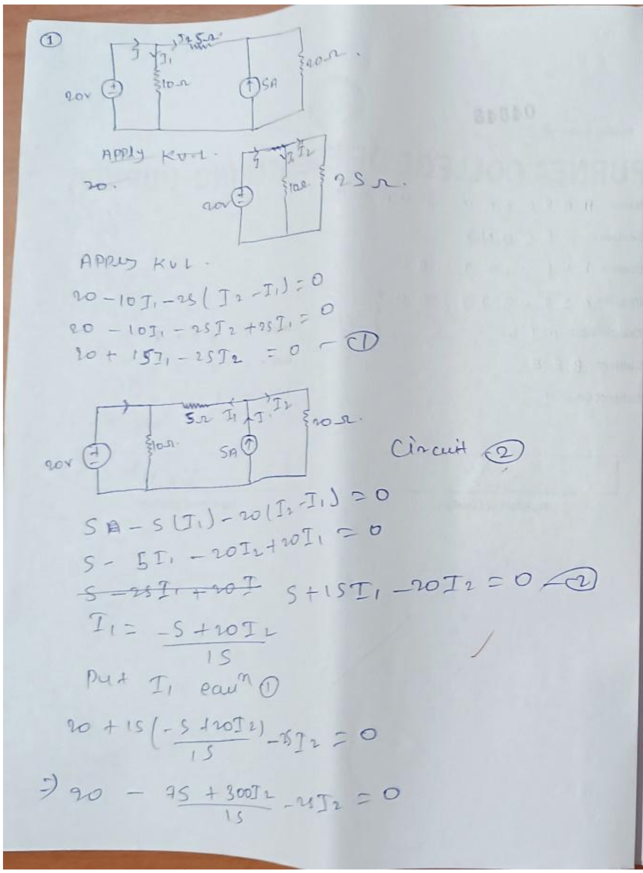
TOTAL	10/20

Signature of Examiner

04/10/24
Signature of Invigilator



①

Apply KVL.

20.

Apply KVL.

$20 - 10I_1 - 25(I_2 - I_1) = 0$

$20 - 10I_1 - 25I_2 + 25I_1 = 0$

$20 + 15I_1 - 25I_2 = 0$ — ①

Circuit ②

$5A - 5(I_1) - 20(I_2 - I_1) = 0$

$5 - 5I_1 - 20I_2 + 20I_1 = 0$

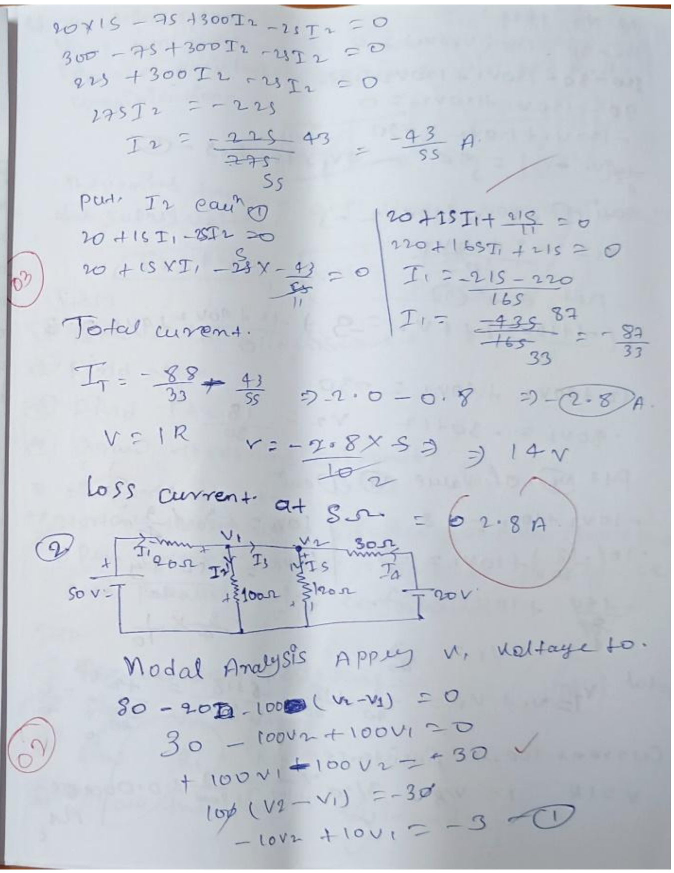
~~$5 - 25I_1 + 20I$~~ $5 + 15I_1 - 20I_2 = 0$ — ②

$I_1 = \frac{-5 + 20I_2}{15}$

Put I_1 eauⁿ ①

$20 + 15\left(\frac{-5 + 20I_2}{15}\right) - 25I_2 = 0$

$\Rightarrow 20 - \frac{75 + 300I_2}{15} - 25I_2 = 0$



$20 \times 15 - 75 + 300I_2 - 25I_2 = 0$

$300 - 75 + 300I_2 - 25I_2 = 0$

$225 + 300I_2 - 25I_2 = 0$

$275I_2 = -225$

$I_2 = \frac{-225}{275} \frac{43}{55} = \frac{-43}{55}$ A.

Put I_2 eauⁿ ①

$20 + 15I_1 - 25I_2 = 0$

$20 + 15 \times I_1 - 25 \times -\frac{43}{55} = 0$

$20 + 15I_1 + \frac{215}{11} = 0$

$220 + 165I_1 + 215 = 0$

$I_1 = \frac{-215 - 220}{165}$

$I_1 = \frac{-435}{165} \frac{87}{33} = -\frac{87}{33}$

03

Total current.

$I_T = -\frac{88}{33} + \frac{43}{55} \Rightarrow -2.0 - 0.8 \Rightarrow -\boxed{2.8}$ A.

$V = IR$ $\quad v = -\frac{2.8 \times 5}{10} \Rightarrow \Rightarrow 14v$

Loss current at 5Ω = 2.8 A

②

Nodal Analysis Apply v_1 voltage to.

$80 - 20 - 100(v_2 - v_1) = 0$

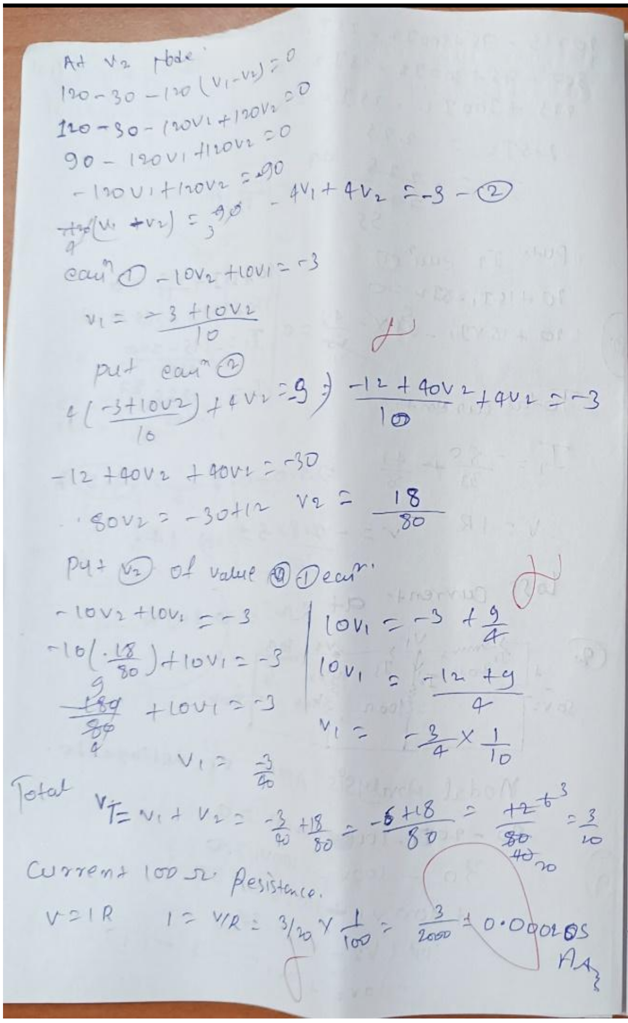
$30 - 100v_2 + 100v_1 = 0$ ✓

$+100v_1 - 100v_2 = +30$

$10(V_2 - V_1) = -30$

$-10v_2 + 10v_1 = -3$ — ①

02



At v_2 node

$120 - 30 - 120(v_1 - v_2) = 0$

$120 - 30 - 120v_1 + 120v_2 = 0$

$90 - 120v_1 + 120v_2 = 0$

$-120v_1 + 120v_2 = -90$ $\quad -4v_1 + 4v_2 = -3$ — ②

$\frac{120}{4}(v_1 + v_2) = \frac{90}{3}$

eauⁿ ① $-10v_2 + 10v_1 = -3$

$v_1 = \frac{-3 + 10v_2}{10}$

put eauⁿ ②

$4\left(\frac{-3 + 10v_2}{10}\right) + 4v_2 = -3 \Rightarrow \frac{-12 + 40v_2}{10} + 4v_2 = -3$

$-12 + 40v_2 + 40v_2 = -30$

$80v_2 = -30 + 12$ $\quad v_2 = \frac{18}{80}$

Put v_2 of value ① eauⁿ

$-10v_2 + 10v_1 = -3$

$-10\left(\frac{18}{80}\right) + 10v_1 = -3$

$\frac{189}{80} + 10v_1 = -3$

$v_1 = \frac{-3}{40}$

$10v_1 = -3 + \frac{9}{4}$

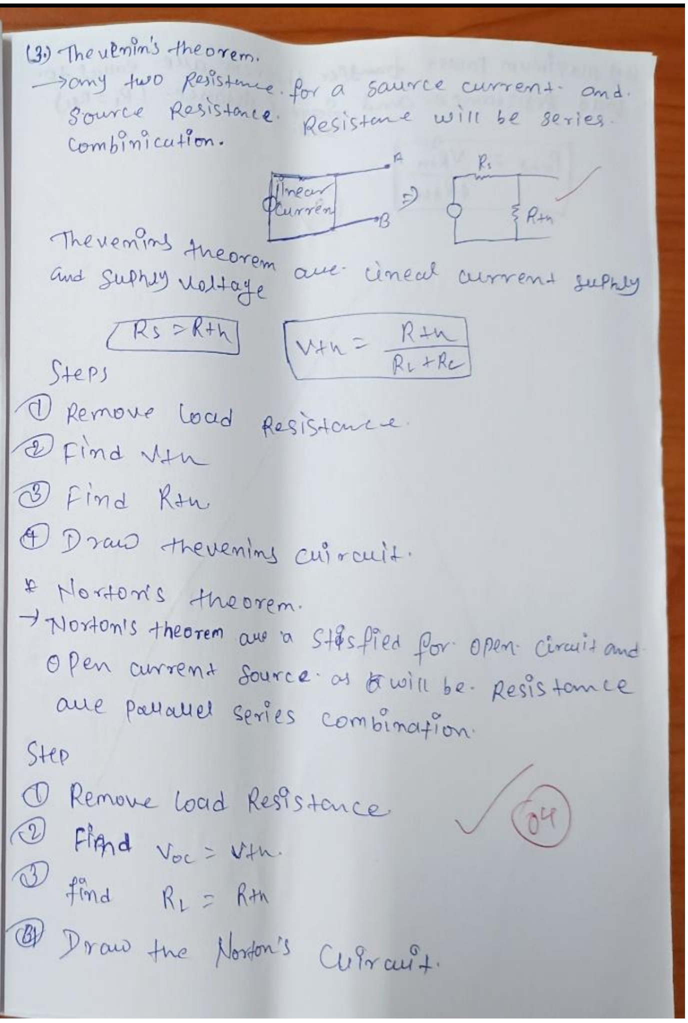
$10v_1 = \frac{-12 + 9}{4}$

$v_1 = -\frac{3}{4} \times \frac{1}{10}$

Total $v_T = v_1 + v_2 = -\frac{3}{40} + \frac{18}{80} = \frac{-6 + 18}{80} = \frac{+12}{80} = \frac{3}{20}$

Current 100Ω Resistance.

$V = IR$ $\quad I = V/R = 3/20 \times \frac{1}{100} = \frac{3}{2000} = 0.00015$ A



(3.) Thevenin's theorem.

→ any two Resistance for a source current and source Resistance. Resistance will be series combinication.

Thevenins theorem are linear current supply and supply voltage

$\boxed{R_s = R_{th}}$ $\quad \boxed{V_{th} = \frac{R_{th}}{R_L + R_C}}$

Steps

① Remove load Resistance.

② Find V_{th}

③ Find R_{th}

④ Draw thevenins circuit.

* Norton's theorem.

→ Norton's theorem are a satisfied for open circuit and open current source. as will be. Resistance are parallel series combination.

Step

① Remove load Resistance

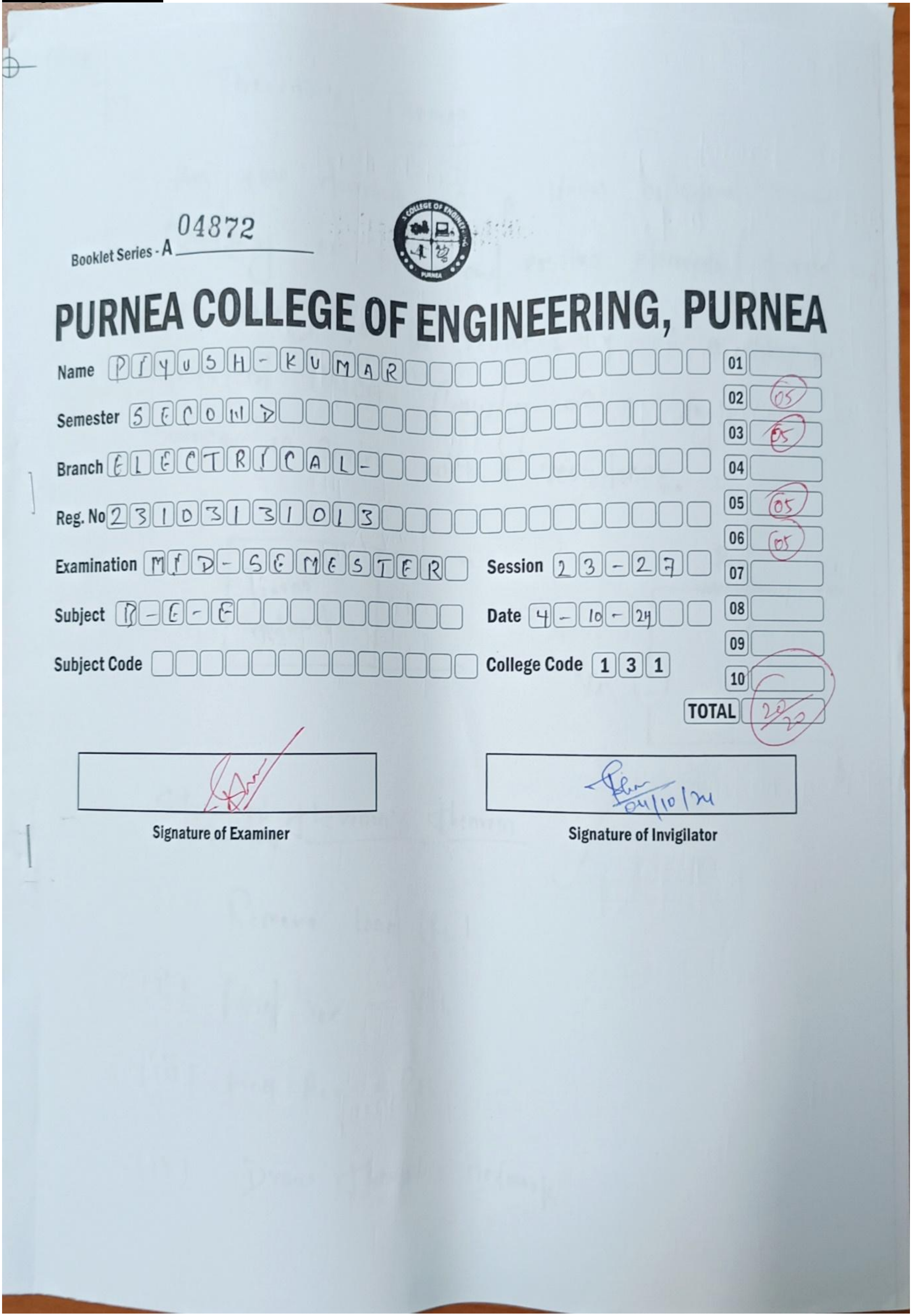
② Find $V_{oc} = V_{th}$.

③ find $R_L = R_{th}$

④ Draw the Norton's Circuit.

04

Bright Student



Booklet Series - A 04872

PURNEA COLLEGE OF ENGINEERING, PURNEA

Name PIYUSH-KUMAR

Semester SECOND

Branch ELECTRICAL-

Reg. No 23103131013

Examination MID-SEMESTER

Session 23-27

Subject B-E-E

Date 4-10-24

Subject Code

College Code 131

01	
02	05
03	05
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06	05
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TOTAL	20/20

Signature of Examiner

04/10/24

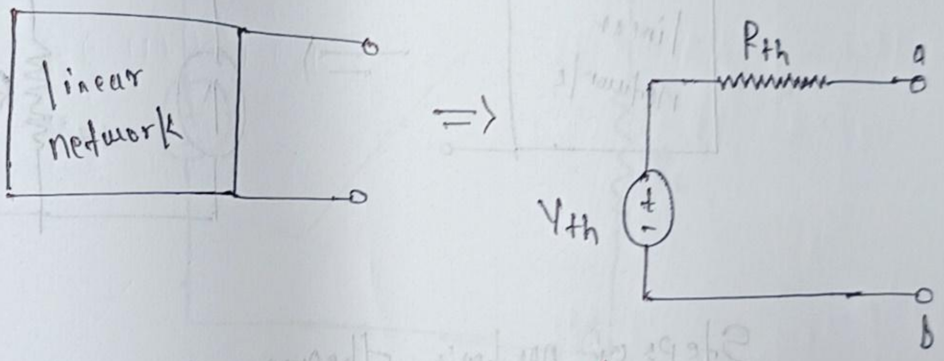
Signature of Invigilator

Q3

Ans

Thevenin's Theorem

→ Any two terminals of a linear bilateral network Consisting of active and passive elements (source and resistance) Can be replaced by of a simple equivalent Circuit Consisting of a single voltage Source in Series with a resistance.



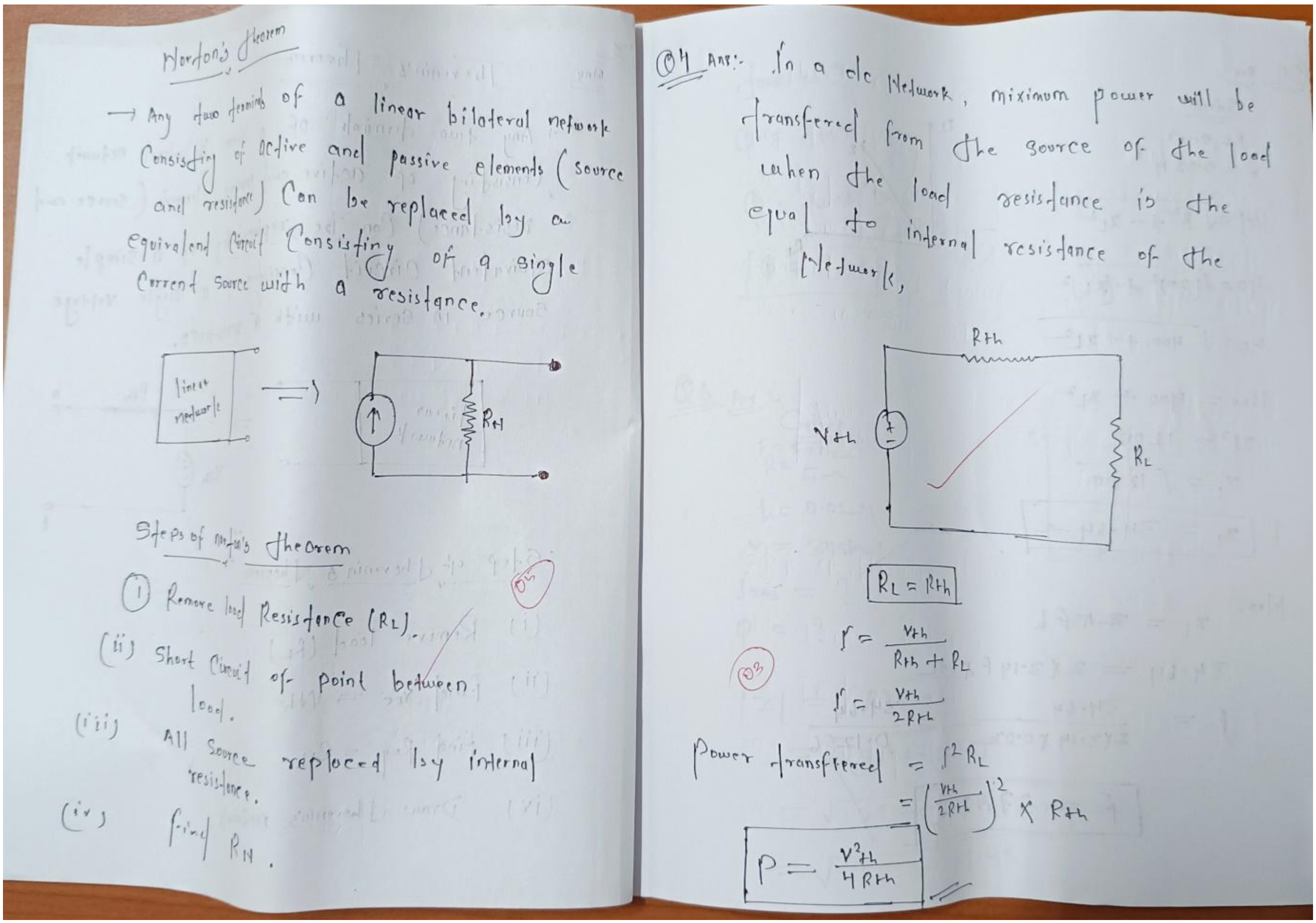
Step of thevenin's theorem

(i) Remove load (R_L)

(ii) find $V_{oc} = V_{th}$

(iii) find $R_{eq} = R_{th}$

(iv) Draw thevenin's network.



Norton's theorem

→ Any two terminals of a linear bilateral network Consisting of active and passive elements (source and resistance) Can be replaced by a equivalent Circuit Consisting of a single Current source with a resistance.

Steps of norton's theorem

① Remove load Resistance (R_L).

(ii) Short Circuit of point between load.

(iii) All Source replaced by internal resistance.

(iv) find R_N.

05

Q4 Ans:- In a dc Network, maximum power will be transfered from the source of the load when the load resistance is the equal to internal resistance of the Network,

$$\boxed{R_L = R_{th}}$$

$$I = \frac{V_{th}}{R_{th} + R_L}$$

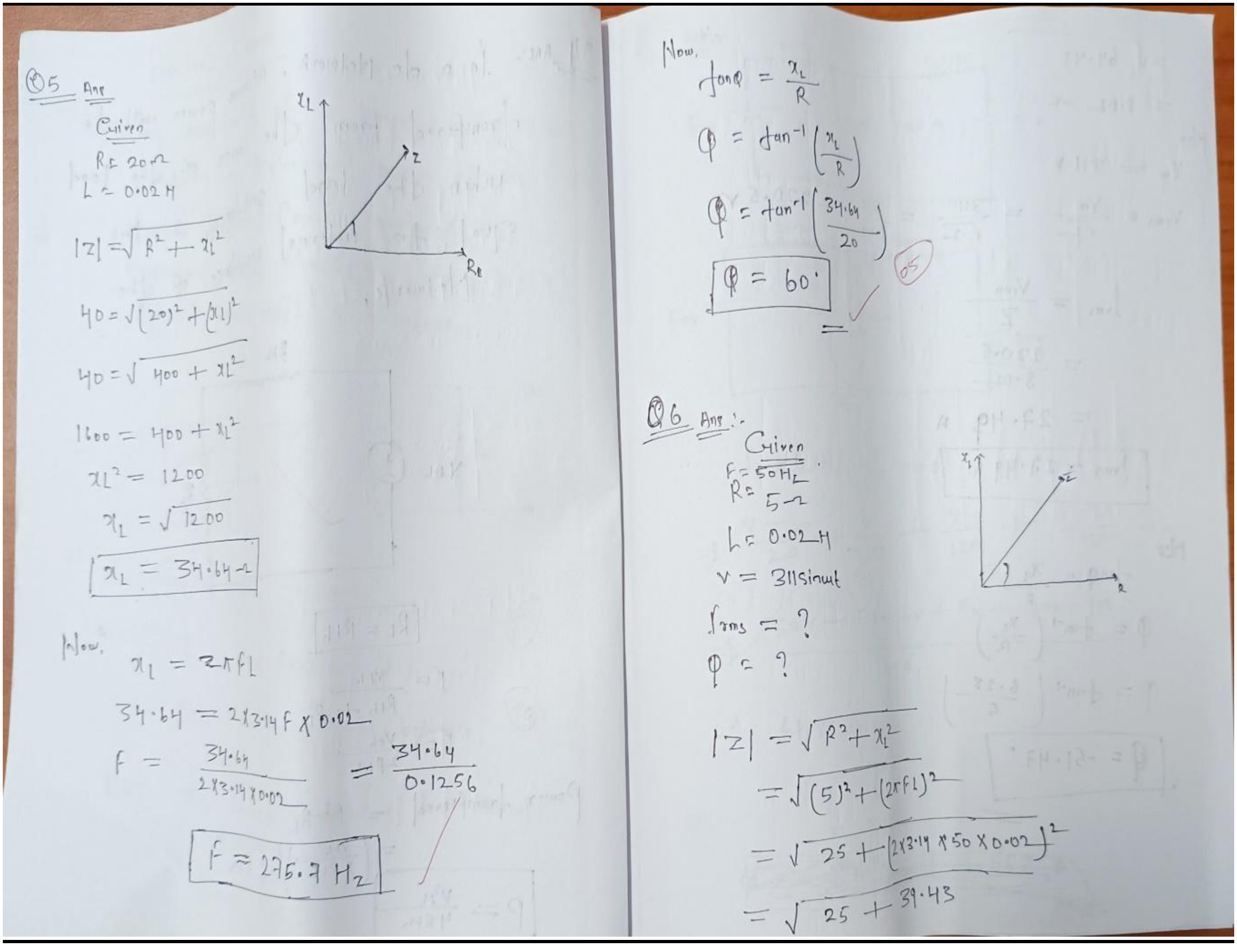
03

$$I = \frac{V_{th}}{2R_{th}}$$

Power transfrered $= I^2 R_L$

$$= \left(\frac{V_{th}}{2R_{th}}\right)^2 \times R_{th}$$

$$\boxed{P = \frac{V^2_{th}}{4R_{th}}}$$



Q5 Ans

Given

R= 20Ω

L = 0.02 H

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

$$40 = \sqrt{(20)^2 + (X_L)^2}$$

$$40 = \sqrt{400 + X_L^2}$$

$$1600 = 400 + X_L^2$$

$$X_L^2 = 1200$$

$$X_L = \sqrt{1200}$$

$$\boxed{X_L = 34.64\Omega}$$

Now,

$$X_L = 2\pi f L$$

$$34.64 = 2 \times 3.14 f \times 0.02$$

$$f = \frac{34.64}{2 \times 3.14 \times 0.02} = \frac{34.64}{0.1256}$$

$$\boxed{f \approx 275.7\ Hz}$$

Now,

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

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

$$\phi = \tan^{-1}\left(\frac{34.64}{20}\right)$$

$$\boxed{\phi = 60^\circ}$$

05

Q6 Ans:-

Given

F = 50 Hz

R = 5Ω

L = 0.02 H

v = 311sinωt

I_{rms} = ?

φ = ?

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

$$= \sqrt{(5)^2 + (2\pi f L)^2}$$

$$= \sqrt{25 + (2 \times 3.14 \times 50 \times 0.02)^2}$$

$$= \sqrt{25 + 39.43}$$

Remedial Action for Weak Students

1. Teaching Methodologies

- Simplified teaching
- Visual aids
- Peer learning
- Mentoring

2. Outcome of Remedial Classes

- Improved performance
- Better understanding
- Increased confidence

3. Challenges Faced

- Attendance issues
- Time constraints

4. Suggestions for Improvement

- Continuous remedial classes
- Use of technology
- Increased mentoring