



POORNIMA

COLLEGE OF ENGINEERING

COURSE: _____

SEMESTER: III sem

SUBJECT: 03EE-05A ELECTRICAL MACHINES-I

SUB. CODE: 03EE05A

CONTENT: PCE Syllabus, Blown-up, Deployment, Zero Lectures,
Detailed lecture notes with cover page, Tutorial/Home-Assignment Sheets

SESSION: 2017-18

NAME OF FACULTY: Dr. CHEJAN KHEMRAJ

DEPARTMENT: ELECTRICAL ENGINEERING.

CAMPUS: POORNIMA COLLEGE OF ENGINEERING.

ISI-6, RIICO Institutional Area, Sitapura, Jaipur-302022 (Rajasthan)

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Course File Content:-

S. No.	ITEM
1	Syllabus
2	ABC Analysis
3	Blown-Up
4	Deployment
5	Zero Lecture
6	Detailed lecture note with cover page
7	5 Year RTU Question Papers
8	Tutorial Sheets / Home Assignment
9	Class Test Question Paper and Analysis
9	Open Book Test Question Paper and Analysis
10	Quiz and Analysis
10	Power point Presentation(PPT) report
11	Expert Video Lecture Report
12	Recording of Self Video Lecture
13	Audio Recordings of 2-lectures and 1-tutorial (if applicable)
14	Others, if any

NAME OF THE SUBJECT / LAB ELECTRICAL MACHINES-1(O3EESA)

CODE O3EESA YEAR 2017-18

NAME OF FACULTY Dr. CHEJAN KHEMRAJ

DESIGNATION PROFESSOR DEPARTMENT ELECTRICAL ENGINEERING

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SYLLABUS

3EE5A: ELECTRICAL MACHINES-I (Common to EE and EX)

Unit 1 (I) Magnetic circuits: Magnetic circuits, magneto motive force magnetic field strength, permeability, reluctance, analogy between electric and magnetic-circuits, B-H curve, hysteresis, series and parallel magnetic circuits, practical magnetic circuits, permanent magnet and their applications.

(ii) Electromechanical energy conversion: Basic principles, conservation of energy, physical phenomenon involved in conversion, energy balance, energy stored in magnetic field.

Unit 2 DC Generators: Introduction, construction, types, emf equation, lap and wave windings, armature reaction, commutation, methods of improving commutation, equalizer rings

Demagnetizing and cross magnetizing ampere turns, various characteristics of shunt, series and compound generators, voltage build up, losses and efficiency, condition for maximum efficiency.

Unit 3 DC Motors: Introduction, principals, back-emf, torque of motor, types, characteristics of shunt, series and compound motors, speed control (field and armature control methods), basic idea of solid state devices in controlling of DC motors

Starting of DC motors, three point and four point starters, losses and efficiency, testing (brake test and swimburnes test), electric braking of DC motors, Applications.

Unit 4 Transformer: Construction, Principal, Types, emf equation, no load and short circuit test, equivalent circuits, back-to-back (Sumpner's test), phasor diagram, Voltage regulation
Efficiency, Condition for maximum efficiency, all day efficiency, parallel operation, auto-transformer, basic idea of welding transformer, current and potential transformer, separation of losses.

Unit 5 Polyphase Transformer: Construction, Various connections and groups, choice of connections, open delta connection, Scott connection, three phase to two phase conversion and vice-versa, Applications, Parallel operation and its conditions
Three to six phase conversion. Excitation phenomenon in transformers, magnetizing harmonic currents and their effects, switching currents in transformers, inrush of magnetizing current. Three winding transformer.

Books

- 1 A. E. Fitzgerald, C. Kingsley Jr and Umans, Electric Machinery, 6th Edition McGraw Hill, International Student Edition. 2002
- 2 Kothari & Nagrath, Electric Machines, 3/e, TMH
3. M. G. Say, The Performance and Design of AC machines, Pit man & Sons. 2003


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ABC ANALYSIS

Course: B. Tech.

Name of Faculty: CHETAN KHEMRAJ

Class/Section: III Sem.

Name of Subject: ELECTRICAL
MACHINES-I

Date: 25 JUNE 2017

Subject Code:
3EE5A

Unit No.	CO	Category A	Category B	Category C	Preparedness for "A" topics
1	CO1	- Energy stored in magnetic field. - B-H curve hysteresis - Series and parallel magnetic circuits	- Basic principles of electromechanical energy conversion. - Magnetic circuits - Magneto motive force - Magnetic field strength - Permeability - Reluctance - Analogy between electric and magnetic-circuits	- Basic aspects and physical phenomena involved in energy conversion. - Energy balance - Practical magnetic circuits - Permanent magnet and their applications	Important questions solving
2	CO2	- Armature reaction, commutation - Methods of improving commutations - Demagnetizing and cross magnetizing mmf - Interpoles - Characteristics	- Construction - Types of DC generators - emf equation - lap & wave windings - Equalizing connections	- Parallel operation - Rosenberg generator	Video lecture
3	CO3,CO4	- DC motor starting. - Speed Control of DC Motor - Armature voltage and field current control methods - Swinburne's test - Hopkinson test	- Principle - back emf - Types - production of torque	- Armature reaction & interpoles - Characteristics of shunt, series & compound motor - Ward Leonard Method. - Braking - Losses and efficiency	OBT


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CO5	• Equivalent circuits • Vector diagrams • switching currents in transformers • Separation of losses.	• Construction, • types • Emf equation. • No load and load conditions	• OC and SC tests, • Sumpner's back-to-back test • Efficiency. • Voltage regulation, • Effect of frequency • Parallel operation • Autotransformers	PPT
CO6	• Phase conversion: 3 to 6 phase and 3 to 2 phase conversions, • Effect of 3-phase winding connections on harmonics	• Single unit or bank of single-phase units, • Polyphase connections, • Open delta and V connections	• 3-phase winding transformers, • tertiary winding	quiz



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BLOWN UP SYLLABUS

Campus: PCE Course: B.TECH

Class/Section: 2ND YEAR/A

Date: 22/06/2017

Name of Faculty: Dr. CHETAN KHEMRAJ

Name of Subject: ELECTRICAL
MACHINE-I

Code: 3EE5A

S.No.	Topic as per Syllabus	BLOWN UP TOPICS (Upto 10 TIMES SYLLABUS)
01	UNIT 1 <u>Magnetic circuits & Electromechanical Energy Conversion</u> 1.1 Basics of Magnetic circuits 1.2 Analogy between electric and magnetic-circuits and series and parallel magnetic circuits 1.3 Series and parallel circuit	 1.1.1 Introduction 1.1.2 Magneto motive force 1.1.3 Magnetic field strength 1.1.4 Permeability Reluctance 1.1.5 Reluctance 1.2.1 Electric circuit 1.2.2 Magnetic circuit 1.2.3 Relation Equation 1.2.4 B-H curve 1.2.5 Hysteresis 1.3.1 Series circuit 1.3.2 Parallel circuit 1.3.3 Relation or combination of circuit 1.3.4 Numerical example


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1.4 Permanent magnet and their applications.

- 1.4.1 Introduction Of permanent magnet
- 1.4.2 Residual
- 1.4.3 Flux density
- 1.4.4 Energy stored

1.5 Basic principles of electronics energy conversion.

- 1.5.1 Introduction
- 1.5.2 Principle of energy Conversion.
- 1.5.3 Coupling fired reaction
- 1.5.4 Singly excited system
- 1.5.5 Example

1.6 Basic aspects and physical phenomena involved in energy Conversion

- 1.6.1 Reluctance motor
- 1.6.2 Double excited magnetic system
- 1.6.2 Electromagnetic and reluctance frequency
- 1.6.4 Elementary synchronous machine

1.7 Energy balance

- 1.7.1 Single excited electric flied system
- 1.7.2 Dynamic equalance
- 1.7.3 Solved examples

UNIT 2

DC generators

2.1 Construction

- 2.1.1 Introduction
- 2.1.2 Neat diagram of DC machine
- 2.1.3 Study of parts
- 2.1.4 Material used


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BLOWN UP SYLLABUS

Campus: PCE Course: B.TECH

Class/Section: 2ND YEAR/A

Date: 22/06/2017

Name of Faculty: Dr. CHETAN KHEMRAJ

Name of Subject: ELECTRICAL
MACHINE-1

Code: 3EE5A

S.No.	Topic as per Syllabus	BLOWN UP TOPICS (Upto 10 TIMES SYLLABUS)
01	UNIT 1 <u>Magnetic circuits & Electromechanical Energy Conversion</u> 1.1 Basics of Magnetic circuits 1.2 Analogy between electric and magnetic-circuits and series and parallel magnetic circuits 1.3 Series and parallel circuit	1.1.1 Introduction 1.1.2 Magneto motive force 1.1.3 Magnetic field strength 1.1.4 Permeability Reluctance 1.1.5 Reluctance 1.2.1 Electric circuit 1.2.2 Magnetic circuit 1.2.3 Relation Equation 1.2.4 B-H curve 1.2.5 Hysteresis 1.3.1 Series circuit 1.3.2 Parallel circuit 1.3.3 Relation or combination of circuit 1.3.4 Numerical example


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1.4 Permanent magnet and their applications.

- 1.4.1 Introduction Of permanent magnet
- 1.4.2 Residual
- 1.4.3 Flux density
- 1.4.4 Energy stored

1.5 Basic principles of electronics energy conversion.

- 1.5.1 Introduction
- 1.5.2 Principle of energy Conversion.
- 1.5.3 Coupling fired reaction
- 1.5.4 Singly excited system
- 1.5.5 Example

1.6 Basic aspects and physical phenomena involved in energy Conversion

- 1.6.1 Reluctance motor
- 1.6.2 Double excited magnetic system
- 1.6.2 Electromagnetic and reluctance frequency
- 1.6.4 Elementary synchronous machine

1.7 Energy balance

- 1.7.1 Single excited electric field system
- 1.7.2 Dynamic equalance
- 1.7.3 Solved examples

UNIT 2

DC generators

2.1 Construction

- 2.1.1 Introduction
- 2.1.2 Neat diagram of DC machine
- 2.1.3 Study of parts
- 2.1.4 Material used

2.1	Types of DC generator	2.1.1 Separately excited generators 2.1.2 Shunt generators 2.2.3 Series generators 2.1.3 Compound generators
2.2	Emf equation	2.2.1 Effect of speed on external characteristic 2.2.2 Emf generated in the alternator 2.2.3 Examples
2.4	Lap and wave winding	2.4.1 Closed winding 2.4.2 Simplex lap winding 2.4.3 Split coils 2.4.4 Simplex wave winding 2.4.5 Dummy coils 2.4.6 Multiplex windings
2.4	Equalizing connection	2.4.1 Equalizing rings
2.5	Armature reaction	2.5.1 Mm and flux density 2.5.2 Armature reaction 2.5.3 Method of limiting the effect of Armature reaction 2.5.4 Effect of brush shift
2.7	Commutation method of improving commutations.	2.7.1 Commutation process 2.7.2 Interposes 2.7.3 Brushes 2.7.4 Compensating winding
2.8	Demagnetizing and cross magnetizing	2.8.1 Basic performance equations for dc generator 2.8.2 Magnetization curve 2.8.3 Effect of armature of dc machine
2.9	various characteristics of shunt, series and Compound generators	2.9.1 Shunt generators 2.9.2 Series generators 2.9.3 Compound generators

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2.10.1 Losses and efficiency

2.10.1 Losses

2.10.2 Efficiency

2.10.3 Condition of maximum efficiency

UNIT 3

DC Motors

3.1 Principle

3.1.1 Principle

3.2 Back emf

3.2.1 Introduction of Back emf

3.3 Types

3.3.1 Shunt motor

3.3.2 Series motor

3.3.3 Compound motor

3.3.4 Operating characteristics of dc motors

3.4 Production of torque

3.4.1 Production of torque in non salience pole machine

3.4.2 Alternative derivation of torque

3.5 DC motor starting

3.5.1 Shunt motor starting

3.5.2 Series motor starting

3.5.3 Compound motor starting

3.6 Speed control of DC motor

3.6.1 Speed control by varying the armature circuit resistance

3.6.2 Speed control by varying the field flux method

3.6.3 Speed control by varying the armature terminal method

3.6.4 Ward Leonard method

3.7 Braking losses and efficiency

3.7.1 Braking losses and efficiency of

3.7.2 Shunt motor

3.7.3 Series motor

3.7.4 Compound motor


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3.8 Direct and Indirect test, Swinburne's test, Hopkinson, field & retraction test.

3.9 Braking of DC motor

3.10 Starters

UNIT 4

Transformers

4.1 Construction

4.2 Types

4.3 Emf equation

4.4 No load and load equation

4.5 Equivalent circuits

3.8.1 Direct and Indirect test, Swinburne's test, Hopkinson, field & retraction test of

3.8.2 Shunt motor

3.8.3 Series motor

3.8.4 Compound motor

3.9.1 Dynamic braking.

3.9.2 Regenerative braking

3.9.3 Plugging or reverse current braking

3.10.1 Three point starter

3.10.2 Four Point Starter

4.1.1 Construction and working principle of transformer

4.2.1 Shell type

4.3.2 Core type

4.3.1 Principle of transformer action

4.3.2 Two winding transformer

4.4.1 Transformer equation

4.4.2 Ideal two winding transformer

4.4.3 Transformer phasor diagram at no load

4.5.4 Under load

4.5.1 Development of the exact circuits of a transformer

4.5.2 Equivalent circuits of a general form

4.5.3 Simplification of exact equivalent circuits

4.6.4 Phasor diagrams of the above


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4.6 O.C&S.C.test	4.6.1 Open circuit test 4.6.2 Short circuit test 4.8.3 Solved examples
4.7 Sumpner's back to back test	4.7.1 Sumpner's back to back test
4.8 Efficiency	4.8.1 Transformer losses 4.8.2 Calculation of efficiency 4.9.3 Conditions for maximum efficiency
4.9 Voltage regulation	4.9.1 Voltage regulation of a transformer 4.9.2 Conditions for maximum regulation 4.9.3 Examples
4.10 Effect of frequency	4.10.1 Effect of frequency 4.10.2 Relation with losses 4.10.3 Relation with rating
4.11 Parallel operation	4.11.1 Parallel operation necessary conditions 4.11.2 No load operation 4.11.3 On load operation
4.12 Autotransformer	4.12.1 Introduction 4.12.2 Advantage of auto trans transformer over two winding transformer 4.12.2 Disadvantage 4.12.3 Equivalent circuit 4.12.4 Phasor diagram 4.12.5 Step up autotransformer 4.12.6 Comparison and characteristics of autotransformer and two winding transformer 4.12.7 Rating 4.12.8 Losses 4.12.9 Impedance drop 4.12.10 Voltage regulation 4.12.11 Short circuit current 4.12.12 Uses


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4.13 Current and potential transformer

4.13.1 Current transformer
4.13.2 Potential transformer

4.14 Separation of losses.

4.14.1 Losses
4.14.2 Methods

UNIT 5

Polyphase transformers

5.1 Single unit or bank of single phase unit

5.1.1 Instruction
5.1.2 Advantage and disadvantage of single unit and three units
5.1.3 Single unit
5.1.4 Three units

5.2 Poly phase connections

5.2.1 Methods of poly phase connections

5.3 Open delta connections or v connection

5.3.1 Method of open delta connections

5.4 Scott three phase/two phase connection

5.4.1 Three phase/two phase connection
5.4.2 Phasor diagram

5.5 Effect of 3-phase winding connections on harmonics

5.5.1 Effect of 3-phase winding connections on harmonics

5.6 Switching currents in transformers

5.6.1 Switching current

5.7 Three winding transformer

5.7.1 Construction
5.7.2 Principal
5.7.3 Phasor diagram
5.7.4 Numerical



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Campus: PCE Course: B.TECH

Class/Section: 2nd YEAR/EE/A

Date: 20/06/2017

Name of Faculty: Dr. CHETAN KHEMRAJ

Name of Subject: Electrical Machines-I

Code: EE23A

S.N o.	TOPIC AS PER BLOWNUP SYLLABUS	LECT. NO.	PLANNED DATE	ACTUAL DEL. DATE	REASON FOR DEVIATION	COURSE OUTCOME E	REF / TEST BOOK / PPT PAGE NO.
01	Zero Lecture		28/6				
	UNIT- 1 : Magnetic circuit and Electromechanical energy conversion	L0		28/6	-		
	<u>Introduction of unit I</u> <u>Introduction of lecture</u> 1.1 Basics of Magnetic circuits 1.1.1 Introduction 1.1.2 Magneto motive force 1.1.3 Magnetic field strength 1.1.4 Permeability Reluctance 1.1.5 Reluctance <u>Conclusion of lecture</u>	L1	30/6	30/6	-	CO1	Asfaq Hussain PP 607-609 PS Bhimb (Appendix)
	<u>Introduction of lecture</u> 1.2 Analogy between electric and magnetic-circuits and series and parallel magnetic circuits 1.2.1 Electric circuit 1.2.2 Magnetic circuit 1.2.3 Relation Equation 1.2.4 B-H curve 1.2.5 Hysteresis <u>Conclusion of lecture</u>	L2	3/7	3/7	-		PS Bhimb PP 881
	<u>Introduction of lecture</u> 1.3 Series and parallel circuit 1.3.1 Series circuit 1.3.2 Parallel circuit 1.3.3 Relation or combination of circuit <u>Conclusion of lecture</u>	L3		4/7	-		PS Bhimb pp 519
	<u>Introduction of lecture</u> 1.4 Permanent magnet and their applications. 1.4.1 Introduction Of permanent magnet	L4	5/7	5/7	-		PS Bhimb PP 521

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1.4.2 Residual					
1.4.3 Flux density					
1.4.3 Energy stored					
Conclusion of lecture	L5				
Introduction of lecture					
1.5.1 Introduction		6/7	6/7	—	Asfaq Hussain pp 610-615
1.5.2 Principle of energy Conversion.					
1.5.3 Energy stored in magnetic field	L6				
Conclusion of lecture		10/7	10/7	—	
Important Question solve		11/7	11/7	—	
UNIT -2					
DC Generator					
Introduction of unit 2	L7				
Introduction of lecture		12/7	12/7	—	
2.1 Construction					CO2 Asfaq Hussain pp 468-470
2.1.1 Introduction					
2.1.2 Neat diagram of DC machine	L8				
Conclusion of lecture		14/7	14/7	—	
Introduction of lecture	L9				Asfaq Hussain 470-471
2.1.3 Study of parts					
2.1.4 Material used		18/7	18/7	—	
Conclusion of lecture					
Introduction of lecture	L10				
2.2.1 Separately excited generators					Asfaq Hussain pp-471
2.2.2 Shunt generators					
2.2.3 Series generators		19/7	19/7	—	
2.2.4 Compound generators					
Conclusion of lecture					
Introduction of lecture					
2.3.1 Effect of speed on external characteristic					
2.3.2 Emf generated in the alternator					
2.3.3 Examples	L11				
Conclusion of lecture					
Introduction of lecture		21/7	21/7	—	Asfaq Hussain pp 474-
2.4.1 Closed winding					
2.4.2 Simplex lap winding					
Split coils	L12				
2.4.3 Simplex wave winding					
2.4.4 Dummy coils		24/7	24/7	—	
2.4.5 Multiplex windings					

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2.6.1 Equalizing drops Conclusion of lecture	L15					
Introduction of lecture						
2.6.1 Arm and flux density		26/7	24/7	-		
2.6.2 Armature reaction Conclusion of lecture						
Introduction of lecture						
2.6.3 Method of limiting the effect of Armature reaction	L16	28/7	28/7	-		
2.6.4 Effect of brush shift Conclusion of lecture						
Introduction of lecture						
2.7.1 Commutation process	L17					
2.7.2 Interpoles						
2.7.3 Brushes Conclusion of lecture	L18	1/8	7/8	-		
Introduction of lecture						
2.7.4 Compensating winding	L16					
2.8.1 Basic performance equations for dc generator Conclusion of lecture		8/8	8/8	-		
Introduction of lecture	L17					
2.8.2 Magnetization curve						
2.8.3 Effect of armature of dc machine Conclusion of lecture		9/8	9/8	-		
Introduction of lecture	L18					
2.09.1 Parallel operation						
2.10.1 Losses and efficiency Conclusion of lecture		11/8	11/8	-		
Conclusion of unit 2						
Video Lecture	L19					
		14/8	14/8	-		
UNIT -3 DC Motor						
Introduction of unit 3						
Introduction of lecture	L20					
3.1.1 Introduction		16/8	17/8	on leave		
3.1.2 Principle						
3.2.1 Introduction of Back emf Conclusion of lecture						
Introduction of lecture						

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3.3.1 Shunt motor	L21	18/8	18/8	-		pp 501-503
3.3.2 Series motor						
3.3.3 Compound motor						
Conclusion of lecture						
Introduction of lecture						
3.3.4 Operating characteristics of dc motor	L22					
3.4.1 Production of torque in non salience pole machine						
3.4.2 Alternative derivation of torque		22/8	22/8	-	CO3	pp 508-509
Conclusion of lecture						
Introduction of lecture	L23					
3.4.3 Shunt motor starting						
3.4.4 Series motor starting		23/8	23/8	-		pp 514-15
3.4.5 Compound motor starting						
Conclusion of lecture						
Introduction of lecture						
3.6.1 Speed control by varying the armature circuit resistance	L24					
3.6.2 Speed control by varying the field flux method		25/8	25/8	-		pp 507-09
Conclusion of lecture						
Introduction of lecture	L25					
3.6.3 Speed control by varying the armature terminal method						
3.6.4 Ward Leonard method		28/8	28/8	-	CO4	pp 529-30
Conclusion of lecture						
Introduction of lecture	L26					
3.7.1 Braking losses and efficiency of		29/8	29/8	-		pp 523-26
3.7.2 Shunt motor						
3.7.3 Series motor						
3.7.4 Compound motor						
Conclusion of lecture						
Introduction of lecture						
3.8.1 Direct and Indirect test, Swinburne's test, Hopkinson's, field & retraction test of	L27					
3.8.2 Shunt motor						
3.8.3 Series motor		30/8	30/8	-		pp 526-29
3.8.4 Compound motor						
Conclusion of lecture						
Introduction of lecture	L28					

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- 3.9.1 Electrical braking
 3.9.2 Dynamic braking.
 3.9.3 Regenerative braking
 3.9.4 Plugging or reverse current braking.

Conclusion of lecture
Conclusion of unit 3

Open Book Test I
ASSESSMENT TEST I

UNIT -4 Transformer

Introduction of unit 4
Introduction of lecture

4.1.1 Construction and working principle of transformer

4.1.2 Shell type

4.1.3 Core type

Conclusion of lecture

Introduction of lecture

4.1.4 Principle of transformer action

4.1.4.2 Phasor diagram

Conclusion of lecture

Introduction of lecture

4.1.5 Two winding transformer

4.1.6 Transformer equation

4.1.7 Ideal two winding transformer

4.1.8 Transformer phasor diagram at no load

4.1.9 Under load

Conclusion of lecture

Introduction of lecture

4.1.10 Development of the exact equivalent circuits of a transformer

4.1.11 Equivalent circuits of a general form

4.1.12 Simplification of exact equivalent circuits

Conclusion of lecture

Introduction of lecture

4.1.13 Phasor diagrams of the above

4.1.14 Open circuit test

4.1.15 Short circuit test

L29

1/9

2/9

CO4

pp 523-26

4/9

4/9

8/9

8/9

14/9

14/9

L30

11/9

11/9

pp 5-6

L31

12/9

12/9

pp 1-4

L32

13/9

13/9

L33

26/9

26/9

pp 6-10

L34

29/9

29/9

pp 10-

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4.1.16 Solved examples Conclusion of lecture	L35	3/10	4/10		COS	PP - 36, 37
Introduction of lecture 4.1.17 Sumpner's back to back test 4.1.18 Transformer losses 4.1.19 Calculation of efficiency 4.1.20 Conditions for maximum efficiency Conclusion of lecture	L36	4/10	4/10	—		PP 27-28
Introduction of lecture 4.1.21 Voltage regulation of a transformer 4.1.22 Conditions for maximum regulation 4.1.23 Examples Conclusion of lecture	L37	6/10	6/10	—		PP-38
Introduction of lecture 4.1.24 Effect of frequency 4.1.25 Relation with losses 4.1.26 Relation with rating Conclusion of lecture	L38	9/10	9/10	—		
Introduction of lecture 4.1.27 Parallel operation necessary conditions 4.1.28 No load operation 4.1.29 On load operation Conclusion of lecture	L39	10/10	10/10	—	COS	PP 126-3
Introduction of lecture 4.1.30 Introduction 4.1.31 Advantage of auto trans transformer over two winding transformer 4.1.32 Disadvantage 4.1.33 Equivalent circuit 4.1.34 Phasor diagram Step up autotransformer Conclusion of lecture						PP - 67.
Introduction of lecture 4.1.35 Comparison and characteristics of autotransformer and two winding transformer 4.1.36 Rating Losses Conclusion of lecture	L40	11/10	11/10	—		PP 67

Introduction of lecture 4.1.37 Impedance drop 4.1.38 Voltage regulation 4.1.39 Short circuit current 4.1.40 Uses Conclusion of lecture Introduction of lecture 4.1.41 Transient in transformers in rush current 4.1.42 Methods to reduce in rush current 4.1.43 Separation of losses in transformers Conclusion of lecture Conclusion of unit 4 Presentation(PPT)	L41	13/10	13/10	—		PP 25-29
Introduction of lecture 4.1.41 Transient in transformers in rush current 4.1.42 Methods to reduce in rush current 4.1.43 Separation of losses in transformers Conclusion of lecture Conclusion of unit 4 Presentation(PPT)	L42	23/10	23/10	—	C05	pp 144-145
Introduction of lecture 4.1.41 Transient in transformers in rush current 4.1.42 Methods to reduce in rush current 4.1.43 Separation of losses in transformers Conclusion of lecture Conclusion of unit 4 Presentation(PPT)	L43	24/10	25/10	on leave		
UNIT- 5 Polyphase Transformer Introduction of unit 5 Introduction of lecture 5.1 Instruction 5.1.1 Advantage and disadvantage of single unit and three units 5.1.2 Three units Conclusion of lecture Introduction of lecture 5.2 Methods of poly phase connections 5.3 Method of open delta connections Conclusion of lecture Introduction of lecture 5.4 Phase conversions 3 to 6 phase and 3 to 2 phase conversions (scott connection) 5.5 Effect of 3-phase winding connections on harmonics Conclusion of lecture Introduction of lecture 5.7 Switching currents in transformers 5.8 3-phase winding transformers 5.8.1 Connections of tertiary	L44	30/10	30/10	—		pp 83-84
UNIT- 5 Polyphase Transformer Introduction of unit 5 Introduction of lecture 5.1 Instruction 5.1.1 Advantage and disadvantage of single unit and three units 5.1.2 Three units Conclusion of lecture Introduction of lecture 5.2 Methods of poly phase connections 5.3 Method of open delta connections Conclusion of lecture Introduction of lecture 5.4 Phase conversions 3 to 6 phase and 3 to 2 phase conversions (scott connection) 5.5 Effect of 3-phase winding connections on harmonics Conclusion of lecture Introduction of lecture 5.7 Switching currents in transformers 5.8 3-phase winding transformers 5.8.1 Connections of tertiary	L45	31/10	31/10	—		
UNIT- 5 Polyphase Transformer Introduction of unit 5 Introduction of lecture 5.1 Instruction 5.1.1 Advantage and disadvantage of single unit and three units 5.1.2 Three units Conclusion of lecture Introduction of lecture 5.2 Methods of poly phase connections 5.3 Method of open delta connections Conclusion of lecture Introduction of lecture 5.4 Phase conversions 3 to 6 phase and 3 to 2 phase conversions (scott connection) 5.5 Effect of 3-phase winding connections on harmonics Conclusion of lecture Introduction of lecture 5.7 Switching currents in transformers 5.8 3-phase winding transformers 5.8.1 Connections of tertiary	L46	1/11	4/11	—	C06	pp 84-87
UNIT- 5 Polyphase Transformer Introduction of unit 5 Introduction of lecture 5.1 Instruction 5.1.1 Advantage and disadvantage of single unit and three units 5.1.2 Three units Conclusion of lecture Introduction of lecture 5.2 Methods of poly phase connections 5.3 Method of open delta connections Conclusion of lecture Introduction of lecture 5.4 Phase conversions 3 to 6 phase and 3 to 2 phase conversions (scott connection) 5.5 Effect of 3-phase winding connections on harmonics Conclusion of lecture Introduction of lecture 5.7 Switching currents in transformers 5.8 3-phase winding transformers 5.8.1 Connections of tertiary	L-47	3/11	4/11	Due to OBT		pp 154-55
UNIT- 5 Polyphase Transformer Introduction of unit 5 Introduction of lecture 5.1 Instruction 5.1.1 Advantage and disadvantage of single unit and three units 5.1.2 Three units Conclusion of lecture Introduction of lecture 5.2 Methods of poly phase connections 5.3 Method of open delta connections Conclusion of lecture Introduction of lecture 5.4 Phase conversions 3 to 6 phase and 3 to 2 phase conversions (scott connection) 5.5 Effect of 3-phase winding connections on harmonics Conclusion of lecture Introduction of lecture 5.7 Switching currents in transformers 5.8 3-phase winding transformers 5.8.1 Connections of tertiary						

winding Conclusion of lecture Conclusion of unit 5	L-48	6/11	6/11	-	C06	PP117-119
<u>QUIZ</u>		11/11	11/11	-		
<u>OPEN BOOK TEST 2</u>		8/11	8/11	-		
<u>ASSESSMENT TEST 2</u>		9/11	9/11	-		



POORNIMA

COLLEGE OF ENGINEERING

Session: 2017-18(Even Sem.)

COURSE: B.TECH

NAME OF FACULTY: CHETAN KHEMRAJ

CLASS/SECTION: II / A

Branch: Electrical Engineering

Zero Lecture

1). Name of Subject with Code

: ELECTRICAL MACHINES-1 (3EE5A)

Course Nature (Compulsory/Elective)

: Compulsory

2). Self-Introduction:

a). Name:

Dr.Chetan Khemraj

b). Qualification:

PhD,M.Tech, B.E

c). Designation:

Professor

d). Research Area:

Power Systems

e). E-mail Id:

chetan.khemraj@poornima.org

1. Areas of proficiency/expertise:

1.1 Subjects taken:

1.1.1 Electrical Measurement

1.1.2 Electrical Engineering

1.1.3 Networks and Analysis

1.1.4 Power systems

1.1.5 Switchgear and protection

1.1.6 Control System

1.1.7 Nonconventional energy sources

1.2 Laboratories Taken

1.2.1 Electrical Engineering Lab

1.2.2 Networks Lab

1.2.3 Electrical Measurement Lab

1.2.4 Advance Power Electronics Lab

1.2.5 Industrial Electronics Lab

1.2.6 System Programming Lab

1.3 Member of Professional Body

IE,ISTE

1.4 Academic Proficiency

1.4.1 English

1.4.2 Hindi

1.5 Book Authored

Five


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Papers published in National/ International Conferences/ Journals
56 research papers published in various national and international journals and conferences.

3) Department Vision and Mission

Vision and Mission of Department

Vision

To be a model of excellence in Professional Education and Research by creating electrical engineers that are prepared for lifelong engagement in the rapidly changing fields and technologies with the ability to work in team.

Mission

Provide a dynamic environment of Technical Education wherein students learn in collaboration with others to develop a disciplined and conceptual knowledge in the field of electrical engineering and become a good professional, researcher and lifelong learner.

4) Department Programme Educational Objectives (PEOs)

The Programme Educational Objectives of the Department of Electrical Engineering have been defined as follows:-

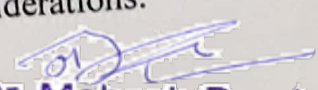
- 1: Graduates will have the ability to formulate, analyze and apply design process to solve electrical engineering problems.
- 2: Graduates will have successful transition into a broad range of career options including industry, government, research and professional education as lifelong learner to compete with global environment.
- 3: Graduates will exhibit dynamic communication and presentation skills with the quality of leadership, team management and time management.
- 4: Graduates will exhibit social and professional responsibility with a commitment towards ethic, equity, public and environmental safety.

5) Department Programme Outcomes & Programme Specific Outcomes (POs and PSOs)

Programme Outcomes of Electrical Engineering Department are as follows:-

Engineering Graduates will be able to:

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **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.


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4. **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.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **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.
7. **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.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **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.
11. **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.
12. **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.

Programme Specific outcomes (PSOs)

PSO1: - Graduates possesses the ability to apply the recent trends and technologies in electrical engineering for the benefit of society.

PSO2: - Graduates will be competent to apply fundamental skills of electrical, electronics and computer on practical grounds to meet the requirement of industries.

PSO3: - To provide sound fundamental knowledge and niche skills to make students increasingly employable in the emerging areas of new power and energy systems, including solar power, renewable energy, electric and hydrogen powered vehicles, communication and networking solutions for the smart cities in India.

6).Introduction of Students:

a).Students will be asked to introduce them covering the following points:

- Name
- Place to which he/she belongs
- Academic merit
- Percentage of marks in XII
- Merit in AIEEE
- Co-curricular activity
- Day scholar/Hosteller
- Medium in class XII: English/Hindi
- Why he/she wants to become an Engineer.

b).Records of students in 12th

Sr. No.	Average result of 12 th	Name of student scored highest marks	Marks 60% above (No. of students)	Marks between 40%-60% (No. of students)	English Medium Students (No.)	Hindi Medium Students (No.)	No. of Hostellers	No. of Day Scholar
1.	69.69%	Nisha Saini	45	11	35	20	26	29

c). Achievement of students in previous years

Sr. No.	Section	Year	Result %
1	A	1.ADITYA SINGH 2.AANCHAL BANWAL 3.GAURAV SAINI ANSHUMAN	87.2% 85.8% 86.5% ROBOWAR-SPORTONS-3 RD PRIZE

d). Targets and Attainments

	ACADEMIC SESSION			
	2014-15	2015-16	2016-17	2017-18
Target	2.83	2.83	2.83	2.83
Attainment	0.60	1.40	1.60	Result Awaited

e). Methods of Evaluation

- I & II Mid-Term Examination.
- Assignment / Tutorials / Lab Records.
- Quiz (Objective) / Viva-Voce
- OBT
- OET


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- (ii) Assignment / Tutorials / Lab Records.
- (iii) Quiz (Objective) / Viva-Voce
- (iv) OBT
- (v) OET
- (vi) Google Classroom

7). Instructional Language: - 100 %English

8). Introduction to subject: -

a). **Relevance to Branch:**

Electrical Machines is very important subject for the students of Electrical Branch because it deals with controlling phenomenon of electrical machines and devices for further reference. Electrical Machines explains about the controlling, working principle and operation of the instruments and devices used in the field of electrical engineering. This is very useful in determining the electrical values of physical parameters so that electrical modeling of a physical system can be done.

b). **Relevance to Society:**

Modern Industry relies heavily on automation for economic viability and mass production. The availability of sophisticated instruments and variety of control methodologies has greatly improved not only the quality of the products but also contribution to reduction of costs. In the present times, it is impossible to think of industrial production without electricity.

c). **Relevance to Self: -**

This subject gives knowledge of machines. This is useful like in further studies. The subject has become interesting with the advent of Electrical machine and all the equipment becoming intelligent. As this subject brushes up the thinking power so we come up to the most optimum utilization of things and subjects. Also it is used to make new projects.

d). **Relation with laboratory:-**

In machine lab we perform all the experiments which study in our subject. Due to which we are clear our concept in particular topic and gain deep knowledge

e). **Connection with previous year and next year: -**

In the previous year we had studied DC Machines for modeling of electrical circuits and networks using the simple laws of Block Diagram Reduction and Signal Flow Graphs. Now we'll study further the concept of steady state stability and transient stability in modern systems

f) **Course Outcome:** Course outcome:

- CO25.1 To understand the basic electromechanical conversion
- CO25.2 To understand basic principle & construction of DC generator
- CO25.3 To understand basic principle & construction of DC Motor
- CO25.4 To understand working and application of 1 phase transformer
- CO25.5 To understand working and application of 3 phase transformer
- CO25.6 To understand the connections and polyphase conversion of three phase transformers.

9). **Syllabus of Rajasthan Technical University, Kota**
Electrical machine-I

Syllabus: (3EE5)

Unit-1 Electromechanical Energy Conversion: Basic principles of electromechanical energy conversion. Basic aspects and physical phenomena involved in energy conversion. Energy balance.

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Magnetic circuits: Magnetic circuits, magneto motive force magnetic field strength, permeability, reluctance, analogy between electric and magnetic-circuits, B-H curve, hysteresis, series and parallel magnetic circuits, practical magnetic circuits, permanent magnet and their applications.

9). Syllabus of Rajasthan Technical University, Kota
Electrical machine-I

Syllabus: (3EE5)

Unit-1 Electromechanical Energy Conversion: Basic principles of electromechanical energy conversion. Basic aspects and physical phenomena involved in energy conversion. Energy balance.

Magnetic circuits: Magnetic circuits, magneto motive force magnetic field strength, permeability, reluctance, analogy between electric and magnetic-circuits, B-H curve, hysteresis, series and parallel magnetic circuits, practical magnetic circuits, permanent magnet and their applications.

Unit-2 DC generators: Construction, Types of DC generators, emf equation, lap & wave windings, equalizing connections, armature reaction, commutation, methods of improving commutations, demagnetizing and cross magnetizing mmf, interpoles, characteristics, parallel operation. Rosenberg generator.

Unit-3 DC Motors: Principle, back emf, types, production of torque, armature reaction & interpoles, characteristics of shunt, series & compound motor, DC motor starting. Speed Control of DC Motor: Armature voltage and field current control methods, Ward Leonard method. Braking, losses and efficiency, direct & indirect test, Swinburne's test, Hopkinson test, field & retardation test, single-phase series motor.

Unit-4 Transformers: Construction, types, emf equation. No load and load conditions. Equivalent circuits, Vector diagrams, OC and SC tests, Sumpner's back-to-back test, efficiency. Voltage regulation, effect of frequency, parallel operation, autotransformers, switching currents in transformers, separation of losses.

Unit-5 Polyphase Transformers: Single unit or bank of single-phase units, polyphase connections, Open delta and V connections, Phase conversion: 3 to 6 phase and 3 to 2 phase conversions, Effect of 3-phase winding connections on harmonics, 3-phase winding transformers, tertiary winding.

Suggested Readings:

1. A. E. Fitzgerald, C. Kingsley Jr and Umans, "Electric Machinery" 6th Edition McGraw Hill, International Student Edition.
2. Kothari & Nagrath, Electric Machines 3/e, TMH
3. M. G. Say, "The Performance and Design of AC machines", Pitman & Sons.
4. Guru, ELECTRIC MACHINERY 3E, Oxford
5. R. K. Srivastava, Electrical Machines, Cengage Learning.
6. P. S. Bimbhra, "Electrical Machinery", Khanna Pub.
7. Stephen J Chapman, "Electric Machinery Fundamentals", McGraw-Hill
8. Husain Ashfaq, "Electrical Machines", Dhanpat Rai & Sons

b). ABC analysis (RGB method) of unit & topics:

Unit-1 Electromechanical Energy Conversion: Basic principles of electromechanical energy conversion. Basic aspects and physical phenomena involved in energy conversion.

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Magnetic circuits: Magnetic circuits, magneto motive force magnetic field strength, permeability, reluctance, analogy between electric and magnetic-circuits, B-H curve, hysteresis, series and parallel magnetic circuits, practical magnetic circuits, permanent magnet and their applications.

Unit-2 DC generators: Construction, Types of DC generators, emf equation, lap & wave windings, equalizing connections, armature reaction, commutation, methods of improving commutations, demagnetizing and cross magnetizing mmf, interpoles, characteristics, parallel operation. Rosenberg generator.

Unit-3 DC Motors: Principle, back emf, types, production of torque, armature reaction & interpoles, characteristics of shunt, series & compound motor, DC motor starting. Speed Control of DC Motor: Armature voltage and field current control methods, Ward Leonard method. Braking, losses and efficiency, direct & indirect test, Swinburne's test, Hopkinson test, field & retardation test, single-phase series motor.

Unit-4 Transformers: Construction, types, emf equation. No load and load conditions. Equivalent circuits, Vector diagrams, OC and SC tests, Sumpner's back-to-back test, efficiency. Voltage regulation, effect of frequency, parallel operation, autotransformers, switching currents in transformers, separation of losses.

Unit-5 Polyphase Transformers: Single unit or bank of single-phase units, polyphase connections, Open delta and V connections, Phase conversion: 3 to 6 phase and 3 to 2 phase conversions, Effect of 3-phase winding connections on harmonics, 3-phase winding transformers, tertiary winding.

RED: Hard

GREEN: Easy

BLUE: Moderate

c) Impact of PMEPI:

i) Use of Keywords

Unit No.	Syllabus	Keywords
I	Basic principles of electromechanical energy conversion. Basic aspects and physical phenomena involved in energy conversion. Energy balance.. Magnetic circuits: Magnetic circuits, magneto motive force magnetic field strength, permeability, reluctance, analogy between electric and magnetic-circuits, B-H curve, hysteresis, series and parallel magnetic circuits, practical magnetic circuits,	Hysterisis loop, leakage flux, analogy, reluctance, magnetic saturation, permanance, coercive force, circuital law, magnetisation and demangentisation, residual, coupling field

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	permanent magnet and their applications.	
II	Construction, Types of DC generators, emf equation, lap & wave windings, equalizing connections, armature reaction, commutation, methods of improving commutations, demagnetizing and cross magnetizing mmf, interpoles, characteristics, parallel operation. Rosenberg generator.	Generators, lap windings, wave windings, commutator, armature, field, separately excited, self excited, mechanical losses, open circuit, short circuit, voltage build up, critical field resistance, over compound, flat compound, external characteristics,
III	: Principle, back emf, types, production of torque, armature reaction & interpoles, characteristics of shunt, series & compound motor, DC motor starting. Speed Control of DC Motor: Armature voltage and field current control methods, Ward Leonard method. Braking, losses and efficiency, direct & indirect test, Swinburne's test, Hopkinson test, field & retardation test, single-phase series motor.	Back EMF, shunt wound, compound wound, torque, shaft torque, brake horse power, speed regulations, power stages, no load, sparking, overheating, pounding noises, flux control, regenerative braking, plugging.
IV	Transformers: Construction, types, emf equation. No load and load conditions. Equivalent circuits, Vector diagrams, OC and SC tests, Sumpner's back-to-back test, efficiency. Voltage regulation, effect of frequency, parallel operation, autotransformers, switching currents in transformers, separation of losses.	Eddy current, voltage transformation ratio, ideal transformer, leakage reactances, phasor diagram, impedance ratio, equivalent circuit, voltage regulation, all day efficiency, maximum efficiency, natural air cooling, breather, centre tap.
V	Polyphase Transformers: Single unit or bank of single-phase units, polyphase connections, Open delta and V connections, Phase conversion: 3 to 6 phase and 3 to 2 phase conversions, Effect of 3-phase winding connections on harmonics, 3-phase winding transformers, tertiary winding.	Phase transformation ratio, phase current, line current, static device, magnetic coupling, tertiary windings, zero voltage regulation, transformer bank, synchronous capacitors,

ii) Recent Technologies & Publication:

Topic	Trends	Publication
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DC Motor	Speed control of DC motor	Research on Speed Control System of Brushless DC Motor Based on Neural Network
DC Generator	Characteristics of the generators	The Short-Circuit Characteristics of D-C Generators
Transformers	Transformer loading	Single Phase Transformer Based Inverter For Nonlinear Load
Three phase transformers	Three phase transformers modelling	Parameter Estimation of Three-Phase Transformer Models for Low-Frequency Transient Studies

iii) Vocabulary Improvement

- Learning 10 New Words each day with their meanings. Sentence formation using these words.

iv) Current Affairs

- Discussion over 5 daily Current affair

- Role Plays By Students on important topics.
- Group Discussion on a topic having different techniques.
- Feedback of every lecture by student
- Think-Pair-Share

10). Books/ Website/Journals & Handbooks/ Association & Institution:

To give information about different journals available relative to the subject and branch

1. IEEE magazine (www.ieee.org.in)
2. IETE publications
3. Institute of Engineers (www.ie.org.in)

a). Recommended Text & Reference Books and Websites:

S. No.	Title of Book	Authors	Publisher	Cost (Rs.)	Books in library
Text Books					
T1	Electrical Machines	Ashfaq Hussain	Dhanpat	240	13
T2	Electrical Machines	P.S.Bhimra	Khanna	280	75
T3	Electrical Machines	J.B.Gupta	S.K.Katariya	290	12
Reference Books					
R1	Electrical Engg. & solved problems	P.S.Dhokal	TMH	90	10
R2	Electrical Machine	Nagnath & Kothari	Easten Economy Edition	45	250
R3	Electrical Machine	B.L.Thereja	S.Chand	250	16
R4	Electrical Machines	S.K.Bhattacharya	TMH	120	

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b). **Journals & Handbooks:** - To give information about different Journals & Handbooks available in library related to the subject and branch.

1. Journal of Scientific and Industrial Research
2. Indian Journal of Engineering and Material Science
3. Green Energy
4. Down of Earth
5. Science Competition Vision
6. Electrical India

c). **Associations and Institutions:** -To give information about different Associations and Institutions related to the subject and branch.

1. Department Of Science and Technology(DST)
2. IEEE
3. IETE
4. BARC
5. DRDO
6. MNIT & IIT

d). **Websites related to subject:-**

1. www.nptel.ac.in
2. www.4shared.com
3. www.mit.com
4. www.google.co.in

11). **Syllabus Deployment:-**

a). **Total weeks available for academics (excluding exams/ holidays) as per PGC calendar-**

SEMESTER	III
No. of Working Days Available (Approx.)	81
No. of Weeks(Approx.)	17

- Total weeks available for covering RTU syllabus- 10-11 weeks (Approx.)
- Total weeks available for special activities (as mentioned below)- 01 weeks (Approx.)

b). **Course Assessment Methods (Special Activities):**

(To be approved by HOD, Dean & Campus Director& must be mentioned in deployment):

- Open Book Test- Once in a semester
- Quiz (50% Technical & 50% Aptitude)- Once in a semester
- Special Lectures (SPL)- 10% of total no. of lectures including following
 - i. One PPT by the faculty, who is teaching the subject
 - ii. SPL by expert faculty at PGC level
 - iii. SPL by expert from industry/academia (other institution)
- Revision classes:- 1 to 3 turn at the end of semester (Before II Mid Term Exam)
- Solving Important Question Bank- 1 Turn before I & II Mid Term Exam (each) - Total Two turn.
- I and II Midterms
- RTU University Examinations

c). **Lecture schedule per week/ Contact Hours:**

- i). University scheme (L+T+P) = 3+1+0
- ii). PGC scheme (L+T+P) = 3+1+0


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- iii. Last 5 min. should be utilized by recapping/ conclusion of the topic. Providing brief introduction of the coming up lecture and suggesting portion to read.
- iv. After completion of any Unit/Chapter a short quiz should be organized.
- v. During lecture student should be encouraged to ask the question.

12) Mapping of POs and COs with Course Outcome

Subject Code	COs and LOs	COs and LOs (Descriptive)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
3EE5 A	C205 .1	1. Students be able to understand the concept of electromechanical energy conversion and analogy between electrical and magnetic circuit..	3	1	1	—	—	—	—	—	1	—	—	2
	C205 .2	2 Students visualizes the principle of operation, construction and different characteristics of DC generator and their applications	2	2	1	1	1	—	—	—	2	—	1	3
	C205 .3	3 Students will be able to understand the principle of operation, construction and different characteristics of DC motors and their applications.	3	2	2	1	1	—	—	—	2	—	1	3
	C205 .4	4 Students will be able to understand the starting, testing and braking of DC motor along with its applications	3	2	2	1	1	—	—	—	2	—	1	3
	C205 .5	5. Students will be able to understand the principle of operation, construction and different characteristics of transformers.	3	1	1	1	—	—	—	—	1	—	1	3
	C205 .6	6. Students will be able to understand the connections and phase conversion in poly-phase transformers and their applications.	3	2	1	1	1	—	—	—	1	—	1	3
			2.83	1.6	1.33	1	1	—	—	—	1.5	—	1	2.83

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Mapping of Cos with PSOs

Subject Code	COs and LOs	COs	PSO 1	PSO 2	PSO 3
3EE5A	C205.1	Students be able to understand the concept of electromechanical energy conversion and analogy between electrical and magnetic circuit.	1	2	3
	C205.2	Students visualizes the principle of operation, construction and different characteristics of DC generator and their applications.	—	2	3
	C205.3	Students will be able to understand the principle of operation, construction and different characteristics of DC motors and their applications.	1	2	3
	C205.4	Students will be able to understand the starting, testing and braking of DC motor along with its applications.	—	3	3
	C205.5	Students will be able to understand the principle of operation, construction and different characteristics of transformers.	—	2	3
	C205.6	Students will be able to understand the connections and phase conversion in poly-phase transformers and their applications.	1	3	3

1	2.33	3
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13). Examination Systems:

Sr. No.	Name of the Exam	Max. Marks	% of passing marks	Nature of paper Theory + Numerical	Syllabus coverage (in %)	Conducted by
1.	I st Mid Term Exam	40	40%	T+N	60%	PCE
2.	II nd Mid Term Exam	40	40%	T+N	40%	PCE
3.	University (End) Term Exam	80	30%	T+N	100%	RTU

Mapping of Cos with PSOs

Subject Code	COs and LOs	COs	PSO 1	PSO 2	PSO 3
3EE5A	C205.1	Students be able to understand the concept of electromechanical energy conversion and analogy between electrical and magnetic circuit.	1	2	3
	C205.2	Students visualizes the principle of operation, construction and different characteristics of DC generator and their applications.	—	2	3
	C205.3	Students will be able to understand the principle of operation, construction and different characteristics of DC motors and their applications.	1	2	3
	C205.4	Students will be able to understand the starting, testing and braking of DC motor along with its applications.	—	3	3
	C205.5	Students will be able to understand the principle of operation, construction and different characteristics of transformers.	—	2	3
	C205.6	Students will be able to understand the connections and phase conversion in poly-phase transformers and their applications.	1	3	3
			1	2.33	3

13). Examination Systems:

Sr. No.	Name of the Exam	Max. Marks	% of passing marks	Nature of paper Theory + Numerical	Syllabus coverage (in %)	Conducted by
1.	I st Mid Term Exam	40	40%	T+N	60%	PCE
2.	II nd Mid Term Exam	40	40%	T+N	40%	PCE
3.	University (End) Term Exam	80	30%	T+N	100%	RTU

Mapping of Cos with PSOs

Subject Code	COs and LOs	COs	PSO 1	PSO 2	PSO 3
3EE5A	C205.1	Students be able to understand the concept of electromechanical energy conversion and analogy between electrical and magnetic circuit.	1	2	3
	C205.2	Students visualizes the principle of operation, construction and different characteristics of DC generator and their applications.	—	2	3
	C205.3	Students will be able to understand the principle of operation, construction and different characteristics of DC motors and their applications.	1	2	3
	C205.4	Students will be able to understand the starting, testing and braking of DC motor along with its applications.	—	3	3
	C205.5	Students will be able to understand the principle of operation, construction and different characteristics of transformers.	—	2	3
	C205.6	Students will be able to understand the connections and phase conversion in poly-phase transformers and their applications.	1	3	3
			1	2.33	3

13). Examination Systems:

Sr. No.	Name of the Exam	Max. Marks	% of passing marks	Nature of paper Theory + Numerical	Syllabus coverage (in %)	Conducted by
1.	I st Mid Term Exam	40	40%	T+N	60%	PCE
2.	II nd Mid Term Exam	40	40%	T+N	40%	PCE
3.	University (End) Term Exam	80	30%	T+N	100%	RTU



POORNIMA

COLLEGE OF ENGINEERING

Calendar for Odd Semester (2017-2018)

June

Sun	Mon	Tue	Wed	Thu	Fri	Sat
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	

July

Sun	Mon	Tue	Wed	Thu	Fri	Sat
						1
30						8
2	3	4	5	6	7	
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29

August

Sun	Mon	Tue	Wed	Thu	Fri	Sat
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	<u>15</u>	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		

September

Sun	Mon	Tue	Wed	Thu	Fri	Sat
					1	2
				7	8	9
3	4	5	6			
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30

October

Sun	Mon	Tue	Wed	Thu	Fri	Sat
			4	5	6	7
1	2	3				
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31				

November

Sun	Mon	Tue	Wed	Thu	Fri	Sat
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30		

December

Sun	Mon	Tue	Wed	Thu	Fri	Sat
31					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30

Note: - Please do the needful.

- 1) Indicate/Underline the Mid-Term Exams dates as per Academic Calendar (AC).
- 2) Encircle the holidays as per AC. (~~X~~ - indication)
- 3) Calculate the number of days available for actual conduction of classes as per time table provided by HOD.
- 4) If you are pursuing higher studies please plan for replacement of classes.

Dr. Mahesh Bunde
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POORNIMA COLLEGE OF ENGINEERING
TIME TABLE FOR ODD SEM. SESSION -2017-18
DEPARTMENT OF ELECTRICAL ENGINEERING

DAY/TIME	8:00-9:00	9:00-10:00	10:00-11:00	11:00-11:40	11:40-12:40	12:40-01:40	01:40-02:40
MONDAY						3EES/A ← CT-20 →	
TUESDAY					3EES/A ← CT-20 →		
WEDNESDAY	3EES/A3 ← CT-20 →		3EES/A ← CT-20 →	LUNCH			
THURSDAY			3EES/A2 ← CT-20 →				
FRIDAY	3EES/A1 ← CT-20 →					3EES/A ← CT-20 →	
SATURDAY							

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Dr. Virendra Sanghani
 HOD, EE

Dr. Ch. Prakash Sharma
 DIRECTOR, PCE

(14) Chetan Khemraj

V. Sharma/ Anil Pratap Singh
 TOR

Department of Electrical Engineering

Session 2016-17

Midterm & University Examination (Attainment Sheet)

Subject: EM-1

S. No.	Reg. No.	Name of Student	I Midterm										II Midterm								Code:3EE05A		Semester III					
			Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	RTU	CO1	CO2	CO3	CO4	CO5	CO6			
1	PCE15EE001	AAKANSHA PRAJAPATI	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	80	10	10	10	10	10	10	10			
2	PCE15EE002	ABHINAV VIJAY				7	8		7		9						5	7	43	9	7	8	7	5	6			
3	PCE15EE003	ABHISHEK GAUTAM	A	A	A	A	A	A	A	A	8		5.5				6	3	43	8	7	7	0	7	5			
4	PCE15EE004	ABHISHEK SINGHAL	4		3.5		4		4		4							A	A	A	A	A	A	A	A			
5	PCE15EE005	ABHISHEK VAIDYA								4.5			6				6	26	4	4	4	4	4	2	7			
6	PCE15EE006	ADITI SHARMA	7		8			3		5	6						3	26	4	0	0	0	5	4				
7	PCE15EE007	AJAY KUMAR TAILOR	6		7		8		7.5	6	6		3				37	7	8	3	3	5	7	4				
8	PCE15EE008	AJAY MEENA	8.5			7	8			8	9		5				6	53	6	7	8	8	5	7				
9	PCE15EE009	AJAY NAGAR	8.5		8		3.5		3		4		6.5	3			3	26	9	8	4	3	7	2				
10	PCE15EE010	AJAY SINGH MEENA	8.5		9		8		9	8	8		9				6.5	46	9	9	8	9	9	7				
11	PCE15EE011	AKHIL VIJAY	5		4		4.5			3	8		3	7			5	33	5	4	5	3	6	8				
12	PCE15EE012	AMAN KHANDELWAL	5.5			5	5			3	6		6				7	34	6	5	5	0	3	4				
13	PCE15EE013	AMAN KUMAR SHARMA	8.5		8		4		8		8			5			2.5	31	9	8	4	8	4	4				
14	PCE15EE015	AMARDEEP SHARMA	8			3	3		1.5		8			0	9	1.5	0	30	8	3	3	2	4	5				
15	PCE15EE016	AMIT KUMAR MEENA		3	7		6			1	8			4			3.5	36	3	7	6	1	4	4				
16	PCE15EE017	AMIT KUMAR SHARMA	2		7.5		8		5		8			3	8		6	26	2	8	8	5	6	7				
17	PCE15EE018	AMIT KUMAWAT	3		5			3.5		4	7			3			2	20	3	5	4	4	5	4				
18	PCE15EE180	AMIT SINGH	A	A	A	A	A	A	A	A	2				5		2	36	A	A	A	A	1	4				
19	PCE15EE019	ANIL JAIN		7	3		5			4.5	6			6			3.5	29	7	3	5	5	3	5				
20	PCE15EE020	ANKIT PANWAR	3					3		7.5				7			3	33	3	0	3	0	3	2				
21	PCE15EE022	ANKUSH KUMAR JHA		1	3				3		6				5		7	10	1	3	0	3	3	2				
22	PCE15EE023	ANURAG CHOUDHARY		9	8	3			7	6	9		3					42	9	11	7	6	6	8				
23	PCE15EE024	ARCHIT BHARGAVA	4				4			4.5	4		4				3.5	31	4	0	4	5	4	4				
24	PCE15EE025	ARPITA BIWAL	3		5					3.5	8			6				34	3	5	4	4	7	1				
25	PCE15EE026	ARUN GARG	7		9	2	7			3	7			7	6		2	54	7	11	7	3	7	4				
26	PCE15EE027	ARUN JALWANIYA	1.5						1	2	3			3				28	2	0	1	2	3	1				
27	PCE15EE028	ARUN KUMAR BAIRWA		8.5		8		4		6	5		6				7	28	9	8	4	6	6	7				
28	PCE15EE029	ARUN SINGH KASHMIR	8.5		5		6			2	5			1.5	6		3	37	9	5	6	2	3	5				
29	PCE15EE030	ARYAN SANJAY CHAD	3		6			6		6.5	5		1		6.5		3	47	3	6	6	7	3	5				
30	PCE15EE031	ASHISH DHAKAR		4	7		6		4		8		3		4		4.5	46	4	7	6	4	6	4				
31	PCE15EE185	ASHOK SHARMA											4	3				39	4	4	2	6	4	4				
32	PCE15EE032	ASHWANI SHARMA	8				4	2	6		8						4	41	8	4	4	4	7	4				
33	PCE15EE033	ATUL SHARMA	8		6									7.5	9	8		38	8	6	4	1	0	4				
34	PCE15EE034	AVNISH KUMAR	3		3.5		1		4		4		2	6	2			26	3	5	4	4	4	4				
35	PCE15EE035	AYUSH BANSAL	3		5				4		4		A	A	A		A	A	A	A	A	A	A	4				
36	PCE15EE036	BABU LAL SHARMA	A	A	A	A	A	A	A	A	A	7		3				A	A	A	A	A	A	4				

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37	PCE15EE037	BHAVIKA GUPTA	6		6				7	A	A	A	A	A	26	6	6	0	7	A	A
38	PCE15EE038	CHANDRAKANT SHARMA	4		6	4			7	1	2	7			1	40	4	6	4	7	2
39	PCE15EE039	CHARUL SHARMA			8	7		6	7	7	6	6			1	47	8	7	6	7	4
40	PCE15EE186	CHIRAG DIXIT			1.5	5		4	5				3			26	2	5	4	5	4
41	PCE15EE040	CHITRA DHAKAR			9	7.5		7		6	8	6			7	30	9	8	7	6	2
42	PCE15EE041	DAGUR KRISHNA SHIVSINGH	6.5							6	6	7			5	40	7	6	4	3	7
43	PCE15EE042	DEEPTI MEENA	8		4	4	7			6	6				39	8	4	7	6	3	3
44	PCE15EE043	DEVANSH PRAJAPATI			9		8	0.5							4	31	0	9	0	2	6
45	PCE15EE044	DEVENDRA SINGH	8.5			4	3			4	6	5				10	9	4	3	0	0
46	PCE15EE045	DEVESH GOTAN	4			1	2			6	5					27	4	1	2	6	4
47	PCE15EE188	DEVI LAL OLA			4	4	3.5			4	6	5				26	4	4	4	6	1
48	PCE15EE046	DHARMENDRA BOCHLYA			9	8.5	3.5			7	8					39	9	9	4	4	6
49	PCE15EE047	DHIERAJ PARIHAR			7		6	4		6	7				5	33	7	6	4	7	8
50	PCE15EE190	DILIP PRAJAPATI			8.5	4	8			6	8	6				31	9	4	8	6	6
51	PCE15EE048	DIVYESH SHRINGI	4		4			3.5	4			4				16	4	4	4	4	4
52	PCE15EE049	DURLABH CHAND GARG	8.5			9	8		7		8	4			2	56	9	9	8	7	6
53	PCE15EE050	GAJENDRA SINGH RATHORE			3						0	0			1	A	3	0	0	0	1
54	PCE15EE051	GAURAV MAHAWAR	6.5			8	9	7.5			A	A	A	A		26	7	8	9	8	A
55	PCE15EE052	GAURAV MEENA			6.5	8	6			5	2	3.5				40	7	8	6	5	3
56	PCE15EE192	GAUTAM KUMAR	4		4	4		4			3					26	4	4	0	4	2
57	PCE15EE053	GIRDHARI SAHU	4.5		5			6					2	7.5		16	5	5	0	6	0
58	PCE15EE054	GOVIND KRISHAN TIWARI	4		4	4	3.5		4		7					26	4	4	4	4	4
59	PCE15EE055	GUPTA SURBHI RAJENDRAKUMAR	8.5		7			4		5		5				34	9	7	4	5	3
60	PCE15EE056	HARMANJOT SINGH			8.5	7		7.5		3	8					4	9	7	8	3	4
61	PCE15EE058	HARSHIT ARORA			6	7	4			2.5	8				5	20	6	7	4	3	4
62	PCE15EE059	HARSHIT GUPTA	3		7			6	1.5		8					30	3	7	6	2	6
63	PCE15EE060	HARSHITA GARG	6		6	7.5		7			8					60	6	6	8	7	8
64	PCE15EE061	HEMANT KULDEEP			6	4	5			2	0					A	6	4	5	2	0
65	PCE15EE062	HEMANT MAHAWAR	3		4		5	3.5			8					36	3	4	5	4	1
66	PCE15EE063	HIMANSHU AGARWAL	4		5.5		3			3	9	4	3.5		3	12	4	6	3	3	7
67	PCE15EE064	HIMANSHU AGRAWAL					1		2		9	0	0		0	3	0	1	0	2	5
68	PCE15EE065	HIMANSHU BANSARE	4			3.5		4	5		9	6.5				22	4	4	4	5	8
69	PCE15EE066	HIMANSHU SHARMA			4	7	5		5		3.5	1.5			4.5	49	4	7	5	2	6
70	PCE15EE067	HITESH KUMAR JAIN				1				3.5			2			19	0	1	0	4	1
71	PCE15EE068	HITESH MORYA	4			8	3	7.5			7		4		6	35	4	8	3	8	6
72	PCE15EE069	HRIYIK TRIPATHI	4			5		5	6		5		4		6	56	4	5	5	6	5
73	PCE15EE070	INDRARAJ SHARMA	6		6			5.5	7.5		5.5				3.5	44	6	6	8	3	2
74	PCE15EE071	JAGDISH KUMAR SONAL	3.5			7.5			6.5		3.5				4	19	4	8	0	7	5
75	PCE15EE072	JANAK CHOUDHARY	4.5								7	6.5			3	35	5	0	0	0	6
76	PCE15EE073	JOBIN THOMAS	9.5			8	8				6.5	5	8		6	39	10	8	7	6	7
77	PCE15EE182	KAPIL GUPTA			9		7.5	10	7		2	8.5				55	9	8	10	7	5
78	PCE15EE074	KARAN CHOUDHARY			8		6.5		6.5		5		4		6	53	8	7	7	2	4
79	PCE15EE075	KARAN SHARMA	7			6	6				6.5		5		6.5	20	7	6	6	5	6
80	PCE15EE076	KARISHMA KUMARI			8.5		7		2	3		8				47	9	7	2	3	2

126	PCE15EE119	PRATEEK SAHNI	4.5		4.5		6.5	5.5	7	1	4	6	17	5	5	7	6	4	5
126	PCE15EE120	PRERNA SINGH		8.5	5.5		7.5		3	8		3		34	9	6	8	3	5
127	PCE15EE121	PRINCE KUMAR	7		6.5	5.5		4		7	3			15	7	7	6	4	5
128	PCE15EE122	PRITAM KUMAR SEN	7		5		6.5		5.5	8		6	2	26	7	5	7	6	6
129	PCE15EE123	PRIYANKA RAMA	7		7		8		6.5	8	4	4		38	7	7	8	7	4
130	PCE15EE124	RAHUL RAJPUROHIT	3								A	A	A	4	3	0	0	0	A
131	PCE15EE125	RAHUL KUMAR YADAV	3							0				14	3	0	0	0	0
132	PCE15EE126	RAHUL RAJORA	7		6.5	1.5		3.5		8	4	8	7.5	41	7	7	2	4	6
133	PCE15EE127	RAHUL SHARMA	3.5		3	2		4.5		5	1		6	13	4	5	0	5	3
134	PCE15EE128	RAJ MOHAN JHA	3		2			1.5					6	10	3	2	2	2	3
135	PCE15EE129	RAJAT AGRAWAL	4		1			1	3	5	5	3		14	4	1	2	1	4
136	PCE15EE130	RAJAT GOYAL	2		4	7		5		10	8	8		48	2	4	7	5	9
137	PCE15EE131	RAJESH SAINI		6	6		5		4	5		4	9	48	6	6	5	4	5
138	PCE15EE132	RAKESH BAIRWA								9		10	2	A	0	0	0	0	0
139	PCE15EE133	RAKESH KUMAR CHOUDHARY	8		10	8		10		A	A	A	A	65	8	10	8	10	A
140	PCE15EE134	RAMAKANT GURJAR			4	7		7		4	8		5	43	0	4	7	7	6
141	PCE15EE135	RAJNIAK MEENA	10		4	3		2	6	8	8		9	54	10	4	2	6	8
142	PCE15EE136	RAVI GEHLOT			4		3	9		8		6	7	43	0	4	3	9	7
143	PCE15EE137	RAVI KUMAR PATIDAR	3		7	5		4	7	7	2		6	44	3	7	5	4	5
144	PCE15EE138	RAVI KUMAR PRAJAPAT	4		4		1	4		7			6	51	4	4	1	4	4
145	PCE15EE139	RAVI NAREDA	10	10		9	8	9	9	6		4	4	63	10	10	9	8	8
146	PCE15EE140	RINIT SHARMA	2	3		1	6	9	6		6	5	2	44	2	3	1	6	8
147	PCE15EE141	RITIKA SRIVASTAVA	10			9			4		4	8		40	10	0	9	0	4
148	PCE15EE142	RITURAJ SINGH SHEKHAWAT	5		1	3		2	A	A	A	A	A	A	5	1	3	2	A
149	PCE15EE143	ROHIT MALAV	2		5			5	8		4			49	2	5	0	5	6
150	PCE15EE144	ROHIT MARU		2	2				4	1	2		2	44	2	2	0	0	3
151	PCE15EE145	ROHIT SINGH DAHIYA		5	7		1	3	4	1		2		28	5	7	1	3	3
152	PCE15EE146	ROMA SOLANKI	10		2		5	4	9	2				51	10	2	5	4	6
153	PCE15EE147	RUPAL MITTAL	4		3		2	7	7			4		57	4	3	2	7	4
154	PCE15EE148	RUPESH BANSAL	3		9		6	4	8	0		3		44	3	9	6	4	4
155	PCE15EE149	SACHIN MEENA		8	8		4	4	5	9	1		2	56	8	8	4	9	5
156	PCE15EE150	SAHIL GARG		5	2	1		3	6		3			38	0	6	2	0	6
157	PCE15EE151	SAHIL KUMAR THAKUR							5					49	5	2	1	3	3
158	PCE15EE152	SANDEEP KUMAR MEENA		3					3	8		6		A	0	0	0	0	3
159	PCE15EE153	SANDEEP SAHU	A	A	A	A	A	A	4		2	2	1	14	3	0	0	3	7
160	PCE15EE154	SANJAY NAGAR	A	A	A	A	A	A	7		4			43	A	A	A	A	4
161	PCE15EE155	SARVESH INDORIA	5	10	6		6	6	9	7		9		52	5	10	6	6	8
162	PCE15EE156	SATIN KUMAR MEENA	A	A	A	A	A	A	A	7	4	5		A	A	A	A	A	6
163	PCE15EE157	SAURABH KUMAR GARG		3	3		4	7	0	0				47	3	3	4	7	1
164	PCE15EE158	SHILPI KARADIA		6	3		5	7	4		2			30	6	6	7	2	6
165	PCE15EE159	SHIPRA SHARMA		4	7	2		6	7		5	1	3	42	4	7	3	5	4
166	PCE15EE160	SHIV KUMAR CHOURASIYA	5		2	4	3	5		A	A	A	A	26	5	6	6	3	A
167	PCE15EE161	SHIVAM PAREEK								A	A	A	A	27	2	8	7	5	A
168	PCE15EE162	SHIVANGI BHAGSRA	2		8		5	2	5										A

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Sl. No.	Roll No.	Name	5	8	10	5	2	10	8	5	0	8	5	0	4	5
213	PCET15EE001	SHARMA RISHI RATHORE														
214	PCET15EE002	SHIVANSH BHATT														
215	PCET15EE003	SHARMA CHANDAN														
216	PCET15EE004	SHARMA BHARMA														
217	PCET15EE005	SHARMA KALAL														
218	PCET15EE006	SHARMA BHARGAVA														
219	PCET15EE007	SHARMA GANLOT														
220	PCET15EE008	SHARMA BHADVA														
221	PCET15EE009	SHARMA LAL GUPTA														
222	PCET15EE010	SHARMA BHARMA														
223	PCET15EE011	SHARMA BHADVA														
224	PCET15EE012	SHARMA BHADVA														
225	PCET15EE013	SHARMA BHADVA														
226	PCET15EE014	SHARMA BHADVA														
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270	PCET15EE058	SHARMA BHADVA														
271	PCET15EE059	SHARMA BHADVA														

Max. Time: 2 hrs.

NOTE:- Attempt all four questions. There is internal choice in Q. 1 & 2, Q. 3 & 4, Q. 5 & 6, Q. 7 & 8.

- Q.1. (a) Explain principle of conversion of energy in electro-mechanical system and give its general expression. (5)
- (b) A toroid coil having 500 turns, average radius 10cm and cross sectional radius of 2cm. If the relative permeability is 1500, find the current required to establish a flux density of 0.5T [CO1] (5)
- OR
- Q.2. (a) Define the following: (5)
- Magnetic flux and flux density
 - Reluctance
 - Permeance
 - MMF
 - Magnetic field intensity
- (b) The total core loss of a specimen of silicon steel is found to be 1500W at 50Hz. Keeping the flux density constant the loss becomes 3000W when the frequency is raised to 75 Hz. Calculate separately the hysteresis and eddy current loss at each of their frequencies. [CO1] (5)
- Q.3. (a) What is armature reaction in DC generators? What are its effects? [CO2] (5)
- (b) A 220V dc generator supplies 4kW at a terminal voltage of 220V, the armature resistance being 0.4Ω . If the machine is now operated as a motor at the same terminal voltage with the same armature current. Calculate the ratio of generator speed to motor speed. Assume that the flux/pole is made to increase by 10% as the operation is changed from generator to motor. (5)
- OR
- Q.4. (a) Explain clearly the process of commutation in a DC machine. What causes sparking at the commutator surface? (5)
- (b) A 6 pole lap wound DC generator has 600 conductors on its armature. The flux per pole is 0.05 Wb. Calculate generated voltage when the speed of the generator is 1000rpm. Also find the electromagnetic torque if the generator supplies a current of 120 A. [CO2] (5)
- Q.5. (a) Establish an expression for the speed of DC motor with the help of neat connection diagram. Explain the method of controlling the speed of dc motor below and above the rated speed. Justify the statement that the DC series motors are never started at no load. (5)
- (b) A 250V dc shunt motor having an armature resistance of 0.25Ω carries an armature current of 50A and runs at 750 rpm. If the flux is reduced by 10% due to armature reaction, find the speed. Assume that the torque remains the same. [CO3] (5)
- OR
- Q.6. (a) Elaborate the Swinburne test with neat circuit diagram. (5)
- (b) A 200V shunt motor having armature resistance of 0.4Ω taken armature current of 20A on full load and runs at 600 rpm. If a resistance of 0.5Ω is placed in the armature circuit, find the speed at (i) Full load torque (ii) Half full load torque [CO3] (5)
- Q.7. (a) What is the difference between lap winding and wave winding of a DC machine? Also derive emf equation for DC generator. (5)
- (b) Draw the performance characteristics of DC shunt generator and explain them. What is voltage regulation of DC generator? [CO4] (5)
- OR
- Q.8. (a) What are the various starting methods of DC motor? Explain any one method. [CO4] (5)
- (b) What is the significance of back emf in DC motor? Derive the torque equation of DC motor. (5)

SECOND MID TERM EXAMINATION 2016-17
3EE05 – ELECTRICAL MACHINE
(BRANCH – ELECTRICAL ENGINEERING)

Max. Time: 2 hrs.

Max. Marks: 60

NOTE:- Attempt all four questions. There is internal choice in Q. 1 & 2, Q. 3 & 4, Q. 5 & 6, Q. 7 & 8.

- Q.1. (a) Explain the process of finding efficiency of transformer by sumpter's test. (5)
- (b) Draw and explain the idea of a welding transformer. [CO5] (5)
- OR**
- Q.2. (a) Develop an equivalent circuit for the practical transformer. (5)
- (b) A single phase transformer working at unity power factor has efficiency of 90% at both half load and at full load of 500W. Determine:
 (i) Iron loss and copper loss [CO5] (5)
 (ii) Maximum efficiency
- Q.3. (a) A transformer has its maximum efficiency of 0.98 at 15 KVA (Unity Power Factor). Compare its all day efficiencies for the following load cycles (5)
 (i) Full load of 20 KVA, 12 hours/day and no load rest of the day
 (ii) Full load of 4 hours/day and 0.4 full load rest of the day
 Assume the load to operate on unity power factor all day
- (b) Justify that under S.C. test the core losses are negligible and under open circuit test copper losses are negligible. [CO5] (5)
- OR**
- Q.4. (a) Draw complete phasor diagram of transformer supplying load at the following power factor (5)
 (i) Unity (ii) Lagging
- (b) Define voltage regulation of a transformer. Derive condition for zero regulation. [CO5] (5)
- Q.5. (a) What is difference between a three phase transformer bank and a three phase transformer unit? What are the advantages of three phase unit transformer over 3 single phase transformer of the same KVA rating? (5)
- (b) Explain Δ - Δ , Y-Y, Δ -Y and Y- Δ connection of three single phase transformer. [CO6] (5)
- OR**
- Q.6. (a) Explain with help of neat connection diagram how to obtain 3 to 6 phase conversion. (5)
- (b) Write short notes on: [CO6] (5)
 (i) Open delta connection
 (ii) Tertiary winding
- Q.7. (a) The core of three phase, 50Hz, 11000/ 550V, Δ -Y, 300KVA core type transformer operates with a flux of 0.02wb. Find: (5)
 (i) Emf per turn (ii) No. of high voltage and low voltage turn per phase. [CO6] (5)
- (b) Explain Scott-connection for 3 phase to 2 phase conversion. **OR** (5)
- Q.8. (a) Explain excitation phenomenon in transformer. (5)
- (b) Write short notes on [CO6] (5)
 (i) Parallel operation of 3 phase transformer
 (ii) Harmonics in 3 phase transformer

FIRST MID TERM EXAMINATION 2015-16
3EE05A – ELECTRICAL MACHINES-I
BRANCH – ELECTRICAL ENGINEERING

Max. Time: 2 hrs.

Max. Marks: 40

NOTE:- Attempt all four questions. There is internal choice in Q. 1 & 2, Q. 3 & 4, Q. 5 & 6, Q. 7 & 8.

- Q.1. (a) A shunt generator gives full load output of 30KW at a terminal voltage of 200V. The armature and field resistances are 0.05Ω and 50Ω respectively. The iron and friction losses are 1000W. Calculate –
 (i) Generated E.M.F.
 (ii) Copper losses.
 (iii) Efficiency. (5)
- (b) What is meant by back E.M.F. in a DC motor? Derive the equation for torque produced in DC motor. (5)

OR

- Q.2. (a) A shunt motor takes a total current of 20A from 250V supply and the shunt field and armature resistance are 200Ω and 0.3Ω respectively. Determine – mechanical power developed in the motor armature. (5)
- (b) What are the different types of DC generators according to the ways in which fields are excited? Show in the connection diagram for each type. (5)
- Q.3. (a) Draw and explain the torque – speed characteristics of the following types of DC motors –
 (i) Shunt motors
 (ii) Series motors
 (iii) Cumulative compound. (5)
- (b) A 4 pole DC generator has 51 slots and each contains 20 conductors. Flux per pole is 7mwb and runs at 1500 r.p.m. Find the produced emf of the machine if its armature is wave wound? (5)

OR

- Q.4. (a) With the help of a neat connection diagram explain the method of controlling the speed of DC motors. (5)
- (b) The length of air core coil is 25cm and has a cross sectional area of 4 cm^2 . the coil is wound by 65 turns. Determine the inductance of the coil. (5)
- Q.5. (a) With the help of neat diagram explain the working principle of a DC generator. Explain clearly the function of commutator in DC machines. (5)
- (b) Explain principle of conservation of energy in electromechanical system and deduce energy balance equation. (5)

OR

- Q.6. (a) What you know about armature reaction? Derive the expression for equation of demagnetizing & cross magnetizing ampere turns. (5)
- (b) Explain the different electric braking techniques for DC motors. (5)
- Q.7. (a) Explain Hysteresis. Draw Hysteresis loop. (5)
- (b) Explain with suitable sketches the various parts of DC machines. (5)

OR

- Q.8. (a) Write the short note on three point starter of D.C. motors. (5)
- (b) Write short note on lap and wave winding of armature winding in DC. Machine. (5)

SECOND MID TERM EXAMINATION 2015-16
SEEDSA - ELECTRICAL MACHINES I
BRANCH - ELECTRICAL ENGINEERING

Max. Marks: 40

Max. Time: 2 hrs.

NOTE:- Attempt all four questions. There is internal choice in Q. 1 & 2, Q. 3 & 4, Q. 5 & 6, Q. 7 & 8.

Q.1. (a) In what way a practical transformer differs from an ideal transformer. Develop an equivalent circuit for the practical transformer. (5)

(b) Write a short note on welding transformer. (5)

OR

Q.2. (a) Explain in detail the double star connections for obtaining 6-phase supply from 3-phase supply. (5)

(b) Define voltage regulation of transformer. Derive condition for- (5)

(i) Zero Regulation

(ii) Maximum Regulation (5)

Q.3. (a) Write a short note on Auto transformer. (5)

(b) Explain Scott Connection for 3-phase to 2-phase conversion and show that the primary neutral divides the primary winding in ratio 2:1. (5)

OR

Q.4. (a) Discuss open delta connection of 3-phase transformers. (5)

(b) A single phase transformer working at unity power factor has an efficiency of 90% at both half and full load and at the full load of 500W. Determine-

(i) Iron Loss

(ii) Full Load Copper Loss (5)

(iii) Maximum Efficiency (5)

Q.5. (a) Describe the constructional features and principle of operation of single phase transformer. (5)

(b) Why the no load current of a transformer contains harmonics? (5)

OR

Q.6. (a) Write a short note on parallel operation of 3- ϕ transformer. (5)

(b) What are the various types of losses in the transformer? Derive the condition for maximum efficiency. (5)

Q.7. (a) Draw time phase relationship between terminal voltage of H.V. and L.V. side of the following three phase transformer configuration:

(i) Y / Δ

(ii) Δ / Y

(iii) Y / Y (5)

(iv) Δ / Δ (5)

(b) Explain the process of finding the efficiency of a transformer by Sumpner's test. (5)

OR

Q.8. (a) Calculate the regulation of a transformer in which the ohmic loss is 1% of the output and the reactance drop is 5% of the voltage when the load power factor is-

(i) 0.8 Lagging

(ii) Unity (5)

(iii) 0.8 Leading

(b) In a transmission system the star side of a star/delta transformer is the H.V. side, while in a distribution transformer, the star side is the L.V. side. Justify the statement. (5)

FIRST MID TERM EXAMINATION 2014-15
3EE05A – ELECTRICAL MACHINES-I
BRANCH – ELECTRICAL ENGINEERING

Max. Time: 2 hrs.

Max. Marks: 40

NOTE:- Attempt all four questions. There is internal choice in Q. 1 & 2, Q. 3 & 4, Q. 5 & 6, Q. 7 & 8.

- Q.1. (a) Describe the principle of energy conversion. Show that the reaction of coupling magnetic field on the electrical or mechanical system is essential for the electro-mechanical energy conversion. (6)
- (b) Define field energy and co-energy. Prove that field energy and co-energy in a linear magnetic system are given by identical expressions. (4)
- OR**
- Q.2. (a) Why most practical energy conversion devices use magnetic field as the coupling medium between electrical and mechanical systems? (6)
- (b) A toroid coil having 500 turns, average radius 10 cm and cross sectional radius of 2 cm. If the relative permeability is 1500, find the current required to establish a flux density of 0.5 T. (4)
- Q.3. (a) What is commutation process? How we can improve the commutation by different methods in DC generator. Explain it. (6)
- (b) In a 110V compound generator, the armature, shunt and series winding resistance are 0.6 Ω , 25 Ω and 0.04 Ω respectively. The load consists of 200 lamps each rated 55 KW, 110V connected in parallel. Find the total emf and armature current when the machine is connected for- (4)
- (i) Long Shunt (ii) Short Shunt
- OR**
- Q.4. (a) Draw the various characteristics of shunt and series DC generator. (6)
- (b) An 8 pole dc generator has 500 armature conductors and has a useful flux per pole of 0.065 wb. What will be the emf generated if it is lap connected and runs at 1000 rpm? What must be the speed at which it is to be driven to produce the same emf if it is wave wound? (4)
- Q.5. (a) Explain the different electrical braking techniques for DC motor and write advantages for mechanical braking over electrical braking. (6)
- (b) A shunt motor takes a total current of 20 A from 250 V supply. The shunt field and armature resistance are 200 Ω and 0.3 Ω respectively. Determine the - (4)
- (i) Value of Back emf and.
- (ii) Mechanical power developed in the motor armature.
- OR**
- Q.6. (a) Explain the Hopkinson's method of testing of the dc machine. Can the swinburnes method of testing of the dc machine be applied on dc series machine? Explain whichever the answer is. (6)
- (b) A 230V dc shunt motor has an armature resistance of 0.5 Ω and field resistance of 115 Ω . At no load, the speed is 1200 RPM and the armature current 2.5A. On application of rated load the speed drops to 1120 RPM. Determine the line current and power input when the motor delivers rated load. (4)
- Q.7. (a) Draw a neat sketch of dc generator with name of each part. Drive an equation for emf induced in a dc generator. (6)
- (b) A shunt generator of terminal voltage 220v delivers a current of 250 A to the load. The shunt field and armature resistance are 50 Ω and 0.02 Ω . Respectively calculate the generated voltage. (4)
- OR**
- (a) What is meant by back emf in a dc motor? Derive the equation for torque produced in dc motor. (6)
- (b) Explain technical short notes on: (4)
- (i) Armature Reaction
- (ii) Lap & Wave winding
- (iii) Dummy coil & Equalizer Rings
- (iv) Interpoles
- (v) Compensating Windings

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SECOND MID TERM EXAMINATION 2014-15
3EE05A – ELECTRICAL MACHINES-I
BRANCH – ELECTRICAL ENGINEERING

Max. Marks: 40

Max. Time: 2 hrs.

NOTE:- Attempt all four questions. There is internal choice in Q. 1 & 2, Q. 3 & 4, Q. 5 & 6, Q. 7 & 8.

- Q.1. (a) Define a transformer. In what way practical transformer differs from an ideal transformer? (4)
- (b) A single phase transformer working at unity power factor has an efficiency of 90% at both half load and at the full load of 500w determine: (6)
- (i) Iron Loss (ii) Full load copper loss (iii) Efficiency at 75% of full load (iv) Maximum efficiency.
- OR
- Q.2. (a) Draw phasor diagram of transformer supplying load at the following factors: (5)
- (i) Unity P.F (ii) Lagging P.F (iii) Leading P.F
- (b) A 20 kVA, 2200/220v, 50 Hz, 1- ϕ transformer is tested efficiency and regulation as follow
- O.C test (L.v side); 220v, 4.2 A, 148w, h.v side open
- S.C test (h.v side); 86v, 10.5A, 360w, L.v shorted
- determine (5)
- (i) Equivalent circuit referred to L.V side
- (ii) Voltage regulation at 0.8 P.F lagging.
- OR
- Q.3. Explain why (10)
- (i) The open circuit test on a transformer is conducted at a rated voltage.
- (ii) The open circuit test give core loss and short circuit test gives copper loss.
- (iii) How the losses can be separate from the transformer.
- OR
- Q.4. Explain sumpner's test and how efficiency is calculated with the help of this test. (10)
- Q.5. (a) Briefly explain the function of closed delta tertiary winding employed in some 3- ϕ transformer. (5)
- (b) Explain how the exciting current (no load current) in transformer contain harmonics even when supply voltage is a sine wave. (5)
- OR
- Q.6. (a) What is an open delta system? What are their applications? (5)
- (b) Explain with the help of connection and phasor diagram, how scott connection are used to obtain two phase supply from 3- ϕ supply main. (5)
- Q.7. Explain the delta/delta, star/star, delta/star and star/delta connection of 3 single phase transformer bank. What are their distinguishing features? State their application. (10)
- OR
- Q.8. Explain different schemes are used for 3 to 6 phase conversion. (10)



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DETAILED LECTURE NOTES

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Compound Generator characteristics:-

There are two types

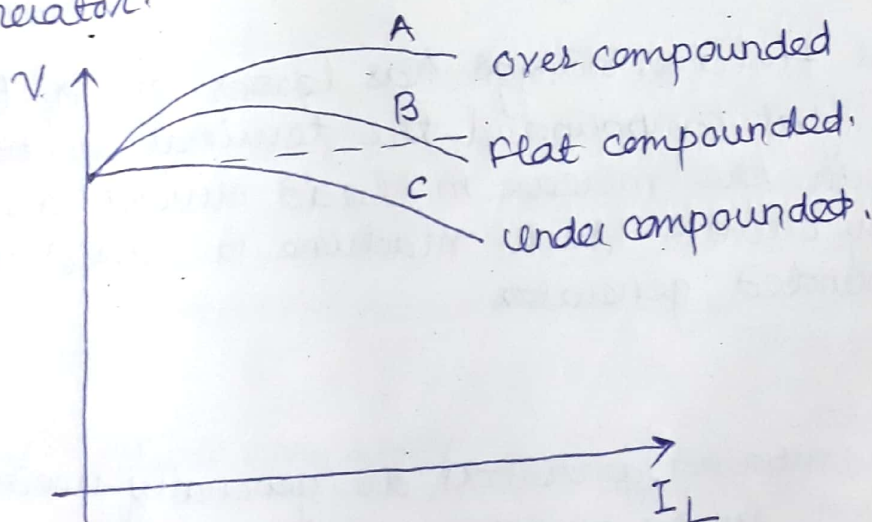
(i) short shunt generator

(ii) long shunt generator

It may be noted that external characteristics of short shunt and long shunt are almost identical.

External characteristics:-

The compound generator can be cumulatively compounded or differentially compounded. The latter is rarely used except we will discuss cumulatively compound generator.



The series and shunt excitation aids one another. The degree of compounding depends upon the increase in series excitation with the increase in load current.

(i) If series windings are so arranged that with the increase in load current, the terminal voltage

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increases, it is called as over compounded generator. In such a case, as the load current increases, the series field mmf increases and tends to increase the flux and hence the generated voltage. The increase in generated voltage is greater than $I_a R_a$ drop so that instead of decreasing, the terminal voltage increases as shown in curve A.

(ii) If series winding turns are so adjusted, such that increase in load current, the terminal voltage substantially remains constant, it is called as flat compounded generator. The series winding of such machine has a lesser no. of turns than the one in over compounded and therefore does not increase the flux as much as for a given load current consequently the full load voltage is nearly equal to the no-load voltage as indicated by curve B.

(iii) If series field windings has lesser no. of turns than the flat compounded the terminal voltage will fall with the increase in load current as indicated by curve C. Such machine is called as under compounded generator.

Applications :-

1. Cumulative compound generators are generally used for lighting, power supply purpose and for heavy power services due to their constant voltage property.
2. For small distance operations, such as power supply for hotels, offices, homes etc, the flat compound generators are used.

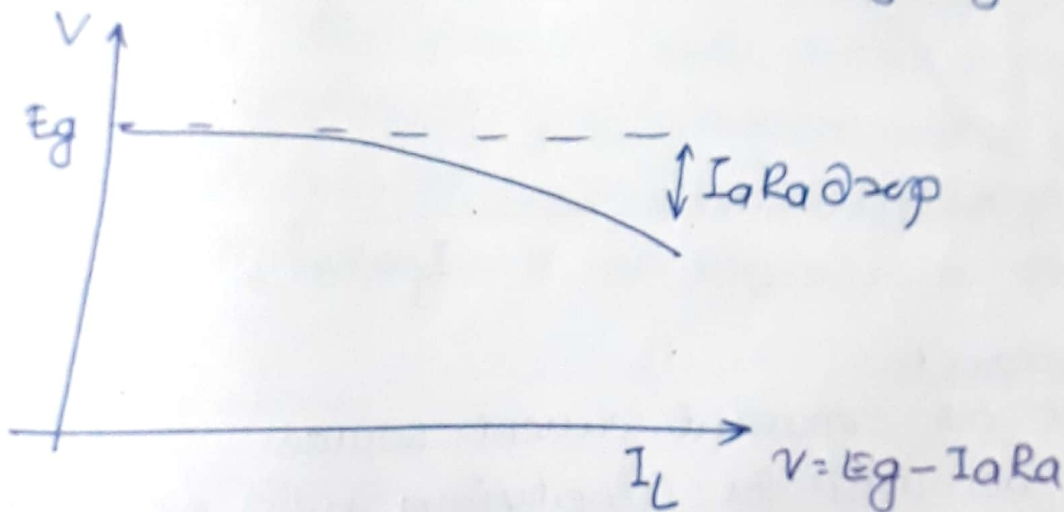


DETAILED LECTURE NOTES

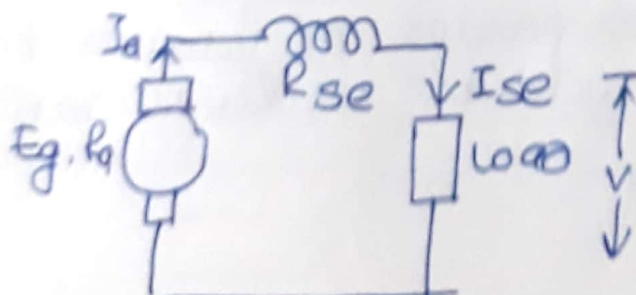
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External characteristics:-

For a DC generator we know $E_g = V + I_a R_a$ neglecting other drops. So as load current I_L increases and the terminal voltage as I_L changes from no load to full load is very small. This is shown in fig. Hence DC shunt generator is called as constant voltage generator.



Load characteristics of DC series generator

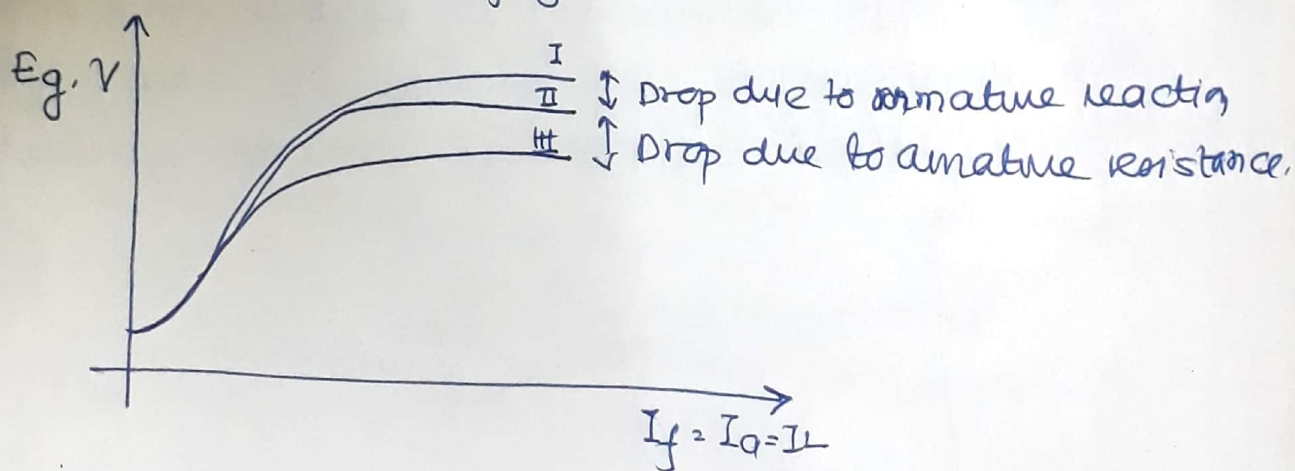


increases, it is called as over compounding.

In case of series generator

$$I_a = I_f = I_L$$

As load current increases, I_f increases. The flux is directly proportional to I_f . As flux also increases, thus the increasing nature is the characteristic. As I_a increases, armature reaction increases but its effect is negligible compared to increase in E . But for high load current, saturation occurs and flux remains constant. In such case, due to the armature reaction E starts decreasing as shown by the dotted line in fig.



Applications:-

They act as constant current source.

1. They are used for supplying field excitation current in DC locomotives for regenerative braking.
2. They are used as boosters to compensate the voltage drop in the feeder in various types of distribution systems such as railway line.
3. Series arc lightening.



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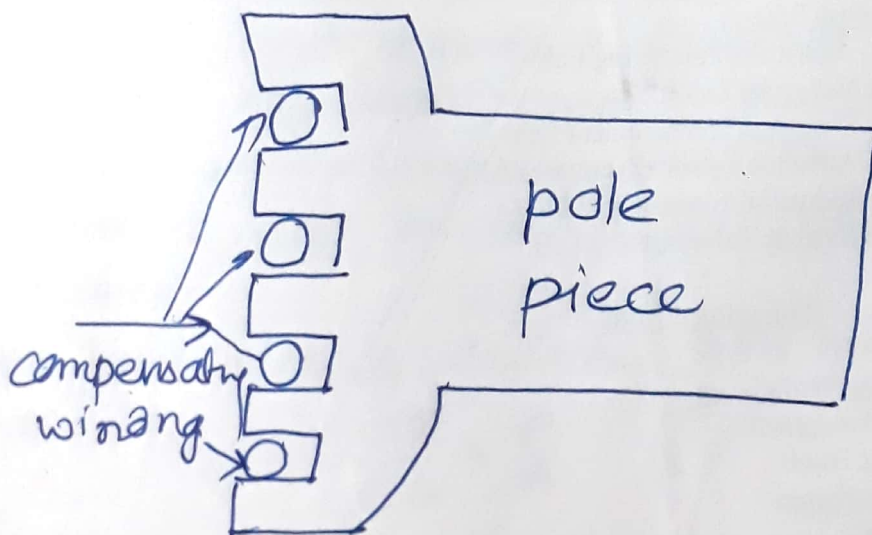
DETAILED LECTURE NOTES

Campus: PCE Course: B.Tech
Name of Faculty: Dr. Chelani K.

Class/Section: III A2C
Name of Subject: EM-I

Date: 26-7-17
Code: 03EE01

Interpoles have one disadvantage. They restore the field only in their immediately area and are not able to overcome all the distortion. Large DC generators use another set of windings called as compensating windings to help restore the main magnetic field. Compensating windings are made by placing a few large wires in the face of pole piece parallel to the armature windings. The compensating winding is connected in series with the armature so that its strength increase with an increase in the output current.



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DETAILED LECTURE NOTES

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Note:-

- (i) The armature reaction is the twisting or bending of the main magnetic field.
- (ii) Armature reaction is caused by the distortion of the magnetic field produced in the armature.
- (iii) Armature reaction is proportional to armature current.
- (iv) Interpoles are small pole pieces connected between the main field poles used to help correct armature reaction.

Performance equations:-

In this section we shall derive two most fundamental and important formulae (namely emf and torque equations) for a DC machine in general. These will be extensively used to analyse the performance and to solve the problems on DC machines.

We had already derived the emf equation

$$\text{as } E_g = \frac{N \Phi Z}{60} \times \frac{P}{A}$$

where E_g = generated emf

Φ = flux per pole
 P = No. of poles
 N = speed of armature in rpm
 Z = no. of armature conductors
 A = No. of parallel path = $\frac{Z}{P}$ (for wave)
 $= \frac{Z}{2}$ (for lap)

The derivation of torque equation is

Let I_a = armature current

Average flux density

$$B_{ave} = \frac{\Phi P}{ADL}$$

Then, $\frac{I_a}{a}$ = current flowing



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DETAILED LECTURE NOTES

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The losses in DC Generator is divided into

- (i) constant losses
- (ii) variable losses

(i) constant losses:

These losses remains constant at all loads are known as constant losses. The constant losses are

- (i) iron losses
- (ii) mechanical losses

(ii) variable losses :-

These losses in DC generator, which vary with the load are called as variable losses. The variable losses in DC generator are

- (a) Copper loss in armature winding ($I_a^2 R_a$)
- (b) copper loss in series field winding ($I_{se}^2 R_{se}$)

Total losses = constant losses + variable losses.

Power stages :-

The various power stages in a DC generator are represented as

A - B = Iron and friction loss

B - C = copper loss

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DETAILED LECTURE NOTES

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$$= V I_L + \text{variable losses} + \text{constant losses}$$

$$= V I_L + I_a^2 R_a + W_c$$

$$= V I_L + (I_L + I_{sh})^2 R_a + W_c \quad [I_a = I_L + I_{sh}]$$

As I_{sh} is generally small as compared to I_L and therefore can be neglected.

$$\text{Generator input} = V I_L + I_L^2 R_a + W_c$$

$$\eta = \frac{\text{output}}{\text{Input}} = \frac{V I_L}{V I_L + I_L^2 R_a + W_c}$$

Dividing $V I_L$ to numerator & denominator

$$= \frac{1}{1 + \left[\frac{I_L R_a}{V} + \frac{W_c}{V I_L} \right]}$$

The efficiency will be maximum when the denominator is minimum

$$\frac{d}{d I_L} \left[\frac{I_L R_a}{V} + \frac{W_c}{V I_L} \right] = 0$$

$$\frac{R_a}{V} - \frac{W_c}{V I_L^2} = 0$$
$$\frac{R_a}{V} = \frac{W_c}{V I_L^2}$$

$$W_c = I_L^2 R_a$$

Variable loss = constant loss

The load current corresponding to the maximum efficiency is given by

$$I_L = \sqrt{\frac{W_c}{R_a}}$$

Hence, the efficiency of a DC generator will be maximum when the load current is such that variable loss is equal to the constant loss.

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DETAILED LECTURE NOTES

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The various losses in a DC generator are -

1. Copper losses:- These losses occur due to currents in the various windings of the machine.

(i) Armature copper loss = $I_a^2 R_a$

(ii) Shunt field copper loss = $I_{sh}^2 R_{sh}$

(iii) Series field copper loss = $I_{se}^2 R_{se}$

2. Iron or core losses:-

These losses occur in the armature of a DC machine and are due to the rotation of the armature in the magnetic field of the poles. They are of two types

(i) Hysteresis loss:-

Hysteresis loss occurs in the armature of a DC machine is subjected to magnetic reversals as it passes under successive poles. In order to magnetise and demagnetise continuously some energy is always provided to the molecular magnet which is called as hysteresis loss.

$$P_h = n B_{max}^{1.6} f V$$

B_{max} = Max. magnetic flux density

$$f = \text{frequency} = \frac{PN}{120}$$

$V =$ Volume of armature core in m^3

$\eta =$ Steinmetz hysteresis coefficient

Hence, the hysteresis loss can be minimised by using materials of low value of Steinmetz hysteresis coefficient eg silicon steel.

iii) Eddy current loss:

When armature rotates in the magnetic field of poles, an emf is induced in which circulates eddy current in the armature core. The power loss due to these eddy current is called as eddy current loss. In order to reduce this loss, the armature core is built of thin laminations insulated from each other by a thin layer of varnish.

Eddy current loss, $P_e = k_e B_{max}^2 f^2 t^2 V$ Watts

$k_e =$ constant

$B_{max} =$ Max. mag. flux density in the core

$f =$ freq.

$t =$ thickness of lamination,

$V =$ Volume of core.

It may be noted that eddy current loss depends upon the square of lamination thickness. For this reason lamination thickness must be kept as small as possible.

3. Mechanical losses:-

These losses are due to friction and windage.

i) Friction loss between bearing, brush friction

ii) Windage loss air friction of rotating machine



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COLLEGE OF ENGINEERING

LECTURE NOTES

Campus: ...PCE... Course: ...B.Tech... Class/Section: ...III... A & C... Date:
Name of Faculty: ...Dr. Chetan Khemraj... Name of Subject: ...Elect. M/C-I... Code:
Date (Prep.): 26/7/17... Date (Del.): 2/8/17... Unit No.: ...III... Lect. No:

OBJECTIVE: To be written before taking the lecture (Pl. write in bullet points the main topics/concepts etc., which will be taught in this lecture)

1. Introduction of DC motor.
2. Principle
3. Introduction of Back EMF

IMPORTANT & RELEVANT QUESTIONS:

- Q.1 Describe the working of a DC motor.
- Q.2 What is the significance of a back EMF?

FEED BACK QUESTIONS (AFTER 20 MINUTES):

- Q.1 What is the role of commutator in a DC motor?
- Q.2 Explain the equation of back EMF.

OUTCOME OF THE DELIVERED LECTURE: To be written after taking the lecture (Pl. write in bullet points about students' feedback on this lecture, level of understanding of this lecture by students etc.)

Excellent

REFERENCES: Text/Ref. Book with Page No. and relevant Internet Websites:

1. Asfaq Hussain - pp
2. P. S. Bhimbasa - pp

DETAILED LECTURE NOTES

Campus: Course:

Name of Faculty:

Class/Section:

Name of Subject:

Date: 2/8/17

Code:

It is based on the principle that when a current carrying conductor is placed in a magnetic field, it experiences a force which is given by Fleming's left hand rule and whose magnitude is given by

$$F = B I L$$

$B \rightarrow$ Magnetic field in Wb/m^2

$I \rightarrow$ current in amperes

$L \rightarrow$ length of conductor cm

The electric motor converts electrical energy into mechanical energy or motion by using electro-magnetic induction. In DC machine when the field magnets are excited and armature conductors are supplied with current, then they experience a force tending to rotate the armature. Armature conductors under north pole (N) are assumed to carry current downwards and under south pole (S) to carry current upwards. Using Fleming's left hand rule, the direction of force on each conductor can be found. The forces collectively produce a driving torque, which keeps the armature rotating.

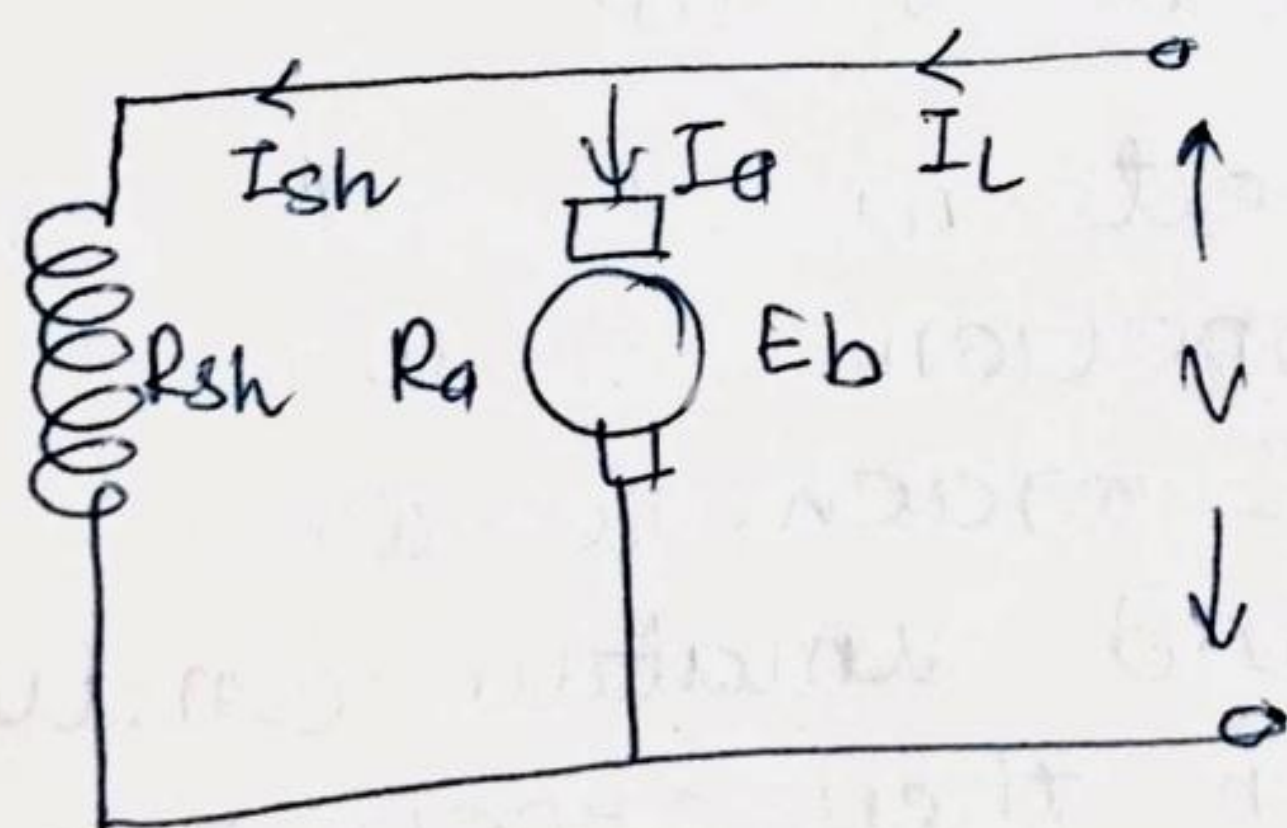
The function of commutator is to produce a unidirectional torque.

Back EMF:-

In a DC motor as the armature rotates, the armature coils cut the magnetic field and thereby induce a voltage or emf in these coils. Since this induced voltage opposes the applied terminal voltage it is called as back emf E_b .

This back emf depends on the factors as the generated emf in the generator - the speed and field strength. If the field strength is stronger than the speed is faster, then back emf will be large. But the back emf will be always less than the applied voltage because of internal voltage drop caused by the resistance of the armature coils.

Consider a DC shunt motor, when a DC



voltage V is applied across the motor terminals, the field magnets are excited and the armature current is flowing. Therefore a driving torque

acts on the armature which begins it to rotate. As the armature rotates, back emf is induced which opposes the terminal voltage V . Thus, the terminal voltage has to force a current in armature against the back emf E_b . The work done in overcoming and causing the current to flow against E_b is converted into mechanical energy developed in the armature. It follows, that the energy conversion

ENGINEERING

DETAILED LECTURE NOTES

Campus: Course:

Name of Faculty:

Class/Section:

Name of Subject:

Date: 2/8/17

Code:

In a DC motor is only possible due to the production of back emf E_b

Net voltage across armature = $V - E_b$

Armature current = $\frac{V - E_b}{R_a}$ (R_a = arm. resistance)

Since V , R_a are constant, the value of E_b will determine the current flowing in armature. If the speed of the motor is high, the back emf $E_b (= \frac{N \Phi Z P}{60 A})$ is large and hence will draw less armature current and vice versa.

Significance:-

The presence of back emf makes the motor a self regulating machine as

- (1) When motor is running on no load, very high speed and hence back emf is nearly equal to the terminal voltage, so armature current is less.
- (2) If the motor is suddenly loaded, the first effect is to cause the armature to slow down, therefore the speed at which armature conductor move falls and therefore the back emf falls. This allows the

Page No.:

a larger current to flow through the armature and the larger current means increasing driving torque. Thus, the driving torque increases as the motor slows down. The motor will stop slowing down when the armature current is sufficient to produce the increased torque required by the load.

iii) If the load on motor is decreased, the driving torque is momentarily in excess of the requirement so that the armature is accelerated. As the armature speed increases, the back emf E_b also increases and causes armature current I_a to decrease. The motor will stop accelerating when the armature current is just sufficient to produce the reduced torque required by the load.

It follows, therefore that the back emf in a DC motor regulates the flow of armature current, i.e. it automatically changes the ~~load~~ armature current to meet the load requirements.



COLLEGE OF ENGINEERING

LECTURE NOTES

Campus: PCE Course: B.Tech Class/Section: III A & C Date:
Name of Faculty: Dr. C. Khemsraj Name of Subject: EM-I Code: 03EE05
Date (Prep.): 27/8/17 Date (Del.): 4/8 Unit No.: III Lect. No:

OBJECTIVE: To be written before taking the lecture (Pl. write in bullet points the main topics/concepts etc., which will be taught in this lecture)

1. series motor
2. shunt motor
3. compound motor

IMPORTANT & RELEVANT QUESTIONS:

- Q. 1 What are the different types of DC motors
- Q. 2 What is cumulative and differential compound motor.

FEED BACK QUESTIONS (AFTER 20 MINUTES):

- Q. 3 Give the brief applications of different types of motors
- Q. 4 What do you understand by differential compound motor, where it is used?

OUTCOME OF THE DELIVERED LECTURE: To be written after taking the lecture (Pl. write in bullet points about students' feedback on this lecture, level of understanding of this lecture by students etc.)

Excellent

REFERENCES: Text/Ref. Book with Page No. and relevant Internet Websites:

1. Asfaq Hussain -
2. P. S. Bhimra -

DETAILED LECTURE NOTES

Campus: Course:
Name of Faculty:

Class/Section:
Name of Subject:

Date:
Code:

Types of DC motors

They are of following types:-

- ① Separately excited DC motor
② self excited DC motor
(a) shunt (b) series
(c) Compound - (i) short shunt
(ii) long shunt

Separately excited DC motors are utilised in control systems where control of armature voltage over a wide range is required.

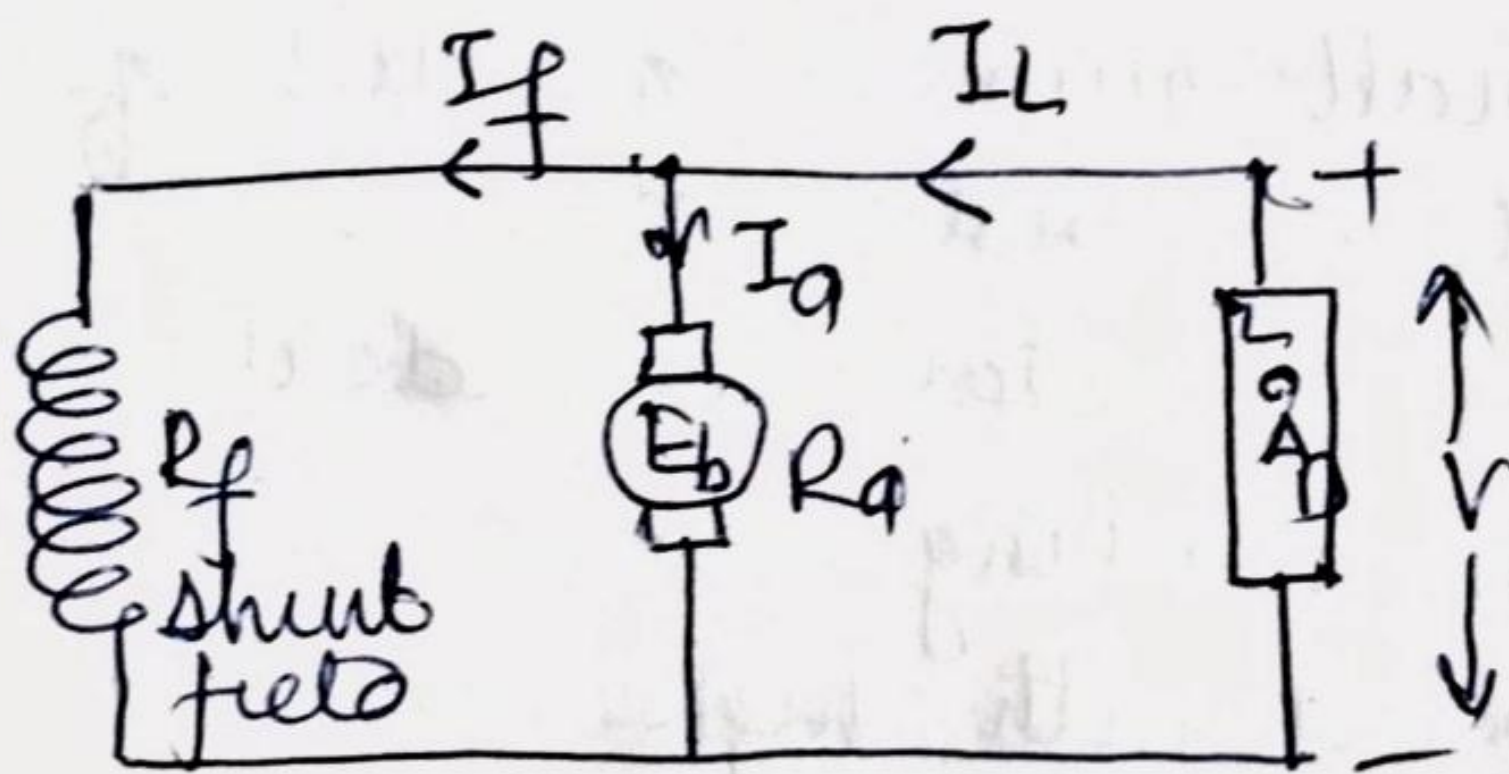
shunt motor

$$I_L = \text{load current}$$

I_a = armature current

R_{f2} field winding resistance.

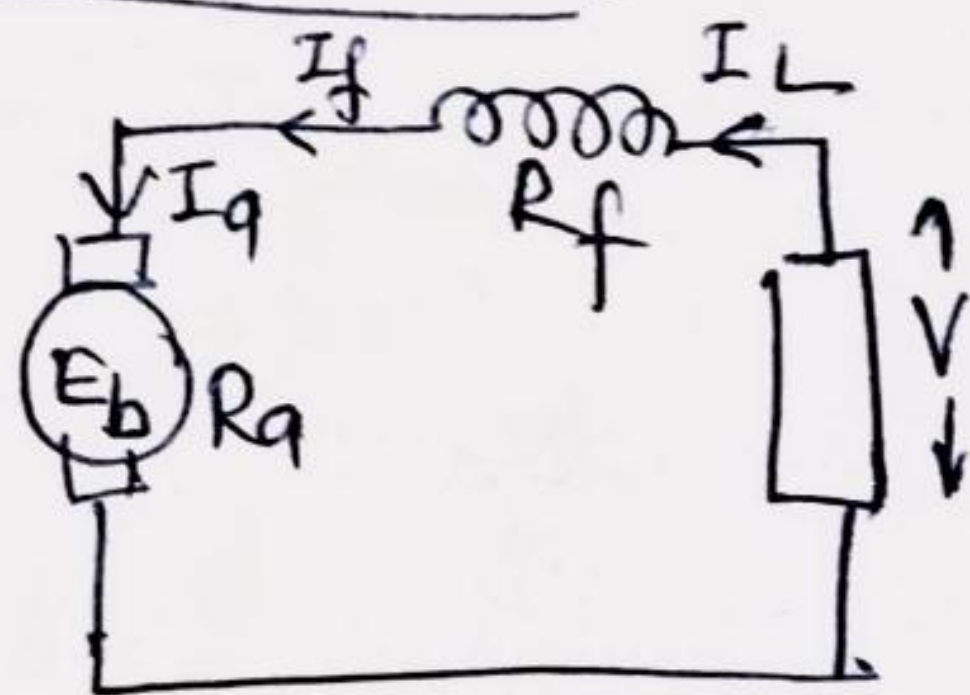
I_f = field winding current.



In shunt motor, the field winding is connected in parallel with the armature as shown in fig. The current through the shunt field winding is not the same as that of the armature current. Shunt field windings are

designed to produce the necessary mmf by using the relatively large number of turns of wire having high resistance. Therefore, shunt field current is relatively small as compared to the armature current.

Series Motor :-



In series motor, the field winding is connected in series with the armature as shown in fig. In this type of motor series field winding is same as that of the armature current, series field windings must be designed with much fewer turns than shunt field windings for the same mmf. Therefore, a series field winding has a relatively small number of turns of thick wire and therefore a low resistance.

These types of motors are ideal for applications requiring a high starting torque, high accelerating torque, and high speed with higher loads.

Compound Motor :-

These types of motors have two field windings, one connected in parallel with the armature and the other in series with it. There are two types of motors -

(i) Long shunt

(ii) Short shunt

DETAILED LECTURE NOTES

Campus: Course:

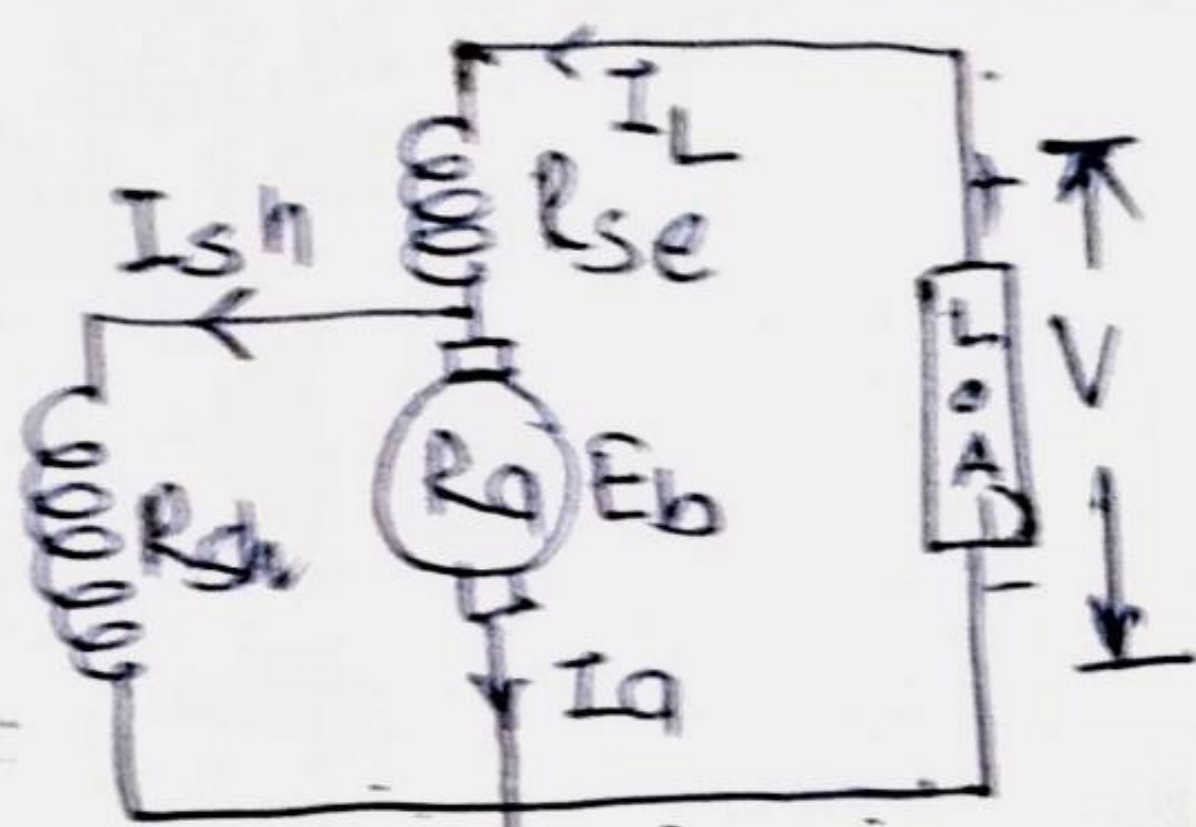
Name of Faculty:

Class/Section:

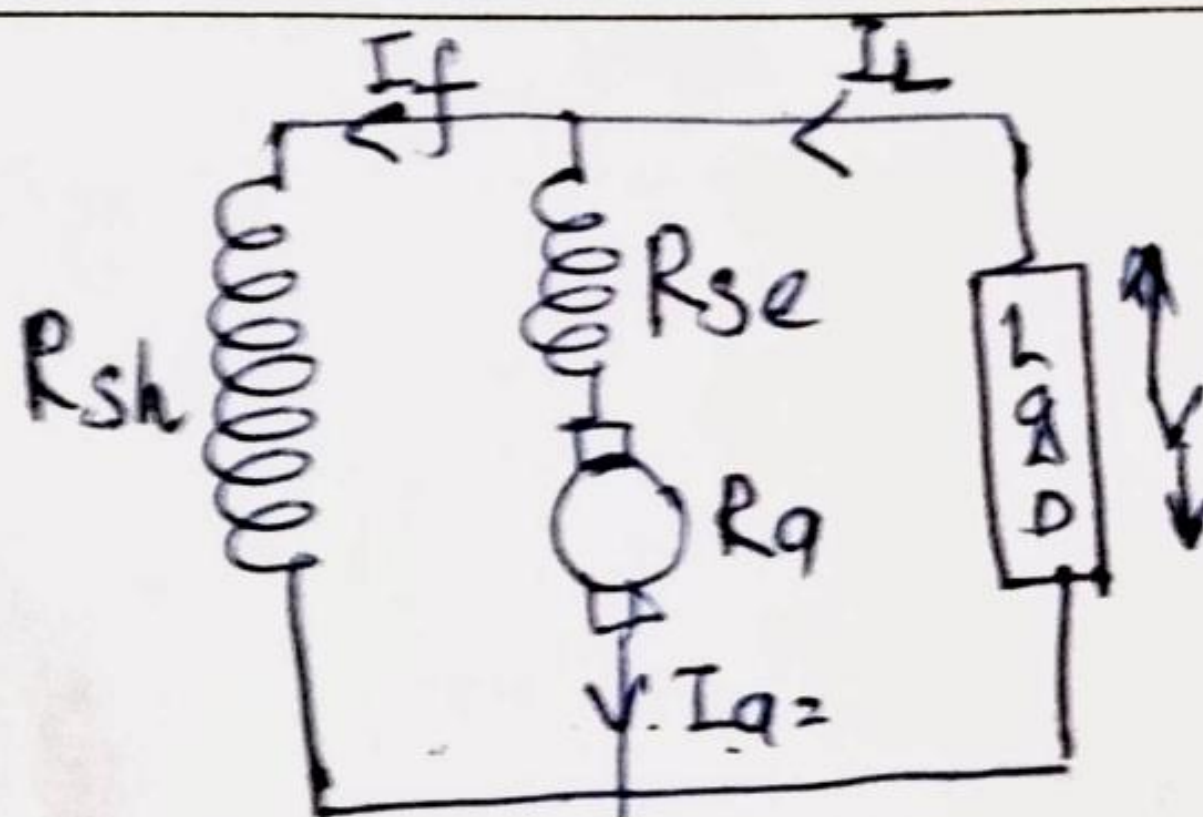
Name of Subject:

Date:

Code:



short shunt



long shunt

The compound are always designed, so that the flux produced by shunt field winding is considerably larger than the flux produced by the series field winding. Therefore shunt field in compound machines is the basic dominant factor in the production of the magnetic field in the machine. This types of motors are ideal for sudden changes in load to maintain a reasonably constant speed.



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LECTURE NOTES

Campus: B.Tech Course: PCE Class/Section: III A & C Date:
Name of Faculty: Dr. C. Khemsaj Name of Subject: EM-I Code: 03EECS
Date (Prep.): 31/7/17 Date (Del.): 9/8/17 Unit No.: III Lect. No.:

OBJECTIVE: To be written before taking the lecture (Pl. write in bullet points the main topics/concepts etc., which will be taught in this lecture)

1. Production of torque.
2. Alternative derivation of torque.
3. Speed equation.

IMPORTANT & RELEVANT QUESTIONS:

- Q.1 Derive the expression for the electro-magnetic torque.
- Q.2 Which is a constant speed motor? Explain.

FEED BACK QUESTIONS (AFTER 20 MINUTES):

- Q.1 Derive the speed equation.
- Q.2 Which motor can be used for heavy load? Explain.

OUTCOME OF THE DELIVERED LECTURE: To be written after taking the lecture (Pl. write in bullet points about students' feedback on this lecture, level of understanding of this lecture by students etc.)

Excellent.

REFERENCES: Text/Ref. Book with Page No. and relevant Internet Websites:

1. Asfaq Hussain -
2. P. B. Bhimbasa -



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DETAILED LECTURE NOTES

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Class/Section:

Name of Subject:

Date:

Code:

Armature torque:-

Torque is the turning moment of a force about an axis and is measured by the product of force and radius at a right angle in which force acts.

$$T = F \times r$$

In a DC motor, each conductor is acted by this force, therefore, each conductor exerts a force tending to rotate the armature. The sum of torque due to all armature conductors is known as gross or armature torque (T_a).

In a DC motor,

r = average ^{radius} ~~resistance~~ of armature,

l = length of armature conductor,

Z = total no. of armature conductors,

A = no. of parallel paths,

i = current in each conductor = I_a / A

B = average flux density (Wb/m^2)

ϕ = flux per pole (Wb)

P = no. of poles

Force on each conductor = $F = B i l$

Torque due to one conductor = $F \times r$

Total armature torque

$$= T_a = Z F \ell$$

$$= Z B I \ell$$

Now, $I = \frac{I_a}{A}$, $B = \frac{\phi}{a}$ $a = \text{cross sectional area of flux path}$
 $= \frac{2\pi r \ell}{p}$

$$\therefore T_a = Z \times \frac{\phi}{a} \times \frac{I_a}{A} \times \ell \times r$$

$$= Z \times \phi \times \frac{I_a}{\frac{2\pi r \ell}{p}} \times \ell \times r$$

$$= \frac{Z \phi I_a p}{2\pi A}$$

$$= 0.159 Z \phi I_a p / A \quad (\text{Nm}) \quad \text{--- (1)}$$

As Z, p, A are fixed for a machine,

$$T_a \propto \phi I_a$$

Hence, torque in a DC motor is directly proportional to the flux per pole and the armature current.

(i) For DC shunt motor, ϕ is constant

$$T_a \propto I_a$$

(ii) For a DC series motor, $I_a = I_f \propto \phi$

$$T_a \propto I_a^2$$

Alternative expressions :-

we know, $E_b = \frac{N \phi Z}{60} \times \frac{p}{A}$

$$\frac{p \phi Z}{A} = \frac{60 E_b}{N} \quad \text{--- (2)}$$

Substituting eqⁿ (2) in eqⁿ (1) we get

$$T_a = 0.159 \times \left(\frac{60 E_b}{N} \right) \times I_a$$



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DETAILED LECTURE NOTES

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$$T_a = 9.55 \frac{E_b I_a}{N} \quad (\text{Nm})$$

Shaft torque:-

The torque which is useful at the motor shaft for doing useful work is known as shaft torque. It is denoted by T_{sh} . It is because that while transmitting the power through the shaft, there is a power loss in friction, windage and the iron loss.

$$T_{sh} = 9.55 \times \frac{\text{Output}}{N}$$

Speed of a DC motor:-

$$E_b = V - I_a R_a$$

$$E_b = \frac{N \phi Z}{60} \times \frac{P}{A}$$

$$\therefore V - I_a R_a = \frac{N \phi Z}{60} \times \frac{P}{A}$$

$$\therefore N = \frac{(V - I_a R_a)}{\phi} \times \frac{60A}{PZ}$$

$$= K \frac{(V - I_a R_a)}{\phi}$$

$$= K \frac{E_b}{\phi}$$

$$\text{where } K = 60A/PZ$$

$$(E_b = V - I_a R_a)$$

$$N \propto \frac{E_b}{\phi}$$

Therefore, in a DC motor, speed is directly proportional to back emf and inversely proportional to flux per pole ϕ .

Speed relations:-

In a DC motor has initial values of speed, flux per pole and back emf as N_1, ϕ_1 and E_{b1} respectively and the corresponding final values are N_2, ϕ_2 and E_{b2} then,

$$N_1 \propto \frac{E_{b1}}{\phi_1}, \quad N_2 \propto \frac{E_{b2}}{\phi_2}$$

$$\frac{N_1}{N_2} = \frac{E_{b1} \times \phi_2}{E_{b2} \phi_1} \quad (\phi_1 = \phi_2 \text{ in a DC shunt motor})$$

(i) For a shunt motor,

$$\frac{N_1}{N_2} = \frac{E_{b1}}{E_{b2}}$$

(ii) For a series motor, $\phi \propto I_a$

$$\frac{N_1}{N_2} = \frac{E_{b1}}{E_{b2}} \times \frac{I_{a2}}{I_{a1}}$$

Speed regulation:-

It is the change of speed from No load speed to the full load speed.

$$\% \text{ speed regulation} = \frac{N_L \text{ speed} - F_L \text{ speed}}{F_L \text{ speed}} \times 100$$

$$= \frac{N_0 - N}{N} \times 100$$

N_0 = No load speed

N = full load speed.



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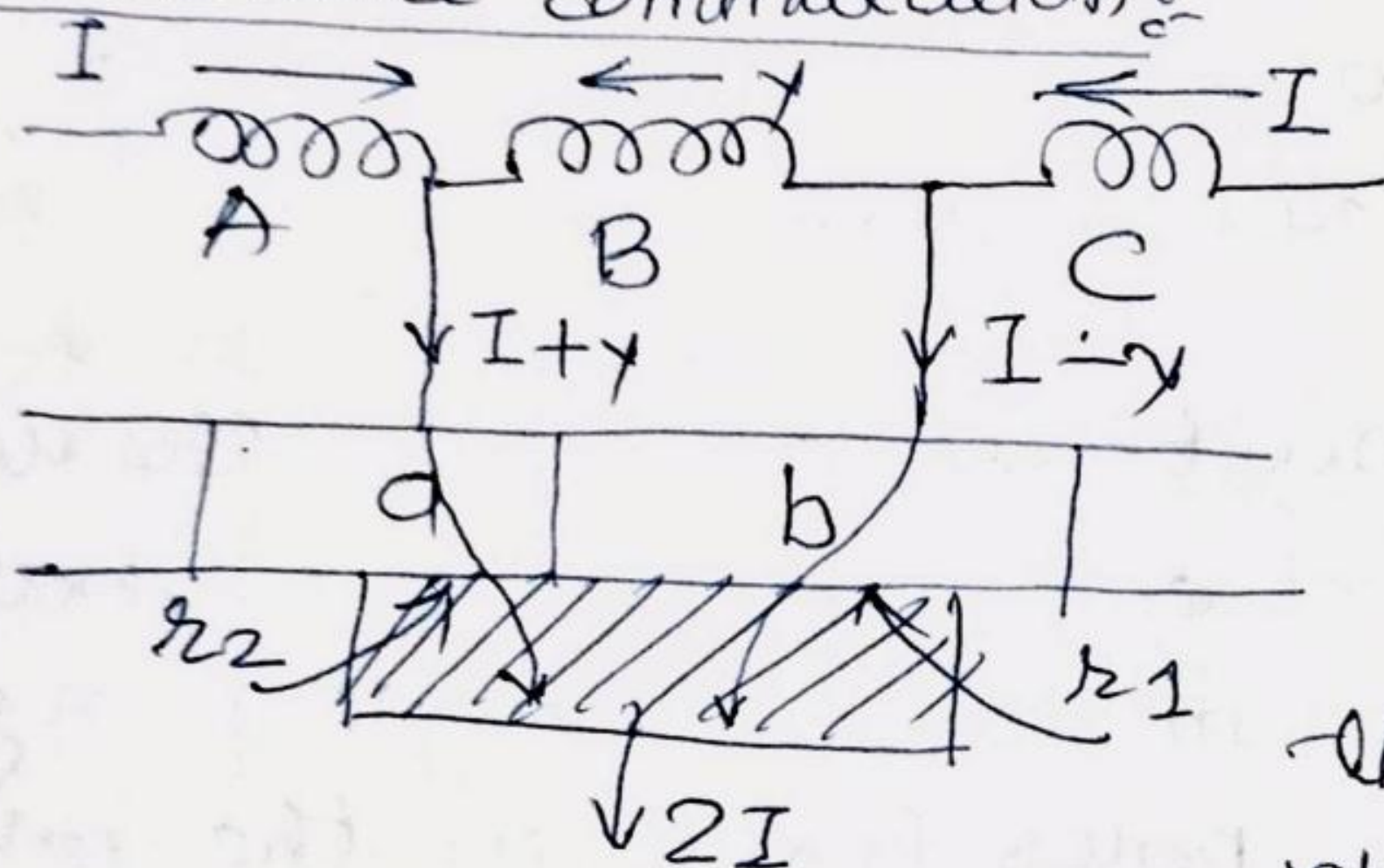
DETAILED LECTURE NOTES

Campus: Course:
Name of Faculty:

Class/Section:
Name of Subject:

Date:
Code:

Resistance commutation:



In this method of improving commutation, the low resistance copper brushes are replaced by high resistance carbon brushes.

From the fig it can be seen that current I from coil C when passing through commutator

segment b has two parallel paths. one is straight from b to brush while the other is through short circuited segment a and then to the brush. By using low resist. copper brush the current will not prefer the second path it will prefer first low resistance path.

When carbon brushes having comparatively high resist. are used then current I through coil C will select the second path as resistance of first path will be increasing due to decrease in contact area of b with brush and resistance r_2 of second path will be decreasing due to increase in contact area a of brush.

thus by increasing contact resist. segment & brushes will limit short ckt current.

ADV - ① If sparking occurs, less damage to commutator as compared to copper brushes.



EMF commutation:-

There are two ways of improving emf commutation—

- ① By giving a forward lead to brushes
- ② By using interpoles.

① If the brushes are shifted forward or backward depending on magnetic neutral axis, the short circuited coil will ~~cancel~~ under the influence of main pole of opposite polarity.

This will partly neutralise the reactance voltage which will help in quick current reversal.

② This method is more suitable and actually used in practice. In this method emf required to neutralise reactance voltage is induced in the coil undergoing commutation by using small poles fixed to the yokes, and placed in between the main poles i.e. along geometrical neutral axis. These poles are called as interpoles.

On these interpoles few heavy gauge copper wire turns are wound and these are connected in series with the armature. The polarity of interpoles is same as main pole ahead in case of generator & opp. in motor.

As the polarity of interpole is same as that of main pole ahead, the induced emf in them help quick reversal of current. The emf induced in the interpoles is called commutating or reversing emf.



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LECTURE NOTES

Campus: PCE Course: A.Tech Class/Section: III CA&C Date: _____
Name of Faculty: Dr. CHEJAN K. HEMPA Name of Subject: Elect. M/C-1 Code: 03EE05
Date (Prep.): _____ Date (Del.): _____ Unit No.: _____ Lect. No.: _____

OBJECTIVE: To be written before taking the lecture (Pl. write in bullet points the main topics/concepts etc., which will be taught in this lecture)

- * Motor starting
- * DC shunt Motor starters
- * DC series Motor starters

IMPORTANT & RELEVANT QUESTIONS:

- Q.1 Why starters are needed in the DC motors.
- Q.2 Explain different starters with their uses.

FEED BACK QUESTIONS (AFTER 20 MINUTES):

- Q.1. Explain two point starters with circuit diagram?
- Q.2 Explain three point starter.

OUTCOME OF THE DELIVERED LECTURE: To be written after taking the lecture (Pl. write in bullet points about students' feedback on this lecture, level of understanding of this lecture by students etc.)

Excellent

REFERENCES: Text/Ref. Book with Page No. and relevant Internet Websites:

P.S. Bhimbar -
Asfaq Hussain -



DETAILED LECTURE NOTES

Campus: Course:

Name of Faculty:

Class/Section:

Name of Subject:

Date:

Code:

Motor starters :-

At starting, when the motor is stationary, there is no back EMF in the armature. Consequently when the motor is directly switched on, armature draws a very heavy current.

As an example, 5HP, 220V Shunt motor has a full load current of 80A and armature resistance of 0.5Ω. If this motor is directly switched on to supply, it would take an armature current of $220/0.5 = 440\text{A}$ which is 22 times the full load current. The heavy starting current may result in

- ① burning of armature due to excessive heating effect.
- ② damaging of commutator and brushes due to sparking.
- ③ excessive voltage drop in the line.

In order to avoid excessive current at starting, a variable resistance (known as starting resistance) is inserted in series with armature circuit. This resistance is gradually reduced as the motor gathers full speed.

Shunt motor starter:-

It consists of starting resistances divided into several sections and connected in series with the armature. The tapping points of the starting resistances are

brought out to a number of studs. One end of shunt field winding is connected to the first stud and the other end to the forward of the supply. Include in this circuit is the no-volt release coil. One end of starting handle A is connected to one side of supply through overload release coil. The other end of starting handle moves against spring and makes contact with each stud during starting operation, cutting out more and more starting resistance as it passes over each stud in clockwise direction.

Operation:-

(i) To start with, the dc supply is switched on with starting handle in the OFF position.

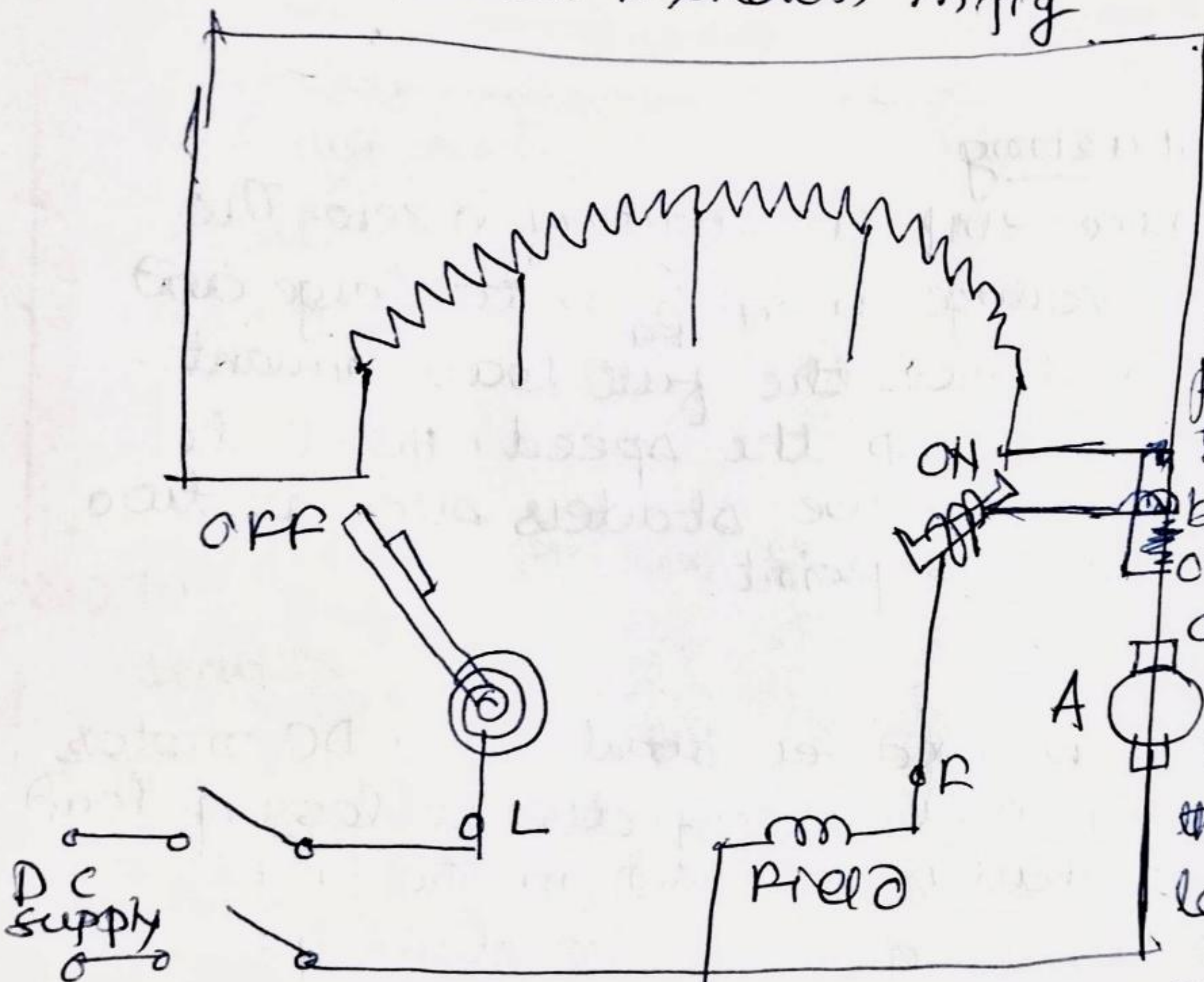
(ii) The handle is now moved clockwise to the first stud. As soon as it comes in contact with the first stud, the shunt field winding is directly connected across the supply, while the whole starting resistance is inserted in series with armature ckt.

(iii) As the handle is gradually moved over to the final stud, the starting resistance is cut out of the armature circuit in steps. The handle is now held magnetically by the no-volt release coil which is energised by shunt field current.

(iv)

Three point starter :-

A Three point starter is used to start a DC shunt or a compound motor. The coil of the hold on electromagnet is connected in series with the shunt field coil. Such a starter is shown in fig.



In case of disconnection in the field circuit due to internal failure or field rheostat failure the control arm will return to the off position due to spring tension. This is necessary because the shunt motor will overspeed in the same manner as the series motor if it loses its field excitation. The starter also returns to the off position in case of low supply voltage or

complete failure of supply voltage. This protection is therefore called as No Volt Release (NVR). Over load protection for the motor can be incorporated by connecting another electromagnetic coil in series with the armature. When motor is overloaded it draws a heavy current. This heavy current also flows through the electromagnetic coils. The electromagnet then pulls an iron piece upwards which short circuits the coil of hold on electromagnet (NVR coil). The hold on electromagnet gets deenergized and therefore the starter arm returns to the off position, thus protecting the motor against overload.

DETAILED LECTURE NOTES

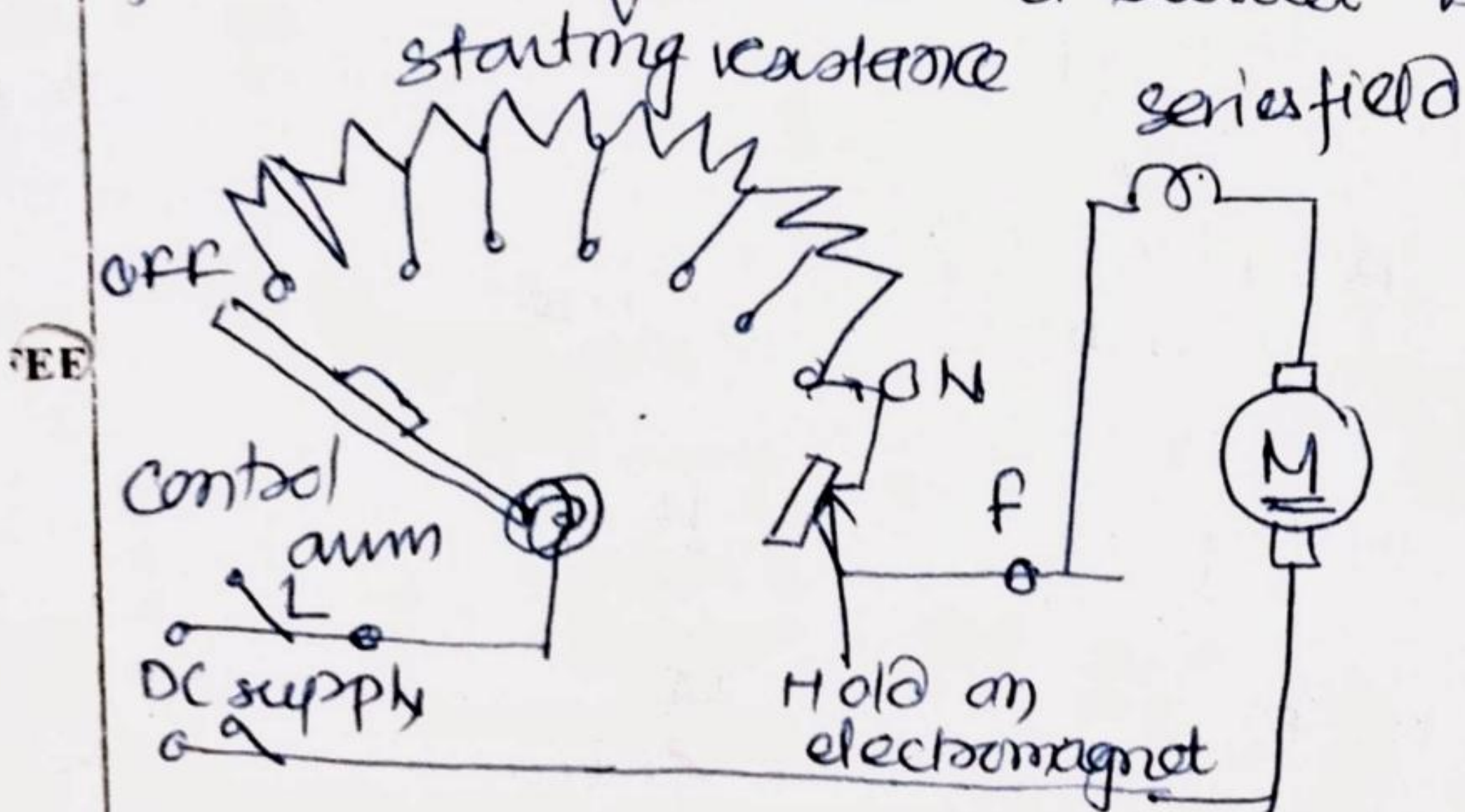
PAGE NO.

DC Motor starting

At starting the induced emf at starting is zero. The armature with rated voltage is $I_a = \frac{V}{R_a}$ is too large and tends to rise several times the full load current. The machine instantly picks up the speed. Hence to start the motor smoothly we use starters such as two point, three point and four point.

① Two point starter:

A two point starter is used for starting a DC motor which has a problem of overspeeding due to loss of load from its shaft. Such a starter is shown in the fig.



Here for starting the motor the control arm is moved clockwise from its off to ON position against spring tension. The arm is held on by an electromagnet. The held on electromagnet is connected in series with armature circuit. If the motor loses its load, current decreases and hence the strength of an

electromagnet is decreased. The control arm returns to the off position due to spring action. L and F are the two points of the starter which are connected with the supply and motor terminals.



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LECTURE NOTES

Campus: PCE Course: B.Tech. Class/Section: III (A & C) Date:
Name of Faculty: DR. CHEJAN K. REMPA Name of Subject: EM-1 Code: 03EE03
Date (Prep.): Date (Del.): Unit No.: III Lect. No:

OBJECTIVE: To be written before taking the lecture (Pl. write in bullet points the main topics/concepts etc., which will be taught in this lecture)

- * speed control by varying the armature terminal method
- * Ward Leonard method

IMPORTANT & RELEVANT QUESTIONS:

1. Explain the Ward-Leonard system of speed control.
2. Explain the flux control methods.

FEED BACK QUESTIONS (AFTER 20 MINUTES):

- Q.1 Give the advantages of flux control method & its applications
- Q.2 Give the advantages & disadvantages of Ward Leonard system.

OUTCOME OF THE DELIVERED LECTURE: To be written after taking the lecture (Pl. write in bullet points about students' feedback on this lecture, level of understanding of this lecture by students etc.)

Excellent.

REFERENCES: Text/Ref. Book with Page No. and relevant Internet Websites:

1. Asfaq Hussain.
2. P. S. Bhionbga



COLLEGE OF ENGINEERING

DETAILED LECTURE NOTES

Campus: Course:

Name of Faculty:

Class/Section:

Name of Subject:

Date:

Code:

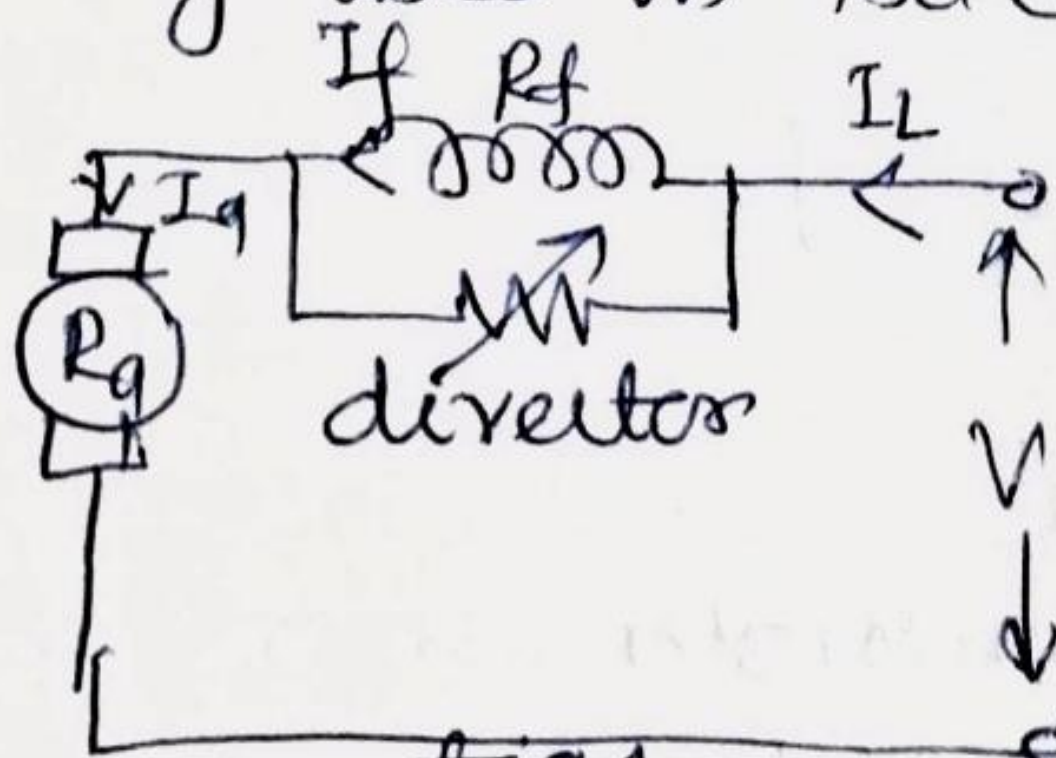
DC series motor:

1. Flux control method:-

This can be done in following ways-

(i) Field diverter:-

In this method, a variable resistance (field diverter) is connected in parallel with series field winding. Its effect is to shunt some portion of line current from series field windings, thus weakening the field and increasing the speed ($N \propto 1/\phi$). Obviously the lowest speed obtainable is normal speed. It can provide speed control above normal speed, hence it is widely used in traction control.



(ii) Armature diverter:- (fig 2)

In order to obtain speed below the normal speed, a variable resistance (called as armature diverter) is connected in parallel with armature. The diverter shunts some of line current, thus reducing the

armature current, Now for a given load, if I_a is decreased flux must increase ($T \propto \phi I_a$) as such speed decreases ($N \propto 1/\phi$). Thus, speed lower than the normal can be achieved.

Tapped field control:-

In this method, the flux is reduced (and hence speed is increased) by decreasing the number of turns of series field winding as shown fig 2. The switch S can short circuit any part of field winding, thus decreasing the flux and raising the speed. With full turns of field windings, the motor runs at normal speed and as the field turns are cut out, speeds higher than normal speed can be achieved.

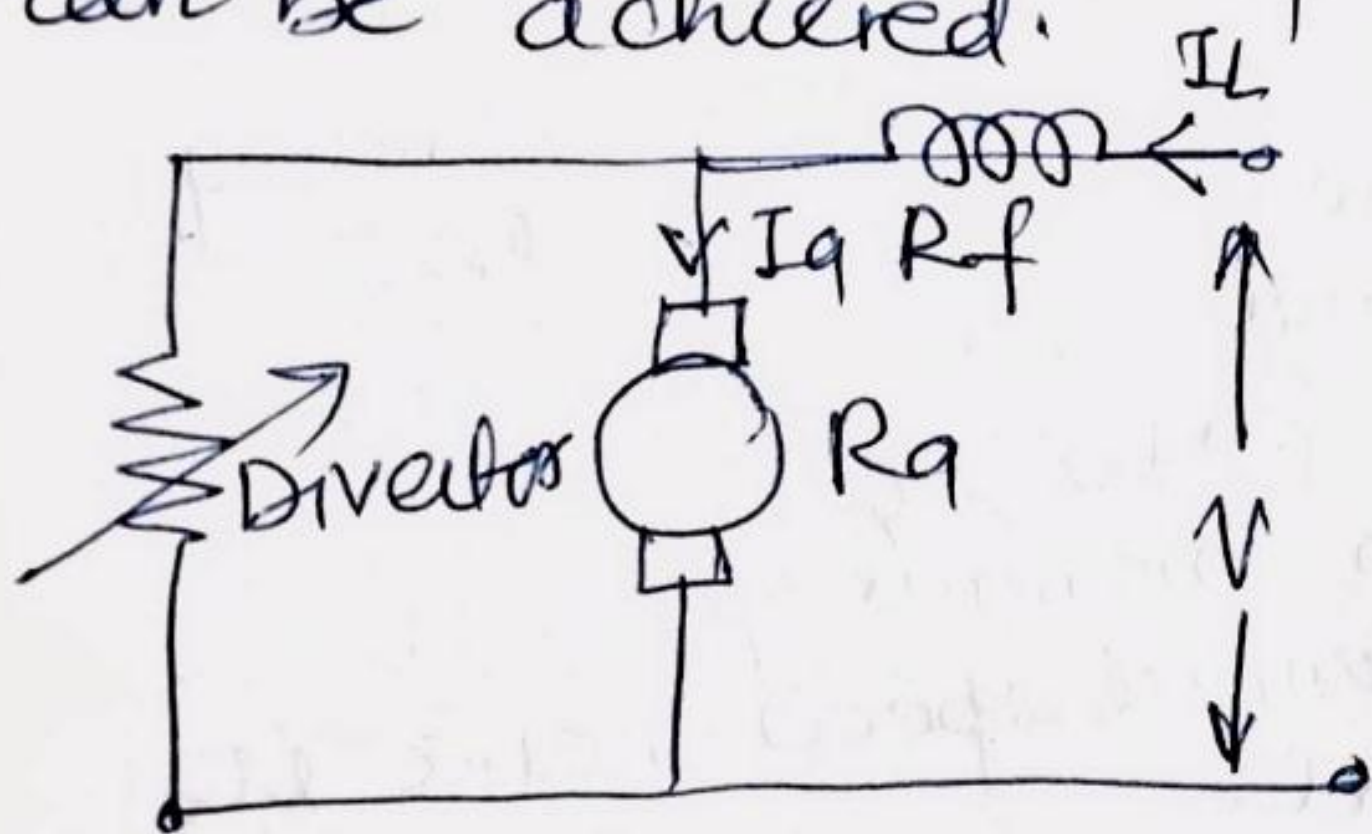


fig 2

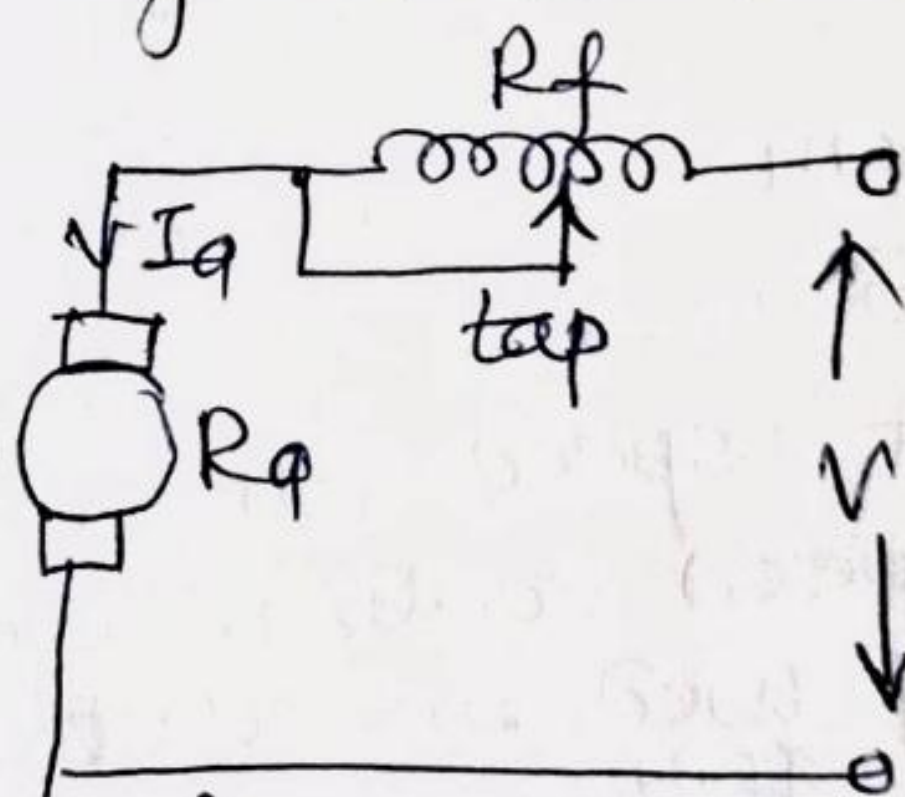
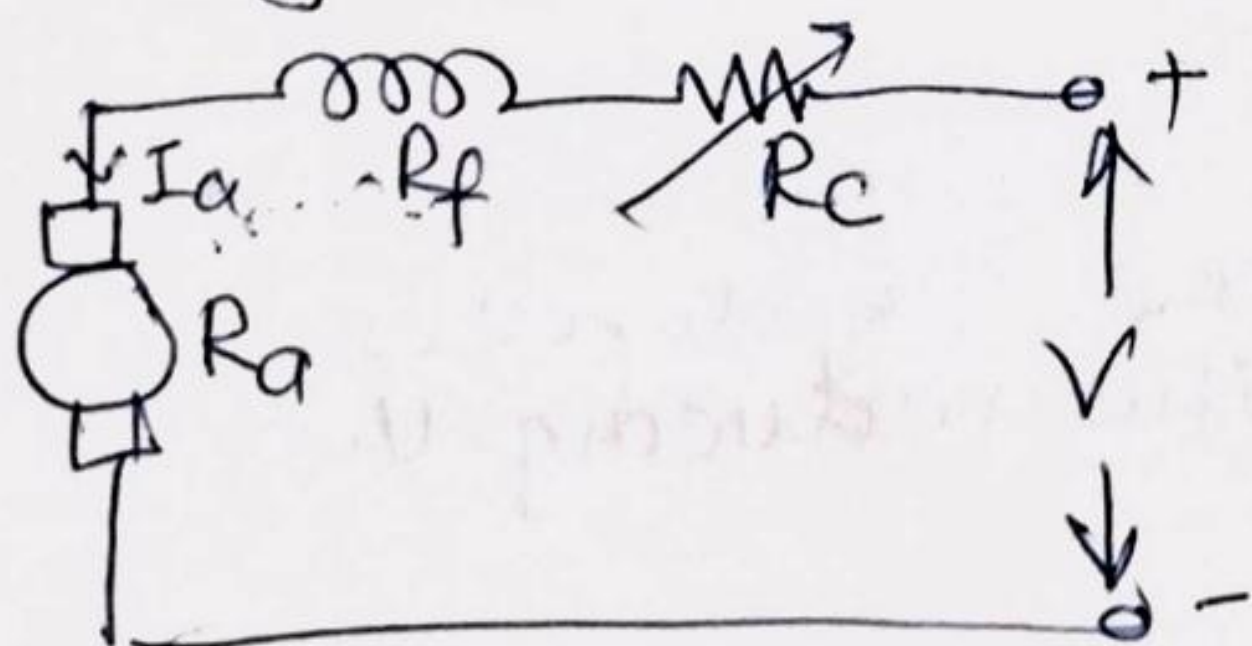


fig 3

2. Armature control method:-

In this method, a variable resistance is directly connected in series with the supply. This reduces the voltage available across the armature and the speed falls. By changing, the value of variable resistance any speed below normal can be obtained. Although this method has poor speed regulation, this has no significance for series motor because they are used for the



method has poor speed regulation, this has no significance for series motor because they are used for the varying speed applications.



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DETAILED LECTURE NOTES

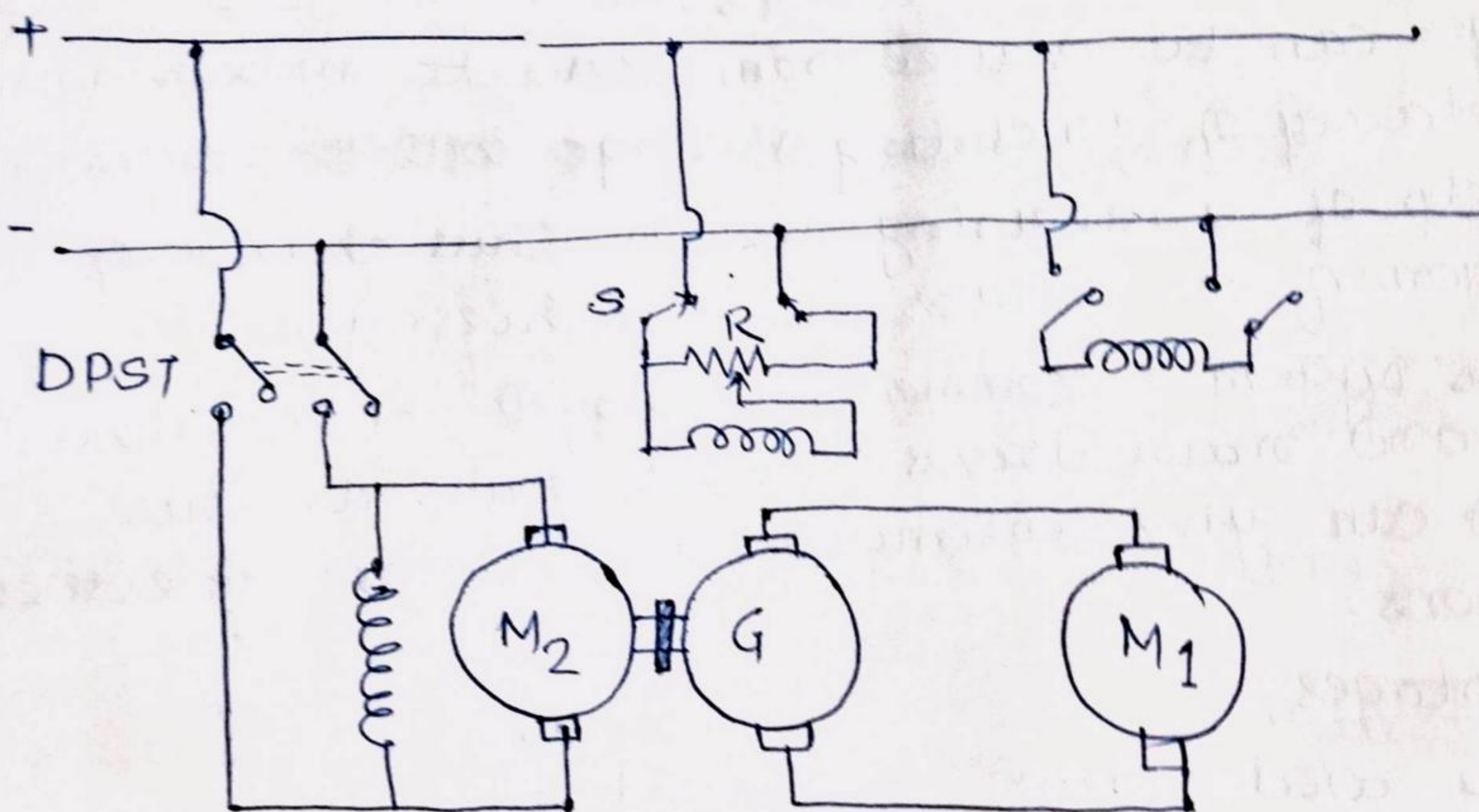
Campus: Course:
Name of Faculty:

Class/Section:
Name of Subject:

Date:
Code:

Ward Leonard Method

The speed control of DC motor accomplished by means of an adjustable voltage generator is called as the Ward-Leonard system. If it is desired to have wide and very sensitive speed control, then this system is generally used.



In this fig. R is potential divider, M₁ is the main motor whose speed is to be controlled, G is the separately

excited generator that feeds the armature of motor M_1 . M_2 is the driving motor that drives generator and main motor, and S is a double throw switch. M_1 is the main motor whose speed control is required. The field winding of this motor is permanently connected to DC supply and armature is fed from variable voltage so that the motor can run at any desired speed. To provide this, motor generator set is used in which the generator is directly coupled to a constant speed motor. The field circuit of this generator is separately excited from the available DC supply through a reversing switch and a potential divider so that its excitation can be varied from zero to maximum in both directions. Thus generator output voltage can be varied from zero to maximum value. The polarity of generating voltage will be reversed with the help of a reversing switch, thus change of direction of the motor M_1 is achieved.

This system is commonly employed for elevators, hoists and main drives in steel mills as this method can give unlimited speed control in either directions.

Advantages:-

1. Very wide range of speed.
2. Provide excellent stepless speed control.
3. Starting without any extra starting equipment.
4. Extremely good speed regulation at any speed.

Disadv:-

1. Initial cost is high.
2. Overall efficiency is low.



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LECTURE NOTES

Campus: P.C.E. Course: B.Tech. Class/Section: III sem. (A & C) Date:
Name of Faculty: Dr. CHETAN KHEMRA Name of Subject: Elect. M/C-1 Code: 03EE05
Date (Prep.): Date (Del.): Unit No.: III Lect. No.:

OBJECTIVE: To be written before taking the lecture (Pl. write in bullet points the main topics/concepts etc., which will be taught in this lecture)

- * Electrical Braking
- * Dynamic Braking
- * Plugging
- * Regenerative braking

IMPORTANT & RELEVANT QUESTIONS:

Q.1 Write short notes on electric braking

Q.2 How energy can be generated using Regen-
erative braking? Explain.

FEED BACK QUESTIONS (AFTER 20 MINUTES):

Q.1 what is plugging?

Q.2 what is rheostatic braking?

OUTCOME OF THE DELIVERED LECTURE: To be written after taking the lecture (Pl. write in bullet points about students' feedback on this lecture, level of understanding of this lecture by students etc.)

Excellent

REFERENCES: Text/Ref. Book with Page No. and relevant Internet Websites:

Asfaq Hussain -

P. S. Bhimrao -

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DETAILED LECTURE NOTES

Campus: Course:
Name of Faculty:

Class/Section:
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Motor Braking (Electric Braking)

The motor and its load may be brought to rest by either (i) mechanical (friction) braking
(ii) electric braking.

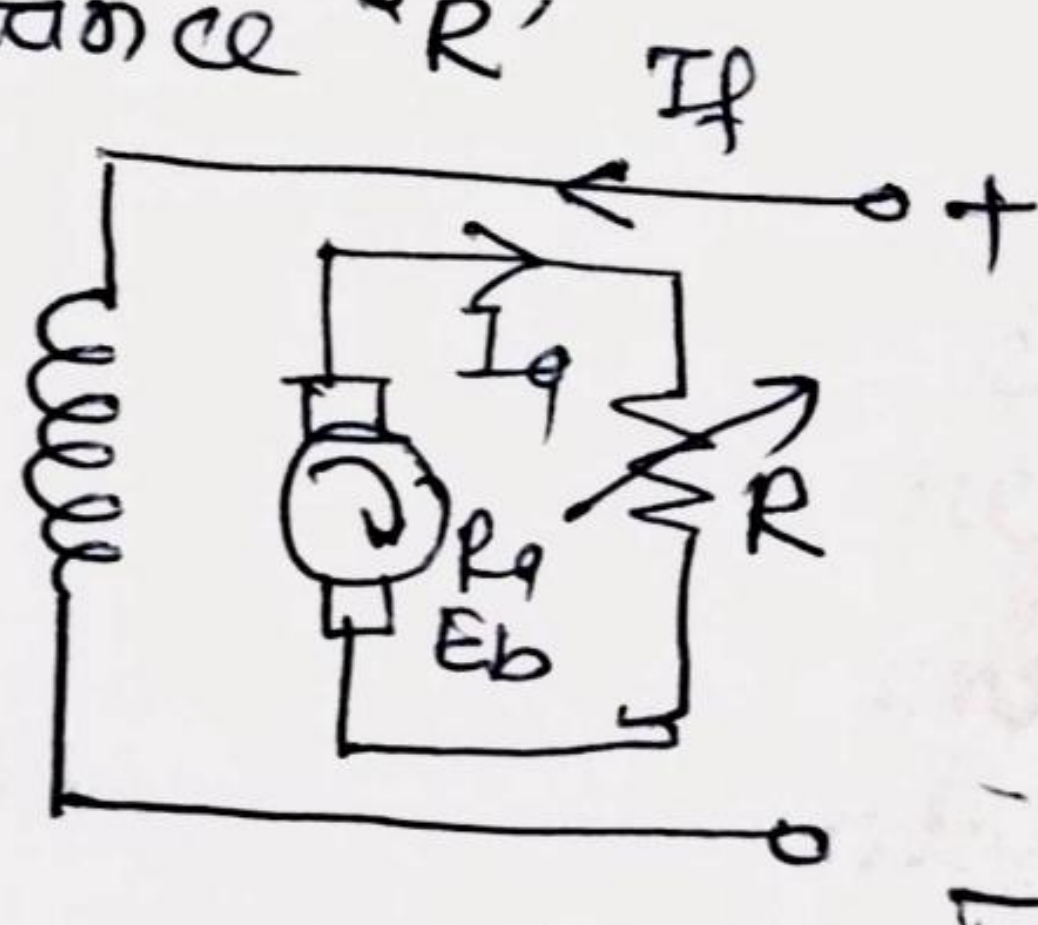
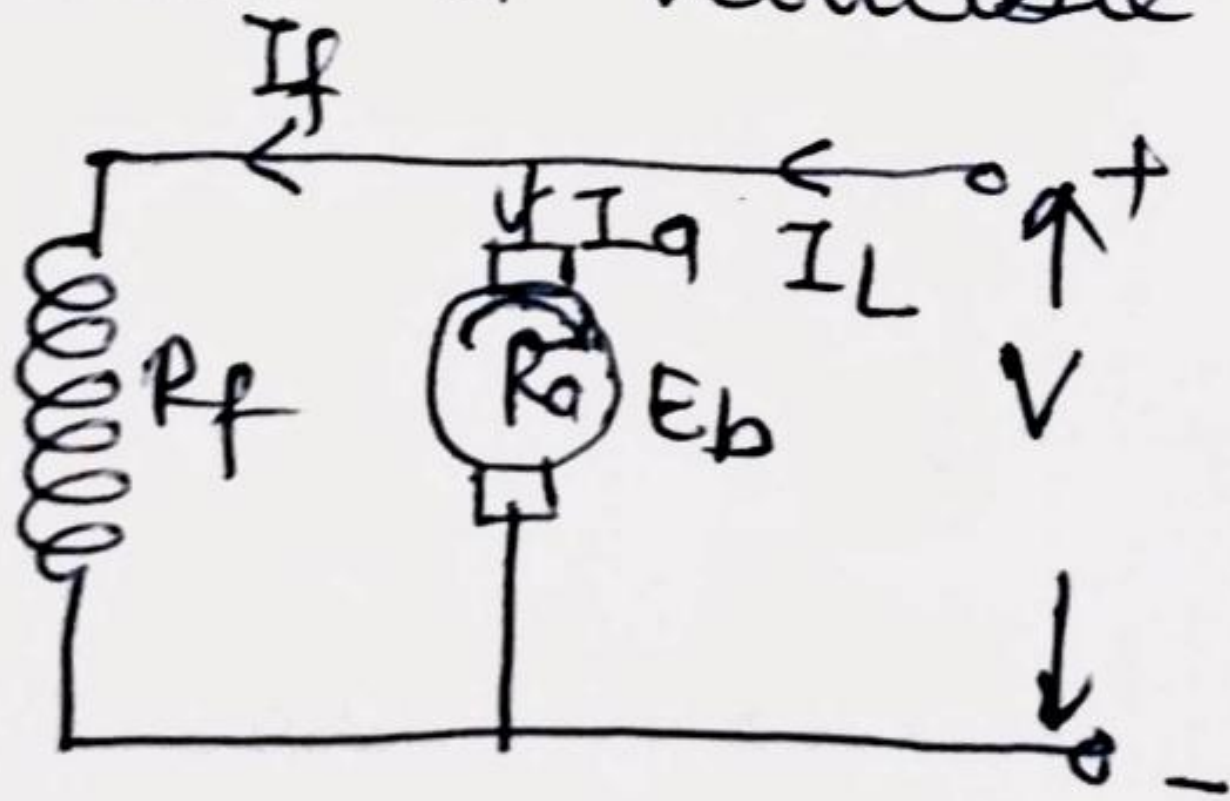
Mechanical braking has several disadvantages including non-smooth stop and greater stopping time.

The following three methods are used

- (i) Rheostatic or dynamic braking
- (ii) Plugging
- (iii) Regenerative braking.

(i) Rheostatic braking :-

In this method, the armature of the running motor is disconnected from the supply and connected across a variable resistance R' .



However the field winding is left unconnected to

the supply. The armature, while slowing down, rotates in a strong magnetic field and therefore, operates as a generator, sending a large current through resistance R . This causes the energy possessed by the rotating armature to be dissipated quickly as heat in the resistance. As a result, the motor is brought to rest quickly.

The braking torque may be controlled by the variation of resistance R . If the value of R is decreased as the motor speed decreases, the braking torque may be maintained at a high value. At a low value of speed, the braking torque becomes small and final stopping is due to friction.

This type of braking is used extensively in control of elevators, hoists in which motors must be started, stopped and reversed quickly.

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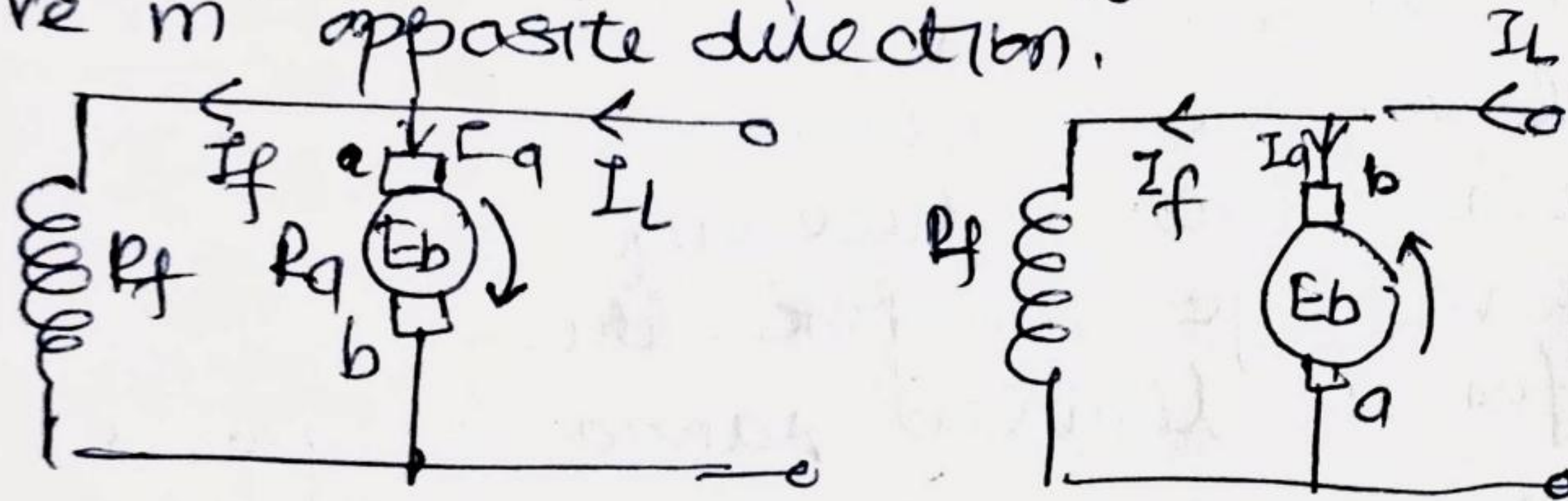
Campus: Course:
Name of Faculty:

Class/Section:
Name of Subject:

Date:
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plugging :-

In this method, connections of armature are reversed so that the motor is rotated in the opposite direction thus providing the necessary braking effect. When the motor comes to the rest the supply must be cutoff otherwise the motor will move in opposite direction.

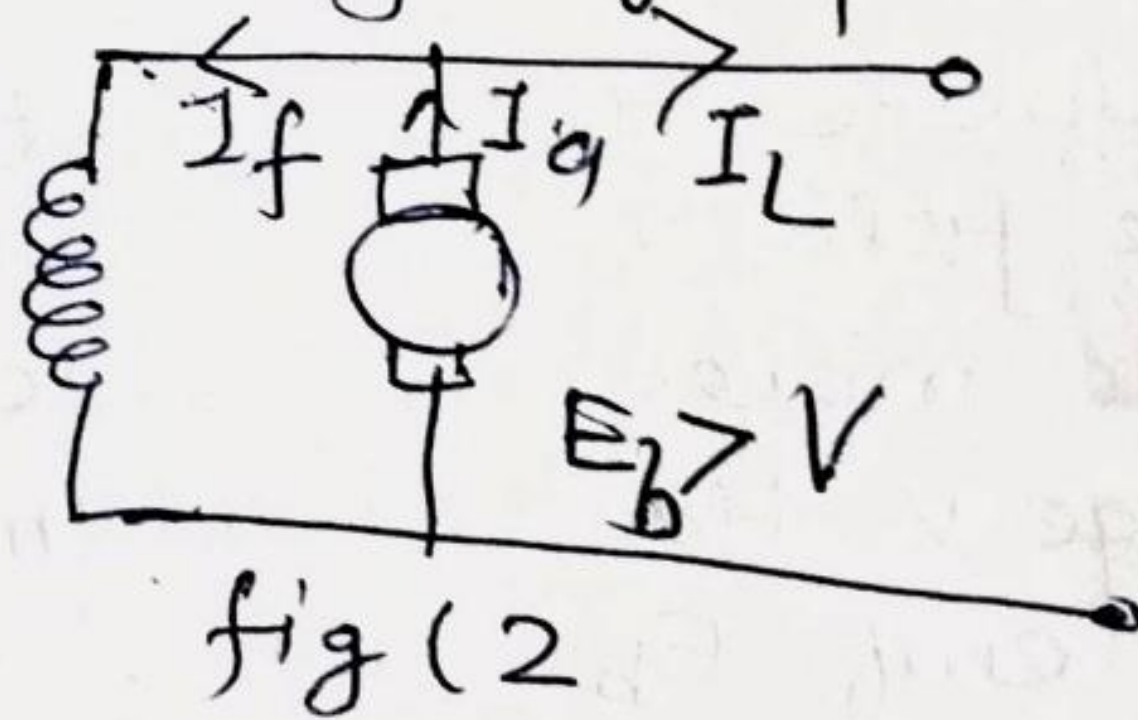
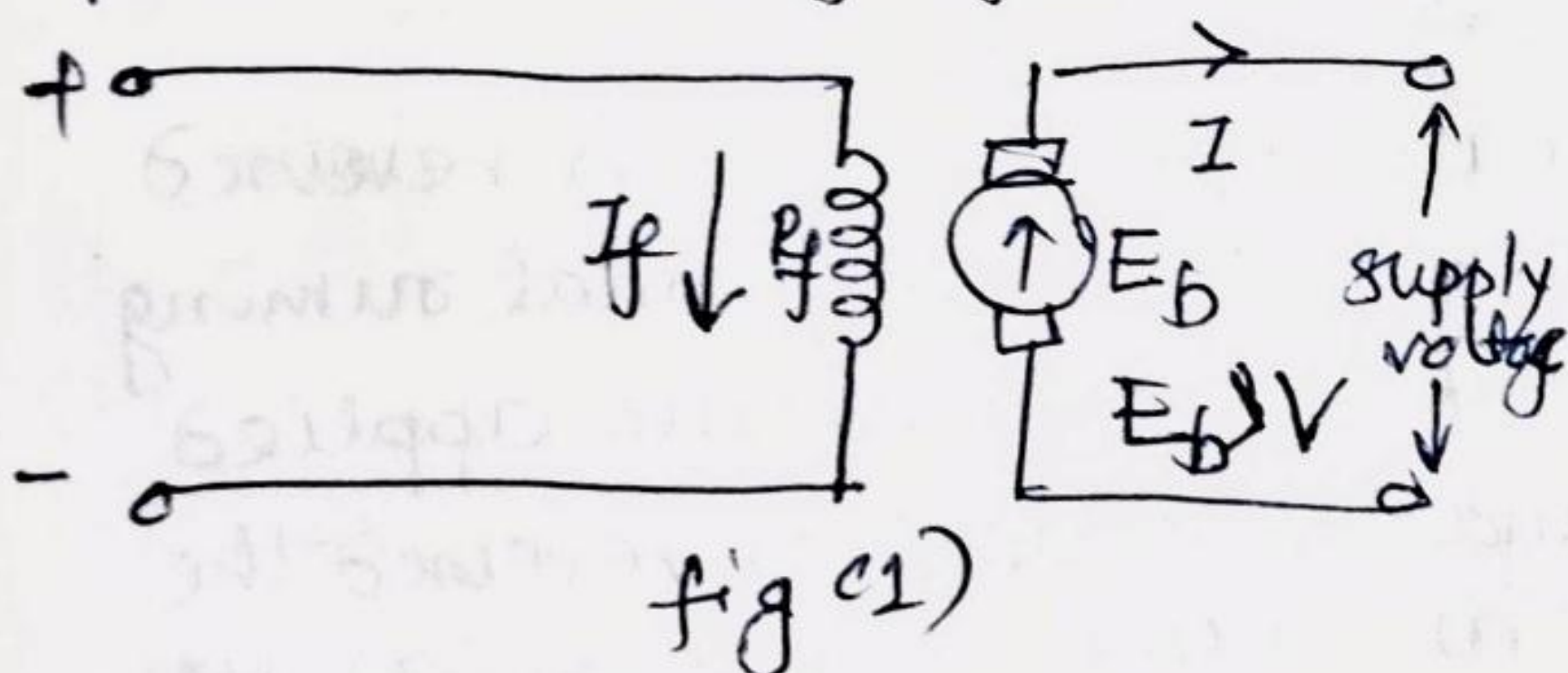


In above diagram, the armature current is reversed while field current remains same. During normal running of the motor the back emf E_b opposes the applied voltage V . However, when armature current is reversed the back emf E_b and V act in same direction as then a voltage of $E_b + V$ is applied across the armature circuit. In order to limit this current the variable resistance is inserted in armature circuit at the time of changing armature connections.

Regenerative braking:-

In this the motor is run as a generator. As a result the kinetic energy of the motor is converted into electrical energy and returned to the supply.

The two methods of regenerative braking are -
a) In one method, field winding is disconnected from the supply and field current is increased by exciting it from another source. As a result, induced emf E exceeds the supply voltage V and machine feeds energy into the supply. Thus braking torque is provided upto the speed at which induced emf and supply voltage are equal. As the machine slows down, it is not possible to maintain induced emf at a higher value than the supply voltage. Therefore, this method is possible only for a limited range of speed.



In the second method, the field excitation does not change but the load causes the motor to rise above normal speed (e.g. descending load on a crane). As a result, the induced emf E becomes greater than the supply voltage V . The direction of armature current I therefore reverses but direction of shunt field current I_f remains unaltered. Hence the torque is reversed and the speed falls until E becomes less than V .



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LECTURE NOTES

Campus: PCE Course: B.Tech Class/Section: III A&C Date:
Name of Faculty: Dr. C. Khemraj Name of Subject: EM-1 Code: 03EE05
Date (Prep.): 28/7/17 Date (Del.): 9/8/17 Unit No.: III Lect. No:

OBJECTIVE: To be written before taking the lecture (Pl. write in bullet points the main topics/concepts etc., which will be taught in this lecture)

1. Operating characteristics of DC motors.
2. Shunt
3. Series
4. Compound motors

IMPORTANT & RELEVANT QUESTIONS:

- Q.1 Draw and explain the characteristics of a DC series motor.
- Q.2 Explain the characteristics of DC shunt motor.

FEED BACK QUESTIONS (AFTER 20 MINUTES):

- Q.1 Explain the characteristics of a compound motor.
- Q.2 Why dc series motor cannot be started on no load conditions.

OUTCOME OF THE DELIVERED LECTURE: To be written after taking the lecture (Pl. write in bullet points about students' feedback on this lecture, level of understanding of this lecture by students etc.)

Excellent.

REFERENCES: Text/Ref. Book with Page No. and relevant Internet Websites:

1. Asfaq Hussain - pp
2. P. S. Bhimbra - pp



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DETAILED LECTURE NOTES

Campus: Course:
Name of Faculty:

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DC motor characteristics

The performance of DC motor can be judged from its characteristics curves known as motor characteristics, following are the three important characteristics of a DC motor

(i) Torque and armature current (T_a / I_a):-

It is a curve between armature torque and the armature current of a DC motor. It is also known as electrical characteristics of a motor

(ii) Speed and armature current (N / I_a):-

It is a curve between speed N and the armature current I_a of a DC motor. It is very important characteristics as it is useful for selection of a particular motor for a given application.

(iii) Speed and torque (N / T_a):-

It is a curve between speed N and armature torque T_a of a DC motor. It is also known as mechanical characteristics.

1. DC shunt motor:-

The field current I_f is constant since the field winding is directly connected to the supply voltage V which is assumed to be constant, hence the flux in shunt motor is also constant.

(i) Torque vs armature current:-

We know in a DC motor

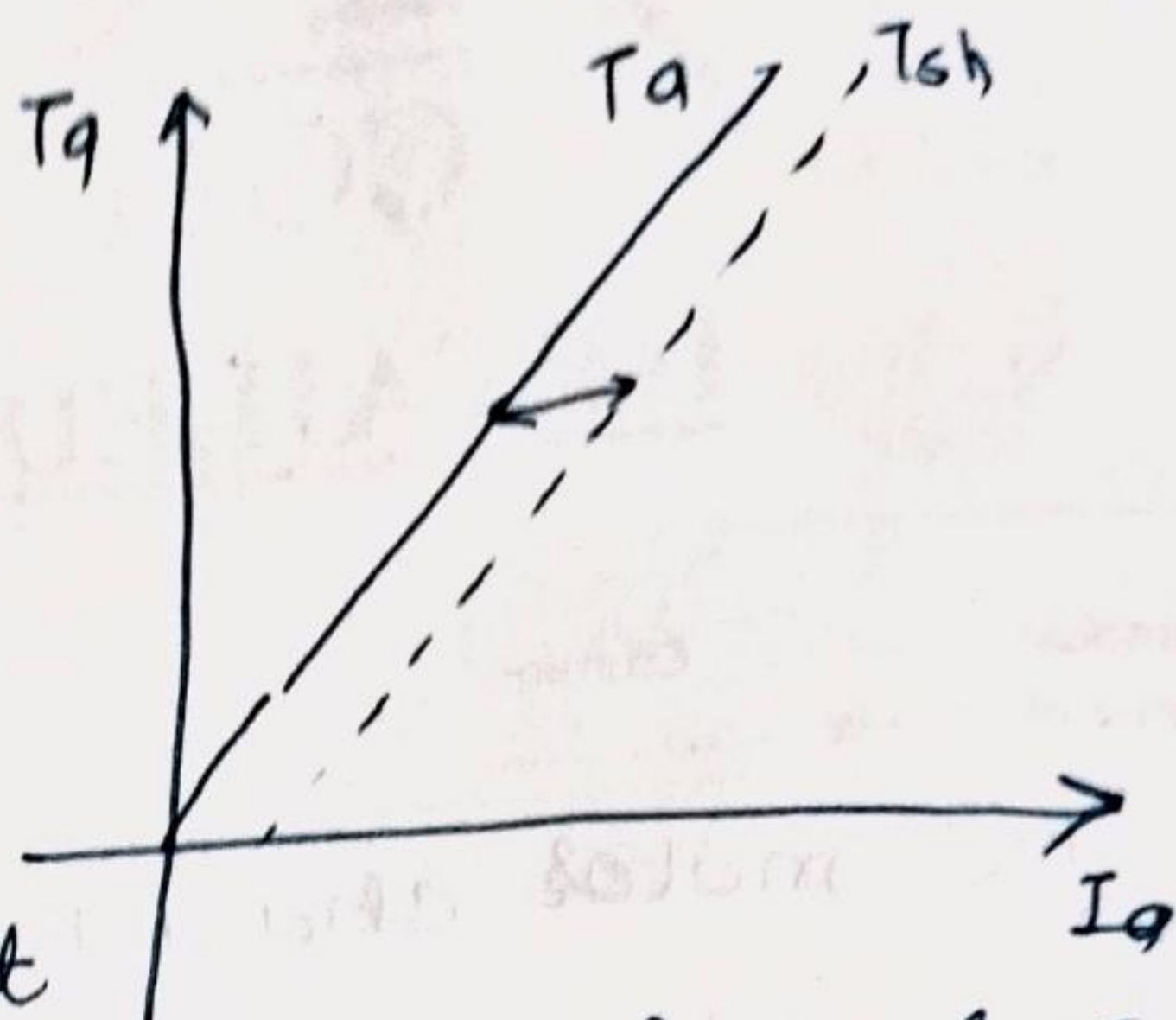
$$T_a \propto \phi I_a$$

also $\phi \propto I_f$ $I_f = \text{constant}$

$$\therefore T_a \propto I_a$$

Hence, it is a straight line passing through the origin.

It is clear from the curve that a very large current is required to start a heavy load. Therefore, a shunt motor should not be started on heavy load.



(ii) speed vs armature current:-

The speed N of motor is given by,

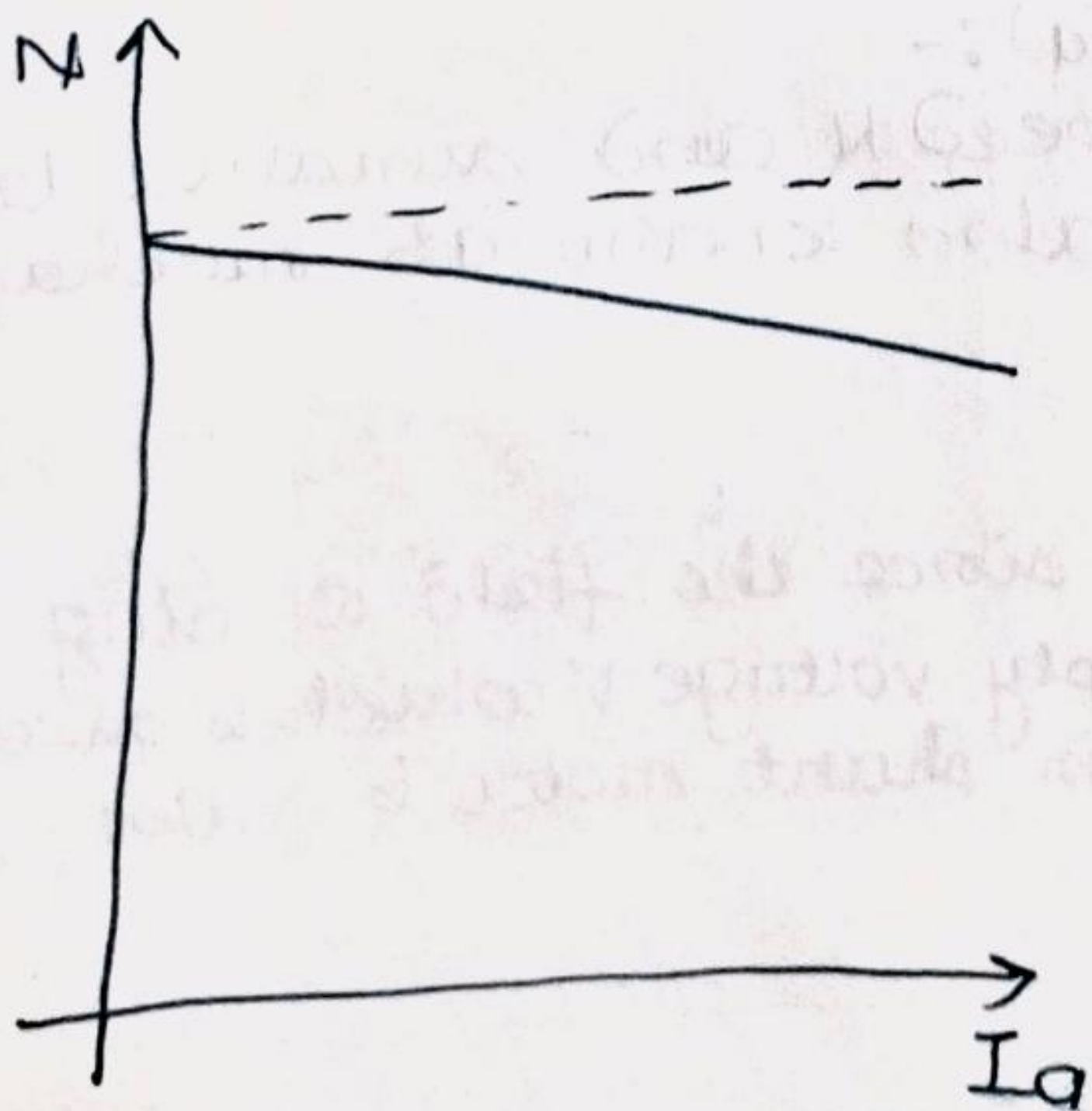
$$N \propto \frac{E_b}{\phi}$$

The flux ϕ and back emf E_b in a shunt motor is almost constant. Therefore, the speed will remain constant with armature current. But in actual

practice we know that

$$E_b = V - I_a R_a$$

hence as I_a increases, $I_a R_a$ increases but E_b decreases therefore the speed decreases slightly with the increase in I_a .



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iii) speed and armature torque :-



we know

$$T_a \propto I_a$$

$$N \propto E_b \propto V - I_a R_a$$

Thus as the I_a increases
 T_a goes on increasing

but then the speed goes on decreasing.

Conclusions :-

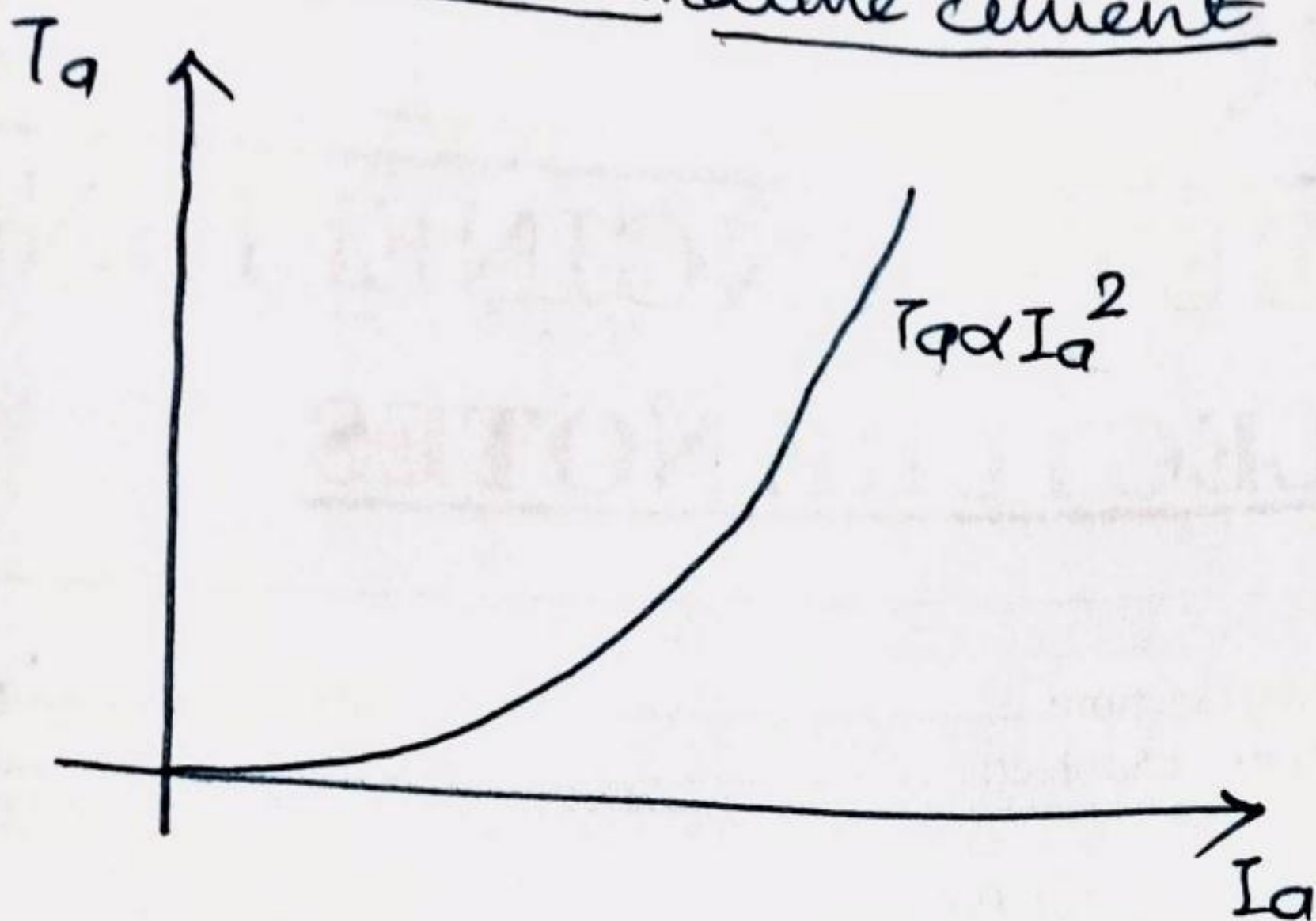
i) There is a slight change in the speed from no load to full load, hence it is basically a constant speed motor.

ii) The starting torque is not high $T_a \propto I_a$

DC series motor :-

In this the current passing through the field winding is same as armature current. If the mechanical load increases, the armature current increases.

4) Torque vs armature current



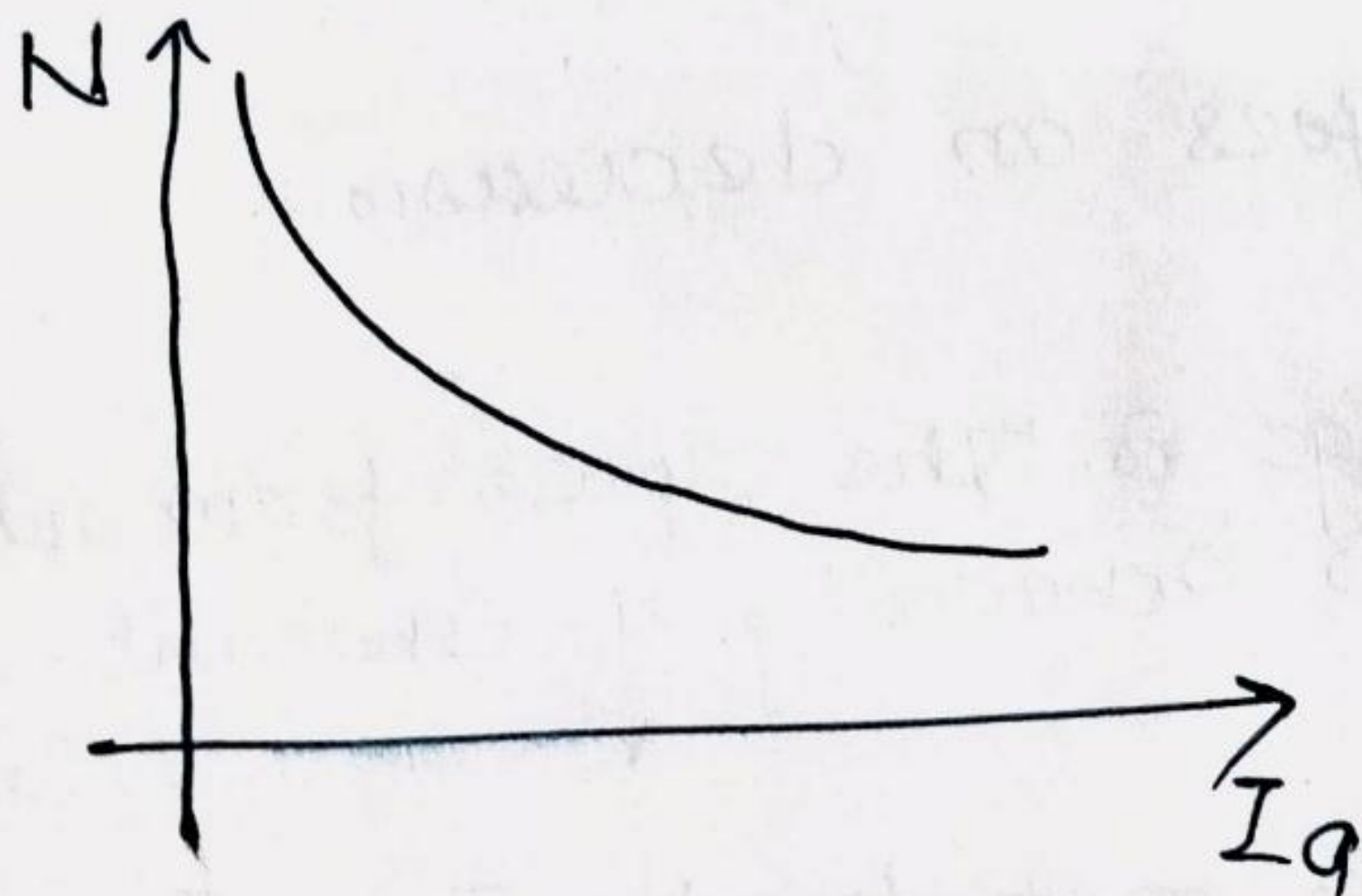
$T_a \propto \phi I_a$
in case of series
motor
 $\phi \propto I_f = I_a$

$$\therefore T_a \propto I_a^2$$

Thus torque is

directly proportional to the square of armature current
This means that the starting torque of a DC series motor will be very high as compared to the DC shunt motor.

(ii) Speed vs armature current:-



we know,

$$N \propto \frac{E_b}{\phi}$$

assuming E_b to be constant

$$N \propto \frac{1}{\phi}$$

also $\phi \propto I_a$

$$N \propto \frac{1}{I_a}$$

Hence with the increase in armature current the speed goes on decreasing.



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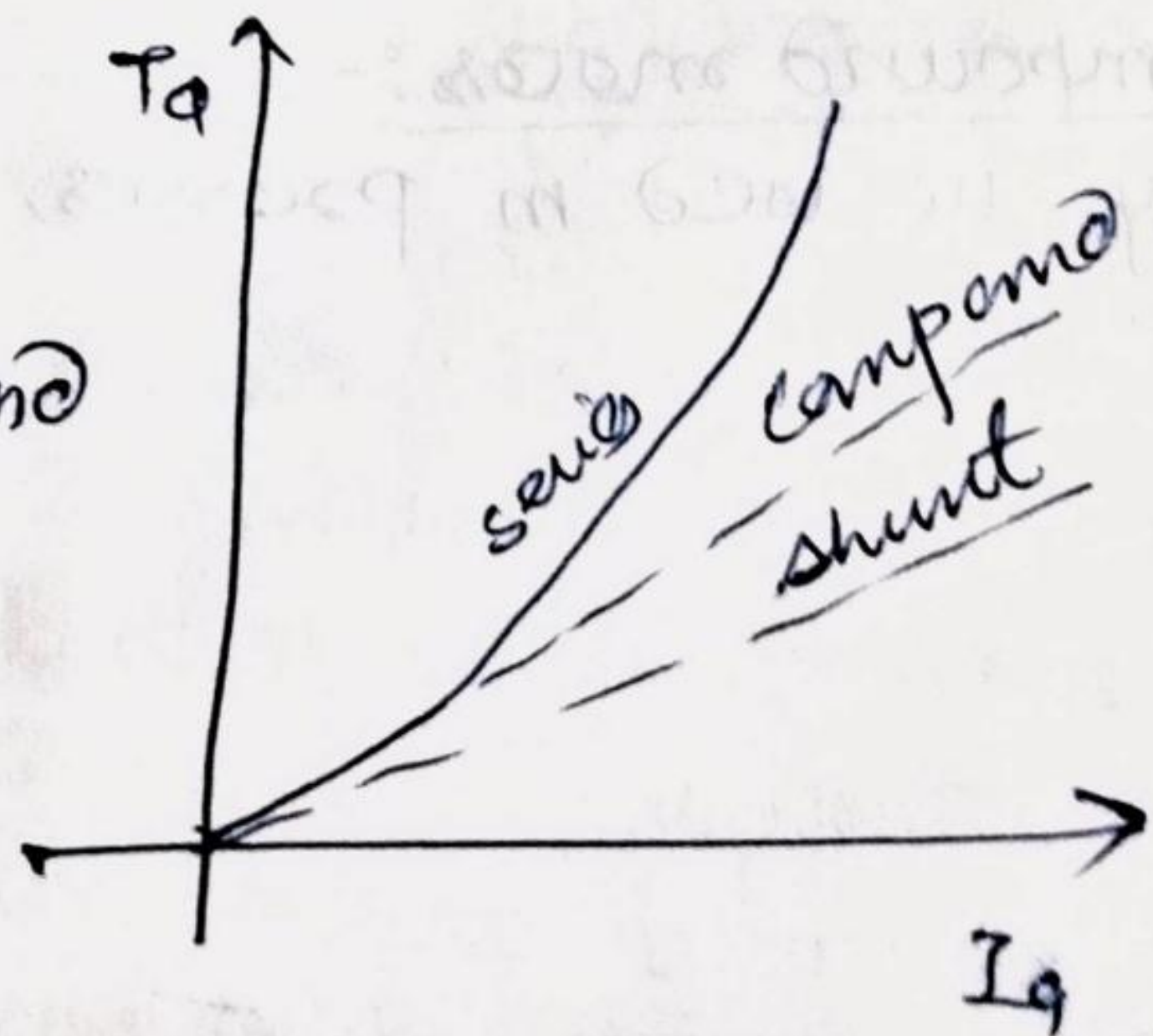
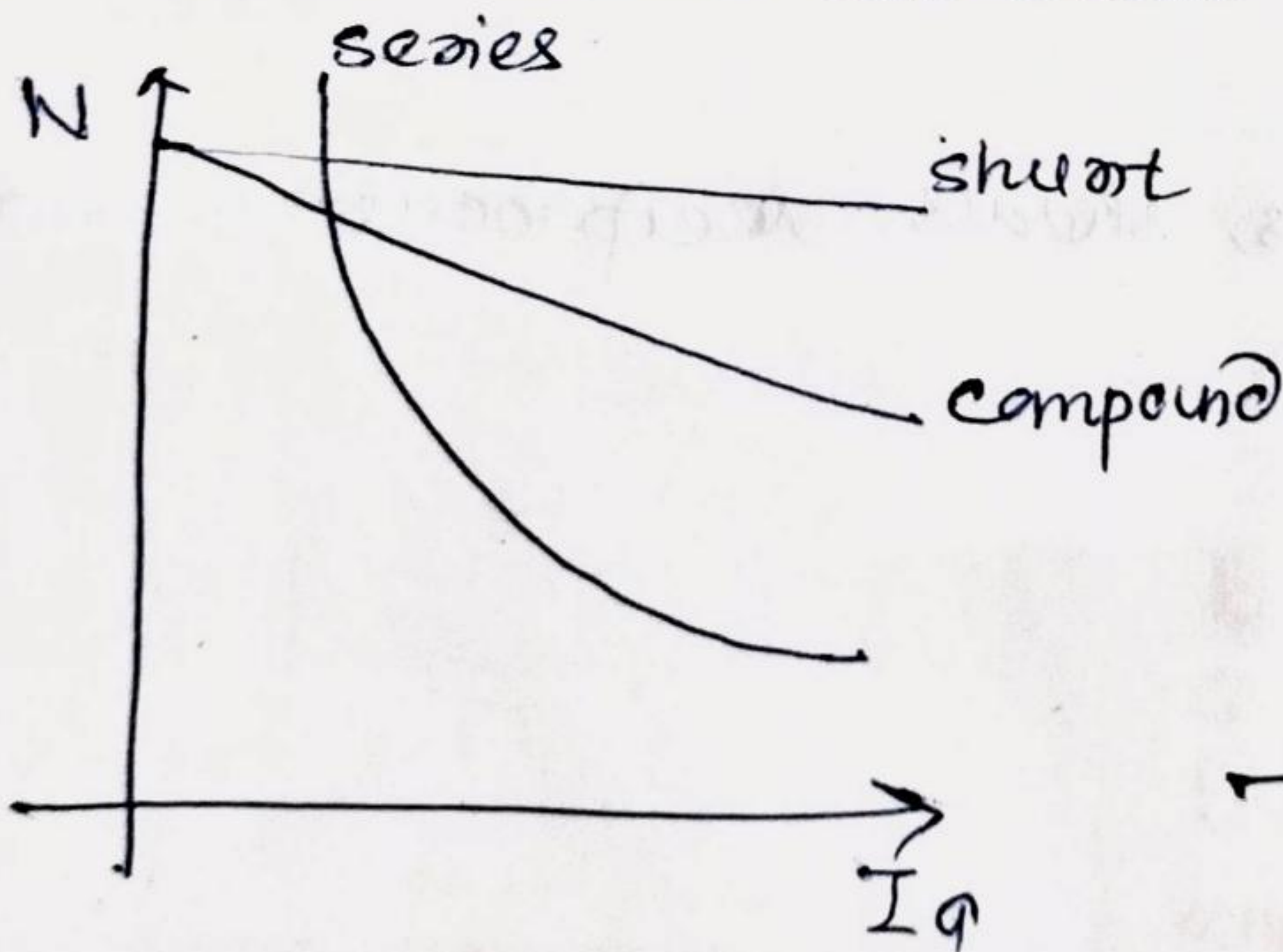
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Comparison of three types of motors:-

- i) The speed regulation of a shunt motor is better than that of series motor. However, speed regulation of a cumulative compound motor lies between shunt and series motor.
- ii) For a given armature current, the starting torque of a series motor is more than that of a shunt motor. However, starting torque of cumulative motor lies between series and shunt motor.



Applications:-

1. DC shunt motor:- It is a constant speed motor hence it is used in
ci) speed requirement is constant,
cii) at no. of speeds with constant values.
Industrial use:- lathes, drills, boring mills, shapers, spinning and weaving machine etc.

2. DC series motor:-

It is a variable speed motor i.e., speed is low ^{at} when the torque is high and vice versa. However at light load, the motor tends to attain the speed dangerously high. It is therefore used to -

- ① Large starting torque is req.
- ② Load is subjected to heavy fluctuations
- ③ Industrial use - electric traction, cranes, elevators, air compressors etc.

3. Compound motor:-

They are used in presses, shears, reciprocating machines etc.

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Compound Motors:-

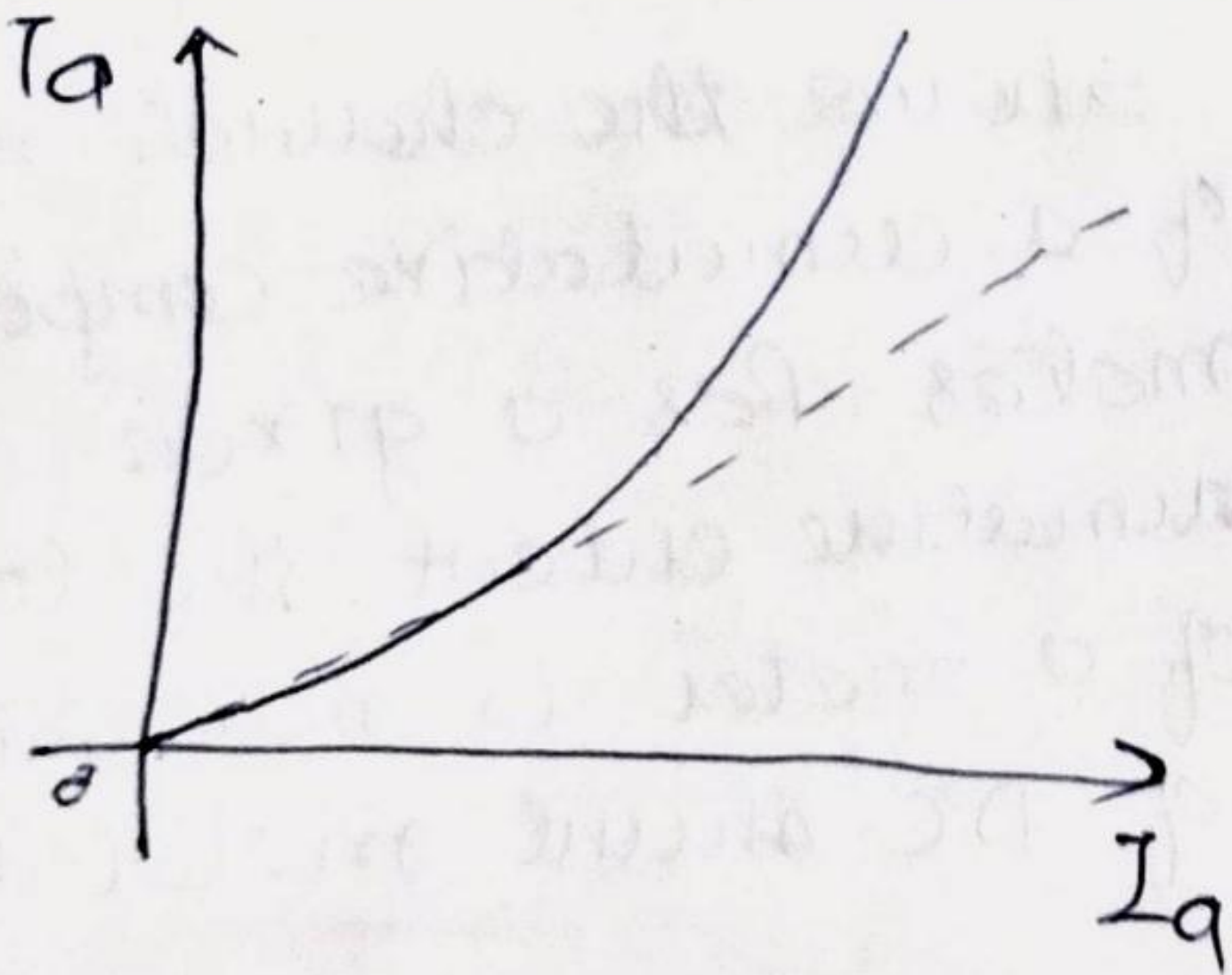
A compound motor has both series and shunt windings. Compound motors are of two types-

- ① Cumulative compound in which both field winding assists each other.
- ② Differential compound in which both field windings oppose one another.

Differential compound motors are rarely used due to their poor torque characteristics on heavy load.

Characteristics of cumulative compound motors:-

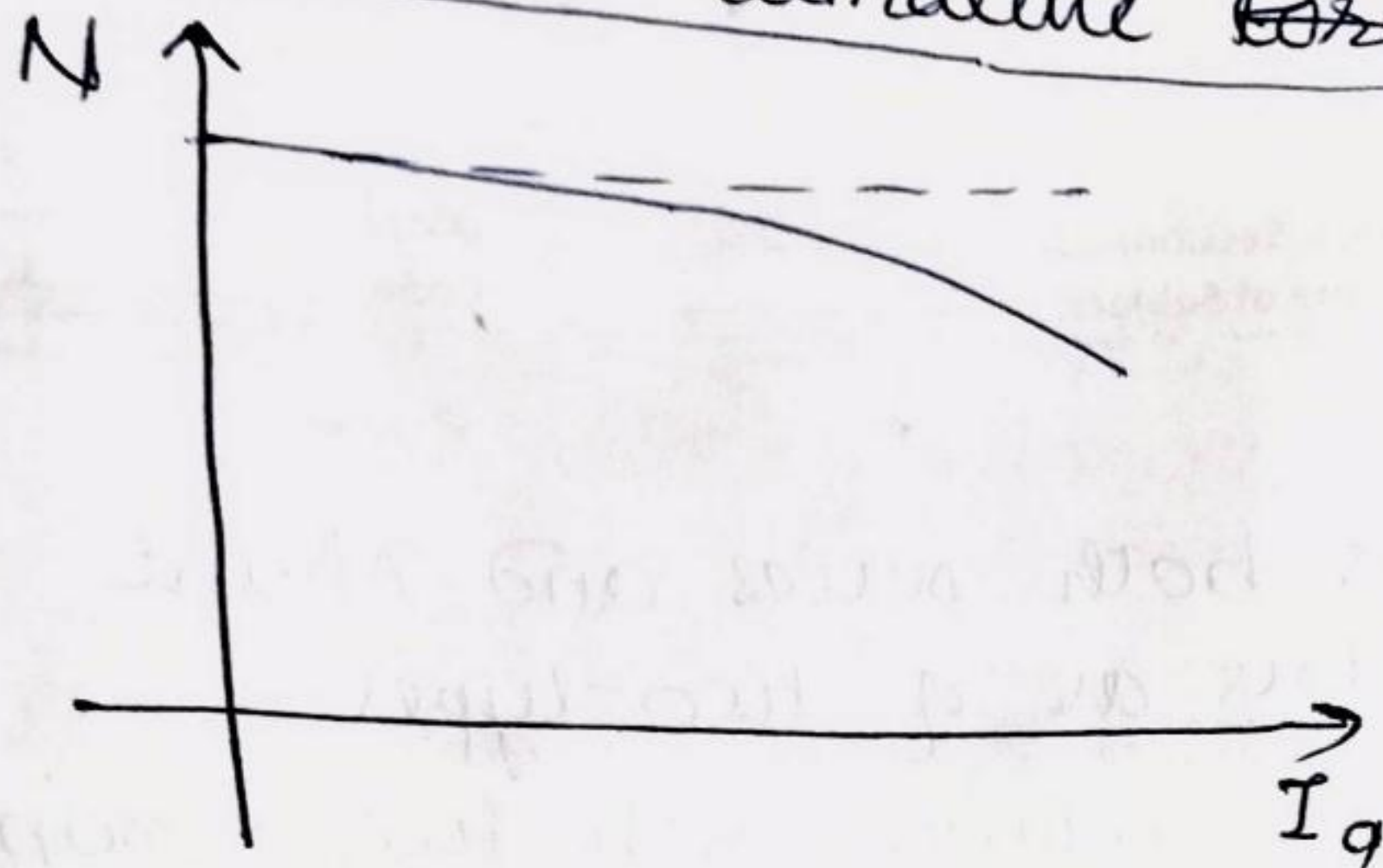
① Torque vs armature current:-



As the load increases, the series field increases but shunt field remains constant. Consequently, the total flux is increased and hence the armature torque ($T_a \propto \phi I_a$). It may

be noted that torque of a cumulative compound motor is greater than that of a DC shunt motor.

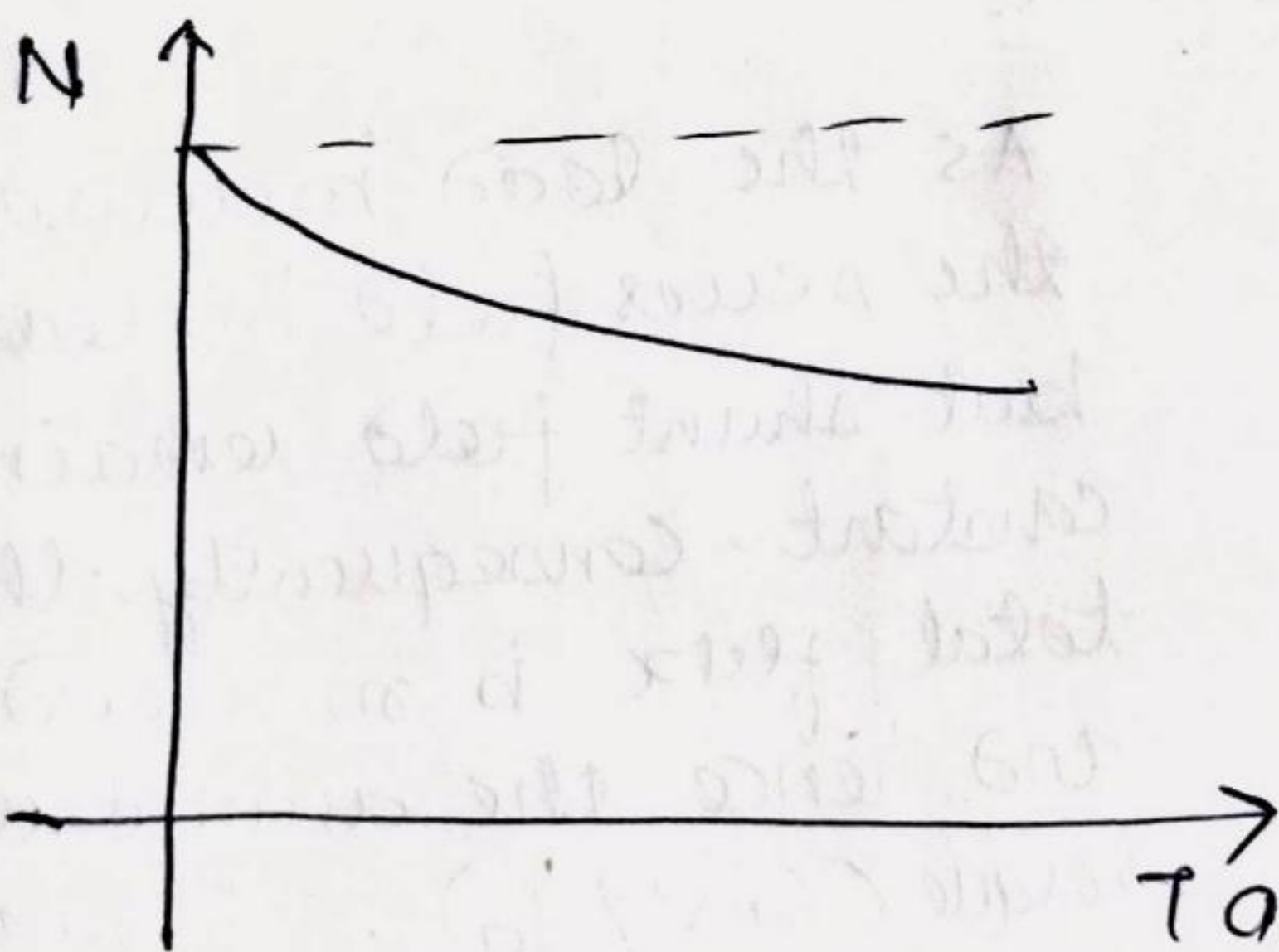
(ii) Speed vs. armature current:-



As explained above, as the load increases, the flux per pole also increases consequently, the speed ($N \propto 1/\phi$) of the motor

falls as the load increases. It may be noted that as load is added the increased amount of flux causes the speed to decrease more than the speed of the DC shunt motor. Thus, speed regulation of a cumulative compound motor is less than of DC shunt motor.

(iii) Speed vs. armature torque:-



shows the characteristic of a cumulative compound motor. For a given armature current, the torque of a motor is more than of DC shunt motor but

less than that of a DC series motor.

Conclusions:- A cumulative compound motor has a characteristics of both shunt & series motors, hence

- (i) It is prevented from running away at no load.
- (ii) Due to series winding, starting torque is increased.



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LECTURE NOTES

Campus: ...PCE... Course: B.Tech... Class/Section: II sem. (A Sec.) Date:
Name of Faculty: Dr. CHEJAN K. KEMPA Name of Subject: EM-I Code: 03.EE.05
Date (Prep.): Date (Del.): Unit No.: III Lect. No:

OBJECTIVE: To be written before taking the lecture (Pl. write in bullet points the main topics/concepts etc., which will be taught in this lecture)

- * Testing of electric motors
- * Swinburne's test
- * Hopkinson's test

IMPORTANT & RELEVANT QUESTIONS:

1. Explain Hopkinson's method of testing of electrical motors.
2. Explain the Swinburns test.

FEED BACK QUESTIONS (AFTER 20 MINUTES):

1. Differentiate between Swinburne's and Hopkinson tests.
2. Can Swinburne Method can be used for testing of DC series motor? Explain.

OUTCOME OF THE DELIVERED LECTURE: To be written after taking the lecture (Pl. write in bullet points about students' feedback on this lecture, level of understanding of this lecture by students etc.)

Excellent.

REFERENCES: Text/Ref. Book with Page No. and relevant Internet Websites:

1. P. S. Bhumbra.
2. Asfaq Hussain.

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DETAILED LECTURE NOTES

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Testing of DC motor :-

Testing of machines used for finding losses, efficiency and temperature rise. Direct method are used for small machines. Indirect method are used for large shunt machines. In practice, Swinburne's and Hopkinson test are mostly used.

Swinburne's test :-

In this method the losses are measured separately and efficiency at any desired load is predetermined.

The iron and friction losses are determined by measuring the input to the machines on no-load the machine being run as a motor at normal voltage and speed. The copper losses are calculated from measured values of the various resistances. The method may be applied to level compound generators and to shunt motors.

Let, V = supply voltage

I_o = input armature current at no-load
(measured by ammeter A_1)

I_{sh} = shunt field ~~resistance~~ current (by A_2)

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No load armature current

$$I_{a0} = I_0 - I_{sh}$$

No load input = $V I_0$ (watts)

Losses, efficiency and testing of DC machines

Power input to armature = $V(I_0 - I_{sh})$

Power input to shunt = $V I_{sh}$

No-load power input supplies the following-

1. Iron losses in core
2. Friction losses
3. Windage losses
4. Armature copper losses

constant losses, $P_{const} = \text{no load input} - \text{no load armature copper loss}$

$$= V I_0 - (I_0 - I_{sh})^2 R_a$$

By knowing the constant losses of a machine, its efficiency at any other load can be determined as follows

Efficiency when the motor is running,

$$I_a = I - I_{sh}$$

where I is the load current at which efficiency is required.

Motor Input = $V I$

Armature copper loss = $I_a^2 R_a = (I - I_{sh})^2 R_a$

constant losses = P_{const}

Total losses = $P_{const} + (I - I_{sh})^2 R_a$

Efficiency of motor, $\eta_m = \frac{\text{input} - \text{losses}}{\text{input}}$

$$= \frac{V I - (I - I_{sh})^2 R_a - P_{const}}{V I}$$

Efficiency when running as a generator,

$$I_a = I + I_{sh}$$

Generator output = $V I$



Pooja

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Armature copper loss = $(I + I_{sh})^2 R_a$

Constant loss = P_{const} (found above)

Total losses = $(I + I_{sh})^2 R_a + P_{const}$

Efficiency of generator,

$$\eta_g = \frac{\text{Output}}{\text{Output} + \text{losses}}$$

$$= \frac{VI}{VI + (I + I_{sh})^2 R_a + P_{const}}$$

Adv:-

- ① Power requirement is very small
- ② The shunt machine is to be run at no load condition requiring little power to be drawn from the supply based on no load loading, efficiency can be predicted for any load current.

Disadv:-

- ① This test cannot be applied to the series motor because the speed becomes dangerously high for a DC series motor on no-load.
- ② Iron losses can increase upto 50% in some cases.

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Hopkinson test (Back to Back test or Regenerative Test) :-

Through this test full load testing of DC shunt machines can be carried out, mainly identical ones. In this test, power drawn from the supply only corresponds to the no load losses of the machine. Electrically these two machines are mechanically connected in parallel and controlled in such a way that one machine act as generator and the other as a motor. The output of the motor is used to drive the generator and the electrical output of generator is used as an input to the motor. Both motor and generator would have run without any external power supply, if there are no losses in the machine. But due to losses, generator output is not sufficient to drive the motor and vice-versa.

Procedure :-

To perform the test, following procedure is adopted. Machine M is started through a starter and its field rheostat is adjusted so that it runs at normal speed. The machine M will drive machine G. The switch 'S' is initially kept open.

The excitation of machine G is gradually increased by decreasing the field circuit resistance till the voltmeter V_1 reads zero. Then the switch S is closed. Machine G is now floating neither taking any current from supply nor delivering any current. The machine with lower excitation will act as a motor and other as a generator.

The power input to the set is only that is required to meet the losses. The electrical o/p of the generator plus the small power taken from it is taken by the motor.

V = Supply voltage

I_1 = o/p current of generator

I_2 = current taken from supply

I_3 = exciting current of generator

I_4 = exciting current of motor

R_a = armature resistance of each machine

Motor input = $V(I_1 + I_2)$

Generator output = $V I_1$

If both machines have same efficiency η , then

output of motor = $\eta \times \text{input}$

= $\eta V(I_1 + I_2)$ = generator input

output of generator = $\eta \times \text{input}$

= $\eta^2 V(I_1 + I_2)$

If both are equal, then

$\eta^2 V(I_1 + I_2) = V I_1$

$\eta = \sqrt{\frac{I_1}{I_1 + I_2}}$

Merits:-

- ① less power requirement as compared to full load power of the two machines.
- ② Both temp. rise and commutation qualities of the machines can be calculated
- ③ Any change in iron loss is being taken care.
- ④ Efficiency can be determined at diff. loads.

Demerits:-

- ① Two identical machines are required hence more costly.

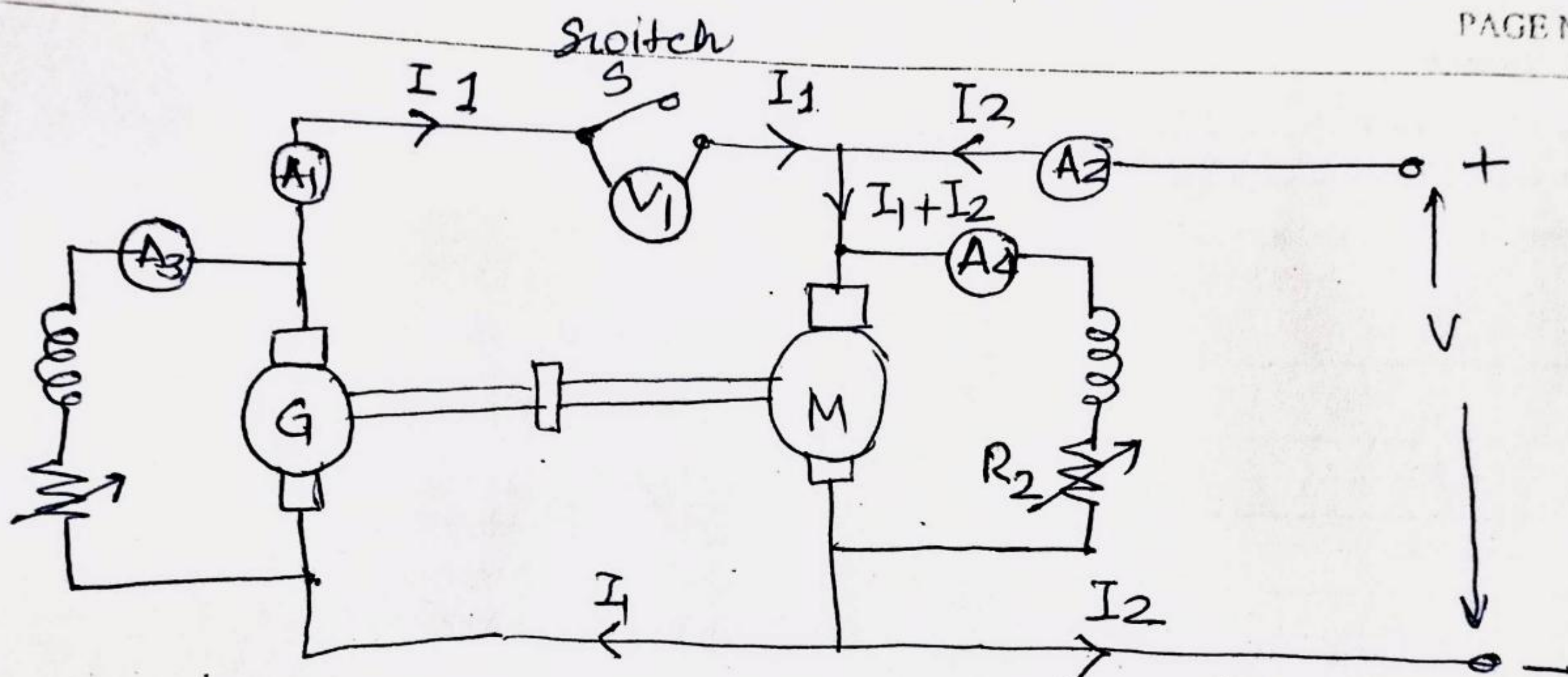


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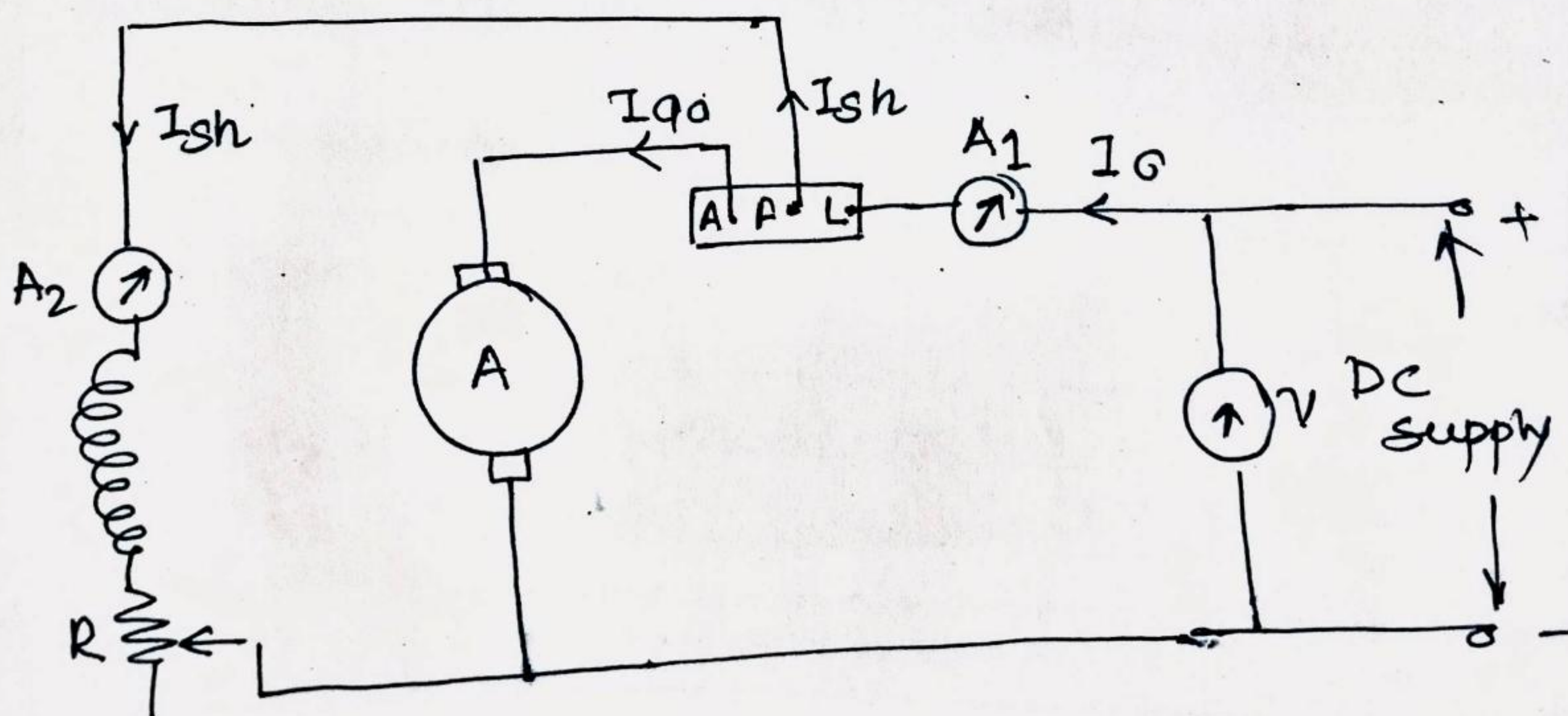
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Hopkinson's test



Swinburne's test



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LECTURE NOTES

Campus: ...PCE... Course: B.Tech... Class/Section: ...III... (C.A.S.C.)... Date:
Name of Faculty: Dr. CHETAN KHEMPA Name of Subject: Elec. M/C-1 Code: 03.EEC5
Date (Prep.): Date (Del.): Unit No.: ...III... Lect. No:

OBJECTIVE: To be written before taking the lecture (Pl. write in bullet points the main topics/concepts etc., which will be taught in this lecture)

- * Speed control by varying the armature circuit resistance
- * speed control by varying the speed control field flux method.

IMPORTANT & RELEVANT QUESTIONS:

- Q.1 How speed control can be done in case of DC shunt motor?
- Q.2 Explain field flux control method.

FEED BACK QUESTIONS (AFTER 20 MINUTES):

- Q.1. Describe the armature control method
- Q.2 Give the advantages and disadvantages of both systems.

OUTCOME OF THE DELIVERED LECTURE: To be written after taking the lecture (Pl. write in bullet points about students' feedback on this lecture, level of understanding of this lecture by students etc.)

Excellent.

REFERENCES: Text/Ref. Book with Page No. and relevant Internet Websites:

1. Asfaq Hussain.
2. P. S. Bhombra

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DETAILED LECTURE NOTES

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Speed control of DC motor

The principle advantage of a DC motor is that its speed can be changed over a wide range by a variety of simple methods. Such, a fine speed control is generally not possible with ac motors. In fact, fine speed control is one of the reasons for the strong competitive position of DC motors in modern industrial applications.

The speed of a DC motor is given by -

$$N \propto \frac{E_b}{\phi}$$

$$N = \frac{k(V - I_a R_a)}{\phi} \quad \begin{aligned} R &= R_a \text{ (shunt motor)} \\ &= R_a + R_f \text{ (series motor)} \end{aligned}$$

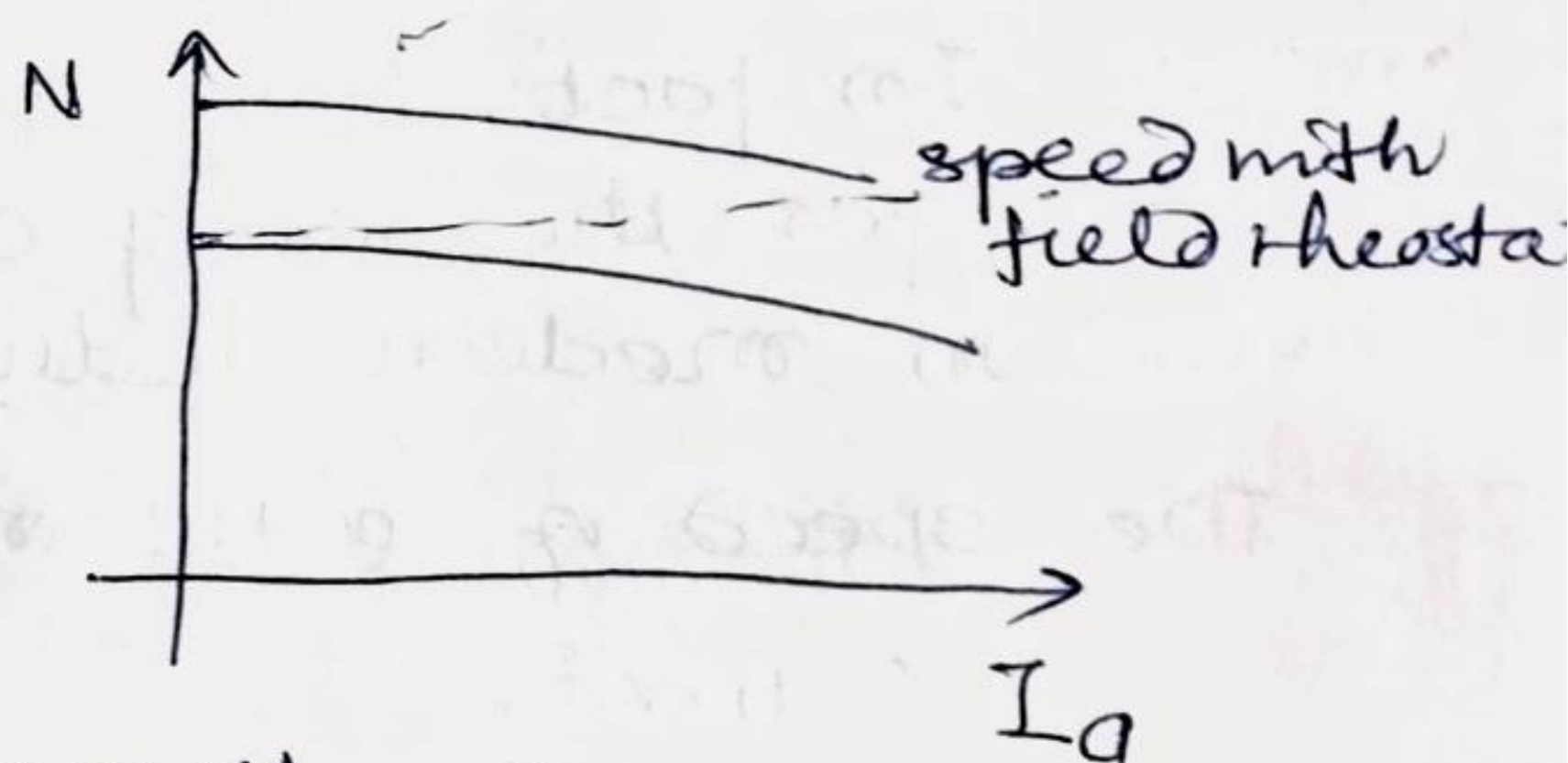
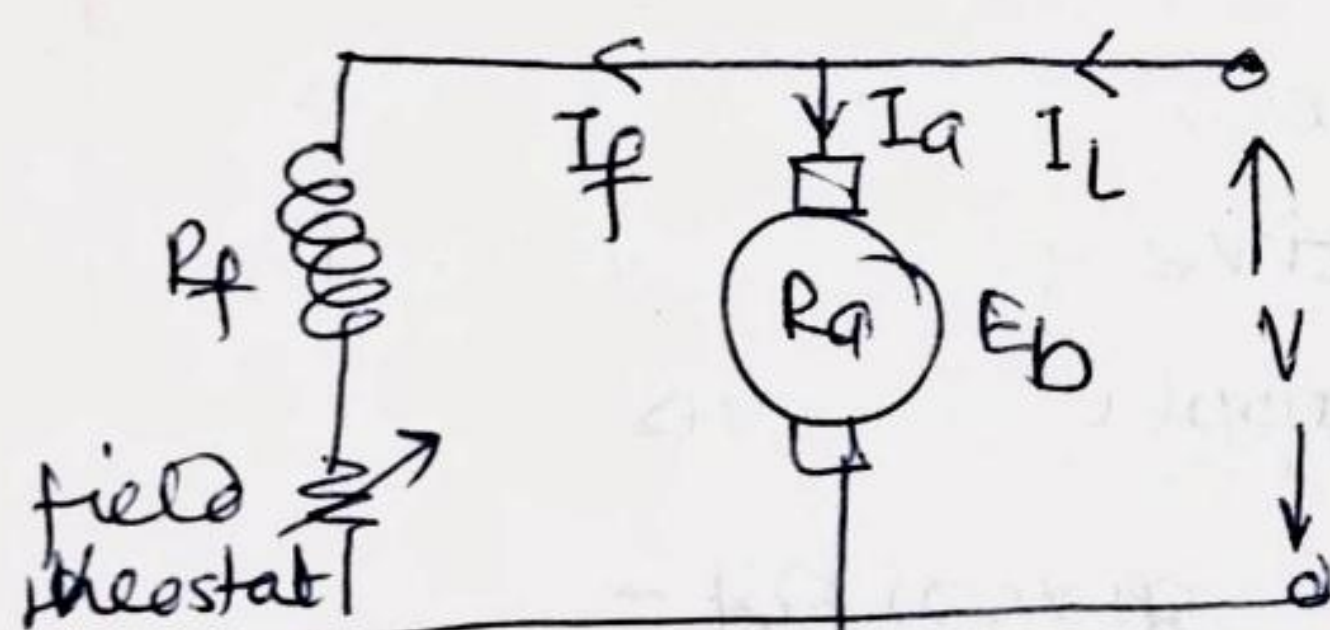
Hence, basically there are two methods of controlling speed of a DC motor as

(i) By varying flux per pole (ϕ) - called as flux control method

(ii) By varying the armature resistance, called as the armature control.

Speed control of shunt motor:-

1. Flux control method:- It is based on the fact that by varying the flux ϕ , the motor speed ($N \propto \frac{1}{\phi}$) can be changed and hence the name flux control method. In this method, a variable resistance (known as the shunt field ~~resistance~~ ^{rheostat}) is placed in series with the shunt field winding as shown.



The shunt field rheostat reduces the shunt current I_f and hence the flux ϕ , hence the speed of DC motor is increased above the rated value. As

$$N \propto \frac{1}{\phi}, \text{ flux decreases, speed increases}$$

Adv:- (i) It is an easy and convenient method
(ii) Very little power is wasted in shunt field rheostat due to small value of I_f .

Disadv:- (i) Only speed higher than rated value are obtained.
(ii) The field cannot be weakened too much as will cause problems in commutation.

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DETAILED LECTURE NOTES

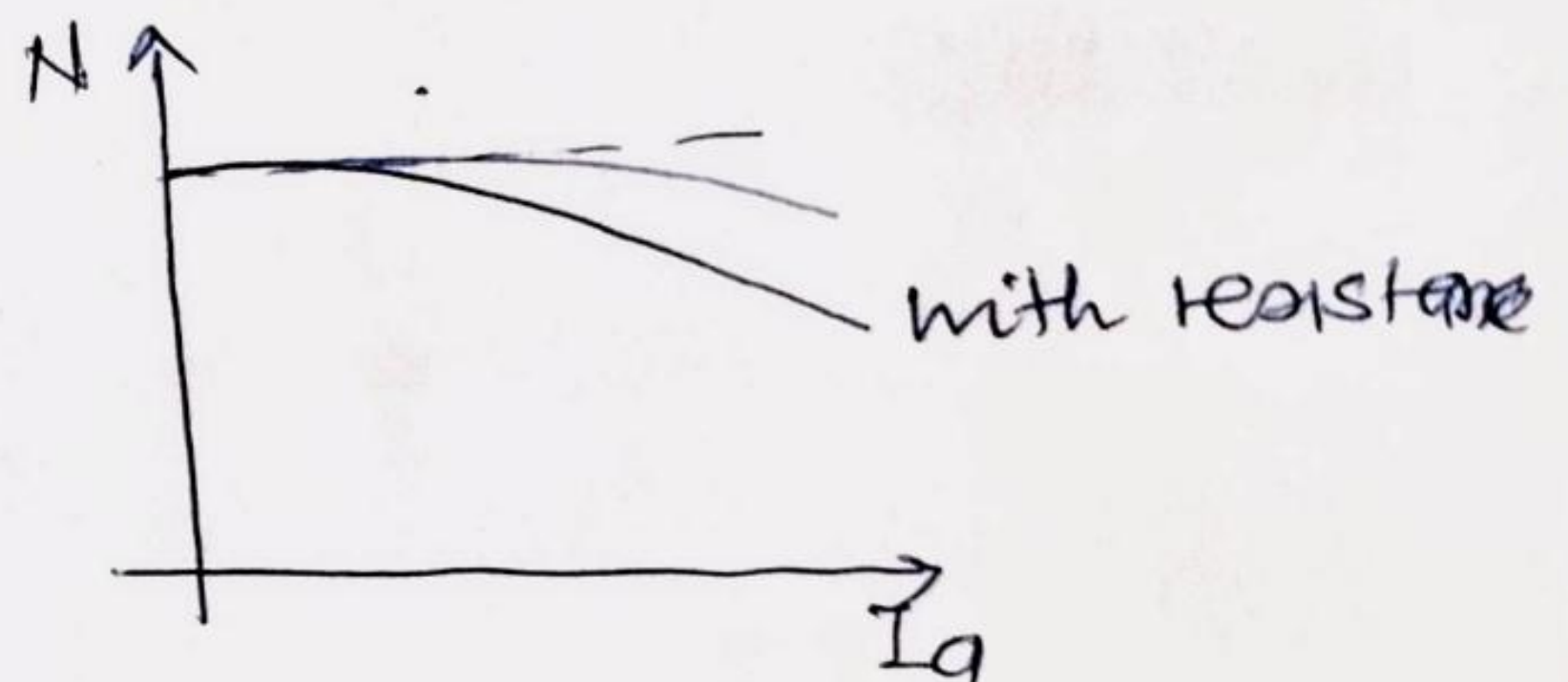
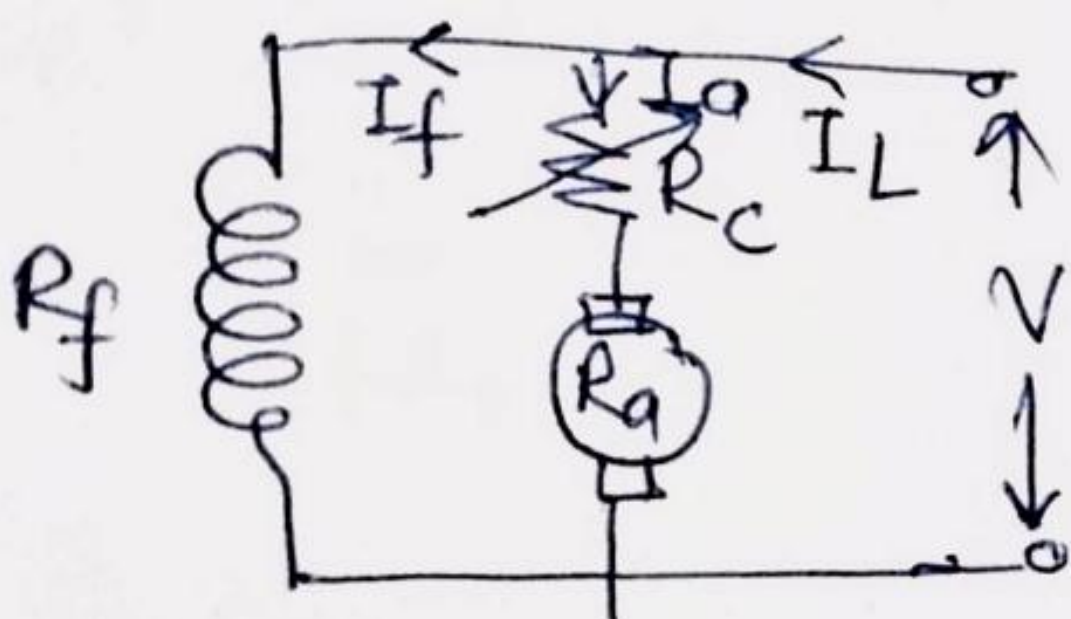
Campus: Course:
Name of Faculty:

Class/Section:
Name of Subject:

Date:
Code:

Armature control :-

This method is based on the fact that by varying the voltage available across the armature, the back emf and hence speed of the motor can be changed. This is done by inserting a variable resistance R in series with the armature.



$$N \propto \frac{E_b}{\phi} \propto V - I_a(R_a + R_c) \quad [\phi = \text{constant}]$$

Due to the voltage drop in controller resistance (R_c) the back emf is decreased, since $N \propto E_b$, the speed of the motor is reduced. The highest speed is that corresponding to $R_c = 0$ i.e. normal speed. Hence, this method can provide speeds below the normal speed.

Disadvantages

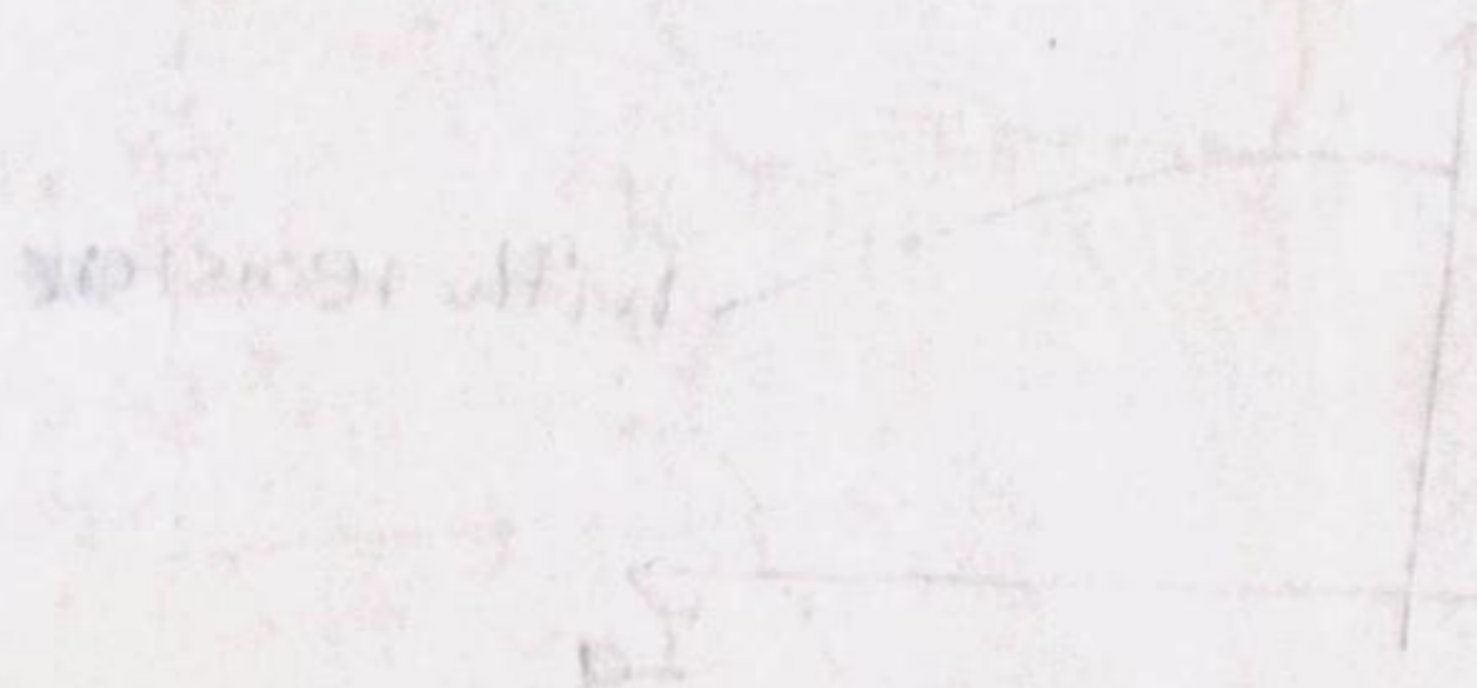
i) The efficiency is reduced.



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(ii) Methods result in peak speed regulation.





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LECTURE NOTES

Campus: P.C.E. Course: B.Tech. Class/Section: III CA & C Date:
Name of Faculty: Dr. Chelān Khemraj Name of Subject: EM-I Code: CBEE05
Date (Prep.): Date (Del.): Unit No.: IV Lect. No:

OBJECTIVE: To be written before taking the lecture (Pl. write in bullet points the main topics/concepts etc., which will be taught in this lecture)

- * Construction and working principle of working transformer.
- * Core type & shell type

IMPORTANT & RELEVANT QUESTIONS:

- Q.1. Describe the principle of operation of a single phase transformer.
- Q.2 Explain in detail the construction of a single phase transformer.

FEED BACK QUESTIONS (AFTER 20 MINUTES):

- Q.1 Explain about tank circuit and accessories in a transformer.
- Q.2 what are power transformers

OUTCOME OF THE DELIVERED LECTURE: To be written after taking the lecture (Pl. write in bullet points about students' feedback on this lecture, level of understanding of this lecture by students etc.)

Excellent

REFERENCES: Text/Ref. Book with Page No. and relevant Internet Websites:

P.S. Bhimbara
Asfaq Hussain

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DETAILED LECTURE NOTES

Campus: Course:
Name of Faculty:

Class/Section:
Name of Subject:

Date:
Code:

EMF equations of transformer:-

The flux in iron core is sinusoidal in nature

$$\phi = \phi_{max} \sin \omega t$$

The primary self induce emf is

$$e_1 = -N_1 \frac{d\phi}{dt} \quad (\text{Lenz's law})$$

$$= -N_1 \frac{d}{dt} (\phi_{max} \sin \omega t)$$

$$= -N_1 \omega \phi_{max} \cos \omega t$$

$$= N_1 \omega \phi_{max} \sin(\omega t - \frac{\pi}{2}) \quad \text{--- (1)}$$

$$\text{When } \sin(\omega t - \frac{\pi}{2}) = 1 \quad E_1 = E_{max}$$

$$\therefore E_{max} = N_1 \omega \phi_{max} \quad \text{--- (2)}$$

~~Combining~~ eqn (1) & (2)

$$e_1 = E_{max} \sin(\omega t - \frac{\pi}{2})$$

$$\text{Similarly } e_2 = E_{max} \sin(\omega t - \frac{\pi}{2})$$

RMS value is $e_{rms} = 1.414 e_{av}$

$$E_1 = 1.414 E_{max} \sin(\omega t - \frac{\pi}{2})$$

$$E_2 = 1.414 E_{max} \sin(\omega t - \frac{\pi}{2})$$

Taking a ratio of

$$\frac{E_2}{E_1} = \frac{N_2}{N_1} = K = \text{turns ratio.}$$



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LECTURE NOTES

Campus: PCE Course: B.Tech Class/Section: III (A & C) Date:
Name of Faculty: Dr. CHEJAN KHEMRAJ Name of Subject: EM-I Code: 03EE0
Date (Prep.): Date (Del.): Unit No.: III Lect. No:

OBJECTIVE: To be written before taking the lecture (Pl. write in bullet points the main topics/concepts etc., which will be taught in this lecture)

- * Ideal transformer
- * Transformer at no load

IMPORTANT & RELEVANT QUESTIONS:

- Q.1 Define an ideal transformer.
- Q.2 Draw and explain the no load phasor diagram of a transformer.

FEED BACK QUESTIONS (AFTER 20 MINUTES):

- Q.1 How does a practical transformer differs from an ideal transformer.
- Q.2 Derive the emf equation of a transformer?

OUTCOME OF THE DELIVERED LECTURE: To be written after taking the lecture (Pl. write in bullet points about students' feedback on this lecture, level of understanding of this lecture by students etc.)

REFERENCES: Text/Ref. Book with Page No. and relevant Internet Websites:



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DETAILED LECTURE NOTES

PAGE NO.

Transformers:

Transformers are used to transform voltage from one level to another without change in frequency. This they do by applying the principle of Faraday's law of electromagnetic induction. Faraday's law states that a voltage appears across the terminals of an electric coil when the flux linkage associated with the same changes.

The emf is proportional to the change of flux linkages. Putting mathematically,

$$e = -N \frac{d\phi}{dt}$$

where e is induced emf and ϕ is flux linkages in coils and N is the no. of turns.

Arrangement of change of flux linkage can be brought about in three ways which are as following -

- 1) Coil may be static and unmoving but the flux linking with the same may change with time eg transformers.

- 2) Flux linkages may be constant and not changing with time but the coil may move in space motor.

- 3) Both 1 and 2 above may take place. The flux space.



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Construction :-

Transformers used in practice are of extremely large variety depending upon the end use. Here more common constructional aspects alone are discussed. They can be broadly divided into five categories -

1. Core construction: Magnetic circuit consists of limbs (core), yokes and clamping structures (providing flux path).
2. Winding arrangements:-
Electric circuit consisting of primary and secondary winding. Dielectric circuit consisting of insulation in different forms and used at different places in transformers.
3. Insulation aspects:- Dielectric circuit consisting of insulation in different forms and used at different places in transformers.
4. Cooling aspects of transformers.
5. Tank and accessories.

Transformer core for power frequency application is made of highly permeable material. The high value of permeability helps to give a low reluctance, for the path of the flux and lines of fluxes mostly confine to the iron core. We moved from Hot rolled non-oriented to Hot rolled grain oriented steel, Cold rolled grain oriented High B grades.



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LECTURE NOTES

Campus: ...DCE... Course: B.Tech... Class/Section: III C.A. & C... Date:
Name of Faculty: Dr. Chetan Khemud Name of Subject: EM-I Code: 03EE05
Date (Prep.): Date (Del.): Unit No.: III Lect. No:

OBJECTIVE: To be written before taking the lecture (Pl. write in bullet points the main topics/concepts etc., which will be taught in this lecture)

- * Equivalent circuit of transformer.
- * Development of equivalent ckt. of a transformer.

IMPORTANT & RELEVANT QUESTIONS:

- * Derive the approximate and simplified circuit of a transformer. Give assumptions made
- * By which tests we can draw an equivalent circuit of a transformer.

FEED BACK QUESTIONS (AFTER 20 MINUTES):

- * What is transformation ratio?
- * How does induced emf and voltages differ in case of transformer? Explain with suitable equations.

OUTCOME OF THE DELIVERED LECTURE: To be written after taking the lecture (Pl. write in bullet points about students' feedback on this lecture, level of understanding of this lecture by students etc.)

Excellent

REFERENCES: Text/Ref. Book with Page No. and relevant Internet Websites:

1. Asfaq Hussain
2. P. S. Bhimbasa.

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DETAILED LECTURE NOTES

Campus: Course:
Name of Faculty:

Class/Section:
Name of Subject:

Date:
Code:

Transformer on no load:-

A transformer is said to be on no load, if its primary winding is connected to the supply and secondary is open. When the transformer is operating on no load the current in secondary winding is zero, while the primary winding carries a small current I_0 consisting of two components

- (i) A reactive or magnetising component (I_m) and
- (ii) An active or power component i.e. I_e

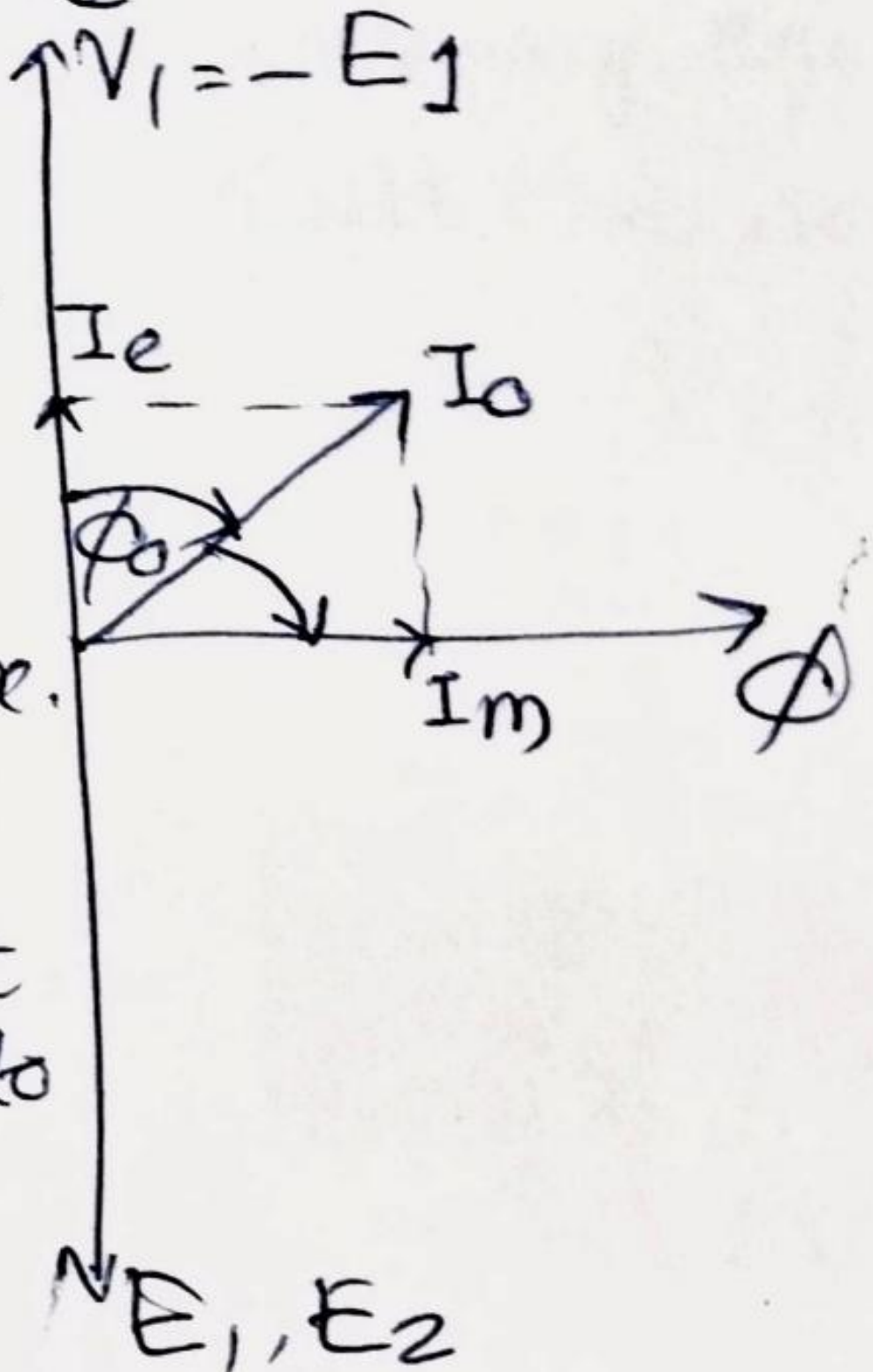
(a) I_m :- This component is in quadrature with V_1 as shown. Its function is to sustain the alternating flux in the core. It is also termed as wattless component, $I_m = I_0 \sin \phi_0$

The function of the magnetisation current is to produce the magnetic flux.

(b) I_e :- This component will be in phase with V_1 . The function of this component is to supply the iron loss in addition to small quantity of copper loss

$$I_e = I_0 \cos \phi_0$$

Active component produces the necessary real power to the supply the hysteresis & eddy current losses in the





iron core and negligible copper losses in the primary windings

This component of no load current is in phase with applied voltage. Normally, the active component (I_e) is very small as compared to the magnetising component (I_m) of no load current I_0

I_0 is the vector sum of I_e and I_m

$$I_0 = \sqrt{I_e^2 + I_m^2}$$

Conclusion:-

- (i) The no load current is less than 1% of full load current
- (ii) The no load primary input or supply is practically equal to the iron loss.



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DETAILED LECTURE NOTES

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Name of Subject:

Date:
Code:

The equivalent circuit can be simplified by transforming the secondary resistances and reactances to the primary side in such a way that ratio of E_2 to I_2 is not affected in magnitude or phase. Let R_2' be the resistance which may be placed in the primary circuit to produce the same voltage drop as R_2 produced in the secondary windings.

Then R_2' causes a voltage drop in primary equal to $I_1' R_2$. The ratio of $I_1' R_2$ and $I_2 R_2$ must be same as turns ratio N_2/N_1 .

$$\frac{I_1' R_2}{I_2 R_2} = \frac{N_2}{N_1} = \frac{I_2 R_2}{I_1' R_2'}$$

$$R_2' = \left(\frac{I_2}{I_1'}\right) \left(\frac{N_1}{N_2}\right) \times R_2$$

$$R_2' = \frac{1}{K} \times \frac{1}{K} \times R_2 = \frac{R_2}{K^2}$$

Referred to primary:-

Total resistance referred to primary

$$R_{01} = R_1 + R_2' = R_1 + \frac{R_2}{K^2}$$

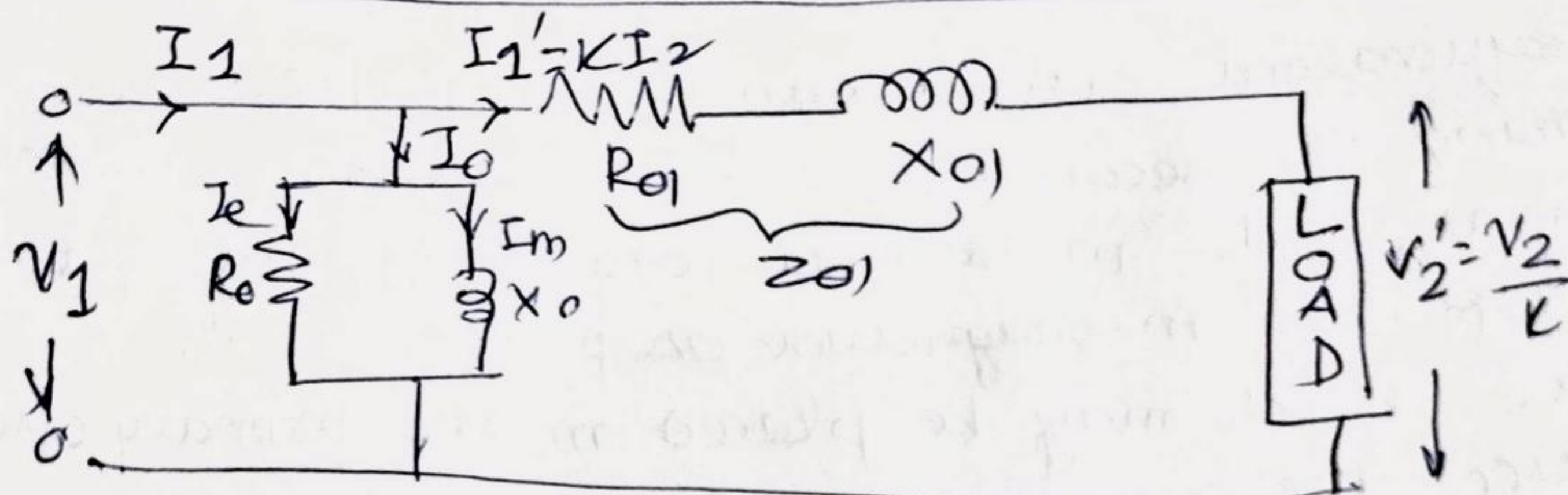
$$X_{01} = X_1 + X_2' = X_1 + \frac{X_2}{K^2}$$

Referred to secondary side:-

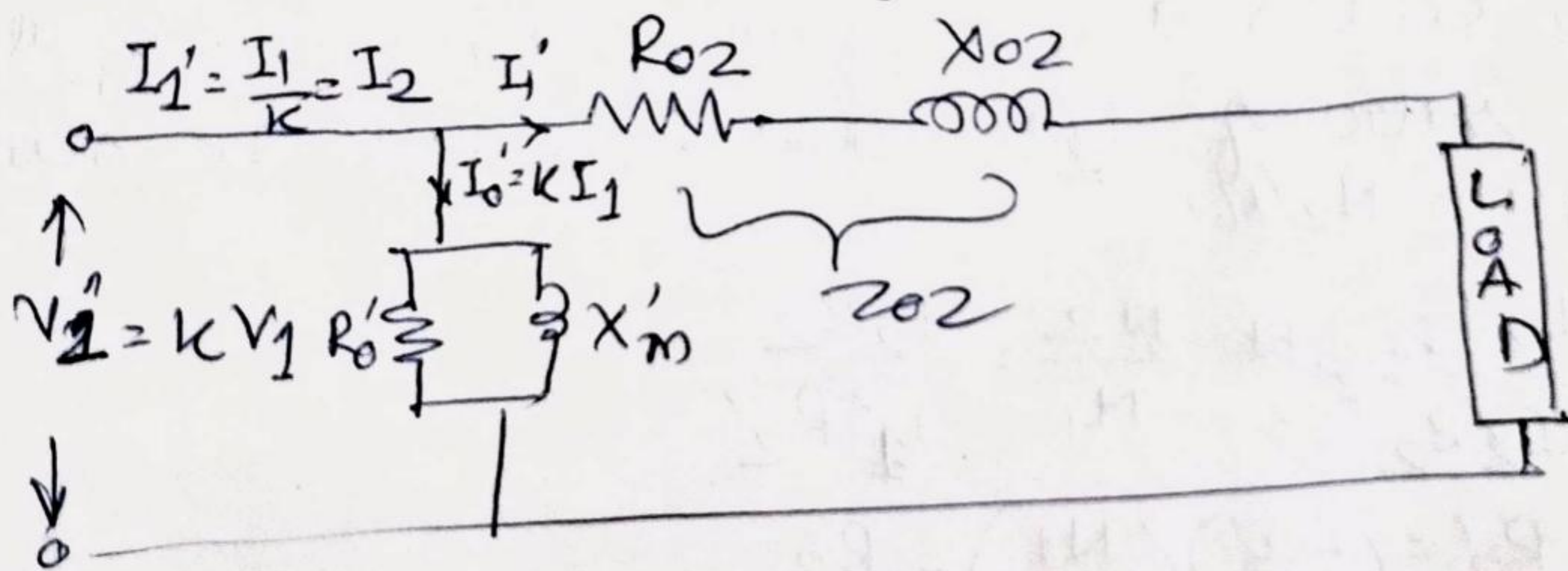
$$R_{02} = R_2 + k^2 R_1$$

$$X_{02} = X_2 + k^2 X_1$$

Equivalent circuit referred to primary side:-



Equivalent circuit referred to secondary side:-





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LECTURE NOTES

Campus: ...PCE... Course: ...B.Tech... Class/Section: ...III, CA&C... Date:
Name of Faculty: Dr. C. Khemsaj... Name of Subject: ...Elect. M/c-I... Code: 03EE05
Date (Prep.): Date (Del.): Unit No.: ...III... Lect. No:

OBJECTIVE: To be written before taking the lecture (Pl. write in bullet points the main topics/concepts etc., which will be taught in this lecture)

- * Open circuit test
- * Short circuit test

IMPORTANT & RELEVANT QUESTIONS:

Q. 1 Explain why

- 1) Open circuit test is conducted on rated voltage.
- 2) Open circuit test gives core loss and short circuit gives copper loss

FEED BACK QUESTIONS (AFTER 20 MINUTES):

Q. 1 Explain why the open circuit test LV is excited and HV open circuited.

Q. 2 Usually low voltage winding is short circuited and high voltage winding is excited in SC test

OUTCOME OF THE DELIVERED LECTURE: To be written after taking the lecture (Pl. write in bullet points about students' feedback on this lecture, level of understanding of this lecture by students etc.)

Excellent

REFERENCES: Text/Ref. Book with Page No. and relevant Internet Websites:

P. S. Bhambhani -

Asfaq Hussain -



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DETAILED LECTURE NOTES

Campus: Course:
Name of Faculty:

Class/Section:
Name of Subject:

Date:
Code:

Testing of transformers

The parameters or constants of transformer can be easily determined by two test as follows:

- (i) open circuit or No load test
- (ii) short circuit or load test

(i) open circuit test:-

This test gives the no-load iron loss or core loss of the transformer. It also gives I_0 , R_0 , X_m parameters.

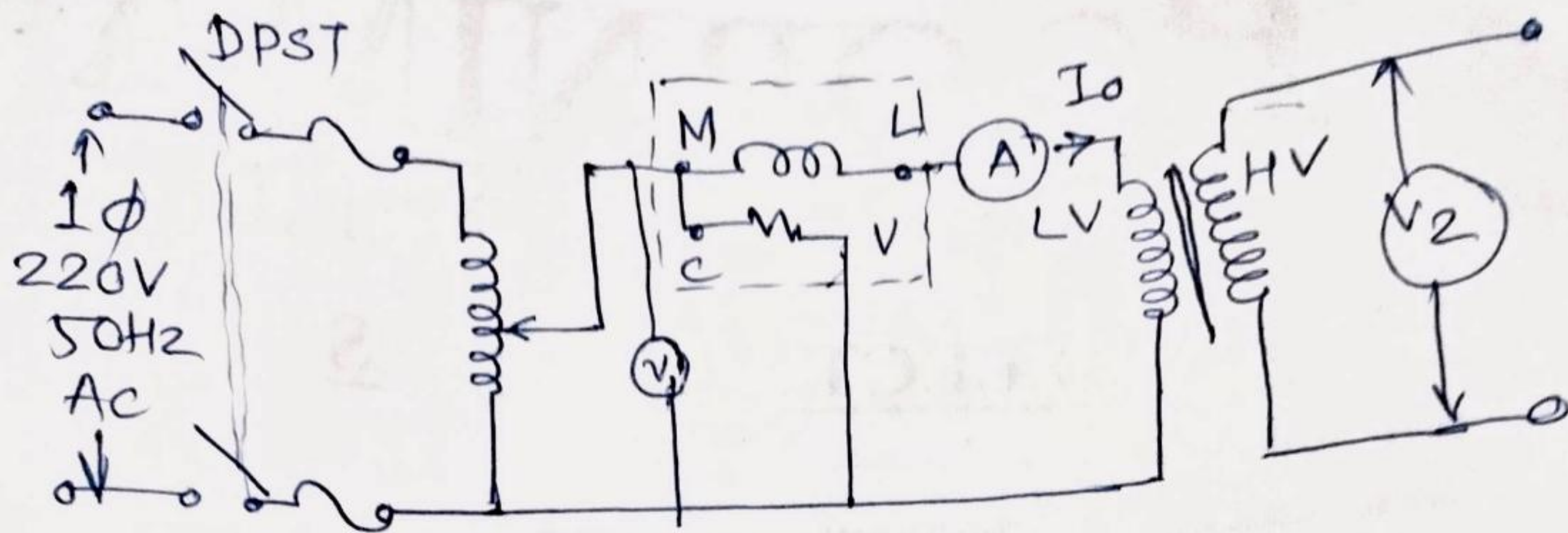
When rated voltage is applied to the transformer using an autotransformer, the ammeter gives the no-load current I_0 , the wattmeter gives the total power loss and the voltmeter reading V_1/V_2 gives the number of turns.

$$\text{Wattmeter reading} = W_0 = V_1 I_0 \cos \phi_0$$

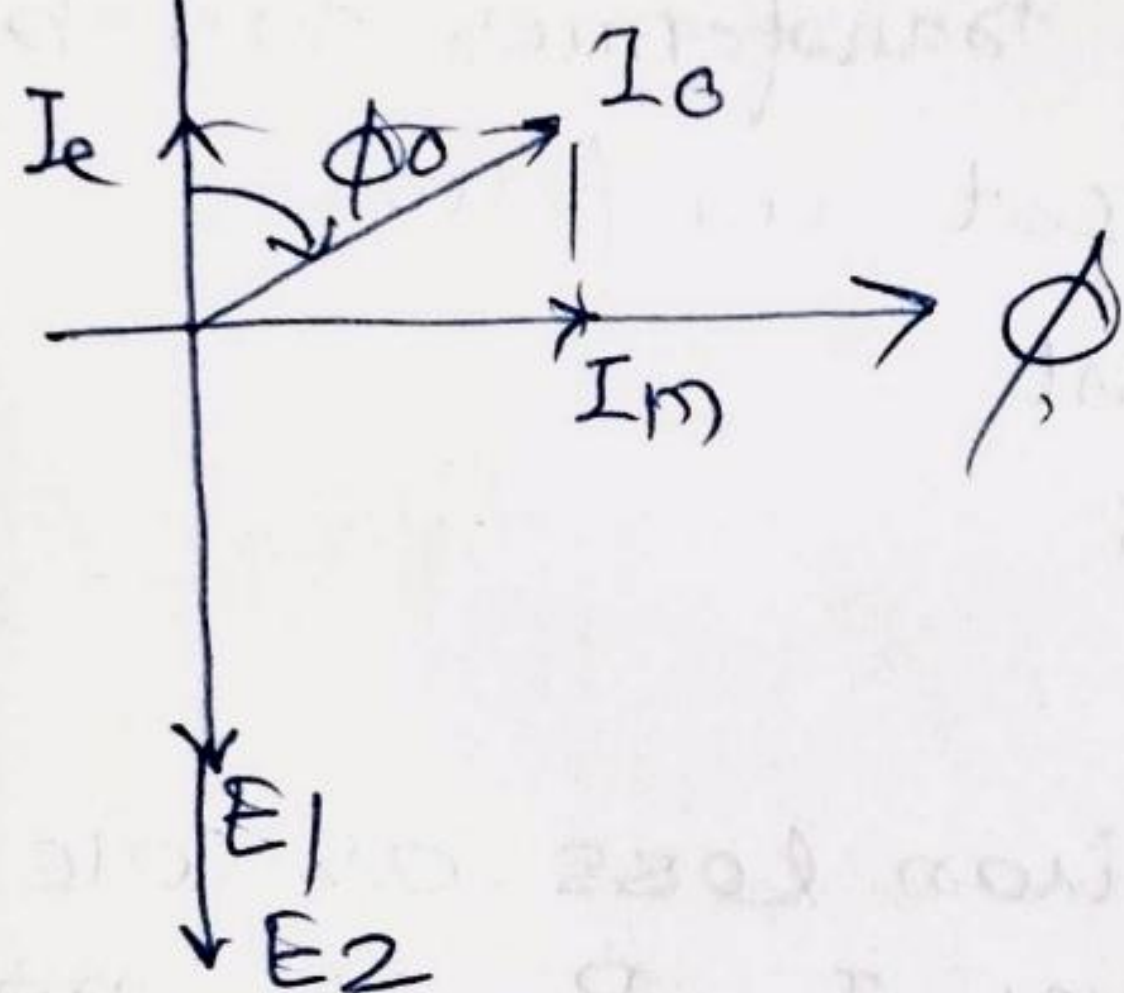
$$I_e = I_0 \cos \phi_0, \quad I_m = I_0 \sin \phi_0$$

$$\cos \phi_0 = \frac{W_0}{V_1 I_0}$$

$$R_0 = \frac{V_1}{I_e}, \quad X_m = \frac{V_1}{I_m}$$



$$V_1 = -E_1$$



from the no load phasor diagram shown, wattmeter W_0

$$W_0 = V_1 I_0 \cos \phi_0$$

$$I_w = I_0 \cos \phi_0$$

$$I_m = I_0 \sin \phi_0$$

$$R_0 = \frac{V_1}{I_w}$$

$$X_0 = \frac{V_1}{I_m}$$

$$\cos \phi = \frac{W_0}{V_1 I_0}$$

Short circuit test:-

In this test, one winding, the low voltage (LV) is short circuited as shown. A small voltage is applied to the primary and is increased gradually till the current I_1 in primary winding reaches to the rated full load value. Under these conditions, the copper loss in winding is the same as that of full load.

On the other hand since the applied voltage and the flux are only 3% of the rated voltage and flux, the iron loss is negligibly small and hence the reading of wattmeter W_{sc} can be taken only as the copper loss in the windings.

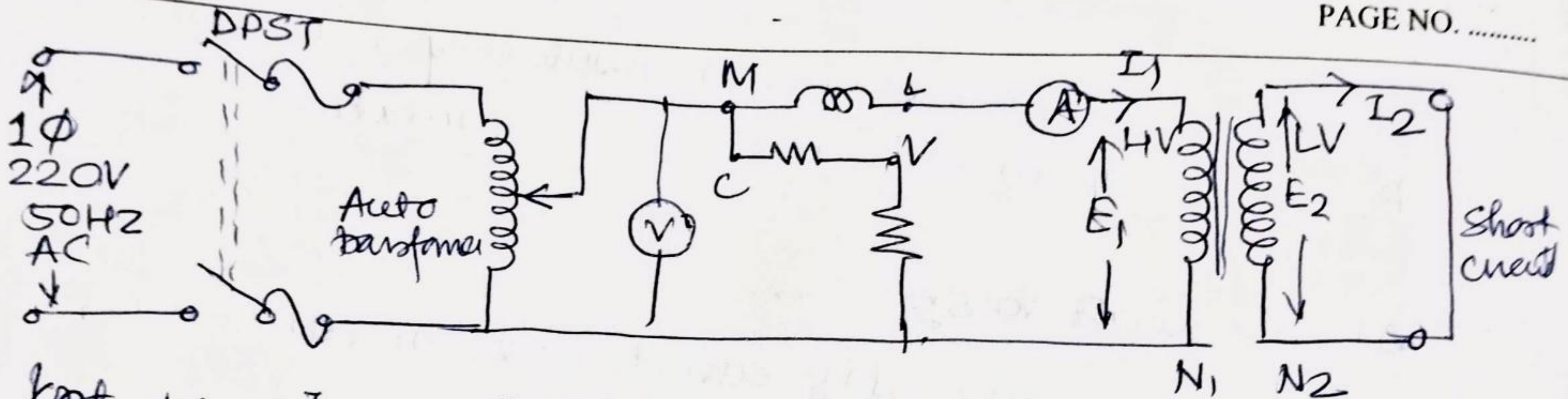


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DETAILED LECTURE NOTES

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Let W_{sc} , I_{sc} and V_{sc} be the readings of wattmeter, ammeter and voltmeter.

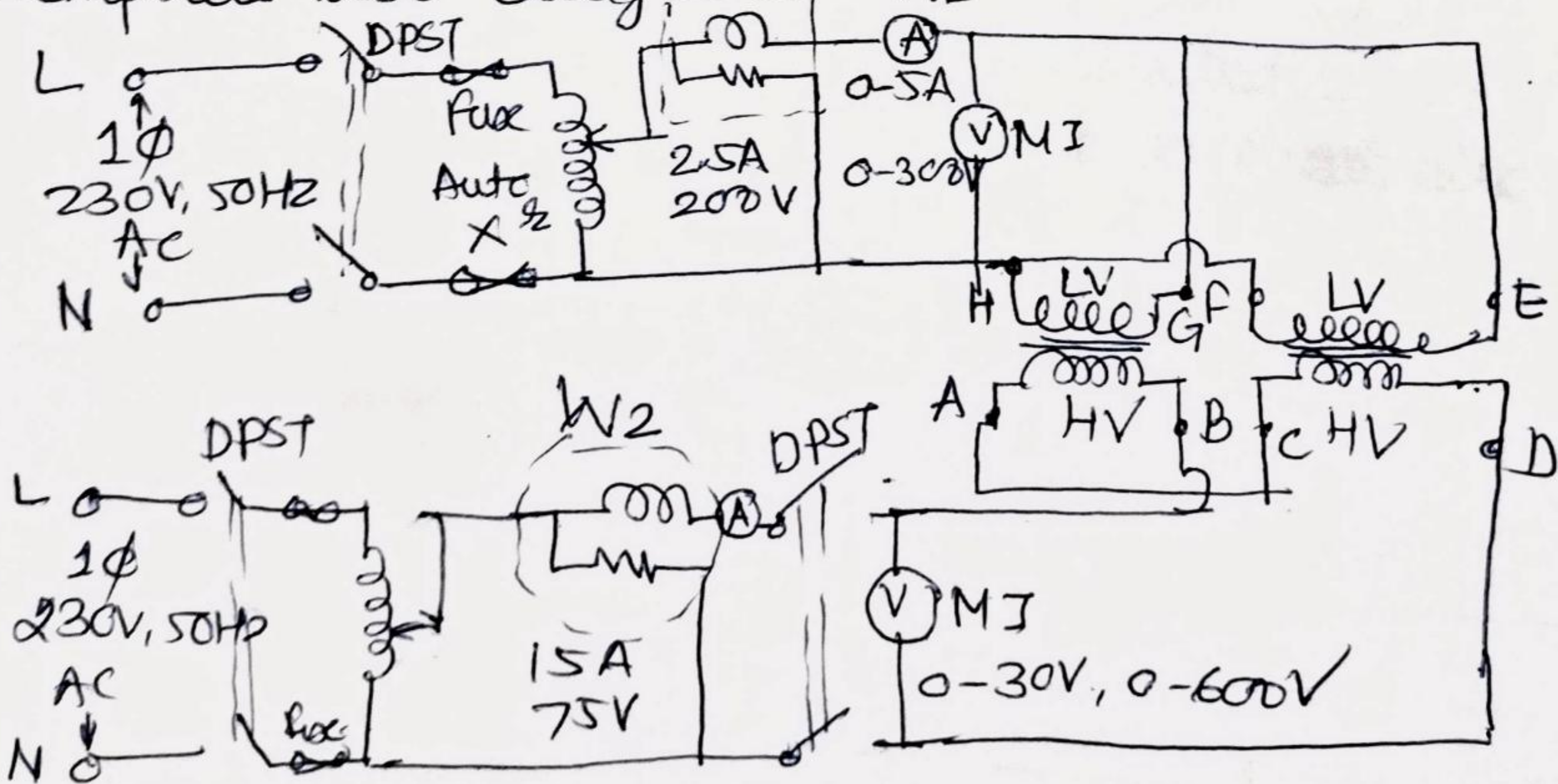
$$\text{Then, } W_{sc} = I_1^2 R_{01}$$

$$Z_{01} = \frac{V_{sc}}{I_1}, \quad R_{01} = \frac{W_{sc}}{I_1^2}$$

$$X_{01} = \sqrt{Z_{01}^2 - R_{01}^2}$$

Where Z_{01} , R_{01} , X_{01} are equivalent impedance, resistance and reactance of transformer referred to primary side.

Sumpner's test diagram





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Core loss: This is also known as Iron loss. This loss occurs in magnetic core. It consists of hysteresis and eddy current loss. The core loss is constant for a transformer operated at constant voltage and frequency.

Dielectric loss:-

This type of loss occurs in insulating material, particularly in oil and solid insulations.

Stray load loss:-

This is basically eddy current loss in tank wall and conductors due to leakage field.



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LECTURE NOTES

Campus:PCE.... Course: ...B.Tech... Class/Section: ...III (A & C).... Date:
Name of Faculty: ...Dr. Chelankhannay... Name of Subject: ...Elect. M/c - I... Code: ...03.EEC5
Date (Prep.): Date (Del.): Unit No.: ...IV.... Lect. No:

OBJECTIVE: To be written before taking the lecture (Pl. write in bullet points the main topics/concepts etc., which will be taught in this lecture)

- * Sumpner's back to back test
- * Transformer losses
- * Calculation of efficiency

IMPORTANT & RELEVANT QUESTIONS:

1. Discuss about Sumpner's Test on single phase transformer.
2. Derive the condition of maximum efficiency in case of transformers.

FEED BACK QUESTIONS (AFTER 20 MINUTES):

- Q.1 Discuss about various losses in transformers
- Q.2 What is all day efficiency? Explain.

OUTCOME OF THE DELIVERED LECTURE: To be written after taking the lecture (Pl. write in bullet points about students' feedback on this lecture, level of understanding of this lecture by students etc.)

Excellent.

REFERENCES: Text/Ref. Book with Page No. and relevant Internet Websites:

1. P. S. Bhimbra.
2. Asfaq Hussain

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DETAILED LECTURE NOTES

Campus: Course:
Name of Faculty:

Class/Section:
Name of Subject:

Date:
Code:

Sumpner's back to back test:-

This test needs two identical transformers. This test provides data for finding the regulation, efficiency and heating under load conditions.

As shown in fig. primary of the two transformers are connected in parallel across the same AC supply. The secondaries are so connected that their potentials are in opposition to each other.

With the switch S_2 open, the wattmeter W_1 reads the core loss of both the transformers. In that case no secondary current flows due to phase opposition.

The iron losses of each transformer = $\frac{1}{2} W_0$

where W_0 is the reading of wattmeter W_1 , when rated voltage is applied to the primary of auto-transformer. Similarly W_2 is the wattmeter connected to the secondary windings.

∴ Full load copper loss of each transformer = $\frac{1}{2} W_c$

Thus efficiency at different loads can be calculated -

① Efficiency at full load -

Let the O/P in KVA of each transformer be P_o .
Total losses of each transformer under full load

$$= \frac{1}{2} P_i + \frac{1}{2} P_{cu}$$

$$\% \text{ efficiency } = \eta = \frac{P_o \times 1000 \times \cos \phi}{P_o \times 1000 \times \cos \phi + \frac{1}{2} P_i + \frac{1}{2} P_{cu}} \times 100$$

(b) Efficiency at half full load:-

Power output of each transformer at half full load
 $= \frac{1}{2} P_o$

Iron loss at half load $= \frac{1}{2} P_i$

Copper loss at half full load $= \left(\frac{1}{2}\right)^2 \left(\frac{1}{2} P_{cu}\right)$
 $= \frac{1}{8} P_{cu}$

$$\text{efficiency} = \frac{\frac{1}{2} P_o \times 1000 \times \cos \phi}{\frac{1}{2} P_o \times 1000 \times \cos \phi + \frac{1}{2} P_i + \frac{1}{2} P_{cu}}$$

Efficiency

It is defined as the ratio of power output to the power input.

$$\text{Efficiency } = \eta = \frac{O/P}{I/P} = \frac{I/P - \text{losses}}{I/P}$$

$$= 1 - \frac{\text{losses}}{I/P}$$

$$= \frac{O/P}{O/P + \text{losses}}$$

The various losses in case of transformers are

① Copper loss:-

This is also known as ohmic or $I^2 R$ loss. Thus loss occurs in winding resistances when transformer carries the load current.



DETAILED LECTURE NOTES

All day efficiency:-

Large capacity transformer used in power systems are broadly classified into power and distribution transformers. The first is used in generating and large substations. Distribution transformer are seen at the distribution substations. The basic difference between them is that power transformers are switched on and off depending on load to be handled. On other hand distribution transformer is never switched off. It has to remain in the circuit irrespective of the load connected. In such cases the constant losses of transformer continues to be dissipated. Hence the concept of energy based efficiency. The all day efficiency is such a concept.

The all day efficiency is the ratio of the energy output of the transformer over a day to the corresponding energy input in one day is taken as a duration of time over which the load pattern repeats itself.

$$\text{All day efficiency} = \frac{\text{Output in KWh for 24 hr}}{\text{Input in KWh for 24 hr}}$$

Condition for max. efficiency
 Let the iron loss be P_i and copper loss P_{cu}

$$\eta = \frac{O/P}{I/P} = \frac{I/P - \text{losses}}{I/P}$$

$$= \frac{V_1 I_1 \cos \phi_1 - (P_i + P_{cu})}{V_1 I_1 \cos \phi_1}$$

$$= 1 - \frac{P_i}{V_1 I_1 \cos \phi_1} + \frac{P_{cu}}{V_1 I_1 \cos \phi_1}$$

$$= 1 - \frac{P_i}{V_1 I_1 \cos \phi_1} - \frac{I_1 R_{o1}}{V_1 \cos \phi_1}$$

differentiating w.r.t I_1

$$\frac{d\eta}{dI_1} = 0 - \frac{R_{o1}}{V_1 \cos \phi_1} + \frac{P_i}{V_1 I_1^2 \cos \phi_1} = 0$$

$$\frac{R_{o1}}{V_1 \cos \phi_1} = \frac{P_i}{V_1 I_1^2 \cos \phi_1}$$

$$I_1^2 R_{o1} = P_i$$

$$P_{cu} = P_i$$

Copper loss equal Iron loss.

This is the condition of the maximum efficiency.



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LECTURE NOTES

Campus: ...PCE... Course: ...B.Tech... Class/Section: ...III CA & C... Date:
Name of Faculty: ...Dr. Chetan Meher... Name of Subject: ...E.M.-I... Code: C3EE05
Date (Prep.): Date (Del.): Unit No.: ...IV... Lect. No:

OBJECTIVE: To be written before taking the lecture (Pl. write in bullet points the main topics/concepts etc., which will be taught in this lecture)

- * Parallel operations of transformers
- * No load operation
- * On load operation.

IMPORTANT & RELEVANT QUESTIONS:

- Q.1 Explain why parallel operations of transformer is necessary.
- Q.2 Deduce expression for load shared by two transformers connected in parallel.

FEED BACK QUESTIONS (AFTER 20 MINUTES):

- Q.1 State the essential and desirable conditions for parallel operations.

OUTCOME OF THE DELIVERED LECTURE: To be written after taking the lecture (Pl. write in bullet points about students' feedback on this lecture, level of understanding of this lecture by students etc.)

Excellent.

REFERENCES: Text/Ref. Book with Page No. and relevant Internet Websites:

Asfaq Hussain -
P. S. Bhimkora -



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DETAILED LECTURE NOTES

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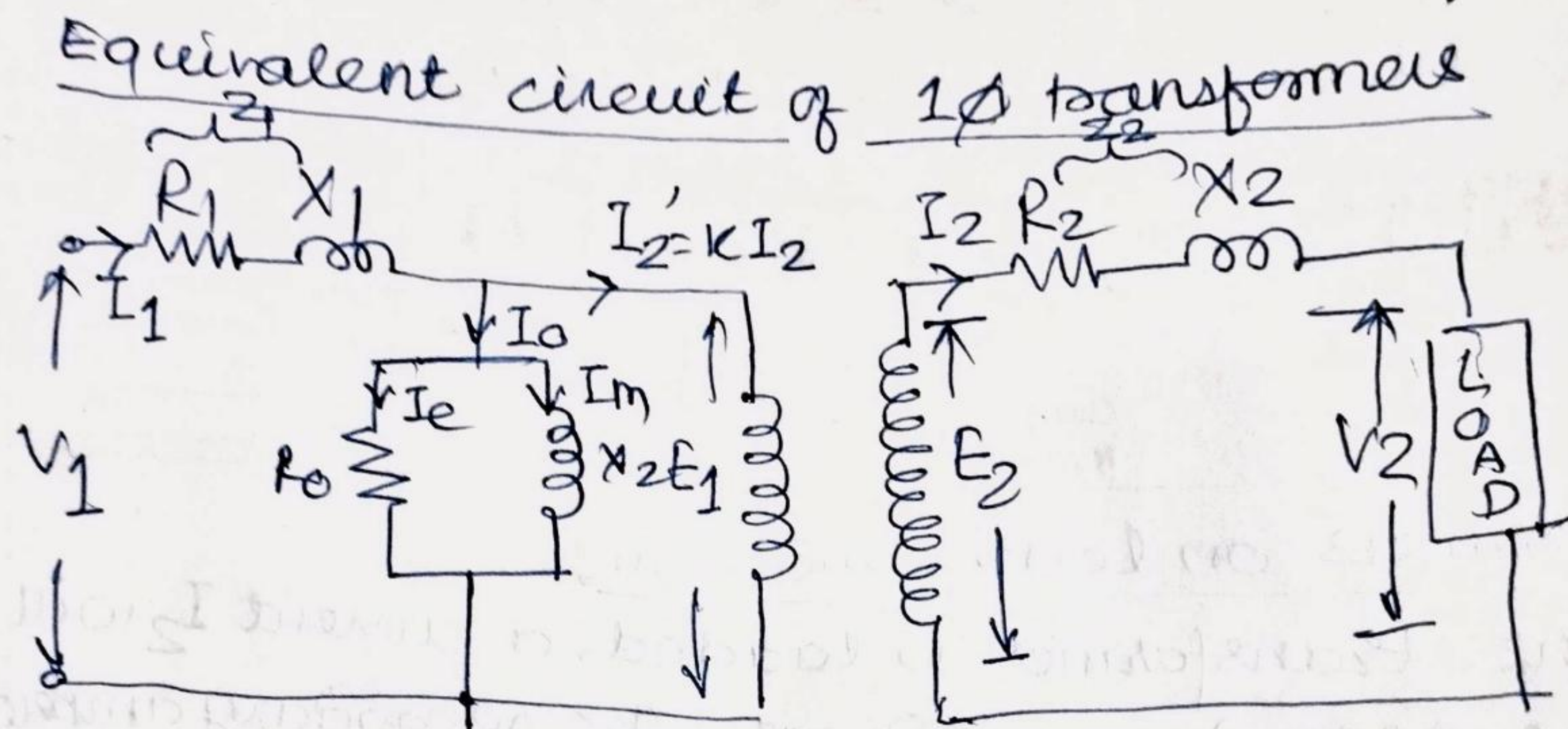
Transformers on load condition:-

When the transformer is loaded, a current I_2 will flow in the secondary windings. The secondary ampere turns $I_2 N_2$ set up a secondary flux that tends to reduce the flux produced by the primary ampere turns. As a result, the induced emf in primary winding E_1 reduces and the balance between V_1 and E_1 would no longer exist.

Hence, on load the presence of secondary ampere turns necessitates the production of primary ampere turns equal in magnitude but opposite in direction. The above condition is achieved by load current I_1' which flows from the supply through the primary winding. As primary ampere turns are same as the secondary turns

$$I_1' N_1 = N_2 I_2$$

$$I_1' = \left(\frac{N_2}{N_1} \right) I_2 = K I_2$$



where

- R_1 = primary winding resistance
- X_1 = " " " " reactance
- I_1 = total primary current
- R_0 = no load p
- X_0 =
- E_1, E_2 =
- I_2 = secondary current
- R_2 = secondary winding resist
- X_2 = " " " " react.
- V_2 = output voltage.

For primary side

$$V_1 = E_1 + I_1 R_1 + j I_1 X_1$$

For secondary side

$$E_2 = V_2 + I_2 R_2 + j I_2 X_2$$

DETAILED LECTURE NOTES

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Ideal transformer:-

In order to study the practical transformer, initially certain idealisations are made as follows-

1. Primary and secondary windings has no resistance. It means no copper loss (I^2R) and no voltage drop ($E=V$)
2. All the flux produced by primary windings links to the secondary windings there is no leakage flux so that all flux is confined to the core.
3. Permeability of the core is infinitely large, in other words, to establish the magnetic flux in the core, zero magnetisation current is required.
4. Core loss comprising of eddy current and hysteresis losses are neglecting.

EMF equation of transformer:-

When transformer is on no load i.e secondary coil is open. The applied voltage, magnetisation current and the flux in core will also be sinusoidal waveform. Hence,

$$\phi = \phi_m \sin \omega t$$

The self induce emf on primary coil is given by

$$E_1 = -N_1 \frac{d\phi}{dt} \quad [\text{Lenz law}]$$

$$= -N_1 \frac{d}{dt} [\phi_m \sin \omega t]$$

$$= -N_1 \omega \phi_m \cos \omega t$$

$$= N_1 \omega \phi_m \sin[\omega t - \frac{\pi}{2}]$$

where $e = N_1 \omega \phi_m = \text{max value of emf}$

where $\sin[\omega t - \frac{\pi}{2}] = 1 \quad E_1 = e = \text{max value}$

Similarly the secondary induced emf is

$$\begin{aligned} E_2 &= -N_2 \frac{d\phi}{dt} \\ &= -N_2 \omega \phi_m \cos \omega t \\ &= N_2 \omega \phi_m \sin(\omega t - \frac{\pi}{2}) \\ &= E_m \sin[\omega t - \frac{\pi}{2}] \end{aligned}$$

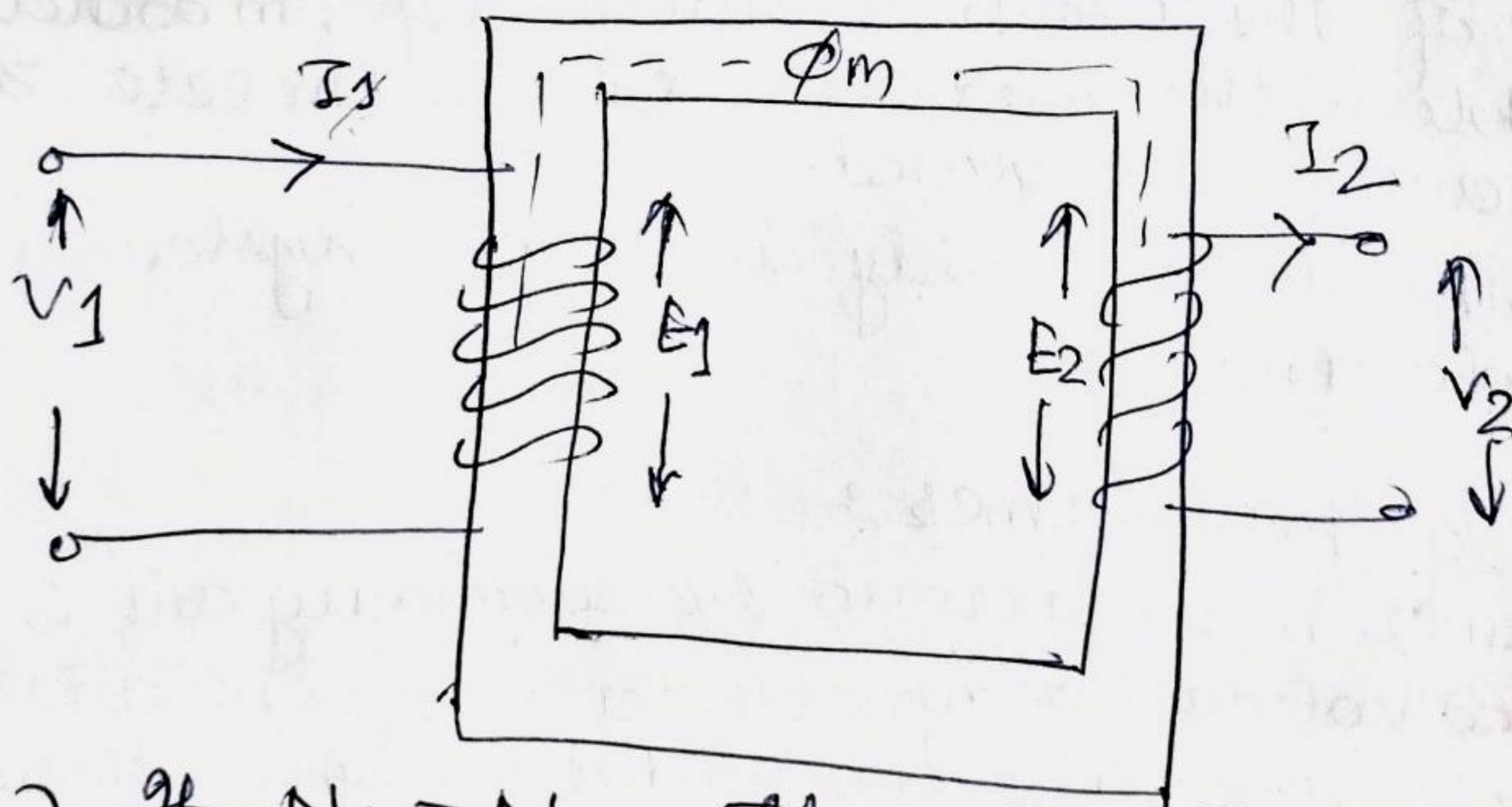
$$\therefore \frac{E_2}{E_1} = \frac{N_2}{N_1} = k = \text{turns ratio}$$

In case of an ideal transformer

$$E_1 = V_1, \quad E_2 = V_2$$

$$P = V_1 I_1 = V_2 I_2$$

$$\therefore \frac{E_2}{E_1} = \frac{V_2}{V_1} = \frac{I_1}{I_2} = \frac{N_2}{N_1} = k$$



(i) If $N_1 > N_2$, then $E_1 > E_2$ so it is a step down transformer.

(ii) If $N_1 < N_2$, then $E_1 < E_2$ so that it is a step up transformer.

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DETAILED LECTURE NOTES

Campus: Course:
Name of Faculty:

Class/Section:
Name of Subject:

Date:
Code:

Parallel operations of transformers

It means two or more transformers are connected to the same supply bus on primary side to a common bar on load on secondary side.

The reasons for parallel operations are as follow -

1. Non availability of a single large transformer to meet the total load requirement.
2. To ensure improved reliability. Even, if one of the transformers get into a fault or is taken out for maintenance or repair, the load can continue to be serviced.
3. To reduce the standby or spare capacity.
4. When transportation problems limit installation of large transformers at site, it may be easier to transport smaller ones to site and work them in parallel.

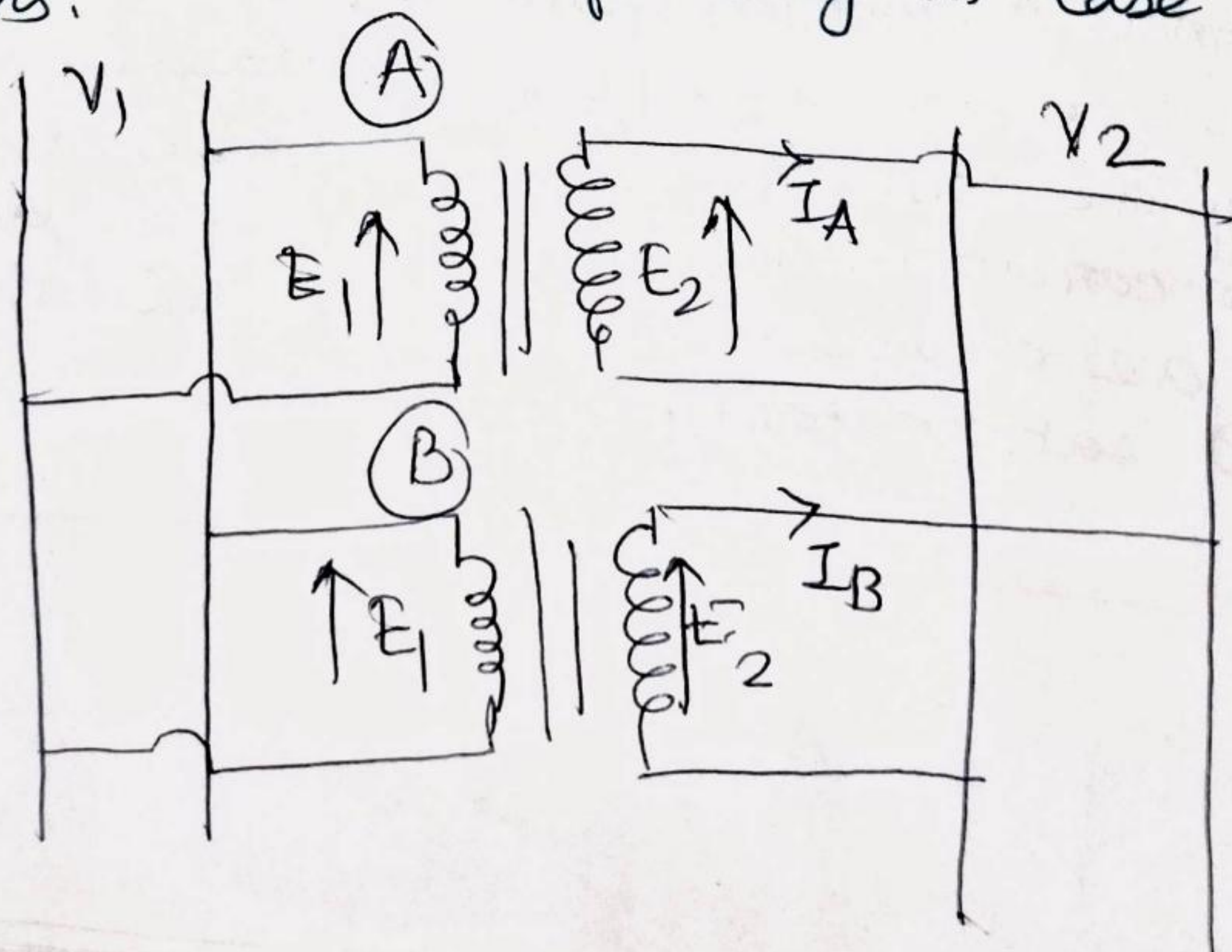
Transformers A and transformer B are connected to input voltage bus bars. After ascertaining the polarities they are connected to the output or load bus bars. Certain conditions have to met before two or more transformers are connected in parallel and share a common load satisfactorily.

They are

1. The voltage ratio must be the same
2. The per unit impedance of a transformer on its own base must be the same.
3. The polarity must be same, so that there is no circulating current between the transformers.
4. The phase sequence must be the same and no phase difference must exist between the voltages of the two transformers.

These conditions are examined first with references to single phase transformers and then the three phase cases are discussed.

- * Same voltage ratio: Generally the turns ratio and voltage ratio are taken to be same. If the ratio is large, there can be considerable error in voltages even if the turns ratios are the same.
- * Per unit impedance: The per unit resistance and per unit reactance of both the transformers must be same.
- * Polarity of transformers must be same
- * Phase sequence is useful only in case of poly phase systems.





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COLLEGE OF ENGINEERING

LECTURE NOTES

Campus: P.C.E. Course: B.Tech Class/Section: III (A & C) Date:
Name of Faculty: Dr. Chetan Khemraj Name of Subject: EM-I Code: 03EE05
Date (Prep.): Date (Del.): Unit No.: IV Lect. No:

OBJECTIVE: To be written before taking the lecture (Pl. write in bullet points the main topics/concepts etc., which will be taught in this lecture)

- * Auto transformer
- * Its advantage over two winding transformer,

IMPORTANT & RELEVANT QUESTIONS:

- Q-1 what is an auto transformer? state its merits and demerits
- Q-2 give applications of auto transformer.

FEED BACK QUESTIONS (AFTER 20 MINUTES):

- Q-1. Derive an expression of efficiency in auto transformer.

OUTCOME OF THE DELIVERED LECTURE: To be written after taking the lecture (Pl. write in bullet points about students' feedback on this lecture, level of understanding of this lecture by students etc.)

Excellent.

REFERENCES: Text/Ref. Book with Page No. and relevant Internet Websites:

P.S. Bhimkasa -
Asfaq Hussain -

COLLEGE OF ENGINEERING

DETAILED LECTURE NOTES

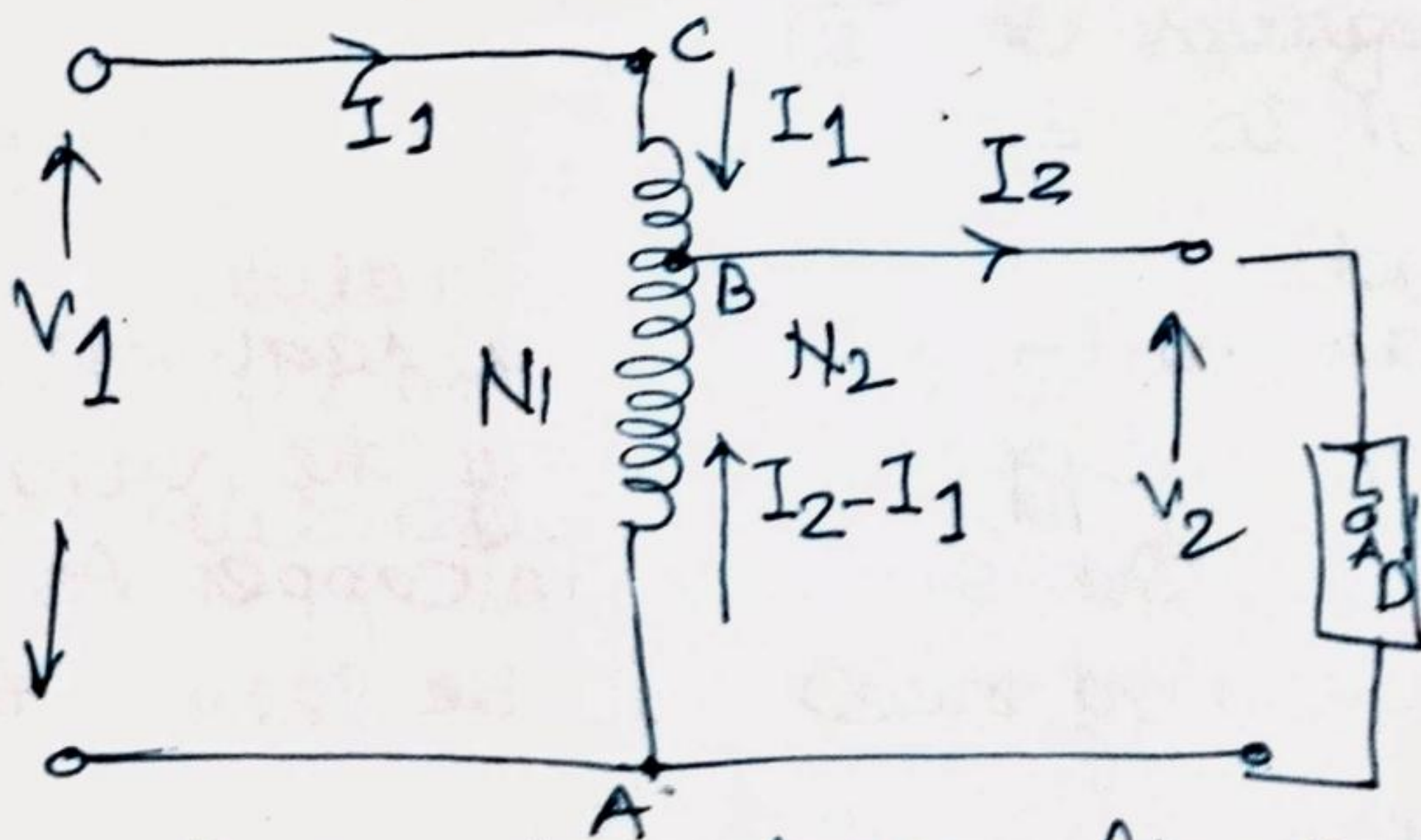
Campus: Course:
Name of Faculty:

Class/Section:
Name of Subject:

Date:
Code:

Auto Transformers

The primary and secondary windings of two windings transformers have induced emf in them due to common mutual flux. The currents drawn by these two windings are 180° out of phase. This prompted the use of a part of the primary as secondary. This is equivalent to fusing the secondary turns into primary turns. The fused section need to have a cross sectional area to carry $(I_2 - I_1)$ ampere. This ingenious thought led to the invention of auto-transformer.



As shown in above fig, a current I_1 flows through the windings between B and C. The current in the winding between A and B is $(I_2 - I_1)$ ampere. The cross section of the wire selected for AB is proportional

to this current, assuming a constant current density for the whole winding. To quantify the saving the total quantity of copper used in an auto-transformer is expressed as a fraction of that used in an two winding transformer as,

$$\frac{\text{Copper in auto transformer}}{\text{Copper in two winding transf.}} = \frac{N_1(N_1 - N_2)I_1 + N_2(I_2 - I_1)}{N_1I_1 + N_2I_2}$$

$$= \frac{N_1I_1 - N_2I_1 + N_2I_2 - N_2I_1}{N_1I_1 + N_2I_2}$$

$$= \frac{(N_1I_1 + N_2I_2) - 2N_2I_1}{N_1I_1 + N_2I_2}$$

$$= 1 - \frac{2N_2I_1}{N_1I_1 + N_2I_2}$$

But $N_1I_1 = N_2I_2$

$$= 1 - \frac{2N_2I_1}{2N_1I_1}$$

$$= 1 - \frac{N_2}{N_1}$$

This means that an auto-transformer requires the use of lesser quantity of copper given by the ratio of turns. This ratio denotes the savings in copper. As the space for second winding need not be there, the window space can be less for an auto transformer giving some saving in the lamination weight also. The larger the ratio of voltages, smaller is the savings. As N_2 approaches N_1 , the savings becomes significant.

Hence, the saving in the cost of copper by using an autotransformer will increase with increasing ratio N_2/N_1 , it depends on the number of secondary turns (N_2) as the fraction of number of primary turns (N_1). Thus if $N_2/N_1 = 0.20$ then the savings in copper is 20% and

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So on. In case of an auto-transformer, the total Cu loss (I^2R) in a transformer will be lower and hence the efficiency will be higher.

Auto transformers are generally used when the ratio of number of turns N_2/N_1 is nearly equal to unity for interconnecting systems that are operating roughly at the same voltage. They are also used for starting the squirrel cage type induction motors and as furnace transformers.

Advantages of an auto transformer:

- (a) For same capacity and voltage ratio, auto transformer requires less winding material hence savings in copper.
- (b) An auto transformer is smaller in size and cheaper than a two winding transformer.
- (c) An auto transformer has higher efficiency.
- (d) An auto transformer is having a variable secondary voltage.

Advantages of auto transformers -

- ① For the same capacity and voltage ratio, an autotransformer requires less winding material than two winding transformer. Hence there is saving in copper.
- ② An autotransformer is smaller in size and cheaper than a two winding transformer of same output.
- ③ An autotransformer has higher efficiency since core loss and ohmic losses are smaller.
- ④ Voltage regulation of autotransformer is better because of reduced voltage drops in the resistance and reactance.
- ⑤ An autotransformer has variable output voltage when a sliding contact is used for the secondary.

Disadvantages -

- ① There is a direct connection between HV and LV side. This HV may cause serious damage to the equipment connected on the secondary side.
- ② The short circuit current is larger for an autotransformer due to reduced internal impedances.

Applications

- ① Auto transformers are used for obtaining continuous variable ac supply.
- ② They are used for interconnection of power systems of different voltage levels.
- ③ They are used for boosting the ac mains voltage.
- ④ Auto transformers are used for starting the induction and synchronous motors.



COLLEGE OF ENGINEERING

LECTURE NOTES

Campus: PCE Course: B.Tech Class/Section: III (A2C) Date: _____
Name of Faculty: Dr. C. Khanna Name of Subject: EM-I Code: 03EE05
Date (Prep.): _____ Date (Del.): _____ Unit No.: _____ Lect. No.: _____

OBJECTIVE: To be written before taking the lecture (Pl. write in bullet points the main topics/concepts etc., which will be taught in this lecture)

- * Impedance drop
- * Voltage regulation
- * Uses

IMPORTANT & RELEVANT QUESTIONS:

Q.1 Define voltage regulation of a transformer?

Q.2 Derive condition for (i) zero regulation
(ii) Maximum regulation.

FEED BACK QUESTIONS (AFTER 20 MINUTES):

Q.1 Write a short note on uses of different types of transformers.

OUTCOME OF THE DELIVERED LECTURE: To be written after taking the lecture (Pl. write in bullet points about students' feedback on this lecture, level of understanding of this lecture by students etc.)

Excellent

REFERENCES: Text/Ref. Book with Page No. and relevant Internet Websites:

- 1) P.S. Bhimba -
- 2) Asfaq Hussain -

DETAILED LECTURE NOTES

Campus: Course:
Name of Faculty:

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Date:
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Modern power systems operate at some standard voltages.

The voltage regulation can be defined as-

- (i) Regulation Down (ii) Regulation up

These two definitions differ only as reference voltages.

Regulation down: This is defined as "the change in terminal voltage when a load current at any power factor is applied" expressed as factor of the no-load terminal voltage, expressed as -

$$\text{Regulation down} = \frac{|V_{NL}| - |V_L|}{V_{NL}}$$

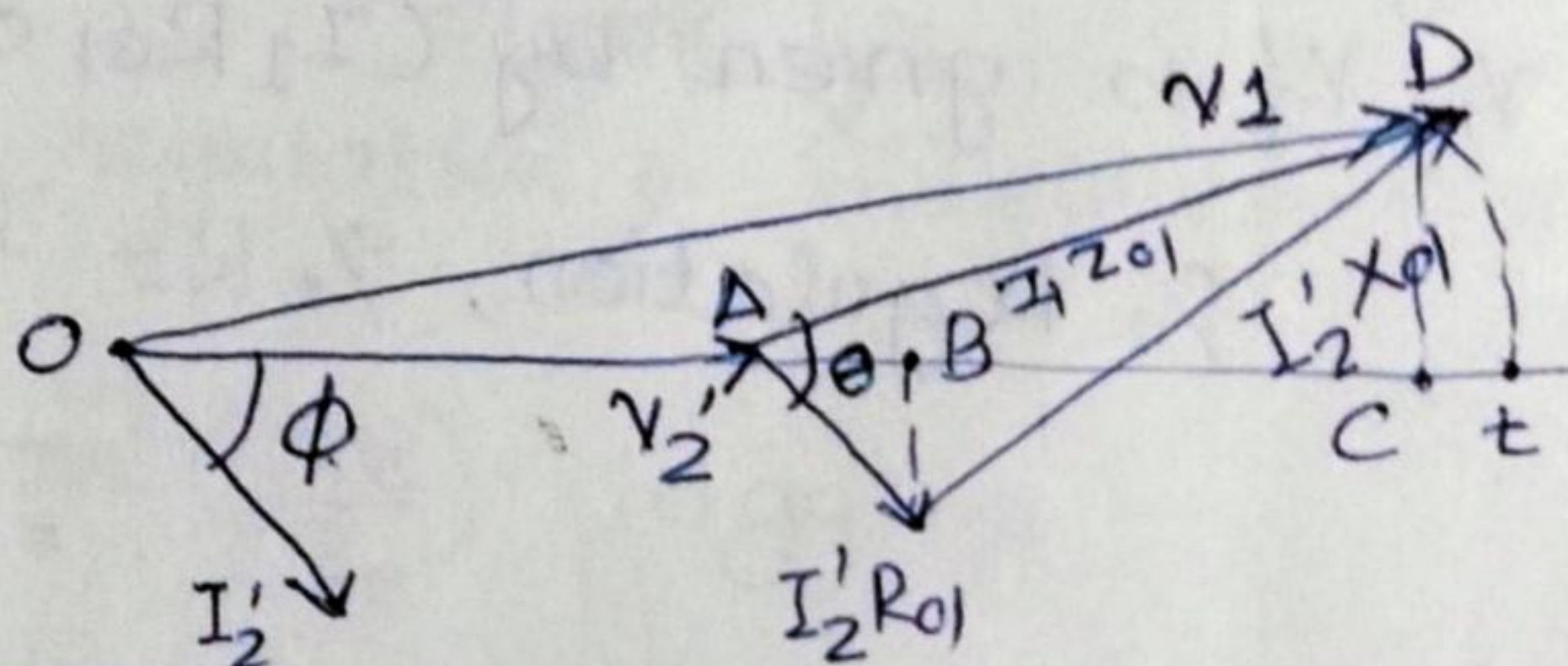
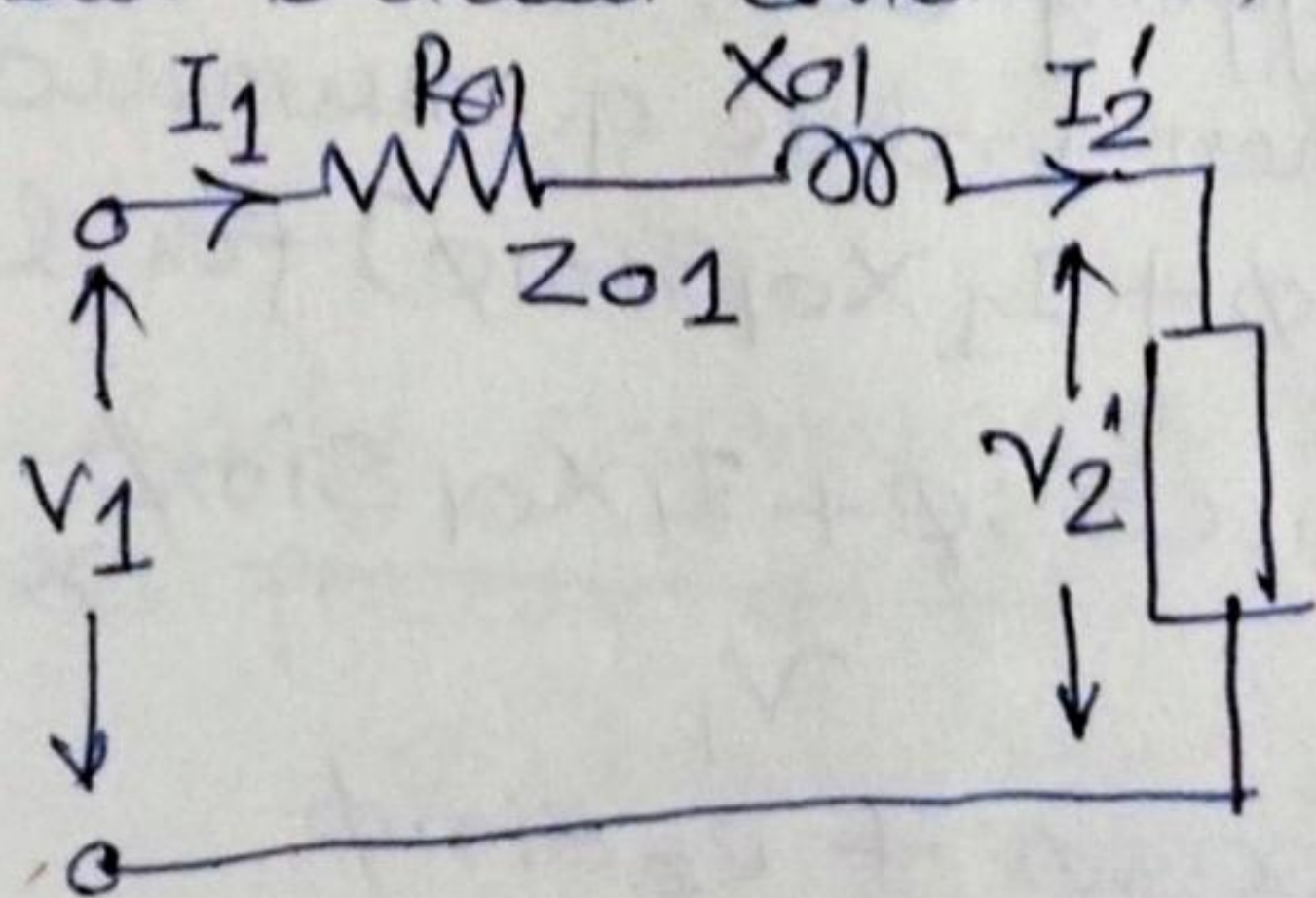
V_{NL} = no load voltage

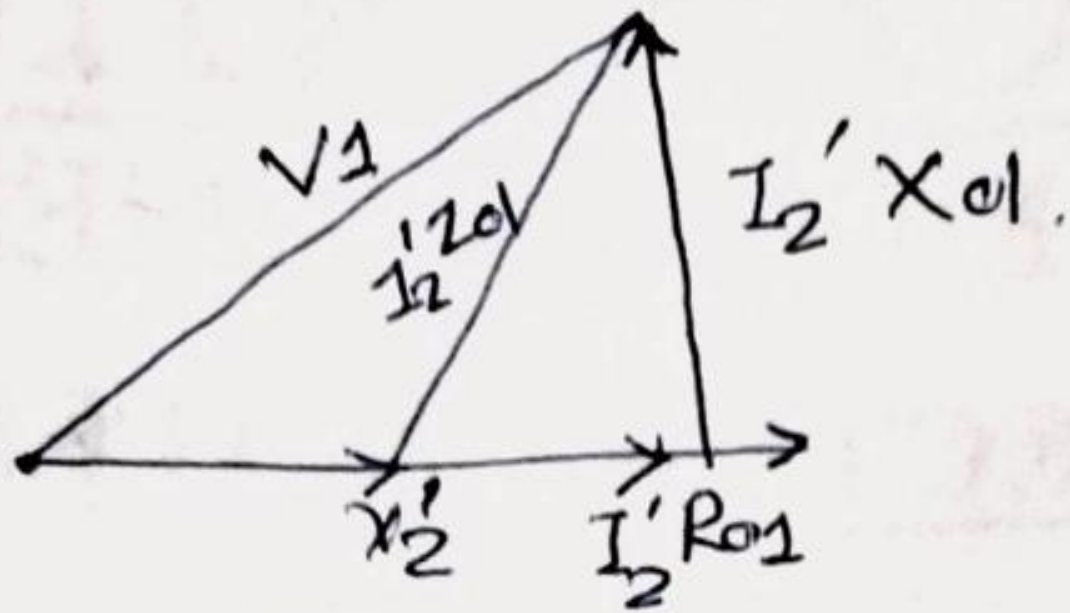
V_L = load terminal voltage

Regulation up:- It is defined as ratio of the change in the terminal voltage when a load at a given power factor is thrown off, and the on load voltage.

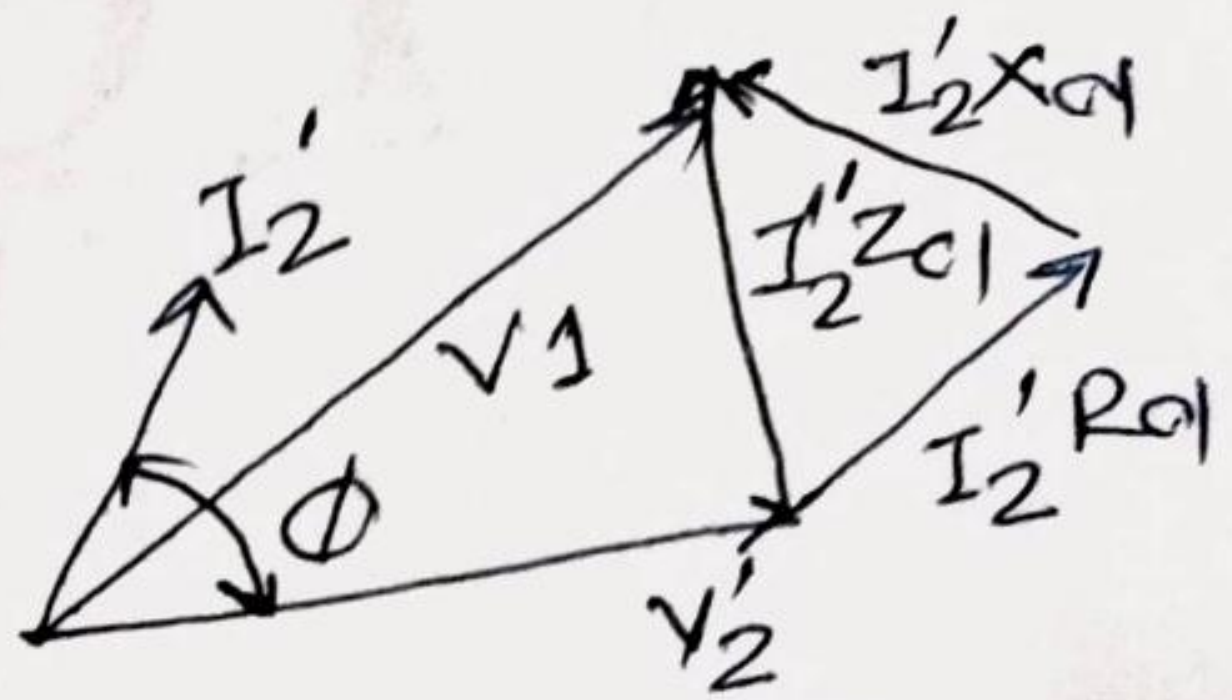
$$\text{Regulation up} = \frac{|V_{NL}| - |V_L|}{V_L}$$

The below phasor diagram of operation of the transformer under loaded condition





Phasor diagram
(2) Resistive load



(3) Leading load

$$I_1 = I_2'$$

$$V_1 = I_2'(R_{01} + jX_{01}) + V_2'$$

$$OD = \sqrt{[OA + AB + BC]^2 + [CD]^2}$$

$$= \sqrt{[V_2' + I_2'R_{01} \cos \phi + I_2'X_{01} \sin \phi]^2 + [I_2'X_{01} \cos \phi - I_2'R_{01} \sin \phi]^2}$$

where, ϕ = power factor angle

$$\theta = \text{impedance angle} = \tan^{-1} \left(\frac{X_{01}}{R_{01}} \right)$$

$$V_1 = V_2' + I_2' [\cos \phi - j \sin \phi] (R_{01} + jX_{01})$$

$$\text{Regulation, } R = \frac{|V_1| - |V_2'|}{|V_2'|} \times 100$$

For the phasor diagram of lagging load, it is clear that the angle V_1 and V_2' is neglected, then value of numerical difference $V_1 - V_2'$ is given by $(I_1 R_{01} \cos \phi + I_1 X_{01} \sin \phi)$ for lag (pf)

$$\begin{aligned} \% \text{ Regulation, } \% R &= \frac{I_1 R_{01} \cos \phi + I_1 X_{01} \sin \phi}{V_1} \times 100 \\ &= e_r \cos \phi \pm e_x \sin \phi \end{aligned}$$

The change in secondary terminal voltage from no load to full load expressed as a percentage of no load secondary voltage is same as equation



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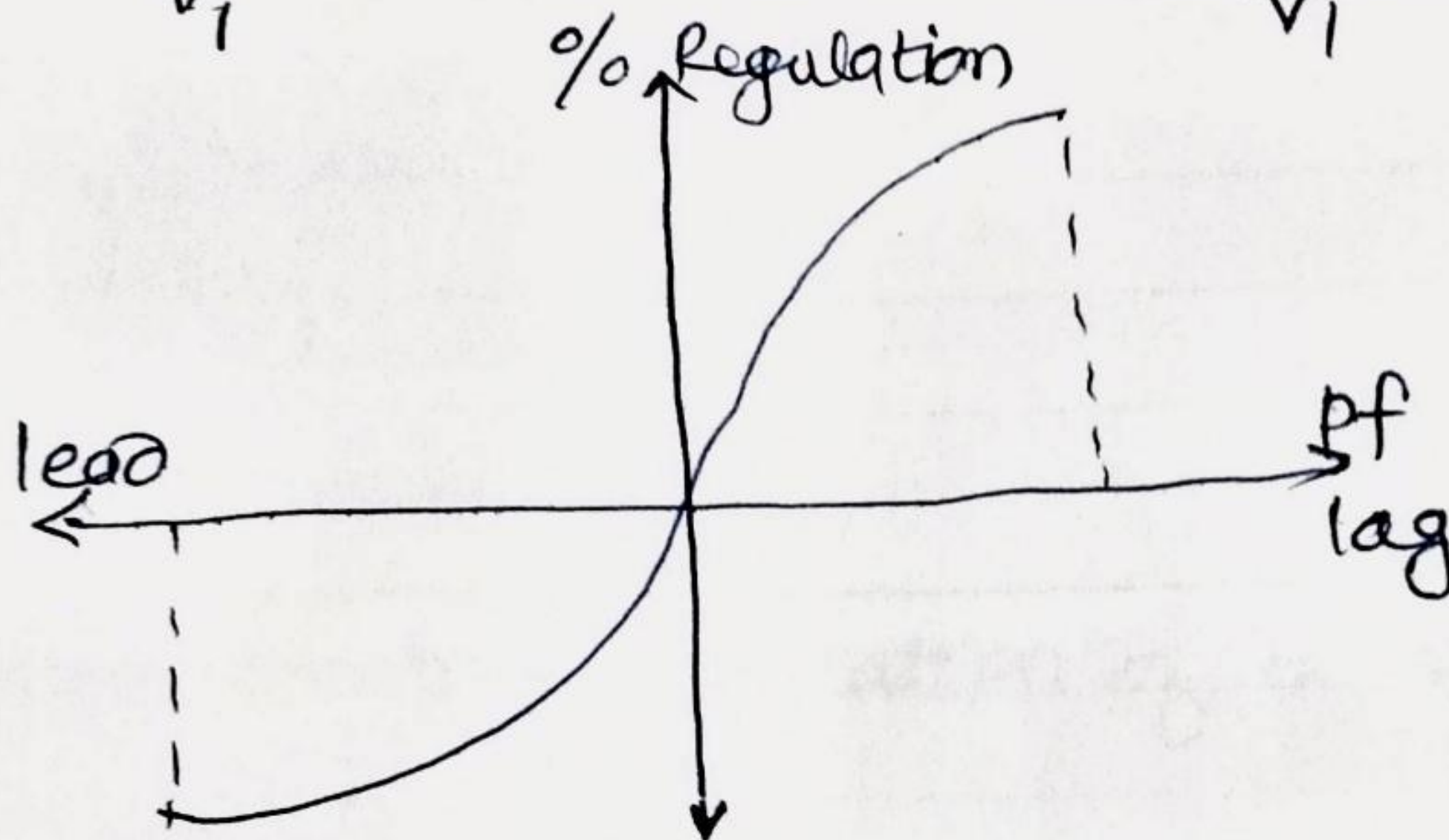
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Name of Subject:

Code:

$$= e_r \cos \phi \pm e_x \sin \phi$$

where $\frac{I_1 R_{01} \cos \phi}{V_1} \times 100 = e_r$ and $\frac{I_1 X_{01} \sin \phi}{V_1} \times 100 = e_x$



The negative sign is applicable when the pf is leading. It can be seen from above expression, the full load regulation becomes zero when the power factor is leading and $e_r \cos \phi = e_x \sin \phi$

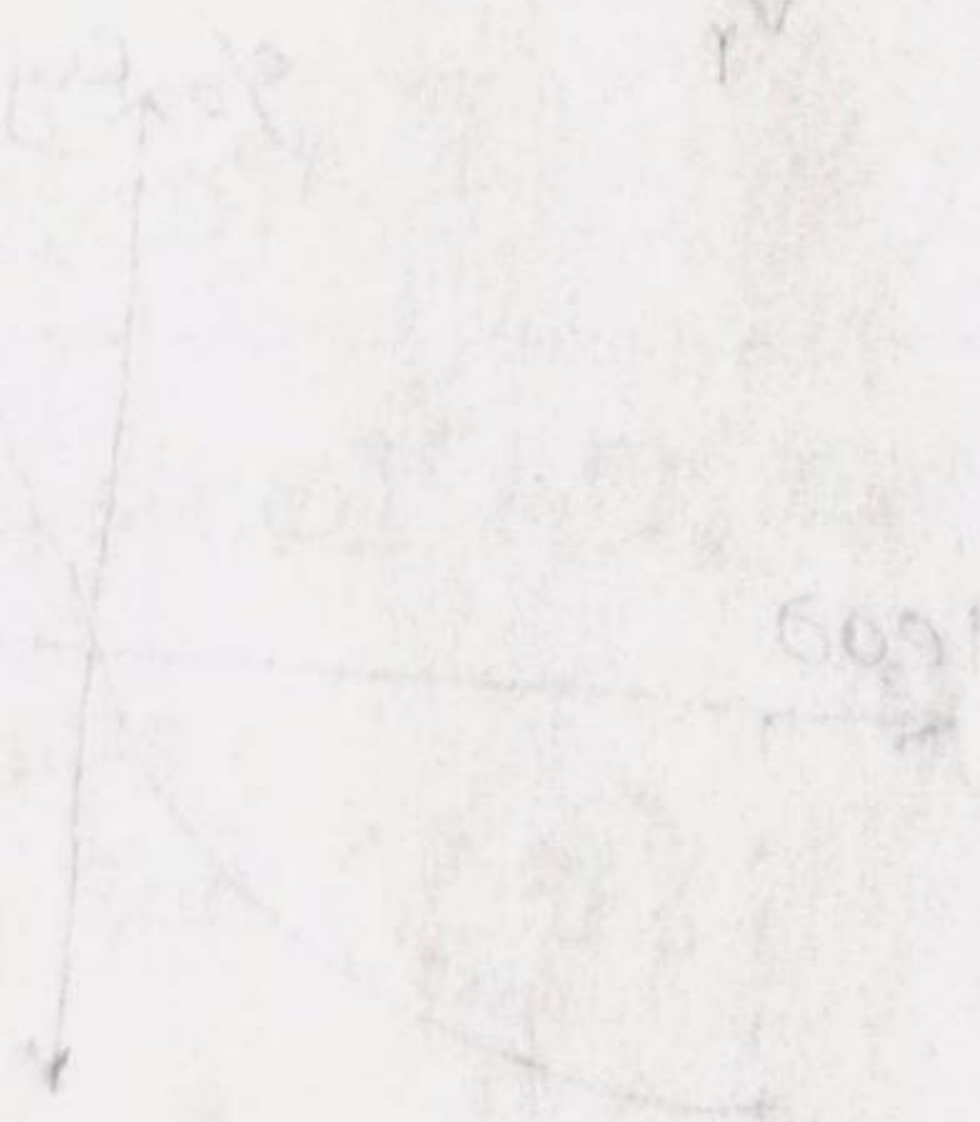
$$\tan \phi = \frac{e_r}{e_x} \rightarrow \phi = \tan^{-1} \left(\frac{e_r}{e_x} \right) = \tan^{-1} \left(\frac{R_{01}}{X_{01}} \right)$$

Similarly, the value of the regulation is maximum at a power factor angle,

$$\phi = \tan^{-1} \left(\frac{e_x}{e_r} \right) = \tan^{-1} \left(\frac{X_{01}}{R_{01}} \right) \text{ lagging}$$

From the graphical representation the variation at full load regulation of a typical transformer as the power factor is varied from zero pf leading, through unity pf to zero pf lagging.

It is seen from graphical representation, that the full load regulation at unity pf is nothing but the percentage resistance of transformer. It is therefore very small and negligible.

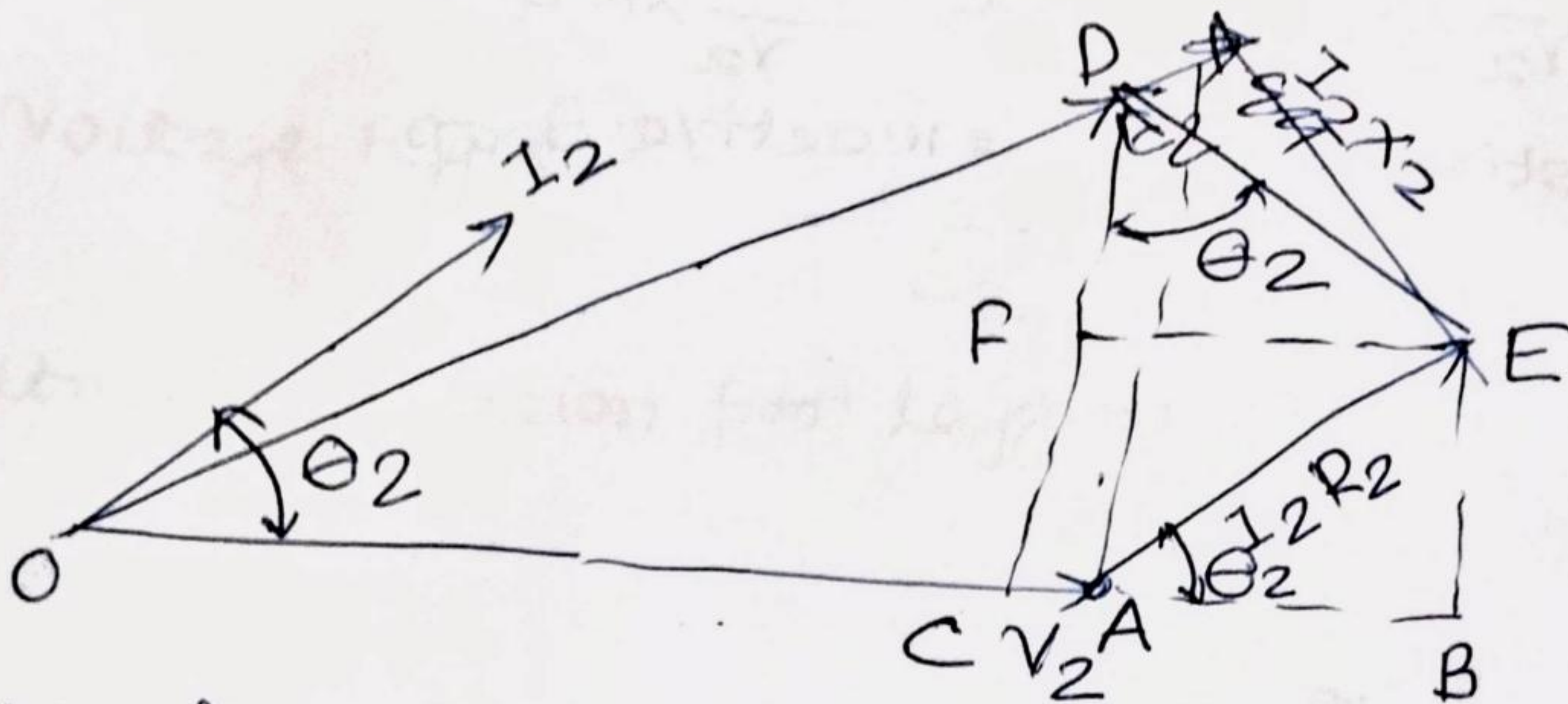


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Voltage regulation for leading power factor:-



In above diagram,

$$OC = OA + AB - BC$$

$$OA = V_2$$

$$AB = AE \cos \theta_2 = I_2 R_2 \cos \theta_2$$

$$BC = DE \sin \theta_2 = I_2 X_2 \sin \theta_2$$

$$E_2 = V_2 + I_2 R_2 \cos \theta_2 - I_2 X_2 \sin \theta_2$$

Angle between OC and OD may be very small, it is neglected
Voltage regulation at leading pf,

$$\text{Voltage regulation} = \frac{E_2 - V_2}{V_2} \times 100$$

$$= \frac{I_2 R_2 \cos \theta_2 - I_2 X_2 \sin \theta_2}{V_2} \times 100$$

$$\text{Thus regula}^n = \frac{I_2 R_2 \cos \phi \pm I_2 X_2 \sin \phi}{V_2} \times 100$$

$$= \frac{I_2 R_2 \cos \phi}{V_2} \pm \frac{I_2 X_2 \sin \phi}{V_2}$$

$$= e_r \cos \phi \pm e_x \sin \phi$$

$$e_r = \frac{I_2 R_2}{V_2} \times 100$$

= resistive drop

$$e_x = \frac{I_2 X_2}{V_2} \times 100$$

= reactive drop

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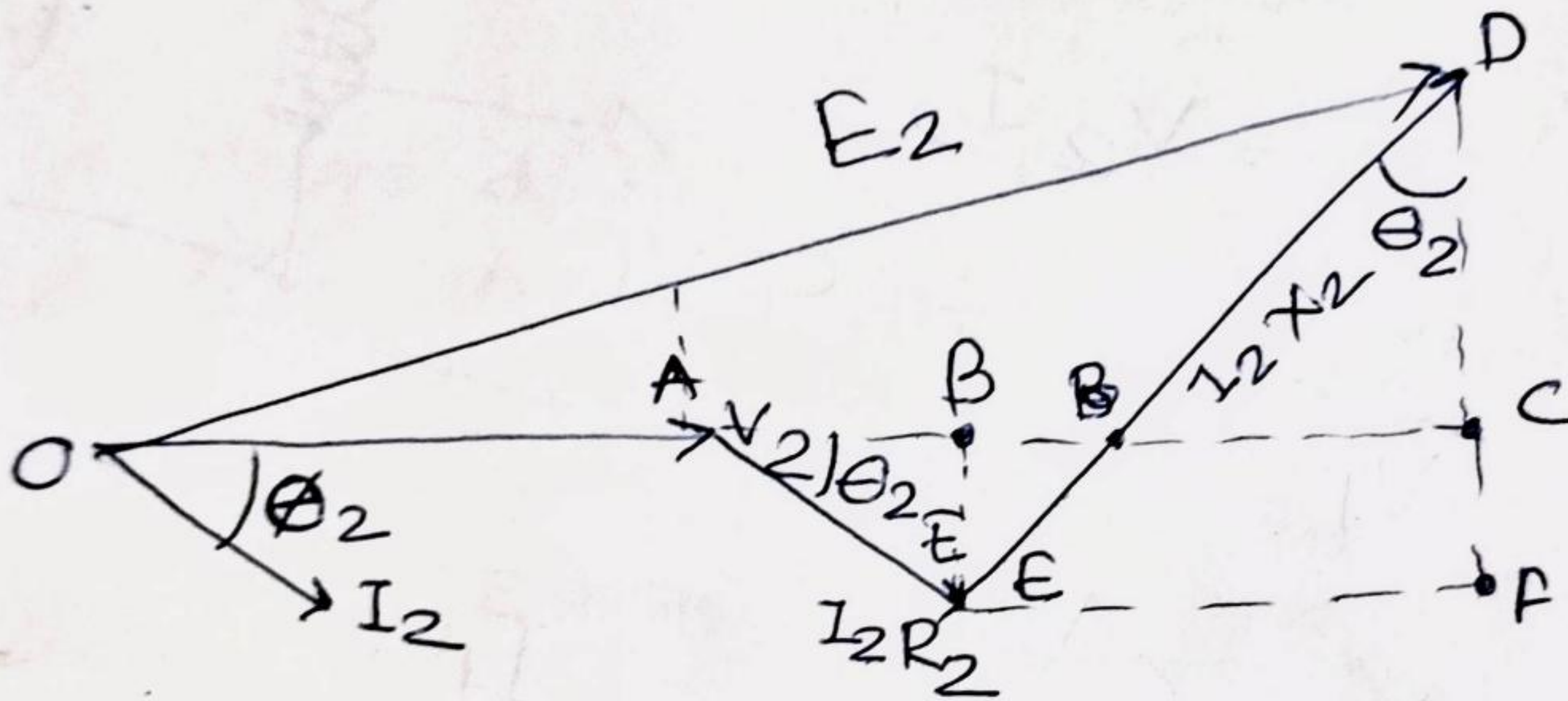
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Voltage regulation :-
It is the change.

$$\text{Voltage regula}^n = \frac{E_2 - V_2}{E_2} \times 100$$

Voltage regulation for lagging power factor



Here from above diagram,

$$OC = OA + AB + BC$$

$$OA = V_2, AB = AE \cos \theta_2 = I_2 R_2 \cos \theta_2$$

$$BC = ED \sin \theta_2 = I_2 X_2 \sin \theta_2$$

$$E_2 = EF$$

$$\therefore E_2 = V_2 + I_2 R_2 \cos \theta_2 + I_2 X_2 \sin \theta_2$$

As angle betⁿ OC and OD is very small OC is considered nearly equal to OD.
Voltage regulation at lagging pf

$$= \frac{E_2 - V_2}{V_2} \times 100\% = \frac{I_2 R_2 \cos \theta_2 + I_2 X_2 \sin \theta_2}{V_2}$$



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Name of Faculty:

Class/Section:

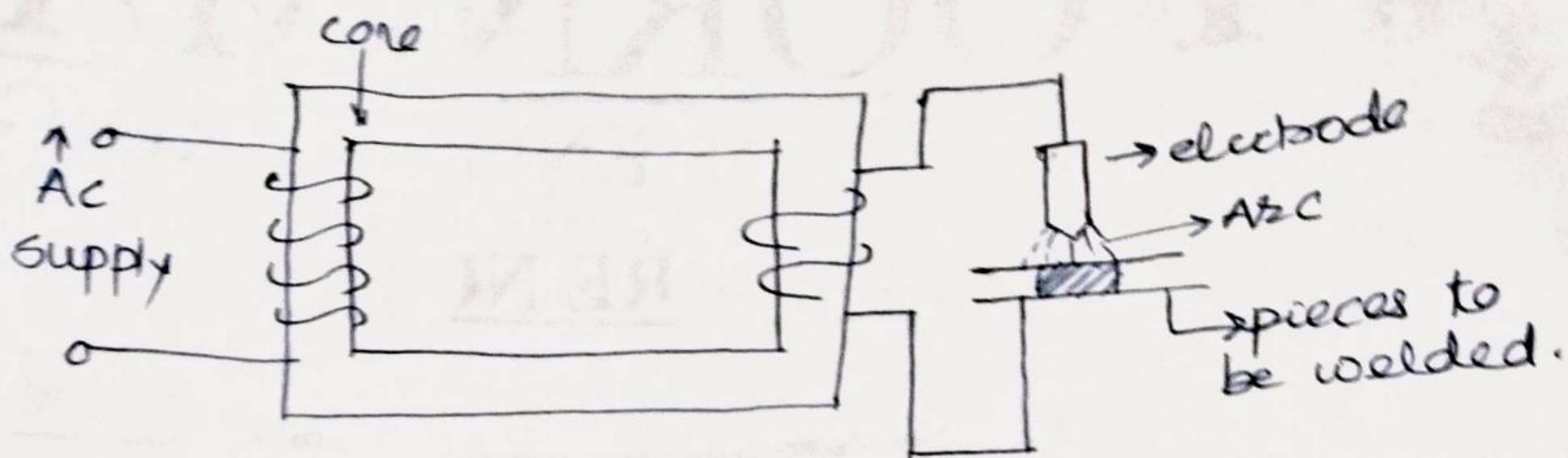
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Welding transformer:-

A welding transformer is a step down transformer that has thin primary winding with a large number of turns and its secondary has more area of cross section and less number of turns ensuring less voltage and very high current in the secondary. The welding transformer reduces the voltage from source voltage to a lower voltage that is suitable for welding, usually between 15 and 45 volts. The secondary current is quite high and it may be typically 200A to 600A but it could be much higher. The secondary may have several taps for adjusting the secondary voltage to controlling the welding current. The taps are connected to several high current plug switch. One end of the secondary is connected to the welding electrode whereas the other end to the pieces to be welded. If any high current flows, heat is produced due to contact resistance between the electrode and the pieces to be welded. The generated heat melts a tip of electrode and the gap between the two pieces is filled. Fig. shows a simple welding transformer.

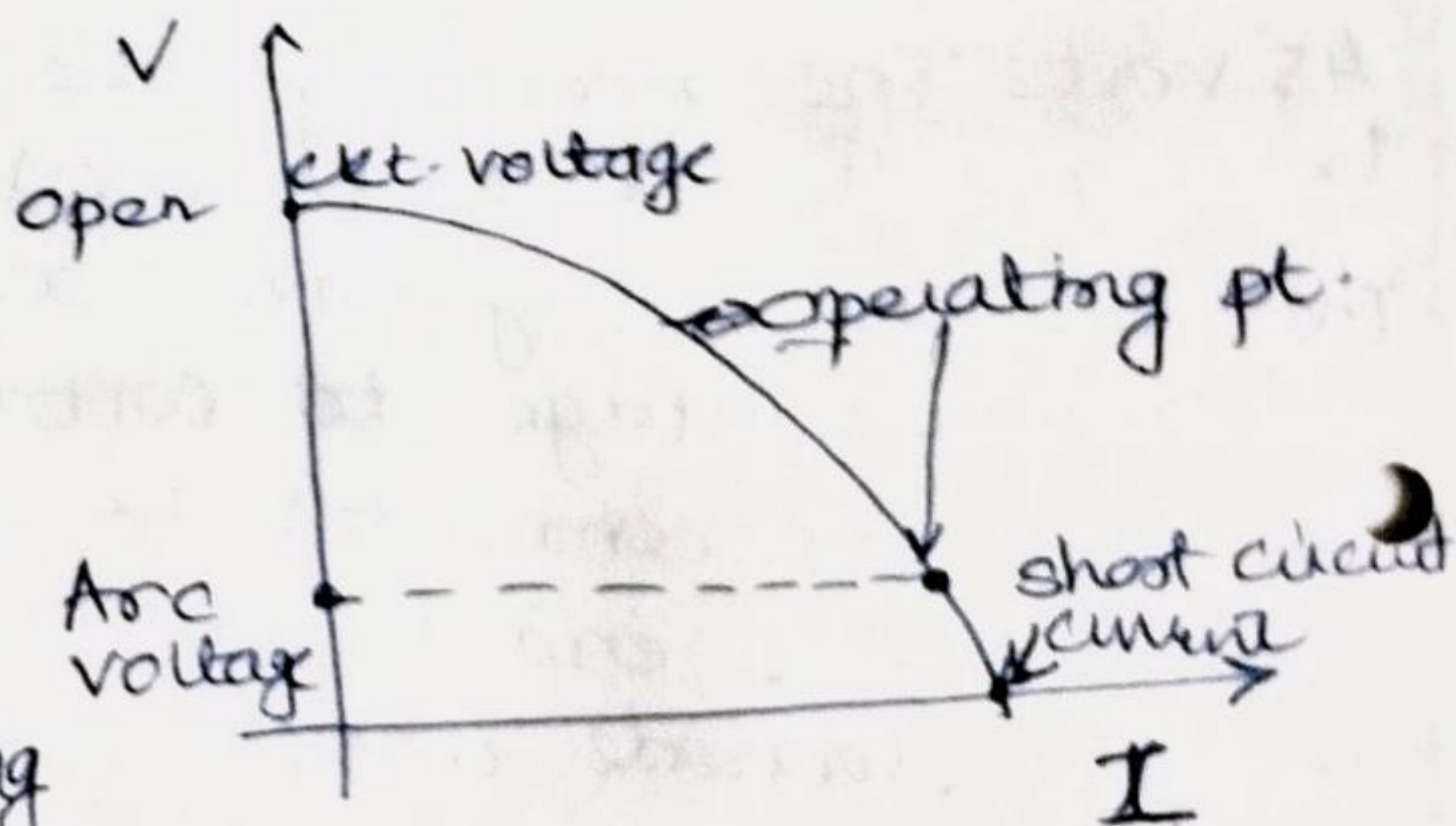


The impedance of welding transformer may be higher than that of the impedance of a general purpose transformer.

The impedance of welding transformer may play a role in the process of establishing an arc and controlling the current. Large welding transformers are most likely to be designed for three phase input. There are many smaller transformers that are designed for single phase input.

The shows the VI characteristics of a welding transformer.

For welding with direct current (DC) a rectifier is connected to the secondary of the transformer. There may be a filter choke or an inductor to smooth the DC current. The entire transformer and rectifier assembly may be called a welding power supply. The welding used for



welding transformer is highly reactive. otherwise, a separate reactor may be added in series with secondary winding. To control the arc, various reactors are used with the welding transformer. Some methods are -

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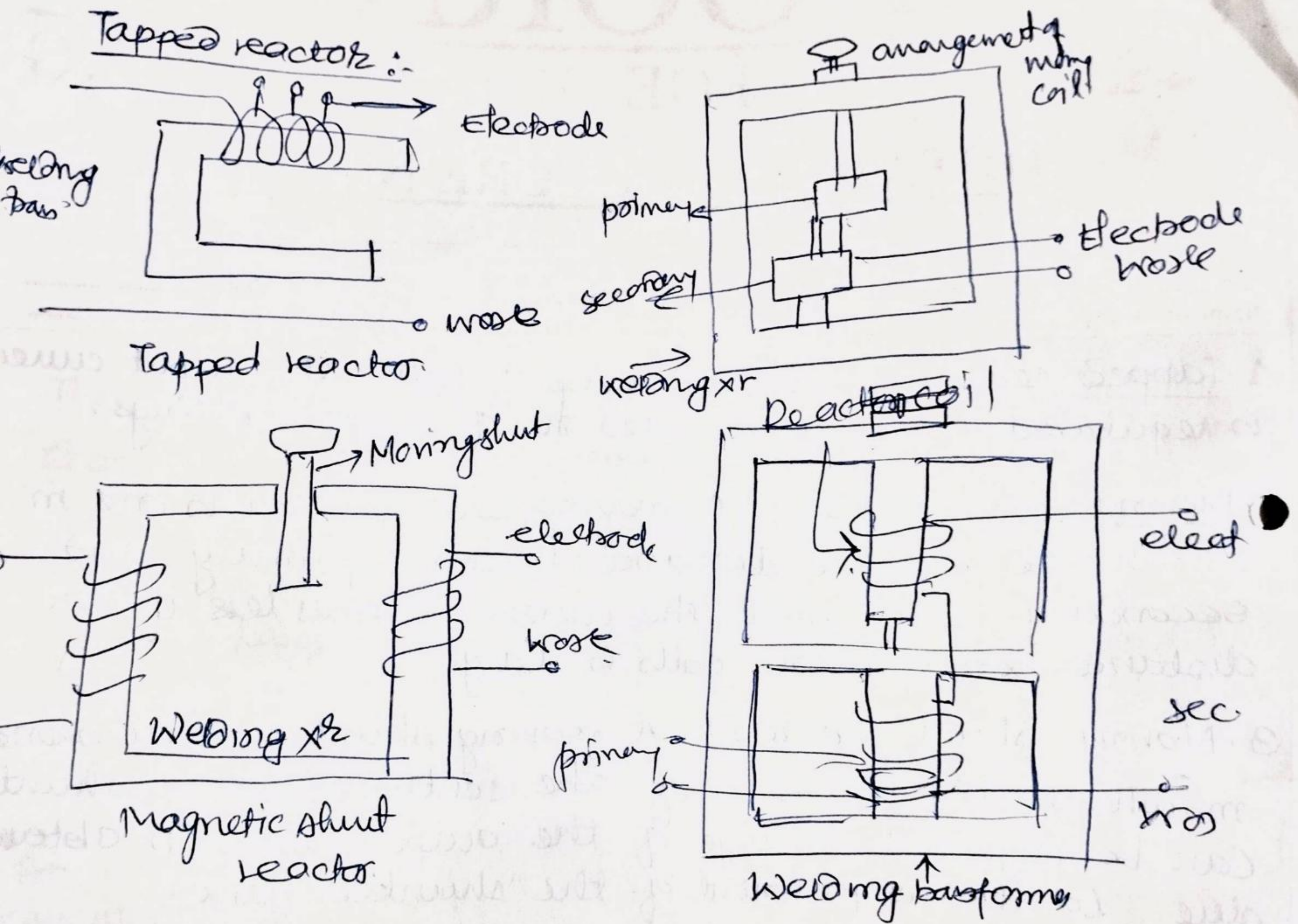
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1. Tapped reactors: With the help of taps, the output current is regulated. This has limited no. of current settings.
2. Moving coil reactor: - A moving coil reactor is one in which the reactive distance between primary and secondary is adjusted. The current becomes less if the distance between the coils is large.
3. Moving shunt reactor: - A moving shunt reactor is one in which the position of the central magnetic shunt can be adjusted, change of the output current is obtained due to the adjustment of the shunted flux.
4. Continuously variable reactor: - A continuously variable reactor is one in which the height of reactor is continuously varied. Greater reactance is obtained due to greater core insertion and hence the output current is less.





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LECTURE NOTES

Campus: PCE Course: B.Tech Class/Section: III (A & C) Date:
Name of Faculty: Dr. Chetan Khemraj Name of Subject: Elect. M/c - I Code: 03EE05
Date (Prep.): Date (Del.): Unit No.: IV Lect. No:

OBJECTIVE: To be written before taking the lecture (Pl. write in bullet points the main topics/concepts etc., which will be taught in this lecture)

- * Voltage regulation of a transformer
- * Conditions for maximum regulation

IMPORTANT & RELEVANT QUESTIONS:

- Q.1 Discuss the importance of voltage regulation.
- Q.2 Derive the condition for maximum voltage regulation.

FEED BACK QUESTIONS (AFTER 20 MINUTES):

- Q.1 Develop an expression for calculating the voltage regulation of two winding transformer having ① unity pf ② lagging pf ③ leading pf

OUTCOME OF THE DELIVERED LECTURE: To be written after taking the lecture (Pl. write in bullet points about students' feedback on this lecture, level of understanding of this lecture by students etc.)

Excellent.

REFERENCES: Text/Ref. Book with Page No. and relevant Internet Websites:

1. P. S. Bhimbood -
2. Asfaq Hussain -

DETAILED LECTURE NOTES

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② Core loss :- They are also W_{as} iron loss. It consists of hysteresis and eddy current losses. The core losses are constant for a transformer operated at constant voltage and frequency.

③ Dielectric loss :- This type of loss occurs in insulating materials, particularly in oil and solid insulations.

④ Stray load loss :- This is basically eddy current loss in tank wall and conductors due to leakage field.

All day efficiency :-

A distribution transformer is never switched off. It has to remain in the circuit irrespective of the load connected. In such cases the constant loss of transformer continues to be dissipated. Hence the concept of energy based efficiency is defined for such transformers. It is called all day efficiency. The all day efficiency is thus the ratio of the energy output of transformer over a day to the corresponding energy input in one day is taken as a duration of time over which the load pattern repeats itself.

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$$\text{All day efficiency} = \frac{\text{O/P in KWh for 24 hrs}}{\text{I/P in KWh for 24 hrs}}$$

Condition for maximum efficiency:-

The condition for maximum efficiency is

Constant loss = variable loss

Iron losses = Copper losses.



P O O J A S H R E E
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DETAILED LECTURE NOTES

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Code:

Efficiency

Transformer efficiency is given by

$$\text{efficiency}(\%) = \frac{\text{output}}{I_{\text{input}}}$$

$$= \frac{\text{output}}{\text{output} + \text{losses}}$$

$$\% \eta = \frac{\text{output}}{O/P + P_c + P_L} \times 100$$



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Name of Subject:

Code:

ciii) Testing of transformers

The performance of transformer can be calculated by knowing the parameters of equivalent circuit. The parameters or constants of equivalent circuit can be easily determined by two tests as follows:-

(i) open circuit test (ii) short circuit test

(i) open circuit test:-

It is also called as no load test.



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LECTURE NOTES

Campus: PCE Course: B.Tech Class/Section: III A & C Date:
Name of Faculty: Dr. Chetan Khemraj Name of Subject: Electrical M/C Code: A3EE0
Date (Prep.): Date (Del.): Unit No.: Lect. No.:

OBJECTIVE: To be written before taking the lecture (Pl. write in bullet points the main topics/concepts etc., which will be taught in this lecture)

1. Introduction to 3ϕ transformers
2. Advantage of single unit over three unit
3. Disadvantages

IMPORTANT & RELEVANT QUESTIONS:

Q.1 Why a three phase unit is preferred over a single phase unit?

Q.2 What are advantages of three unit of 1ϕ transformer?

FEED BACK QUESTIONS (AFTER 20 MINUTES):

Q.3. Describe the importance of three phase transformers in power systems.

OUTCOME OF THE DELIVERED LECTURE: To be written after taking the lecture (Pl. write in bullet points about students' feedback on this lecture, level of understanding of this lecture by students etc.)

1. Asfaq Hussain -
2. P. S. Bhimbax -

REFERENCES: Text/Ref. Book with Page No. and relevant Internet Websites:

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DETAILED LECTURE NOTES

Campus: Course:
Name of Faculty:

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Introduction

Most of the power is generated, transmitted and distributed in form of three phase ac. Three phase ac is more efficient than single phase ac, when single phase ac is needed, it is available between any two phases of a three phase system or in some systems between one of the phases and ground. By the use of three conductors of a single phase system. Three phase power allows heavy duty industrial equipments to operate more smoothly and efficiently. Three phase power can be transmitted over long distances with smaller conductor size. Three phase transformers are used throughout the industry to change values of three phase voltages and current.

A three phase transformer is constructed by winding three single phase transformers on a single core. These transformers are put into an enclosure which is then filled with dielectric oil. The dielectric oil performs several functions. Since it is a dielectric, a non conductor of electricity, it provides electrical insulation between the windings and the case.

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RING

It is also used to help provide cooling and to prevent the formation of moisture, which can deteriorate the winding insulation.

Single unit or Bank of single phase units

In case of single phase transformers connected to form three phase bank, each transformer is magnetically decoupled from the other. The flows of harmonic currents are decided by the type of the electrical connection used on the primary and secondary side.

As against a bank of three phase transformers connected to three phase mains, a 3 phase transformer generally has the three magnetic circuits that are interacting. The exception to this rule is a 3 phase shell type transformer. In the shell type of construction, even though the three cores are together, they are non-interacting. Three limb core type 3 phase transformer is the one in which each phase is magnetically linked with each other.

In place of this, a three phase transformer wound on common core offers number of advantages over a bank of single phase transformers. A three phase transformer wound on a common core is lighter, smaller and cheaper than the bank of three phase transformer wound on a common core. Three phase transformer also requires much less external wiring than the bank of single phase transformers and can typically achieve a higher efficiency. The bank of three single phase transformers



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The bank of three single phase transformers does offer the advantages of flexibility. In case of an unbalanced load, one or more transformers in the bank can be replaced by a larger or smaller KVA rated transformer. In terms of maintenance, a malfunctioning transformer in the bank of transformers can be easily replaced while the entire common core three phase transformer would require replacement.

Advantages of polyphase connections:-

Because of various advantages of polyphase during generation, transmission and utilisation, polyphase power handling and operations are very important. Star and delta are the most commonly used forms. Ap

Many polyphase connections can be formed using single phase transformers. In a balanced two phase system, two voltages that are equal in magnitude differing in phase by 90° . Similarly in a three phase system there are three equal voltages differing in phase by 120° electrical degrees. Further there is an order in which they reach a particular voltage magnitude. This is known as phase



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LECTURE NOTES

Campus: ...PCE... Course: B.Tech... Class/Section: III A 2C... Date: ...11/17...
Name of Faculty: Dr. Chetan Khemraj Name of Subject: Electrical M/c-1 Code: 03EECS
Date (Prep.): Date (Del.): Unit No.: Lect. No.:

OBJECTIVE: To be written before taking the lecture (Pl. write in bullet points the main topics/concepts etc., which will be taught in this lecture)

1. Methods of polyphase connections
2. Method of open delta connection

IMPORTANT & RELEVANT QUESTIONS:

- Q.1 Describe the various polyphase connections.
- Q.2 Why star-star connection is rarely used.

FEED BACK QUESTIONS (AFTER 20 MINUTES):

- Q.3 List the advantages of star-delta transformer with its applications.
- Q.4 What are the applications of open delta configuration?

OUTCOME OF THE DELIVERED LECTURE: To be written after taking the lecture (Pl. write in bullet points about students' feedback on this lecture, level of understanding of this lecture by students etc.)

1. Asfaq Hussain - pp
2. P. S. Bhimbor - pp

REFERENCES: Text/Ref. Book with Page No. and relevant Internet Websites:

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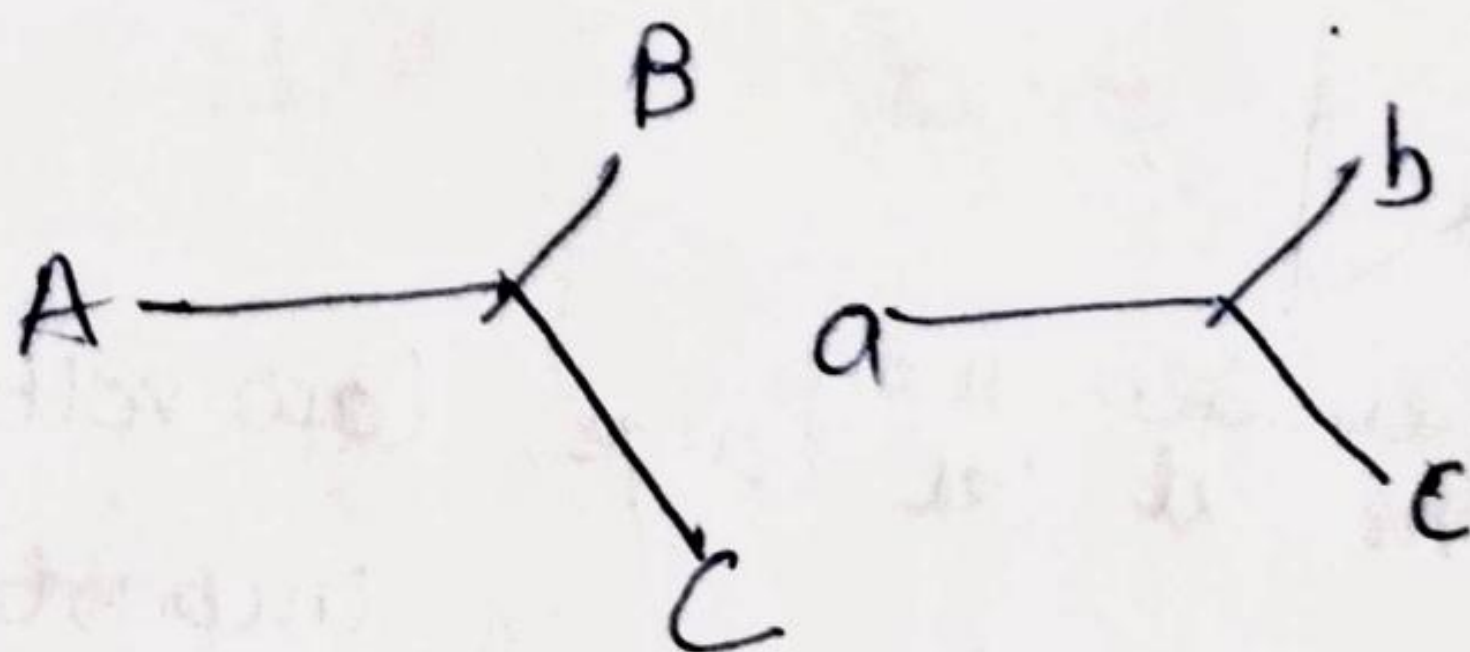
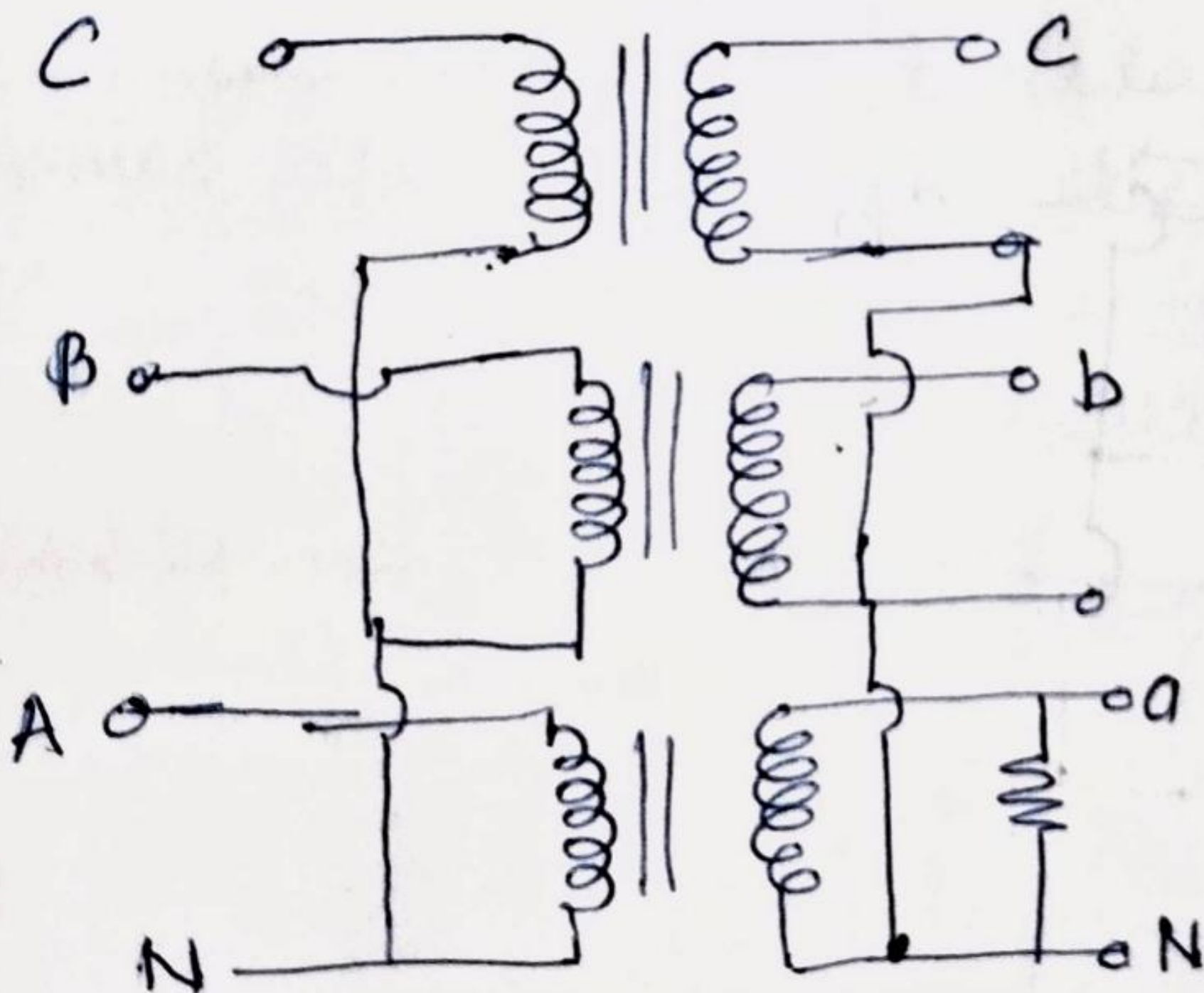
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Methods of polyphase connections

1] Star/star connection:-

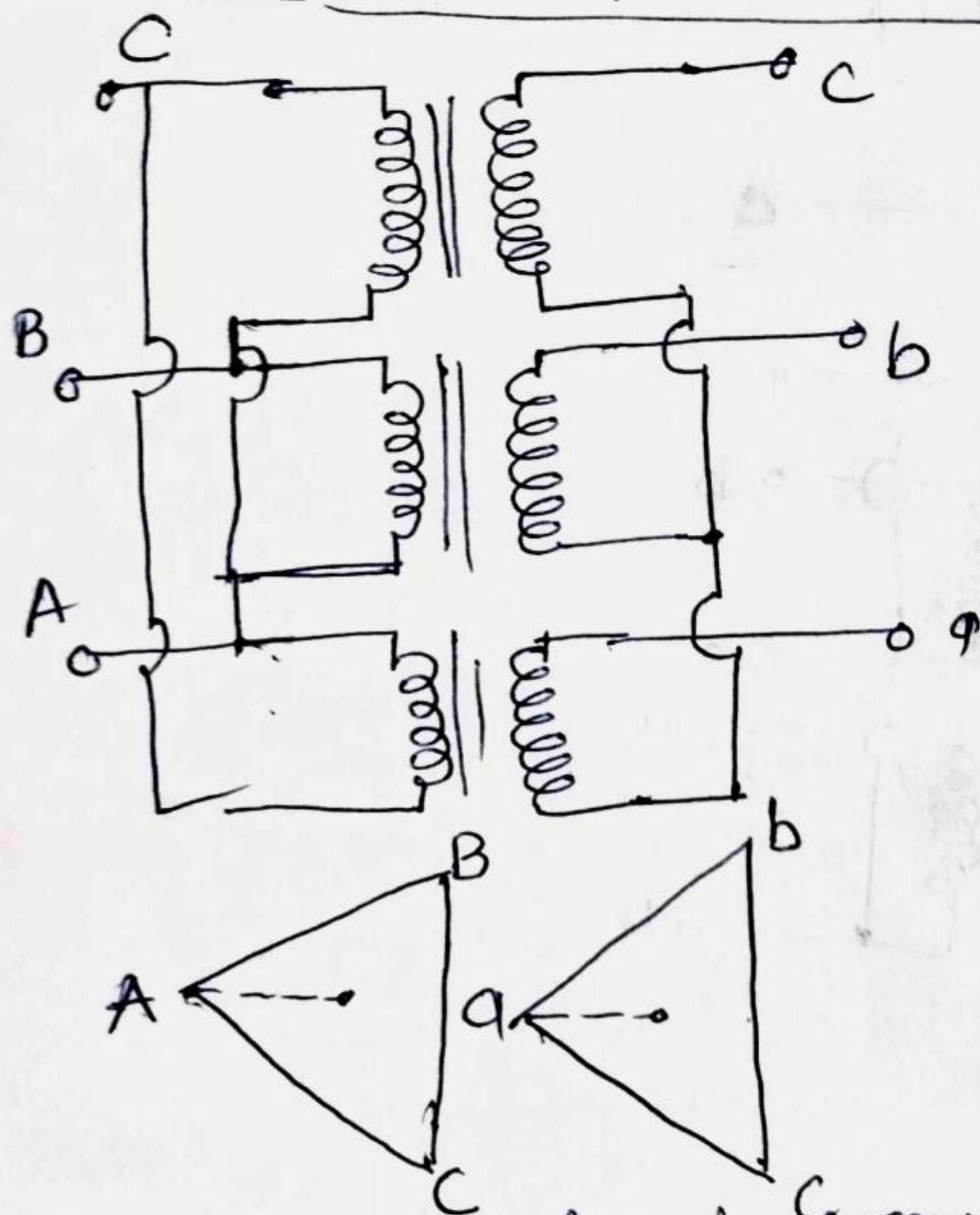
This is the most economical one for small, high voltage transformers. Insulation required and no. of turns/phase are highly reduced, because the phase voltage is only $1/\sqrt{3}$ of line voltage. This connection works only for balanced load.



0° angular displacement

In other words under short circuit conditions, the neutral is pulled too much towards coil 'a'. This reduces V_{an} but increases V_{bn} and V_{cn} (line voltage V_{AB} , V_{BC} and V_{CA} are unaffected). On primary side V_{AN} will be practically reduced to zero whereas V_{BN} and V_{CN} will rise to nearly full primary line voltage V_{AB} . It should be noted that if a single phase load is connected between the lines a and b, there will be a similar but less pronounced neutral shift which results in an overvoltage on one or more transformers.

2] Mesh/Mesh or Delta/Delta ($\Delta-\Delta$) connection



This connection is economical for large, low voltage transformers where insulation problems is not very much important because it increases the number of turns/phase. Here the ratio of transformation between primary and secondary line voltage is exactly the same as that of each transformer. There is no angular displacement between the primary and secondary line voltages.

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and there is no internal phase shift between phase and line voltage.

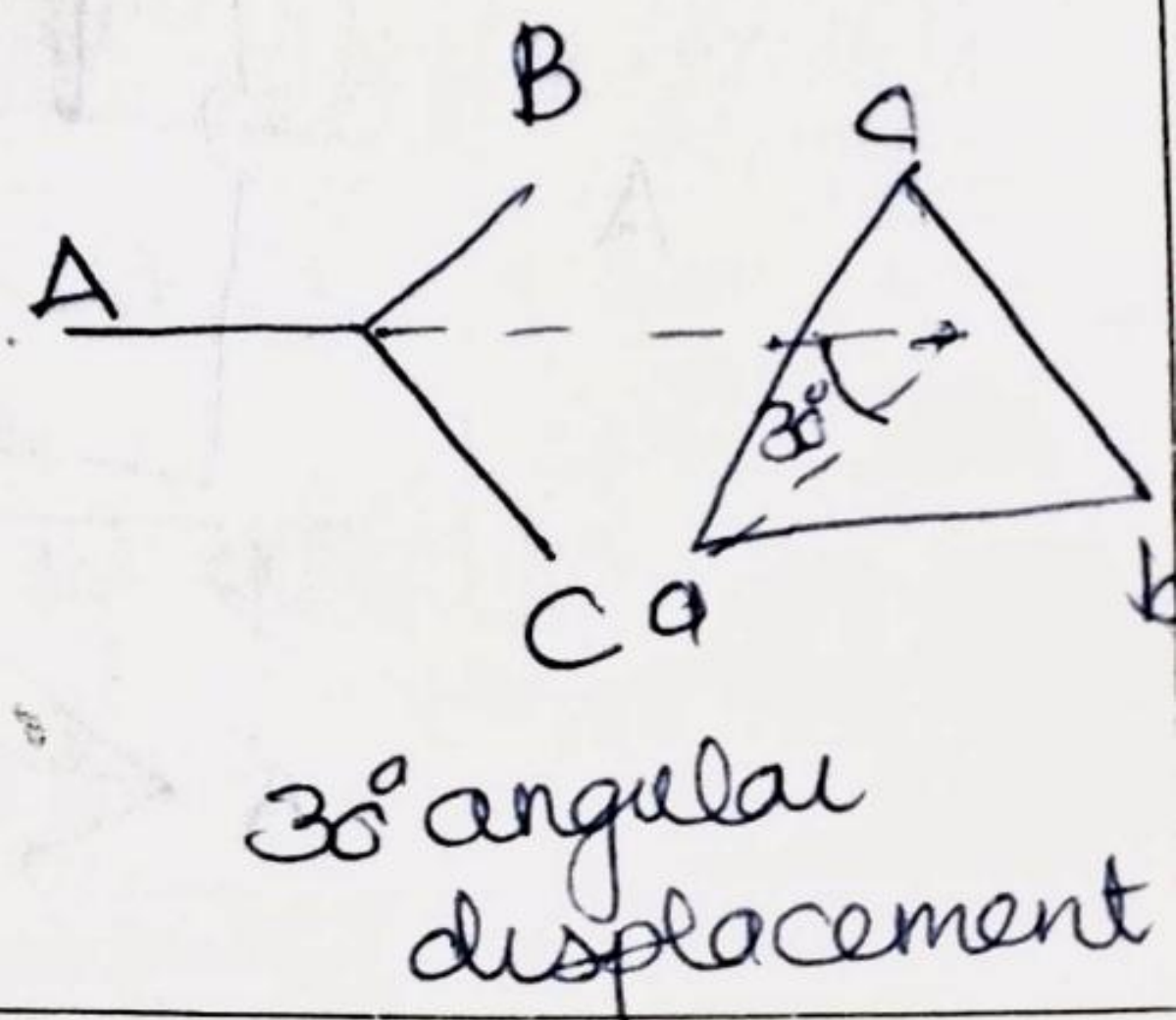
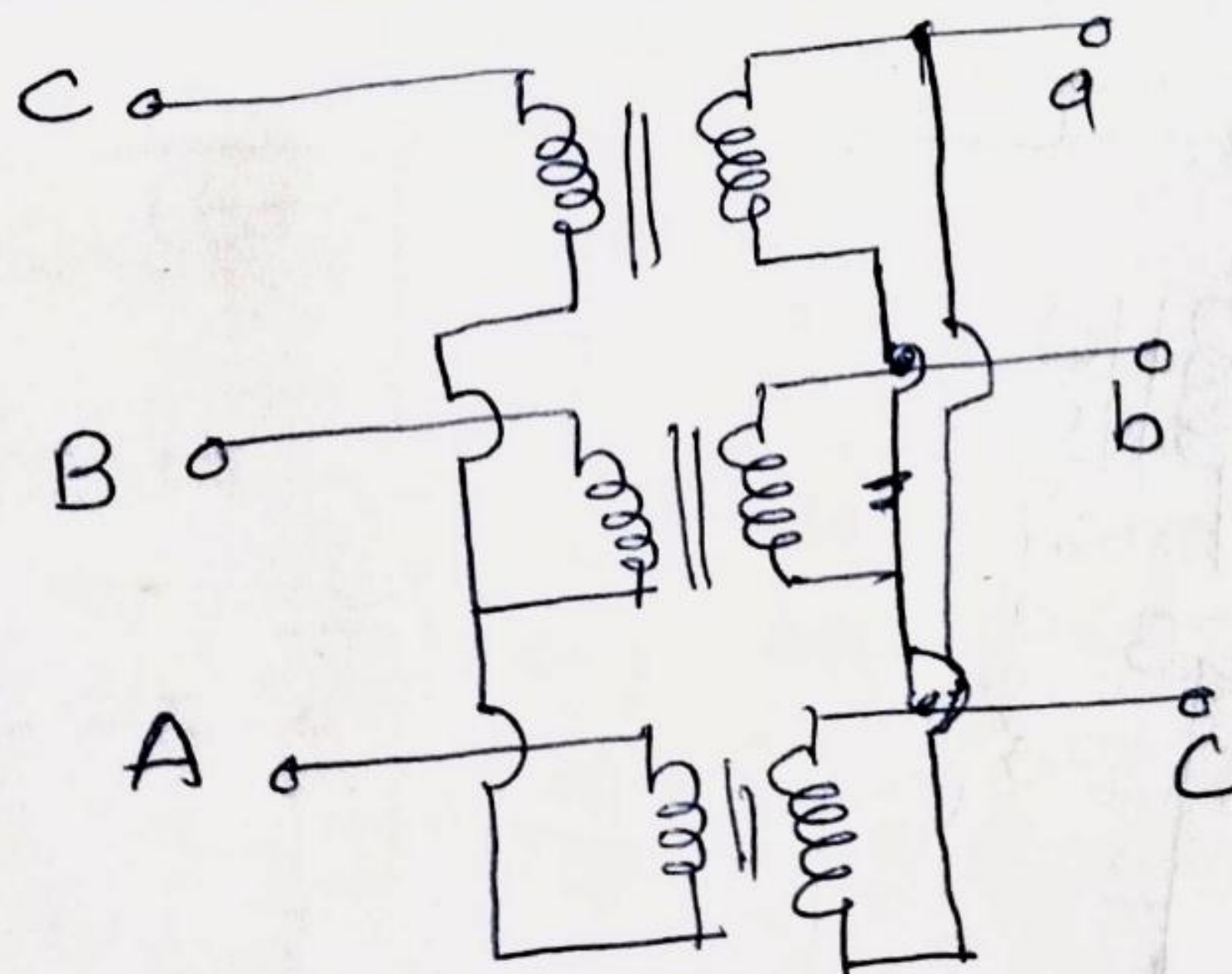
Advantages:-

(i) In this connection, the magnetisation, the magnetising current of the transformer contains the third harmonic component which is necessary for output voltage to be sinusoidal.

(ii) Large amount of unbalanced load can be met with ease. Mesh permits a circulating path for triple harmonics thus attenuates the same.

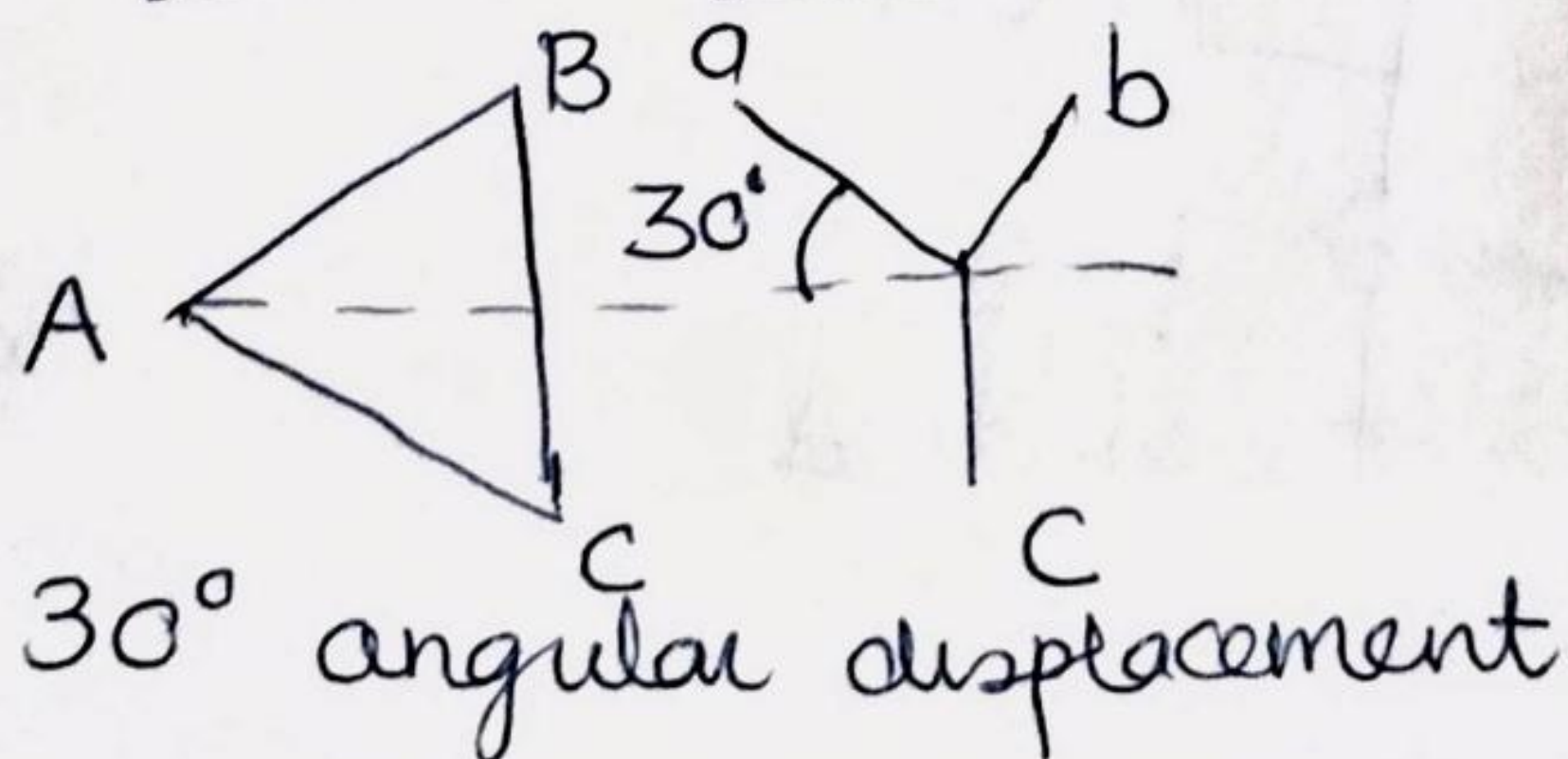
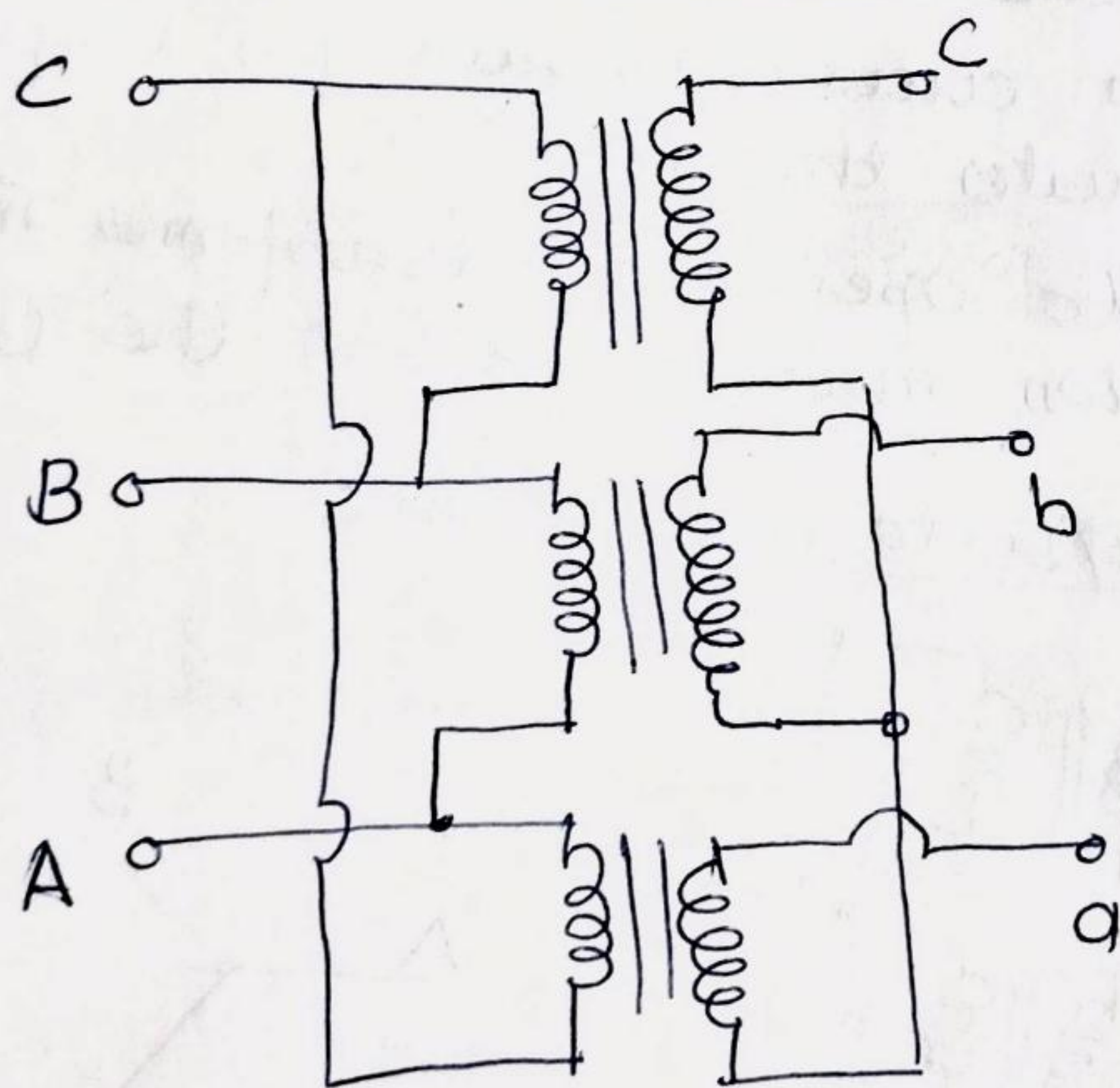
(iii) It is possible to operate the transformer in open delta or vee connection meeting 58% of the load.

3. star delta or vee/delta connection:-



At substation end of the transmission line where the voltage is to be stepped down, this type of connection is in use. The primary winding is star connected with grounded neutral. The third harmonics current flows in the delta (Δ) to provide sinusoidal flux. There is a 30° phase shift between primary and secondary line voltages i.e. star/delta transformer bank cannot be paralleled with either a (Y-Y) or a delta-delta bank.

Delta-Wye connection



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This connection is generally employed where it is necessary to step up the voltage. This connection is mainly employed at the beginning of the high tension transmission systems. The neutral is grounded for providing 3 phase 4 wire system. This connection can be used for both 3 phase power requirement and single phase supply.

It is impossible to parallel such a bank with a delta-delta ($\Delta-\Delta$) or wye-wye ($Y-Y$) bank of transformers.

choice of transformer connections :-

connection	choice.	Remarks
star-star	small HV transformers	rarely used
Delta-Delta	for large HV transformer	Large unbalanced load can be tolerated.
star-Delta	for power systems as a step up transformer	The phase shift of $\pm 30^\circ$ can be taken.
Delta-star	for power systems as a step down transformers	

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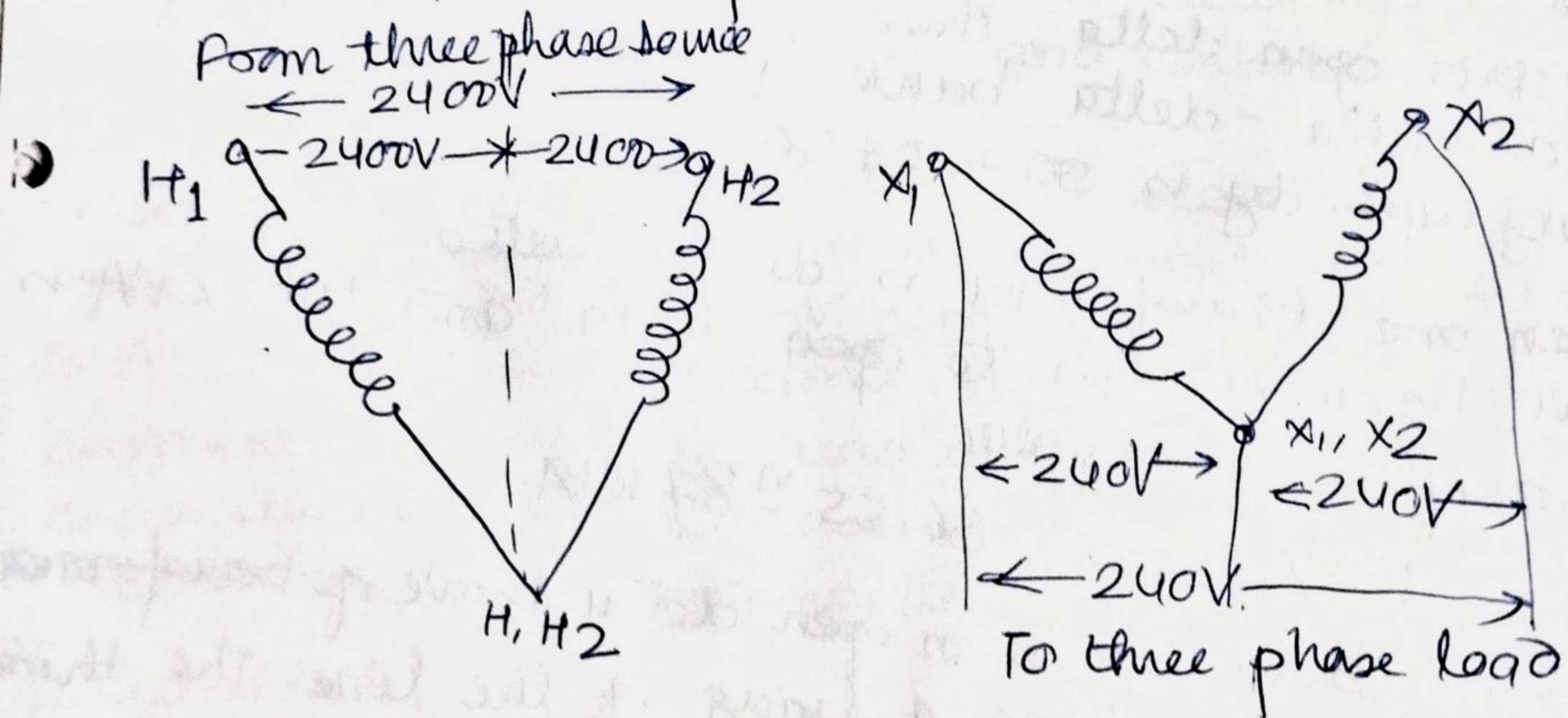
Campus: Course:
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Open Delta or V connection

In power transmission, three phase transformation of energy can be possible only by using two similar transformers in open delta configuration as shown. This arrangement is called as V connection. The open delta connection is often used in an emergency when one of the three transformers in a delta-delta bank becomes defective or in maintenance. When it is repaired, a consumer power supply can be restored as soon as possible.



Three 50KVA transformers each rated at 2.4KV on high voltage (HV) winding and 240V on low voltage (LV). If three phase supply is interrupted due to lightning strikes, or other natural or man made accidents.

This situation is shown in the given fig.

The third transformer is defective transformer. If all the leads of the damaged transformer is disconnected, then closed delta bank automatically becomes open delta bank.

While the total KVA of the open delta bank should be two thirds that of a closed delta bank, the actual KVA rating of an open delta bank is only 57.7% of the capacity of a closed delta bank.

Because, the currents of the two transformers in the open delta connection are out of phase, resulting in the total available capacity of the open delta bank being only 57.7% instead of 66.7%.

In this open delta, three 50 KVA transformer connected in a delta-delta bank. For closed delta the total capacity is $50 + 50 + 50 = 150 \text{ KVA}$

When one transformer is disconnected, the transformer bank changes to open delta and the KVA is 57.7 of original value

$$150 \times 0.577 = 86.55 \approx 87 \text{ KVA}$$

In some situations, an open delta bank of transformer are installed at the time of laying of the line. The third transformer is added when the increase in industrial power load on the transformer. When the third transformer is added to the bank, a closed-delta bank is formed.

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When two transformers are installed in an open delta configuration.

The total bank capacity calculated as-

1. Add the two individual KVA capacity

$$= 50 + 50 = 100 \text{ KVA.}$$
2. Then multiply the total KVA value by 86.5%. This will give the total KVA capacity of open delta bank

$$= 100 \times 86.5\% = 87 \text{ KVA}$$

Applications:-

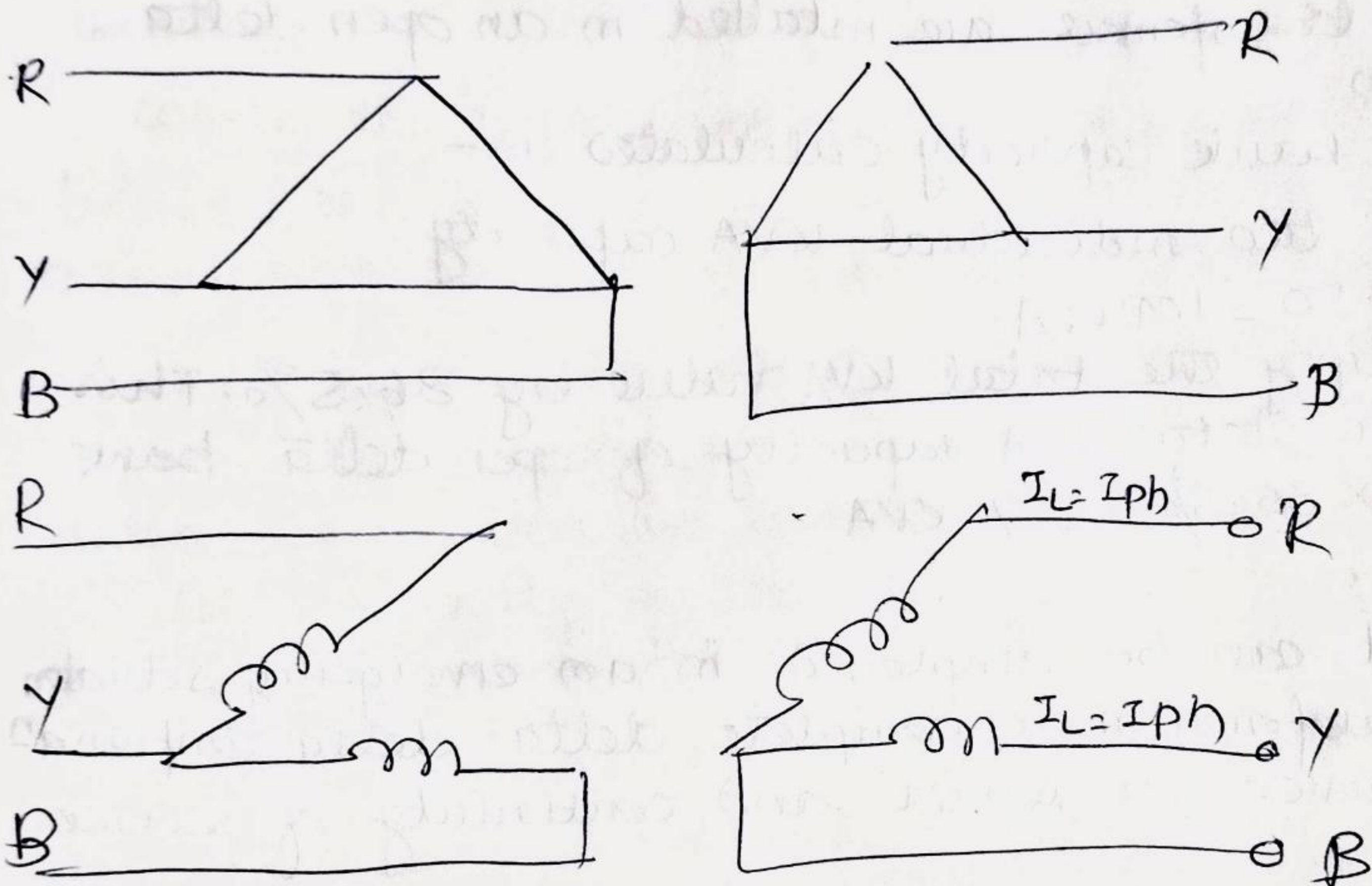
1. The circuit can be employed in an emergency situation when one transformer in a complete delta-delta connection must be removed for repair and continuity of service is required.
2. Upon failure of primary and secondary of one transformer of a delta-delta connection, the system can be operated as V-V connection.
3. A circuit is sometimes installed as a V-V connection with the understanding that its capacity may be increased by adding one more transformer to form complete delta-delta circuit.

Limitations

1. Average pf at which V-V bank is operating is less than that of the load. This power factor is 86.6%

of the balanced load power factor.
 2. The two transformers in V-V bank operate at different power factor except for a balanced unity power factor load.

It can be seen



$$\Delta - \Delta \text{ capacity} = \sqrt{3} V_L I_L = \sqrt{3} (V_L) (\sqrt{3} I_{ph}) \\ = 3 V_L I_{ph}$$

$$V - V \text{ capacity} = \sqrt{3} V_L I_L = \sqrt{3} V_L I_{ph}$$

$$\frac{\cancel{\Delta - \Delta}}{V - V} = \frac{\cancel{\sqrt{3} V_L I_{ph}} \sqrt{3}}{\sqrt{3} V_L I_{ph}} = \frac{1}{\sqrt{3}}$$

$$V - V = \frac{1}{\sqrt{3}} \Delta - \Delta \text{ connection}$$

$$= .577 \approx .58 = 58\%$$

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delta transformer bank $\rightarrow 100 \times 86.5\% = 87 \text{ KVA}$.
Hence, an open delta bank has a capacity of 57.7% of the capacity of a closed delta bank and an open delta bank has a KVA capacity of 86.5% of the capacity of two transformers.

Application of open delta :-

1. The circuit can be employed in an emergency situation when one transformer in a complete delta-delta configuration must be removed for repair and continuity of service is required.
2. Upon the failure of the primary or secondary of one transformer of a complete delta-delta circuit, the system can be operated as V-V circuit and can deliver 3 phase power to a 3 phase load.
3. A circuit is sometimes installed as V-V circuit with the understanding that its capacity may be increased by adding one more transformer to form complete delta-delta circuit.

We have,

$$\frac{P_V}{P_\Delta} = \frac{1}{\sqrt{3}} = 0.577$$

$$P_\Delta = \sqrt{3} P_V$$

Thus, if a V-V circuit is changed to complete $\Delta-\Delta$

configuration, then the capacity is increased by a factor of $\sqrt{3}$.

Limitations :-

1. Average pf at which V connection is less than the load. This power factor is 86.6% of balanced load power factor.
2. The two transformers in V-V bank operate at different power factors except for a balanced unity power factor load.
3. The terminal voltages available on secondary side becomes unbalanced when the load is increased. This may happen even when the load is perfectly balanced.

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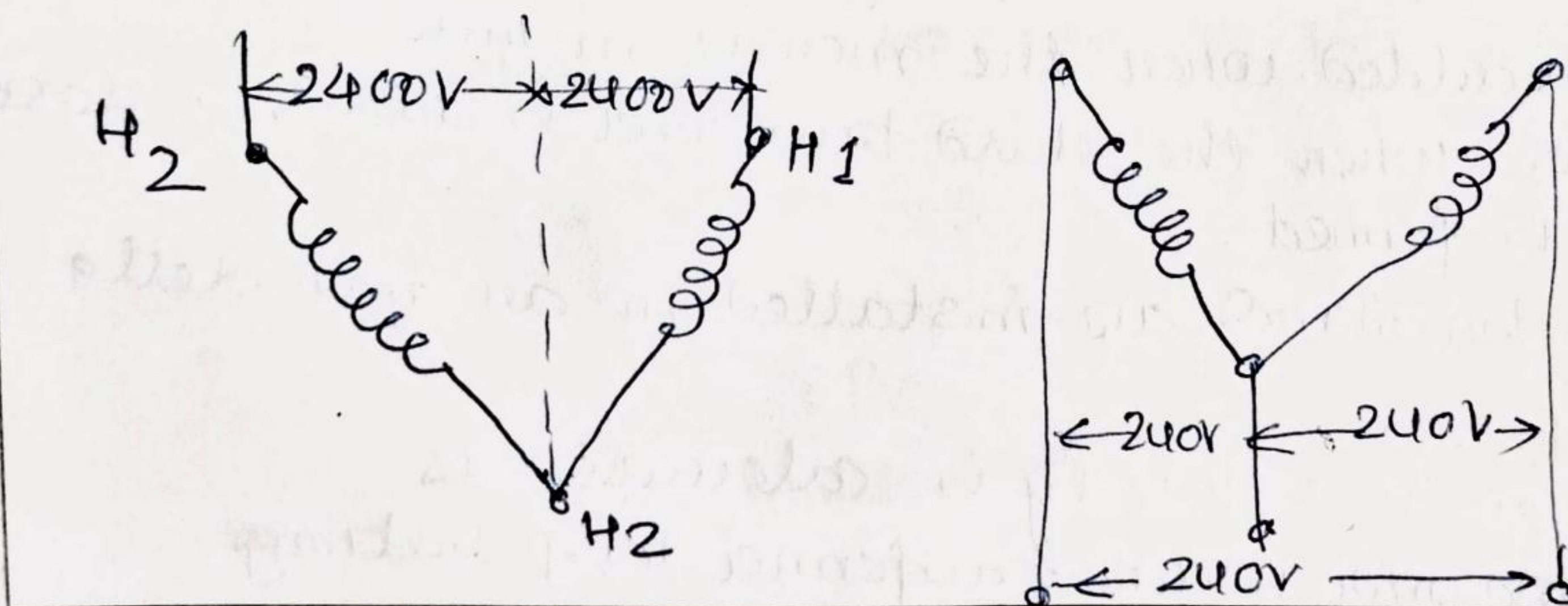
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Name of Subject:

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Code:

Open Delta or V connection:-

In power transformation, three phase transformation of energy can be possible only by using two similar transformer in open-delta configuration. This connection arrangement is also called as V connection. The open delta connection is often used in an emergency when one of the three transformer in a delta delta bank becomes defective or in maintenance work.

Let us consider three 50 KVA transformer each rated at 2.4 kV on HV side and 240V on LV side. This closed delta bank is used to step down 2.4 kV to 240V 3 phase output to supply an industrial consumer. If the three phase power service is interrupted due to striking of lightning or other natural or man made accidents and damages one of the transformer, then service must be restored instantly.



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The transformer 3 is defective. If all the leads of the damaged transformer are disconnected, then closed-delta bank automatically becomes an open delta transformer bank.

While the actual load should be one third of a closed delta bank, the actual KVA rating of an open delta bank is only 57.7% of the capacity of a closed delta bank. Because of two transformers in the open delta connection are out of phase, resulting in the total available capacity of the open-delta bank being only 57.7% instead of 66.7%.

In this open delta example, three 50 KVA transformers connected in a delta-delta bank. For the closed delta bank the total KVA capacity is $50 + 50 + 50 = 150 \text{ KVA}$.

When one transformer is disconnected, the transformer bank changes to an open delta configuration and the total KVA capacity now is 57.7 percent of the original closed-delta capacity $150 \times 0.577 = 86.55 \text{ KVA} \approx 87 \text{ KVA}$.

In some situations, an open delta bank of transformer are installed at the time of laying of the line. The third transformer is added when the increase in industrial load on the transformer. When the third transformer is added, a closed delta bank is formed.

When two transformers are installed in an open delta configuration.

The total bank capacity is calculated as

1. Add the two individual transformer KVA ratings.

For example — $50 + 50 = 100 \text{ KVA}$

2. Then multiply the total KVA value by 86.5 percent. This will give the total KVA capacity of open



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LECTURE NOTES

Campus: ...DCE... Course: B.Tech... Class/Section: III A & C... Date:
Name of Faculty: Dr. Chetan Khemraj... Name of Subject: Dr. C. Khemraj... Code: 03EE05...
Date (Prep.): Date (Del.): Unit No.: V... Lect. No:

OBJECTIVE: To be written before taking the lecture (Pl. write in bullet points the main topics/concepts etc., which will be taught in this lecture)

1. Phase conversion from three to six phase
2. 2 phase conversion using Scott connection
3. Effect of 3 phase winding connections on harmonics.

IMPORTANT & RELEVANT QUESTIONS:

- Q. 1 Describe the different methods of three phase to six phase conversion.
- Q. 2 Explain 3 phase to 2 phase conversion using Scott connection.

FEED BACK QUESTIONS (AFTER 20 MINUTES):

- Q. 3 Why a electric arc furnace requires a two phase supply?
- Q. 4 Discuss the diametrical connection of six phase transformation.

OUTCOME OF THE DELIVERED LECTURE: To be written after taking the lecture (Pl. write in bullet points about students' feedback on this lecture, level of understanding of this lecture by students etc.)

Excellent.

REFERENCES: Text/Ref. Book with Page No. and relevant Internet Websites:

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3 to 6 phase conversion

four different schemes are used for three phase to six phase conversion.

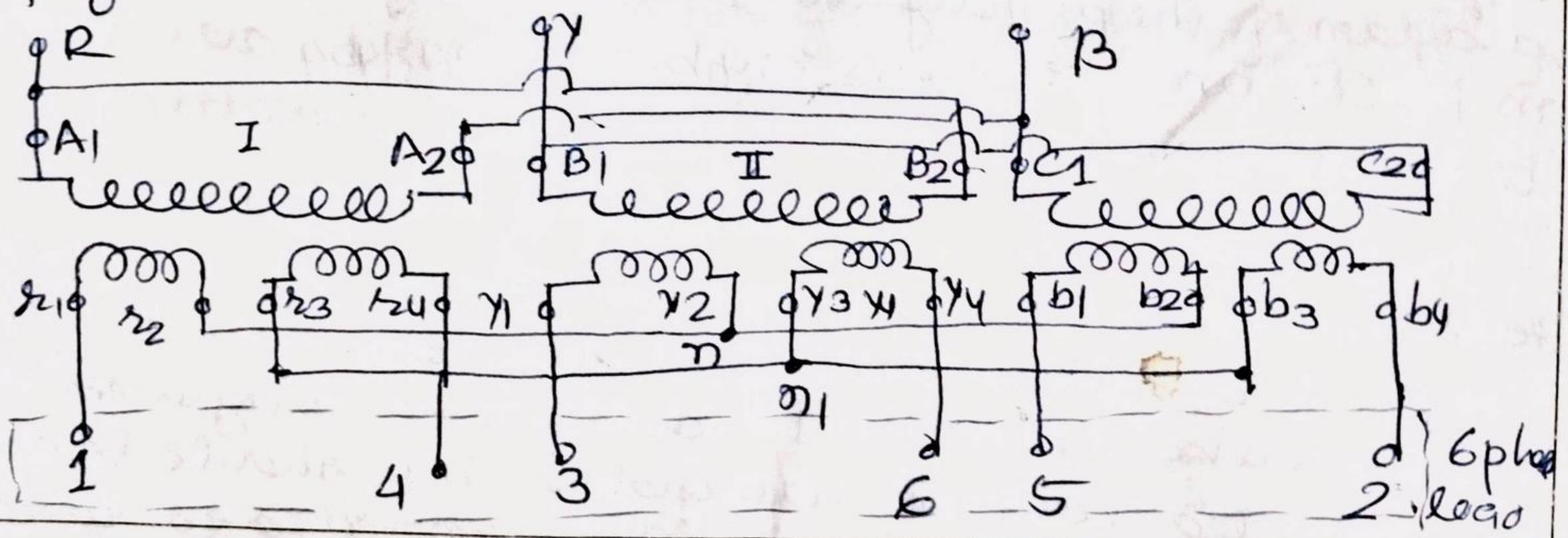
- (a) double star connection
- (b) double-delta connection
- (c) six phase star connection
- (d) diametrical connection

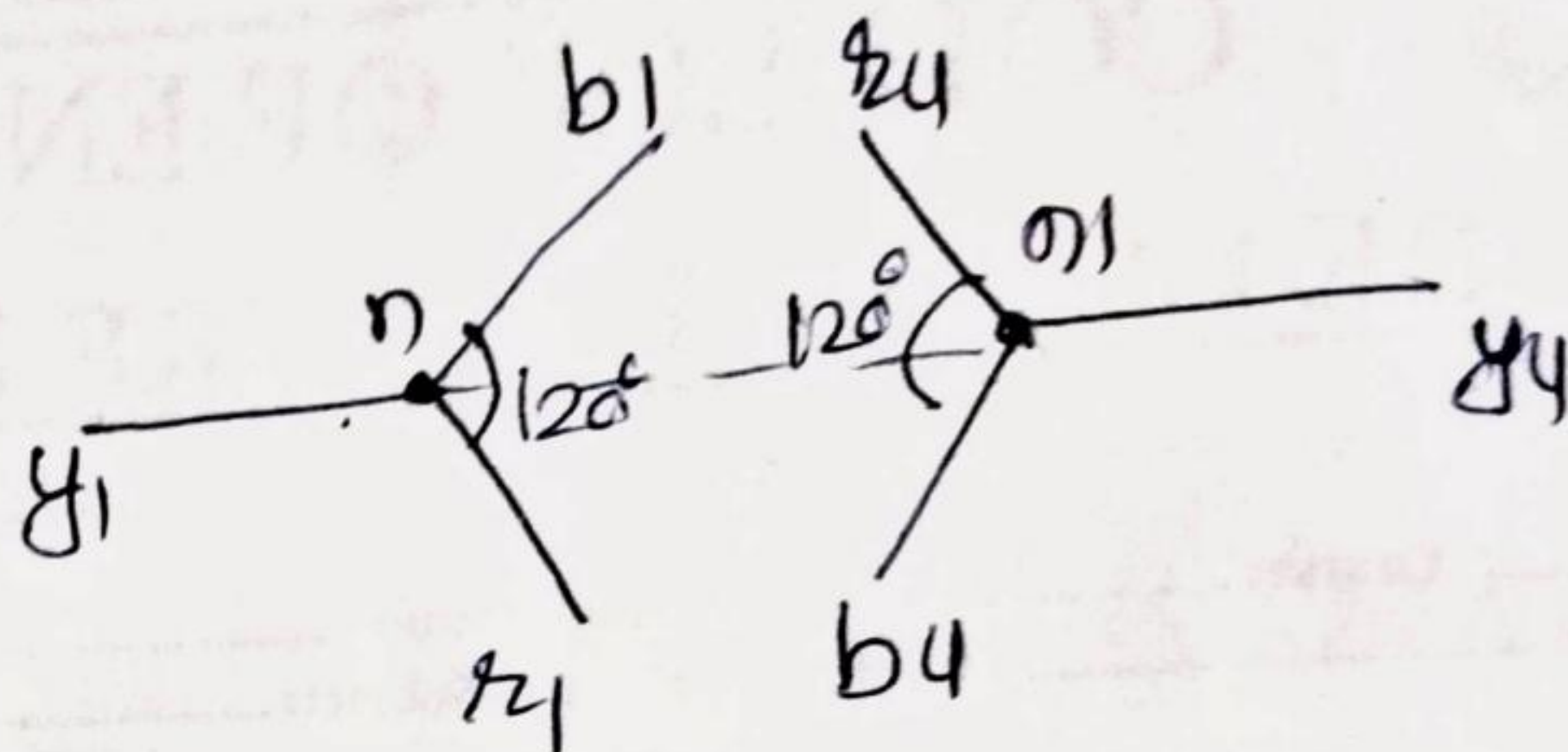
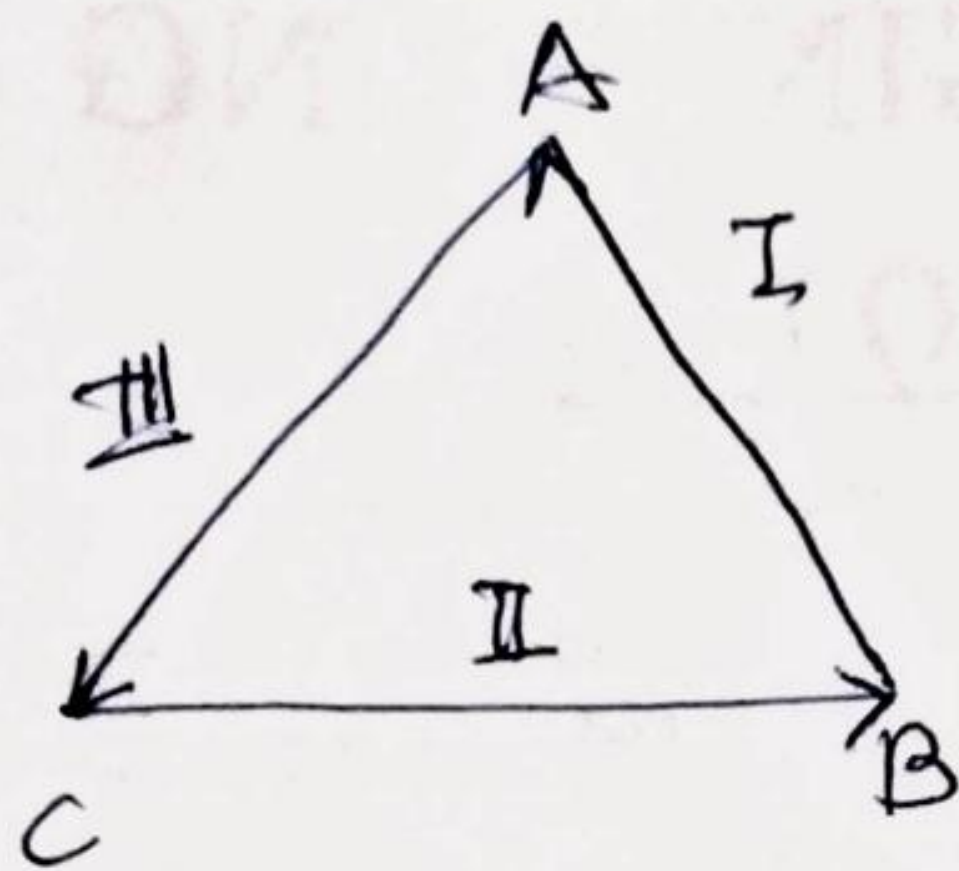
let's discuss them briefly

(a) double star:-

In this connection three identical single phase transformers are used. The three primaries are connected in delta whereas each transformer in the secondary unit splits into two equal connections and each set of the secondaries are connected in star. The connection is shown in the

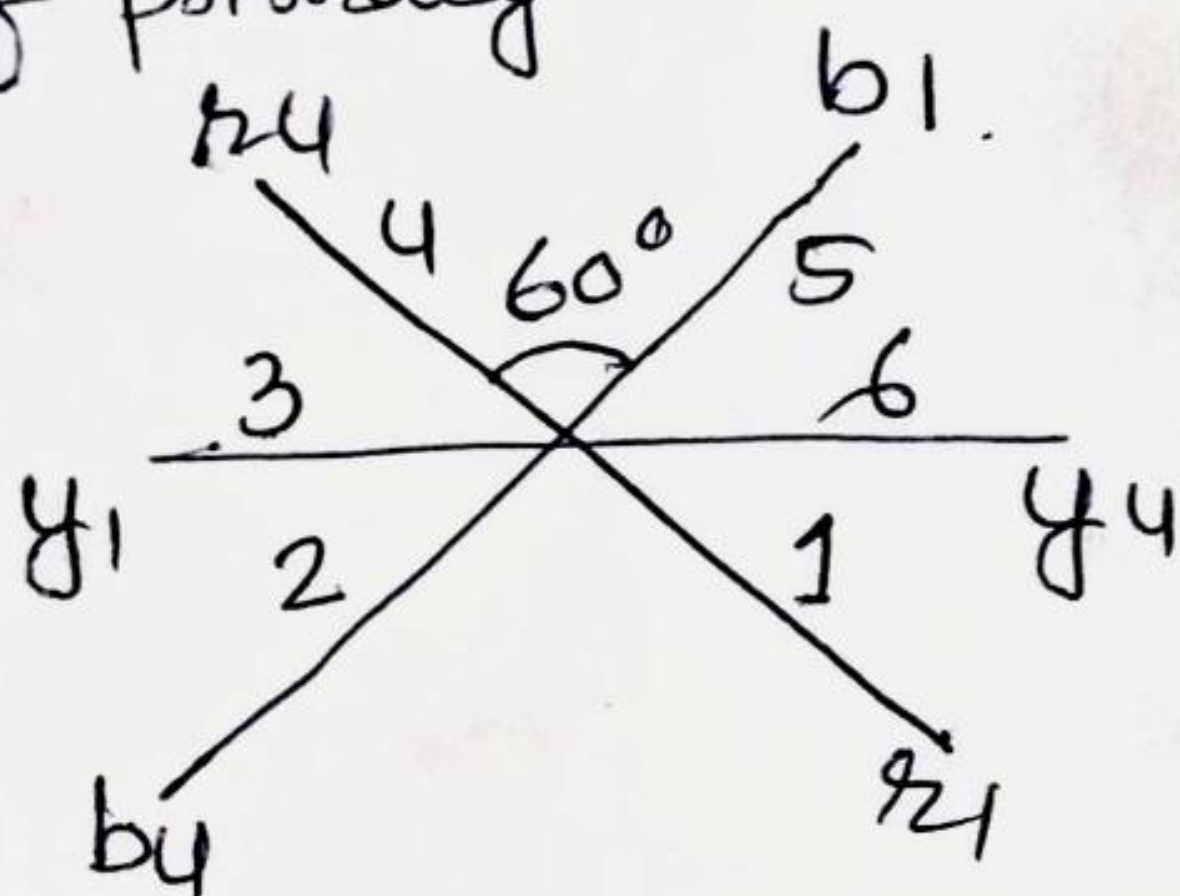
fig.





(a) phasor diagram of primary

(cb) phasor diagram of secondary



(c) Six phase star connection

The output terminals for one star are r_1, y_1, b_1 with r_2, y_2, b_2 connected together to form neutral n . The output terminals for second star are r_4, y_4, b_4 with r_3, y_3, b_3 connected together to form neutral n_1 as shown in fig. The phasor diagram of the primary are shown in fig (a) and secondary in fig (cb) and terminals r, y, b_1 and r_4, y_4, b_4 are connected to 6 phase load terminals 1, 4, 3, 6, 5, 2 respectively.

To determine the connections of the transformer terminals to load terminals the transformer terminal is marked 1 as shown in fig and other terminals ^{are marked as} 2, 3, 4, 5, 6 in clockwise directions. In this phasor diagram ^{r1} should be connected to load terminals 1 b_4 should be connected to load terminals 1, y_1 should be connected to load terminals 3 and so on.

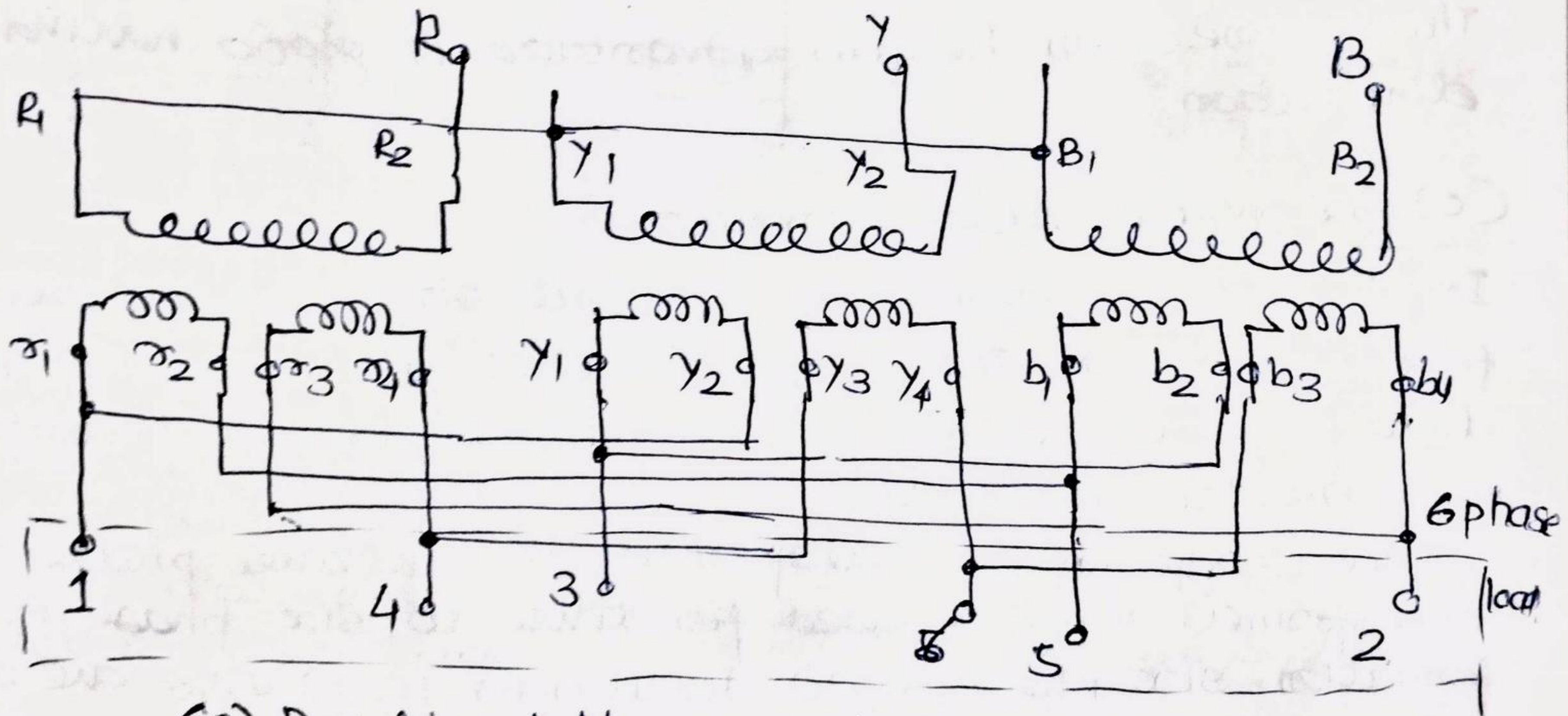
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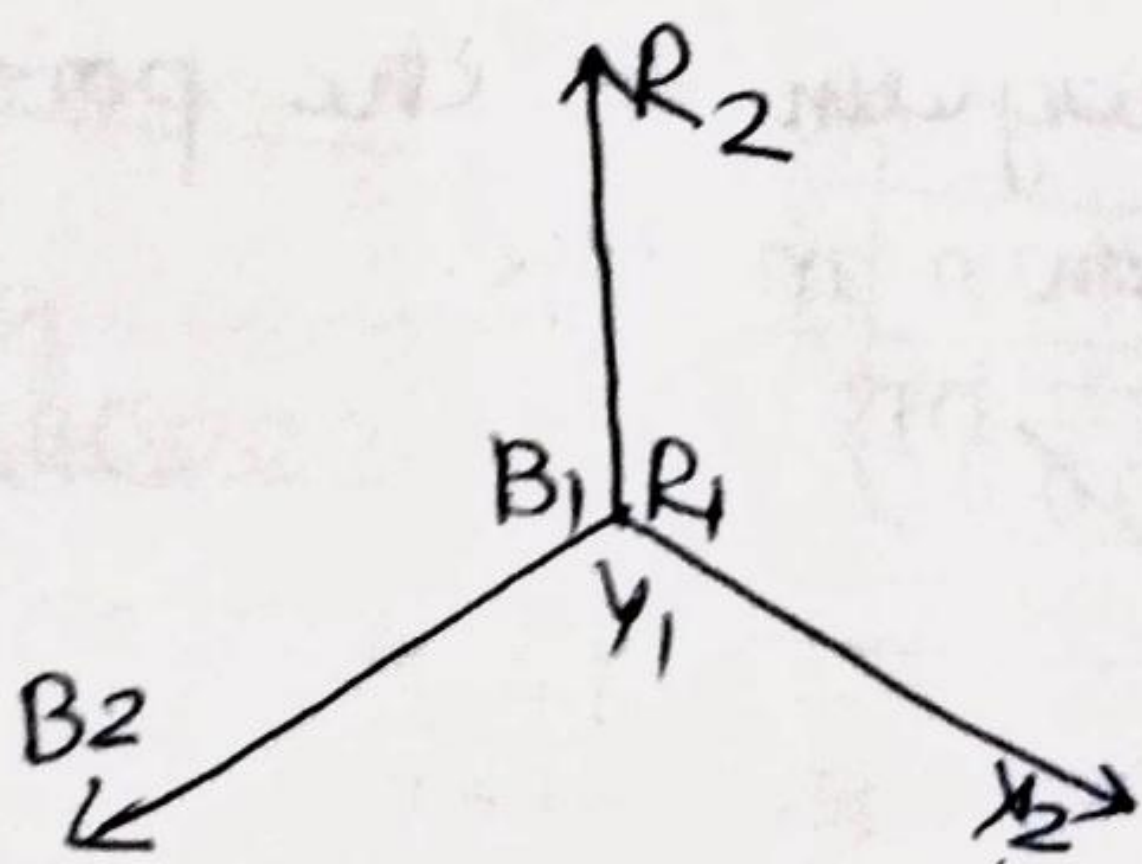
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Double delta connection:

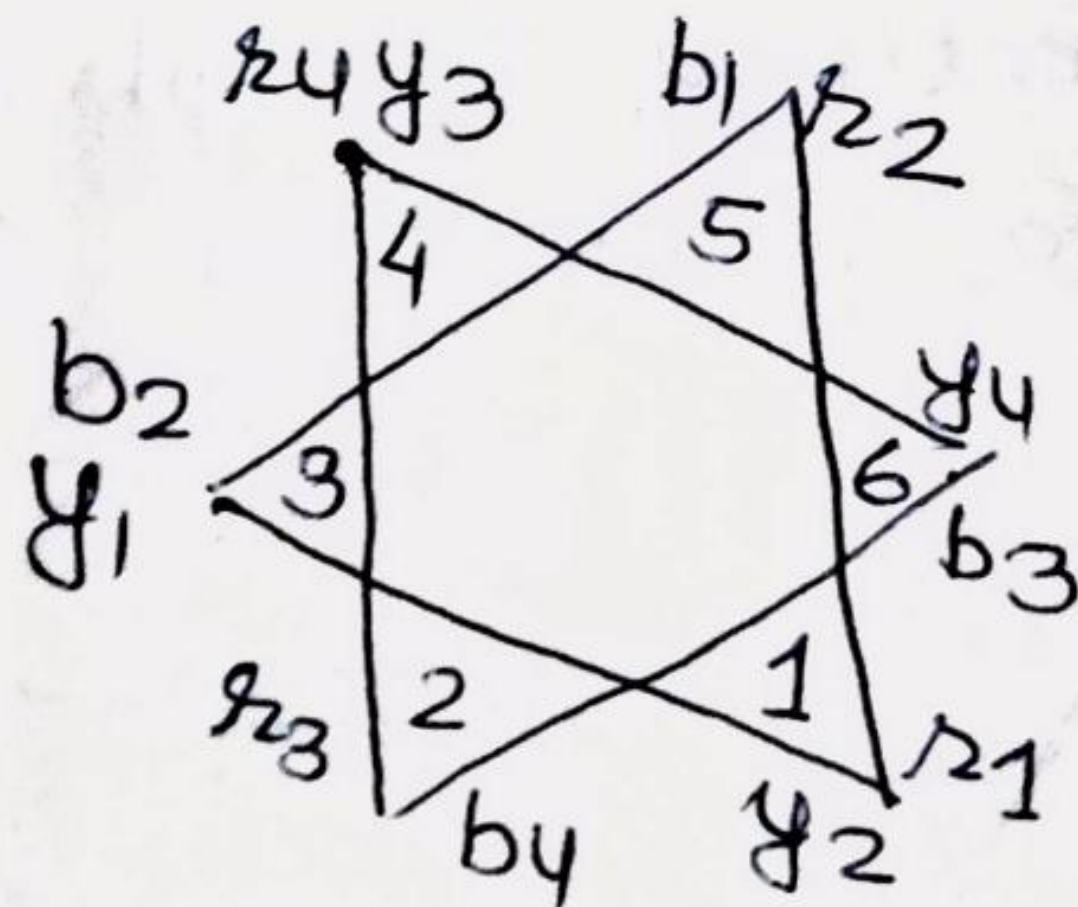
In this connection, three identical single-phase transformers are used. The three primaries are connected in delta whereas each transformer in the secondary unit splits into two equal connections and each set of secondaries are connected in delta. The connection is shown below



(a) Double delta connection



(b) primary phasors



(c) secondary phasors

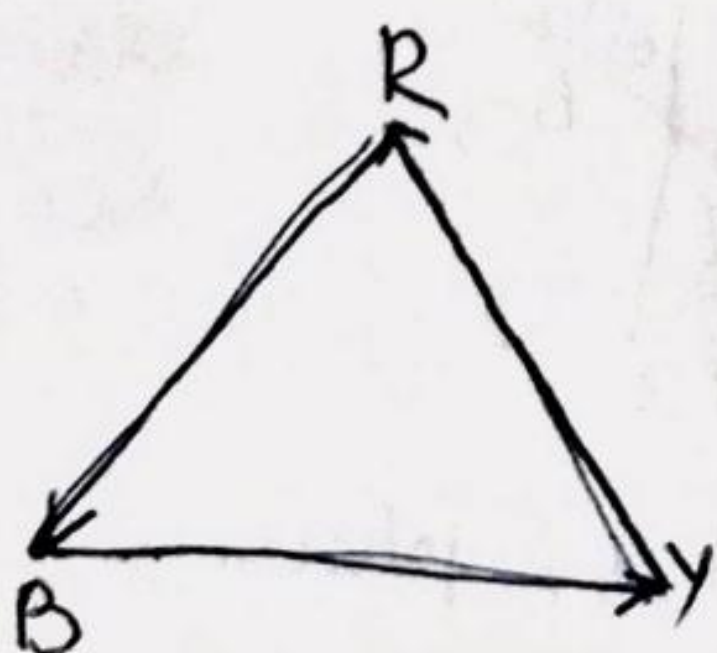
One set of the secondary connections $r_1 r_2, y_1 y_2, b_1 b_2$ are connected in normal delta by connecting starting end r_1 of the first to finishing end y_2 of the second, starting end y_1 of the second to the finishing end b_2 of the third and starting end b_1 of the third to the finishing end r_2 of the first. The other set $r_3 r_4, y_3 y_4, b_3 b_4$ of the secondary winding is connected in reverse delta by connecting finishing end r_4 of the first to the starting end y_3 of the second and so on.

This connection has an advantage of good harmonic elimination.

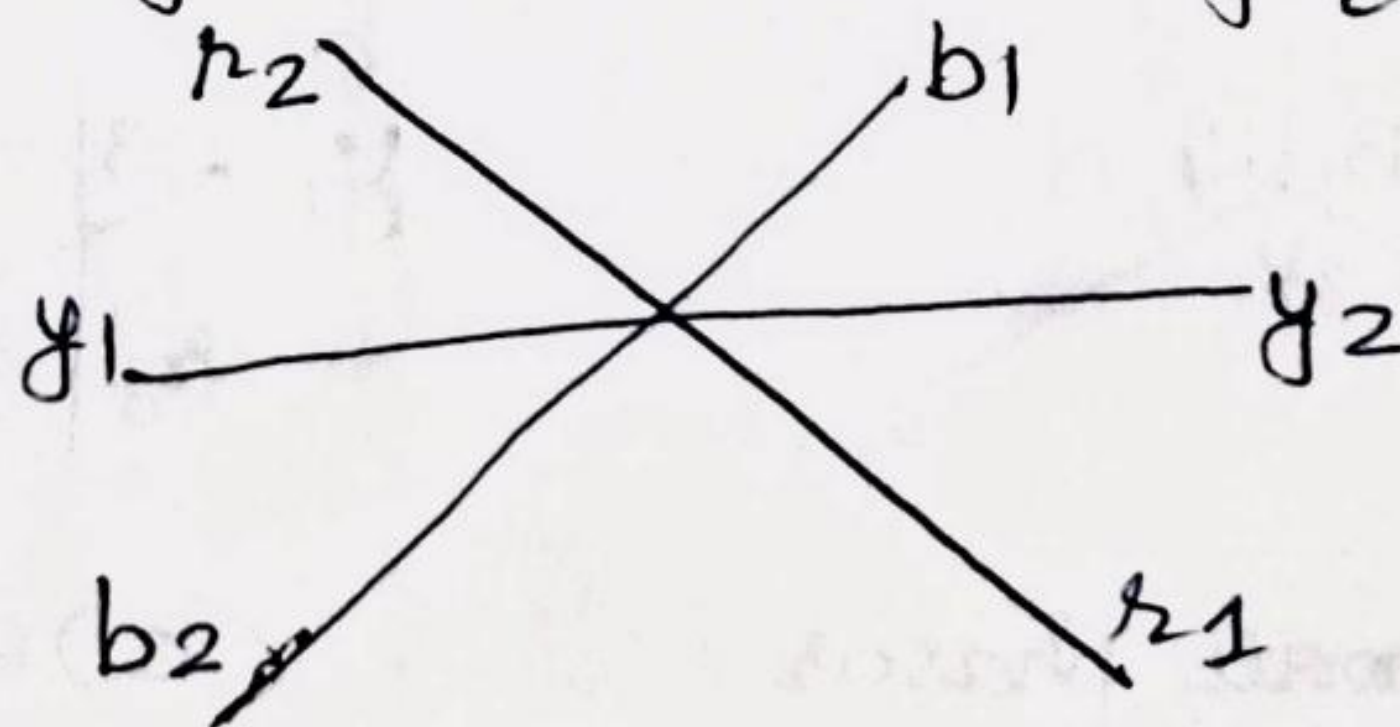
(c) Six phase star connection

In this connection, three identical single phase transformers are used. The three primaries are connected in delta and the centre tap of each secondary transformer is connected to neutral.

Three single phase transformers or one three phase transformer may be used for three to six phase transformation. Six phase load terminals 1, 2, 3, 4, 5, 6 are connected to six transformer secondary terminals $r_1, b_1, y_1, r_2, b_2, y_2$ respectively. The phaser diagram of the primary and secondary windings are shown in fig.



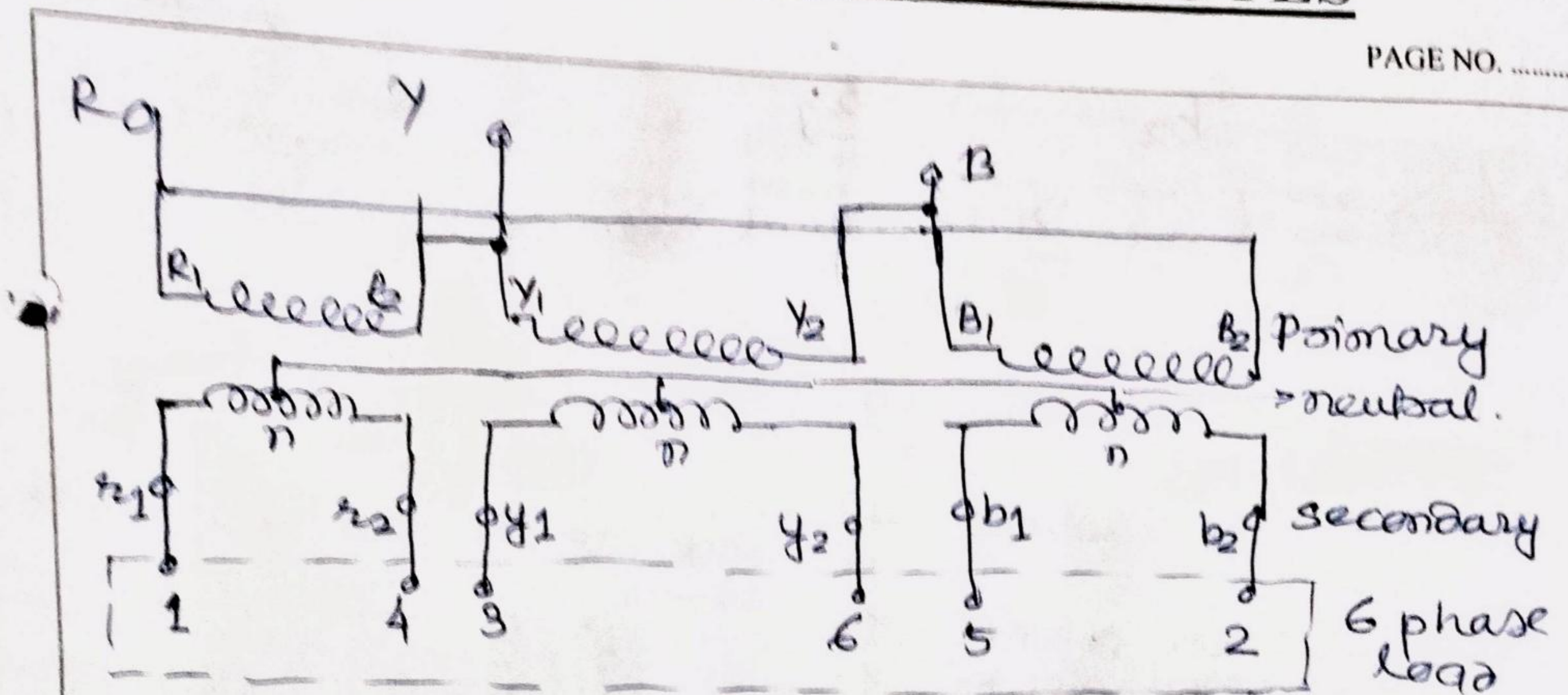
(a) primary phases



(b) secondary phases

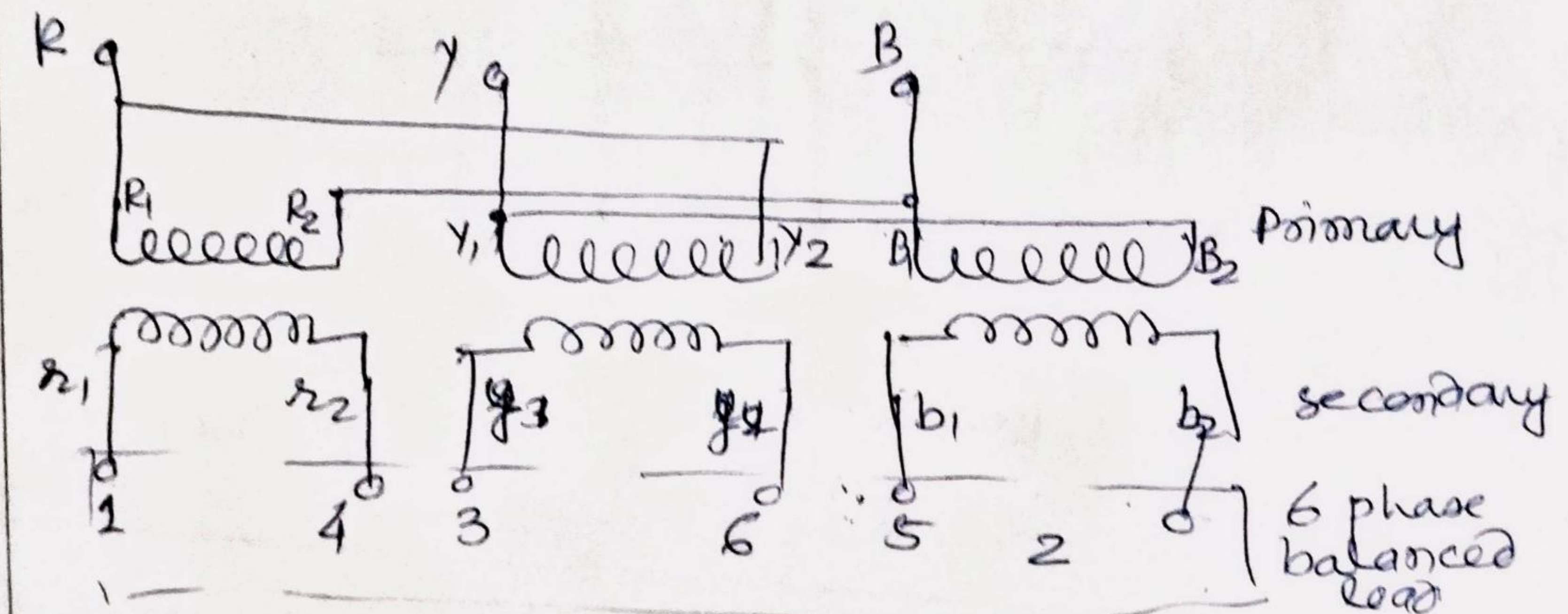
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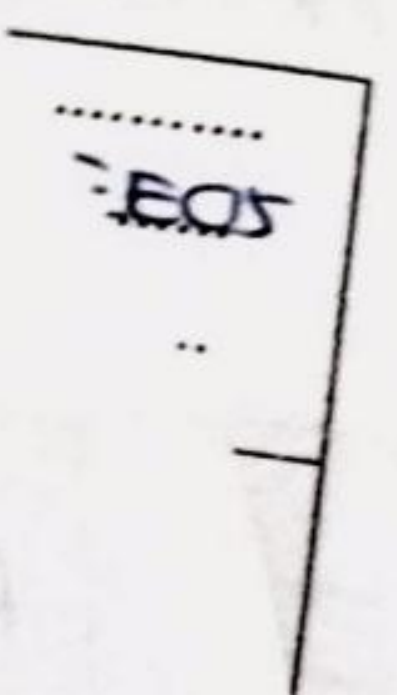
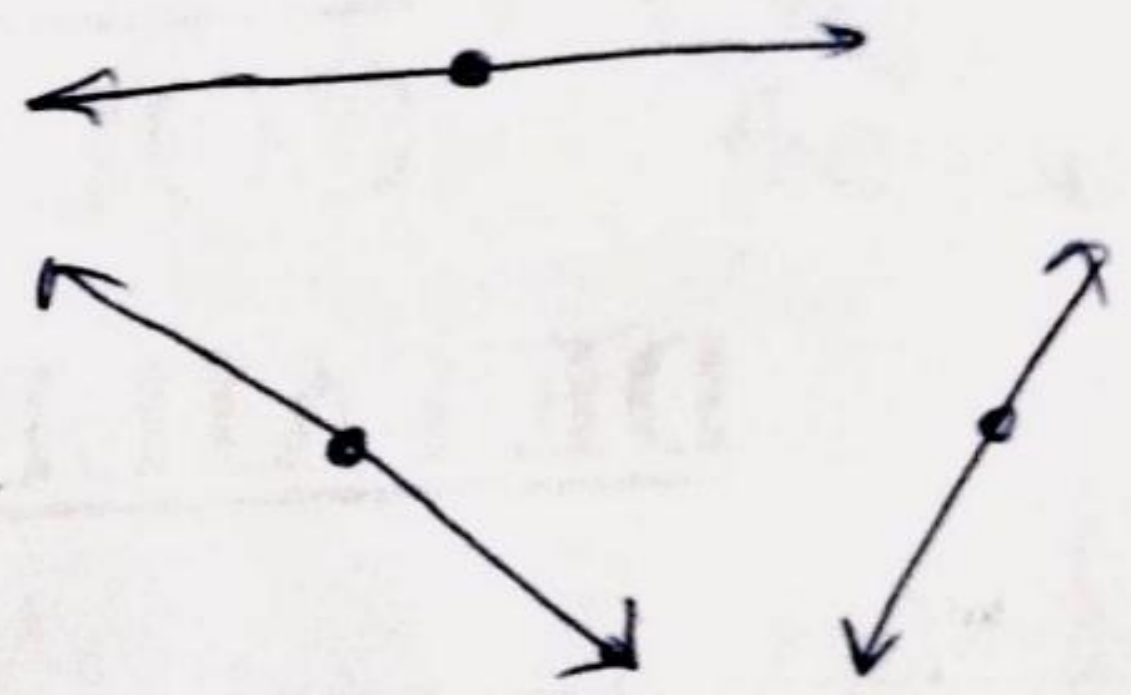
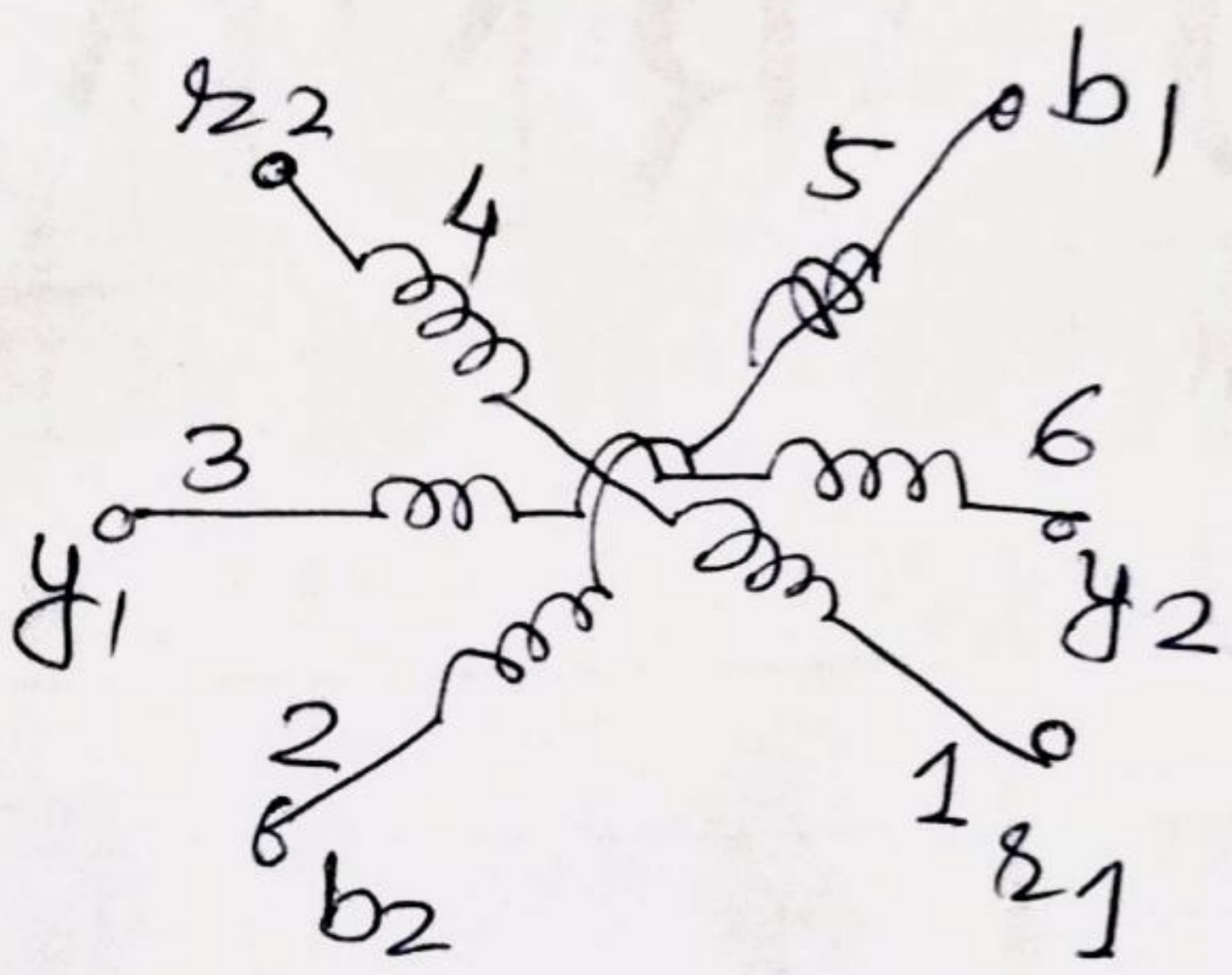
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(c) diagrammatical connection:

In this connection there is no centre tapping. Neutral connections are not required here. Here transformer terminals $r_1, r_2, y_1, y_2, b_1, b_2$ are connected to the load terminals 1, 4, 3, 6, 5, 2 respectively as shown.





Diametrical connection

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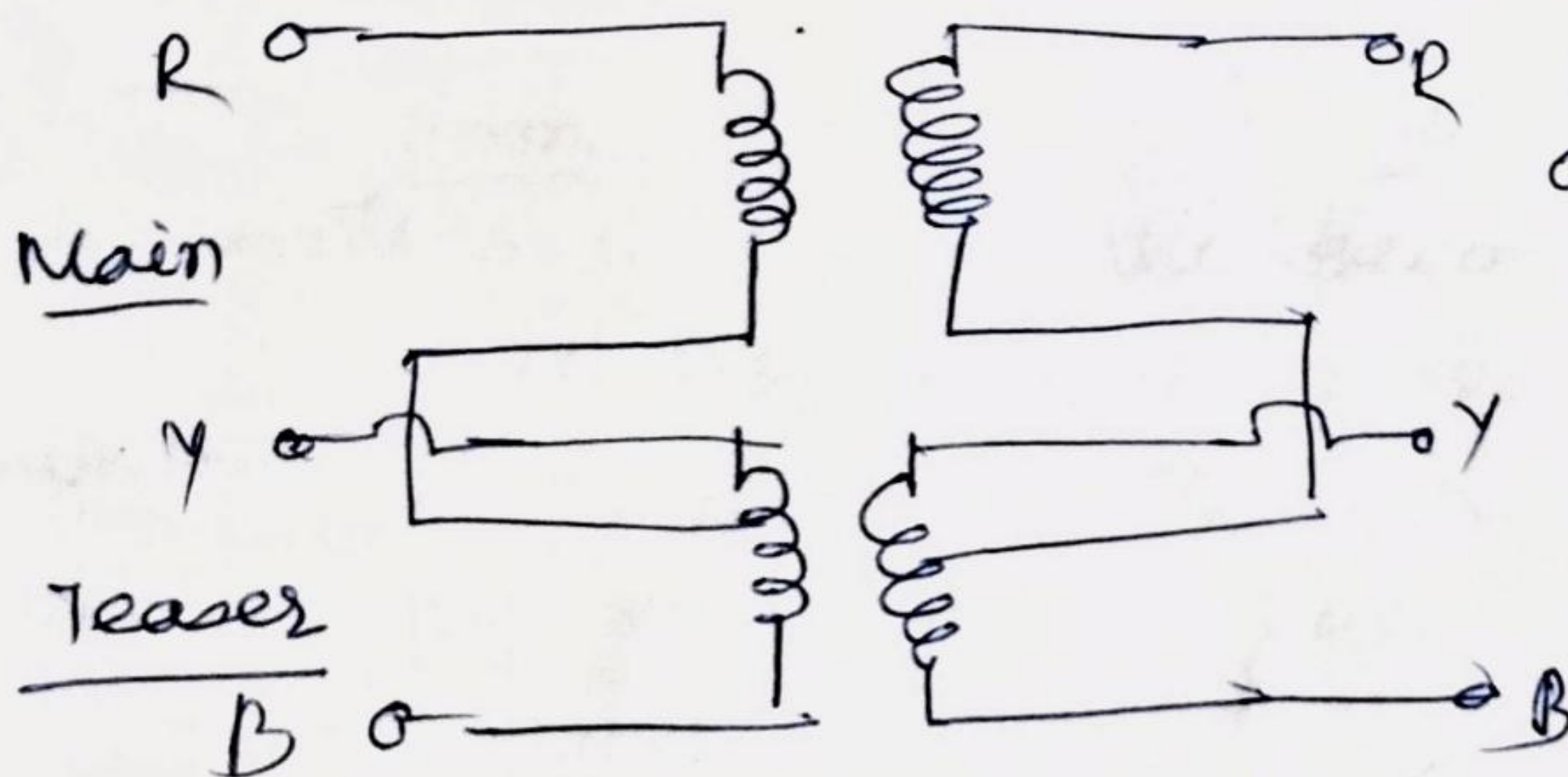
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3 to 2 phase connection or Scott connection

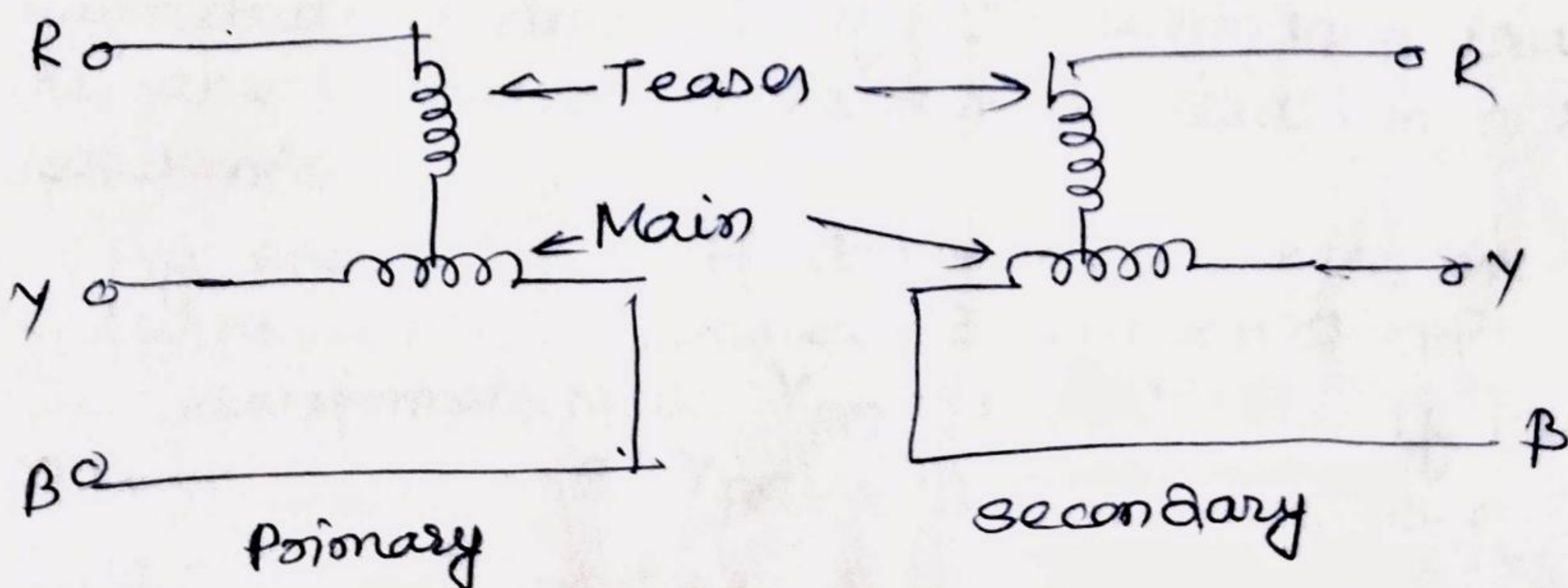
For conversion of 3ϕ to 2ϕ or vice versa the connection is used which is a Scott connection having two transformers of different ratings.

This connection was proposed by Charles P. Scott. Hence many times it is called Scott connection.



One of the transformer is called ~~main~~ ^{teaser} transformer and other the main transformer. The main transformer is provided with 50% tapping and the teaser with 86.6% tapping.

connected to the centre tap of the transformer.



The teaser may be designed for 86.6 percent of the line or main transformer voltage but generally is made identical with the main transformer and operated at a reduced flux density. Thus it is possible to operate two identical transformers either in T-T or V-V connection.

The phasor diagram is shown below

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V:

tc., wh

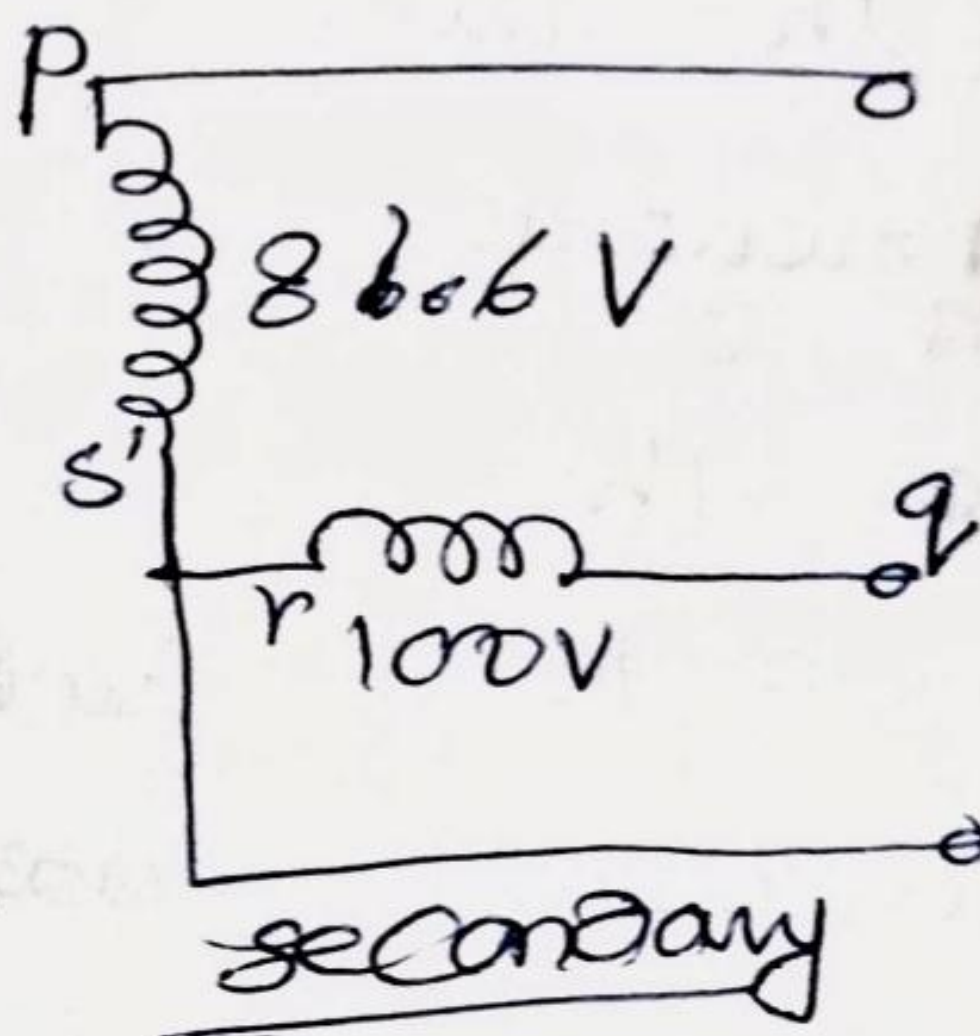
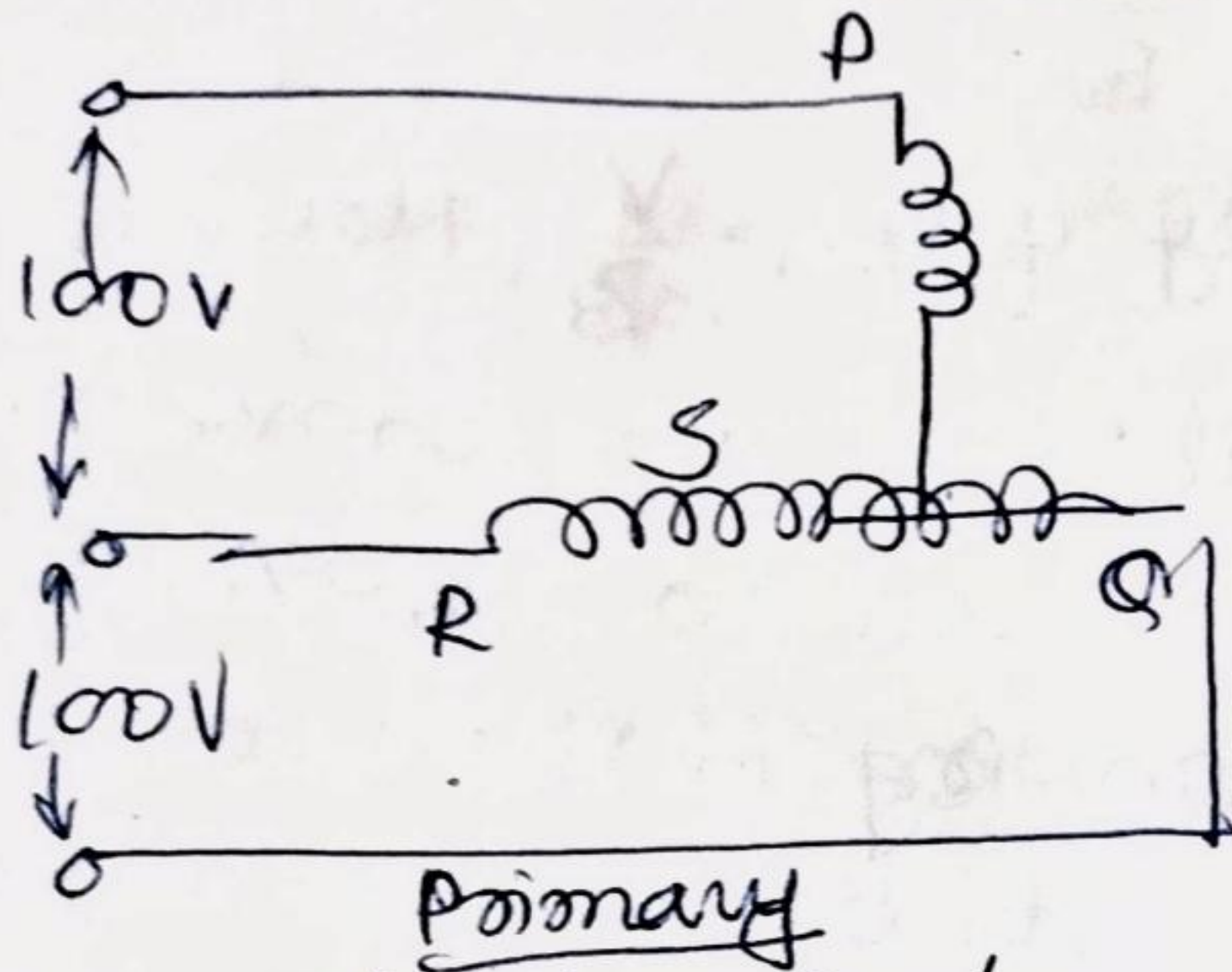
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Balanced

The points s' and r' of the secondary are connected as shown in fig which gives two phase three wire system. Here $V_{s'p} = 86.6V$ whereas $V_{s'q} = 100V$ producing two unequal voltages. To get the same volt/turn both on primary and secondary side, one line is connected to point P whereas $s'p$ is 86.6% of the total primary turns. The secondary voltages will be equal in magnitude if and only if the secondary transformers have the same number of turns which results in a symmetrical 2 ϕ , 3 wire system.

Fig shows a diff. connection where the primary has N_1 turns and is connected between Q and R of the main transformer. Now, $V_{pq} = V_{qr} = V_{rs} = V$ if the supply line voltage is V and $V_{ps} = \frac{\sqrt{3}}{2}V$. The number of turns betw P and S is $\frac{\sqrt{3}}{2}N_1$ to give same volt/turn on both

both primary. The secondary terminal voltage will be equal in magnitude if the secondaries have an equal number of turns. But the secondary terminal voltages will be quadrature to one another, since $V_{ps} = \frac{\sqrt{3}}{2} V$ and not equal to $\frac{V}{\sqrt{3}}$, is not the neutral point. To get the position of neutral point, let us take N as the neutral point.

N will be a neutral point only if $V_{PN} = \frac{V}{\sqrt{3}}$, Now $V_{NS} = \frac{\sqrt{3}}{2} V - \frac{V}{\sqrt{3}} = 0.288 V$. This means that point N is above pt. S by a number of turns which is equal to 28.8% of N_1 . Point N divides the teaser winding in the ratio 1:2 because $\frac{0.286}{3} = 0.288$, Now let the current supplied by the teaser secondary be I_{2T} at unity power factor. The teaser primary current becomes

$$I_{1T} = I_{2T} \times \frac{N_2}{\frac{\sqrt{3} N_1}{2}} = 1.15 \left(\frac{N_2}{N_1} \right) I_{2T} = 1.15 \left(\frac{I_{2T}}{K} \right)$$

where $K = \frac{N_1}{N_2}$ is the turns ratio

The current I_{1M} of each half of main transformer of the primary has the following two components

(i) one part is required to balance the secondary current (I_{2M}) which is

$$I_{2M} \times \frac{N_2}{N_1} = \frac{I_{2M}}{K}$$

(ii) the other part is equal to one half of the teaser primary current or $\frac{1}{2} I_{1T}$ because the main transformer primary serves as the return path for the



COLLEGE OF ENGINEERING

DETAILED LECTURE NOTES

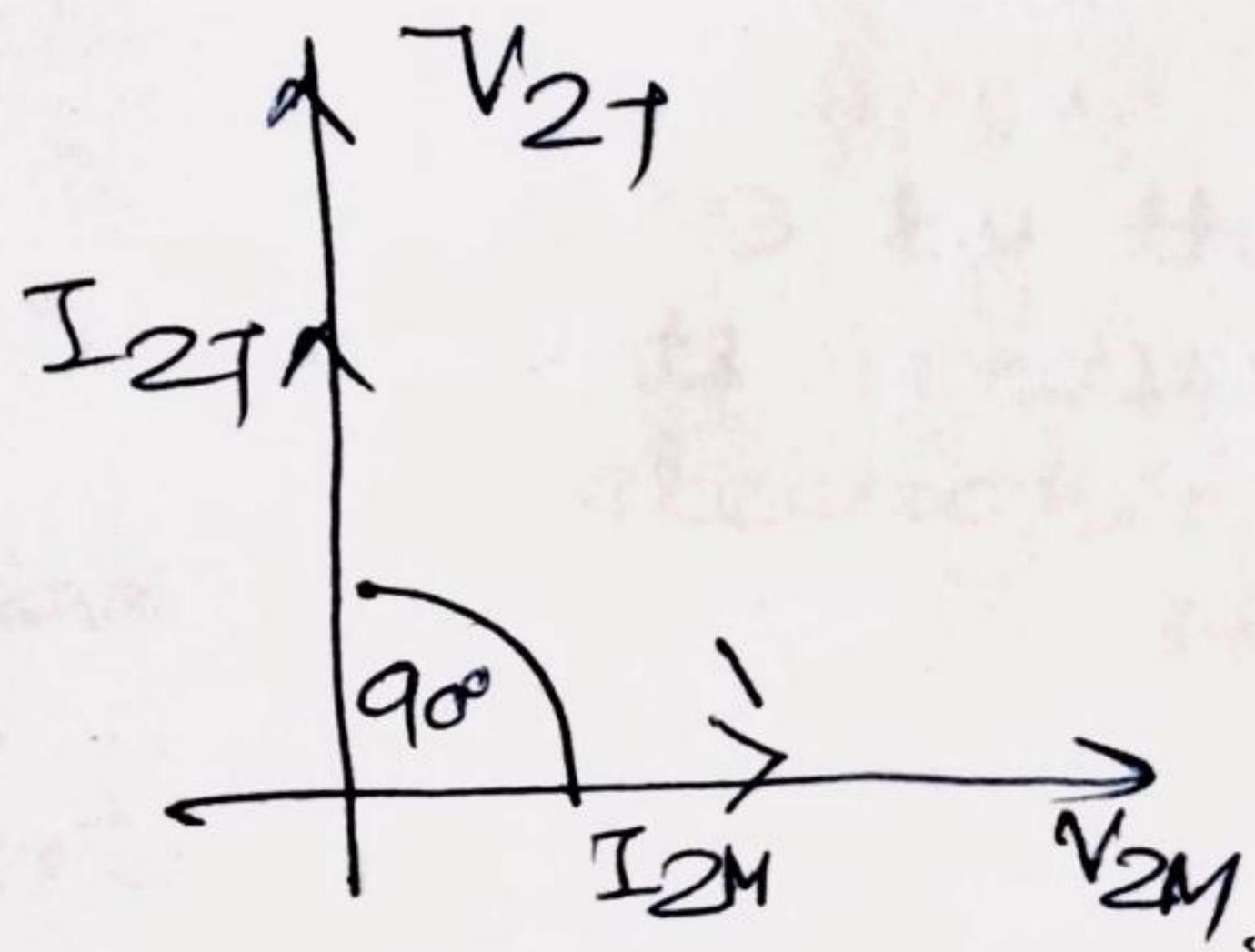
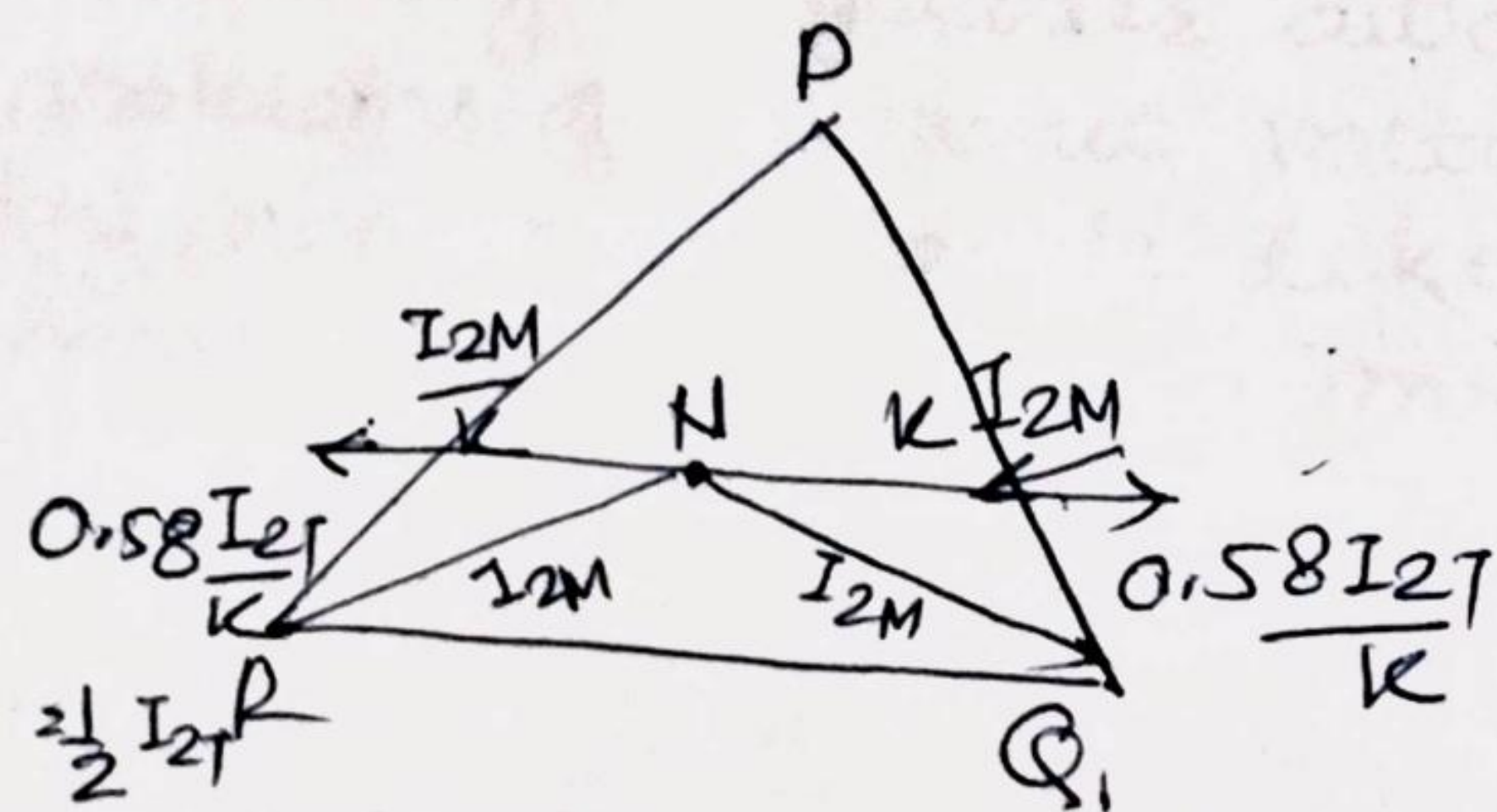
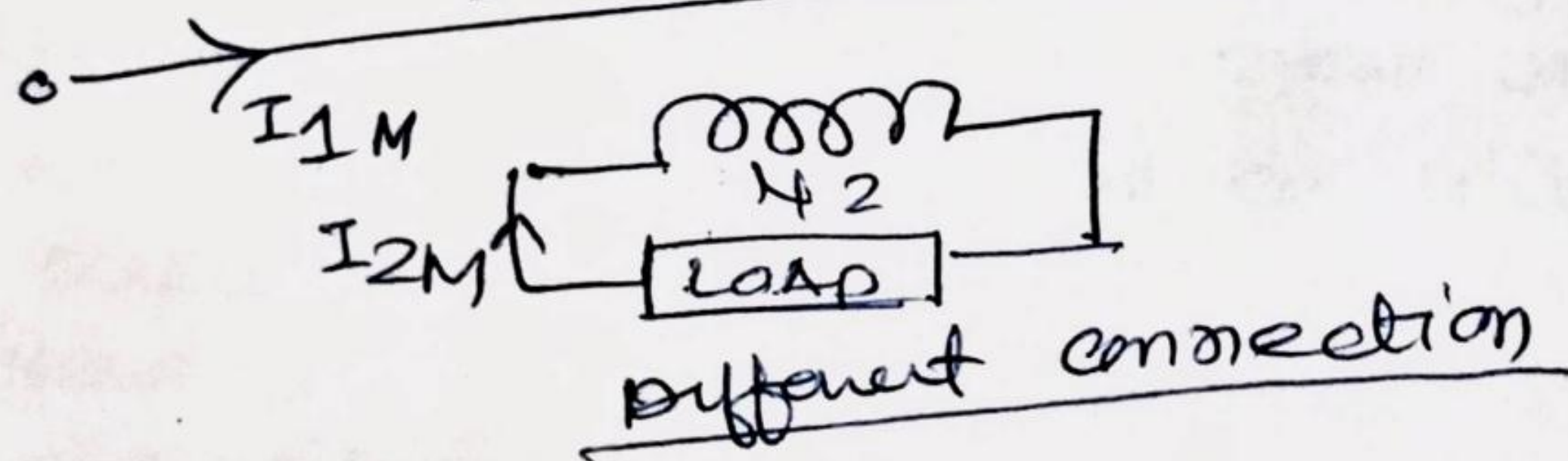
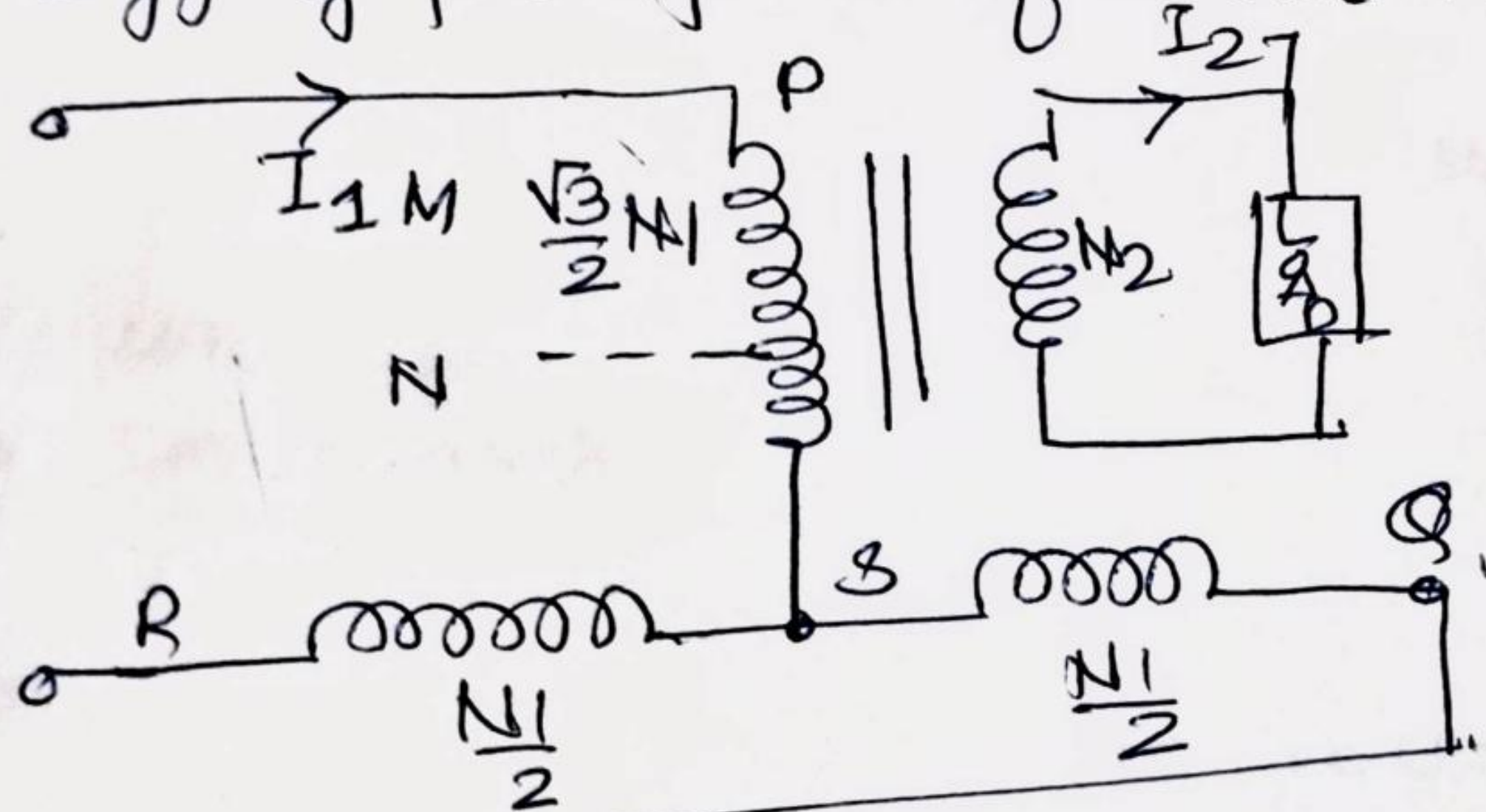
Campus: Course:
Name of Faculty:

Class/Section:
Name of Subject:

Date:
Code:

Leaves primary current and it divides itself into two halves at the midpoints.

The condition due to balanced two phase load at a lagging power factor of 0.866 has been shown in fig.



ENGINEERING

DETAILED LECTURE NOTES

Campus: Course:
Name of Faculty:

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Effect on 3 phase windings connections on harmonics

The effect of harmonic currents are as follows

1. Additional copper loss due to harmonic currents.
2. Increased core loss
3. Increased electromagnetic interference with the communication circuits.

The effects of harmonic voltages are as follows

1. Increased dielectric stress on insulation
2. electrostatic interference with communication circuits.
3. Resonance between winding reactance and feeder capacitance.

Presently a greater awareness is generated by the problems of harmonic voltages and currents produced by nonlinear loads like the power electronic converters. These problems combine with nonlinear nature of transformer core which produces severe distortions in voltages and currents and increase the power loss. Thus the study is a great physical significance.

The harmonic current components are obtained from this analysis. These harmonic current produces harmonic fields in the core and harmonic voltages in the windings. Relative small amount of harmonic fields generates considerable magnitude of harmonic voltages. For example, a 10% magnitude of 3 harmonic flux produces a 30% magnitude of 3rd harmonic. These effects get even more pronounced for higher order harmonics. As these harmonic voltages get short circuited through the low impedances of the supply, they produce harmonic currents.

Normally the third harmonic is the largest in magnitude and hence the discussions is based on it. The same can be hold of other harmonics also. In the case of a single phase transformer the harmonics are confined mostly to the primary side as source impedance is less than the load impedances.

When the load is connected on the secondary side the harmonic currents flow through the load and the voltages tends to becomes sinusoidal in nature.

The harmonic voltages induces electric stress on dielectrics and increased electrostatic interference.



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LECTURE NOTES

Campus: ...DCE... Course: B.Tech... Class/Section: ...III...A & C... Date:
Name of Faculty: Dr. Chetan Khemraj Name of Subject: Elec. M/c - I.. Code: 03EE05
Date (Prep.): Date (Del.): Unit No.: Lect. No:

OBJECTIVE: To be written before taking the lecture (Pl. write in bullet points the main topics/concepts etc., which will be taught in this lecture)

1. switching currents in transformers
2. 3 phase winding transformers
3. connections of tertiary windings

IMPORTANT & RELEVANT QUESTIONS:

- Q.1 What is a tertiary winding
- Q.2 How stabilisation can be achieved by using tertiary windings.
- Q.3 Why magnetic rush current happens?

FEED BACK QUESTIONS (AFTER 20 MINUTES):

- Q.4 Discuss the switching currents in transformers
- Q.5 What is excitation phenomena in transformer?

OUTCOME OF THE DELIVERED LECTURE: To be written after taking the lecture (Pl. write in bullet points about students' feedback on this lecture, level of understanding of this lecture by students etc.)

1. Asfaq Hussain —
2. P. S. Bhimbax —

REFERENCES: Text/Ref. Book with Page No. and relevant Internet Websites:

DETAILED LECTURE NOTES

Campus: Course:
Name of Faculty:

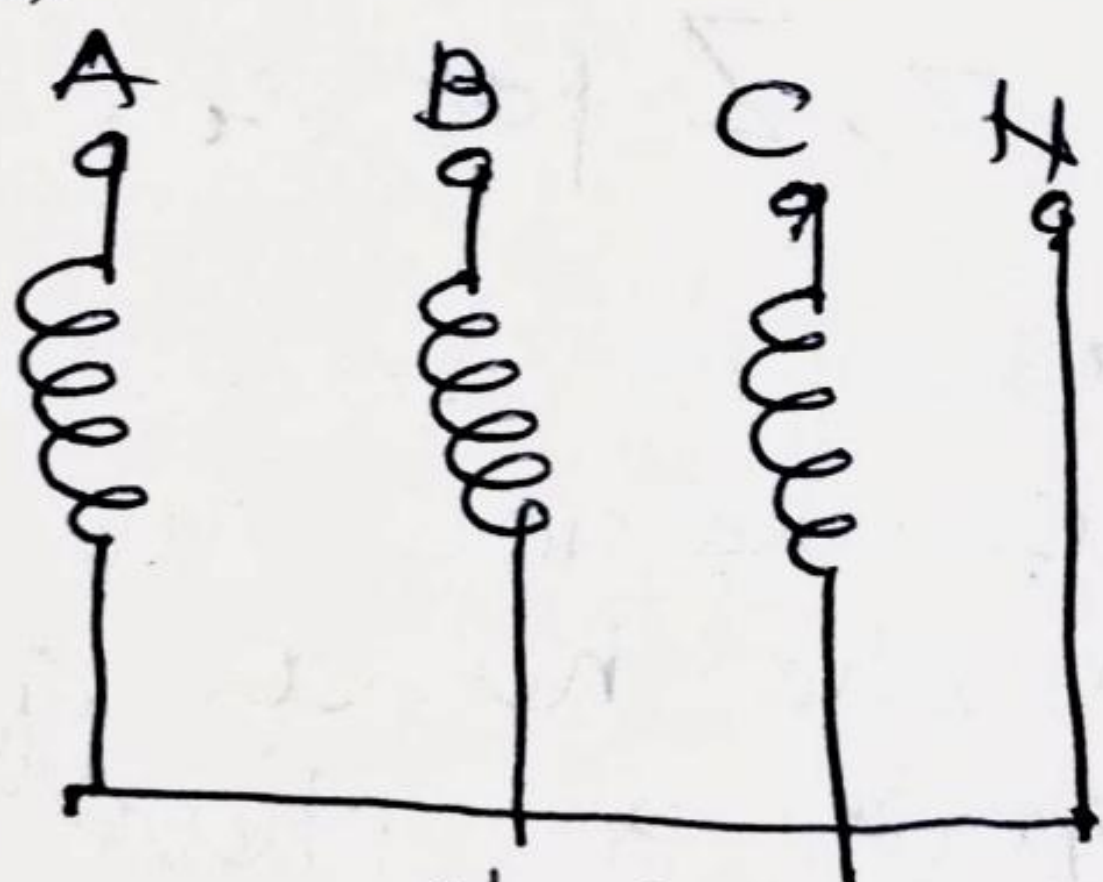
Class/Section:
Name of Subject:

Date:
Code:

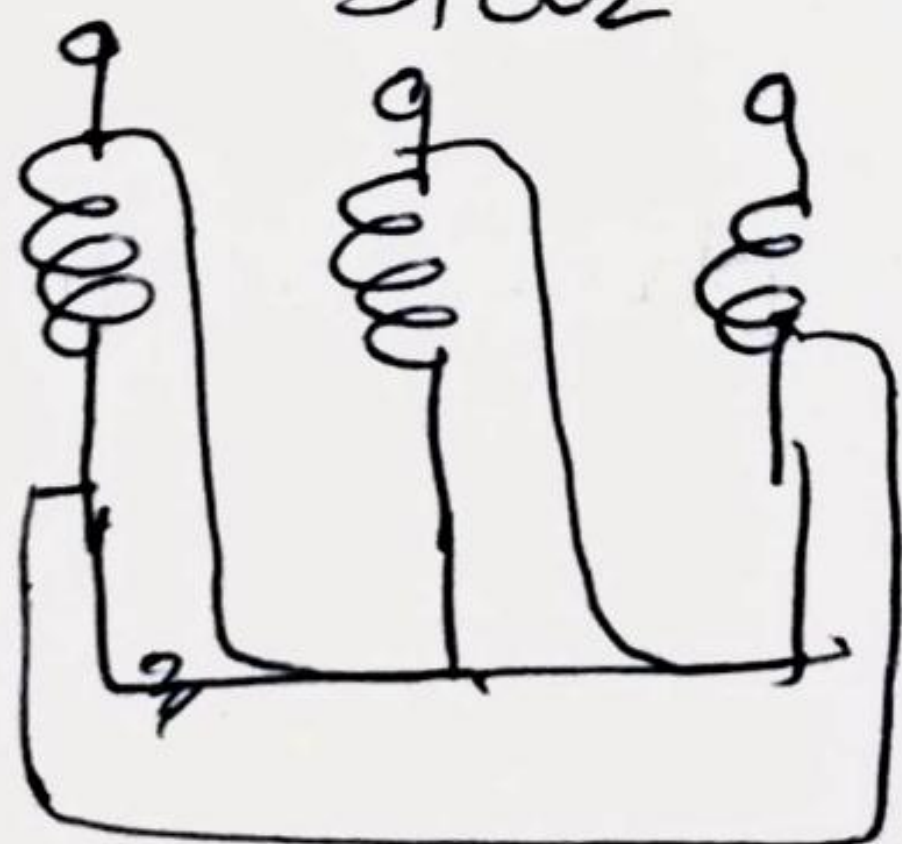
3 phase winding transformers:

3 phase transformers are necessary to step up the generated voltages to that of the transmission line. 3 phase transformers are like single phase transformers having both core and shell types.

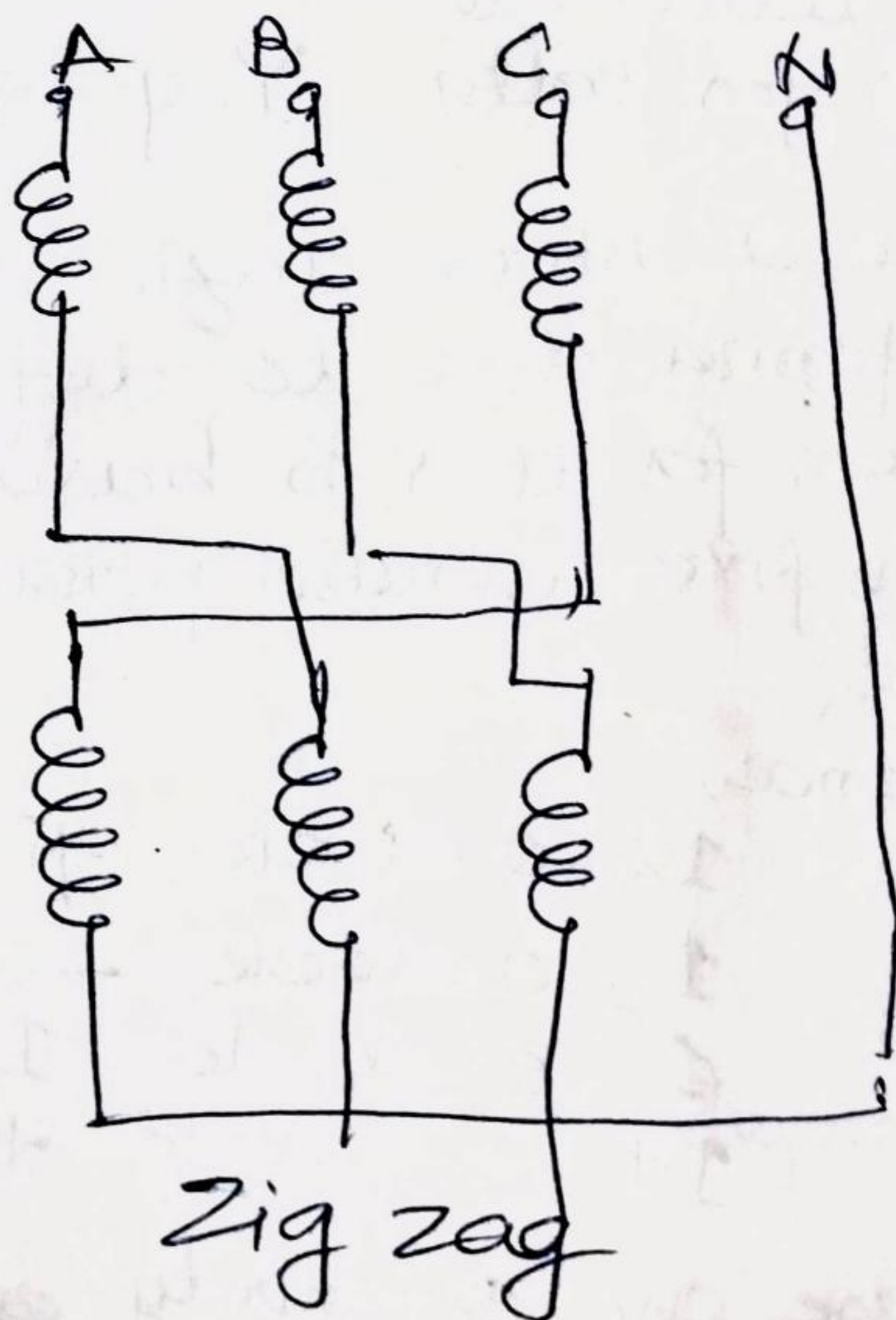
For arranging the winding of a 3ϕ transformer, mainly three methods are used - star, delta and zig-zag. Each of the methods can be applied to either both of primary and secondary winding as shown.



star



delta



Zig zag

When a neutral connection is required, it is used as earthing or for unbalanced loads star windings. Delta windings are most frequently used on high voltage winding, which is normally the winding connected to the supply or generating unit.

The delta connection also allows 3rd harmonic currents to circulate which improves the waveforms of the line currents and voltages on both side of transformer. Delta winding may be slightly more expensive due to full line to line voltages.

The type of winding e.g. star, delta is given a letter, again upper case for HV and lower case for LV winding. The letters are
d, D for Delta Y, y star z, Z for zigzag.

Since, a phase angle displacement can occur at transformer due to different connections. The numbering system for this is based on the hands of a clock. Each five minute position gives 30° phase displacement.

Hence,

12 o'clock	gives zero phase displacement
1 o'clock	-30°
6 o'clock	180°
11 o'clock	$+30^\circ$

These are commonly encountered displacement.

The phasor rotation is in anticlockwise direction.

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DETAILED LECTURE NOTES

Campus: Course:
Name of Faculty:

Class/Section:
Name of Subject:

Date:
Code:

For example, a transformer has a HV delta winding, a star LV winding and a $+30^\circ$ displacement. It is described by the letter Dy11 transformer.

Advantages and disadvantages of three winding transformer-

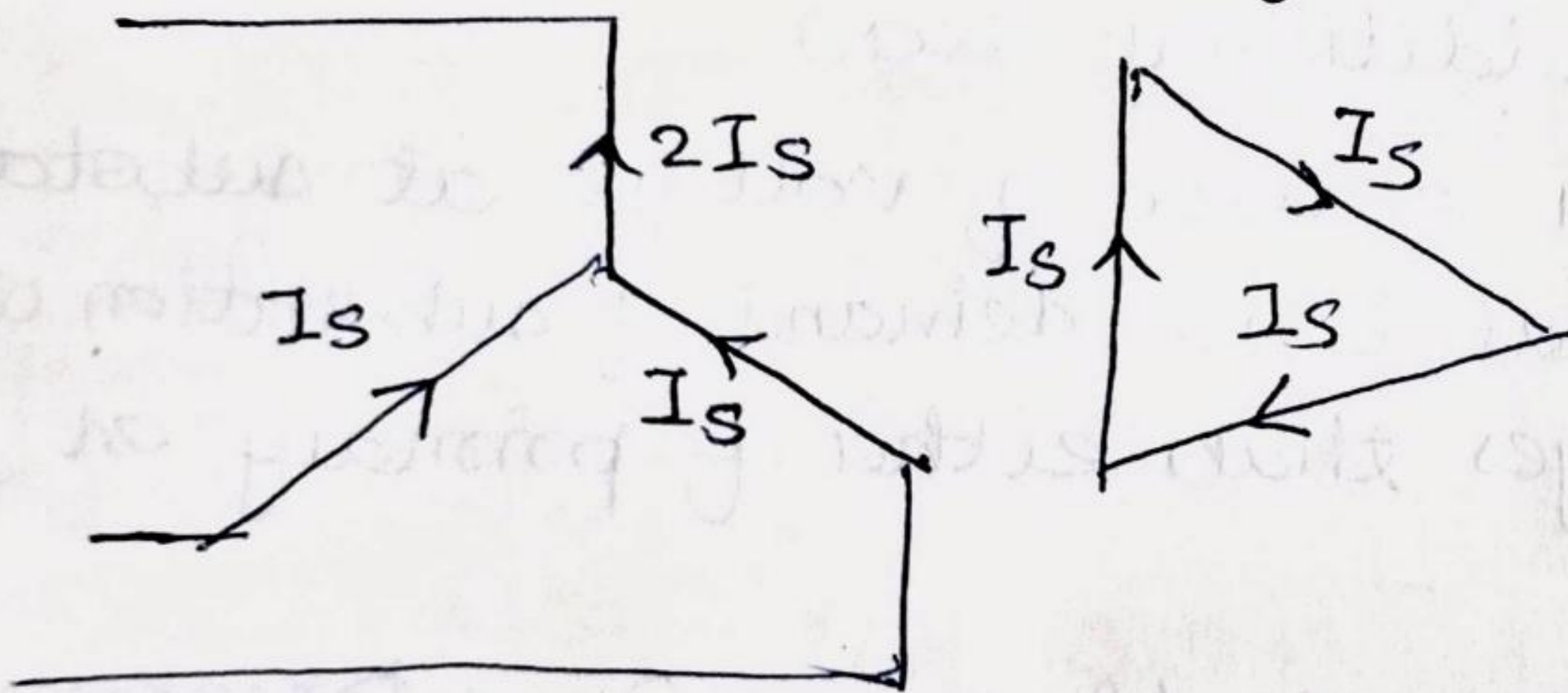
- (1) It can supply additional load
- (2) It can act as a source of voltage at substation to meet the internal load demand of substation which is at diff. voltages than either of primary or secondary.
- (3) The third winding of three winding transformer usually called as tertiary can be used to serve purpose of measuring voltages of HV testing transformer.
- (4) Three transmission lines at different voltage levels can be interconnected using 3 winding transformer.
- (5) The reactive power injection into the system is possible for voltage control by connecting synchronous condensers or static capacitors to tertiary windings.

Tertiary winding:-

In many case transformer with a third winding is called as a tertiary winding. In single phase a tertiary winding is connected in delta connection.

Many other reasons are.

1. To limit the fault level on the LV system by subdividing the infeed i.e. double secondary transformer.
2. The interconnection of several power systems operation at different supply voltages.
3. The regulation of system voltage and of reactive power by means of a synchronous capacitor connected to the terminals of one windings



It is desirable that a three phase transformer has one set of three phase windings delta connected thus providing a path of third harmonic currents. The presence of delta connected windings also allows current to circulate around the delta.

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DETAILED LECTURE NOTES

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Name of Faculty:

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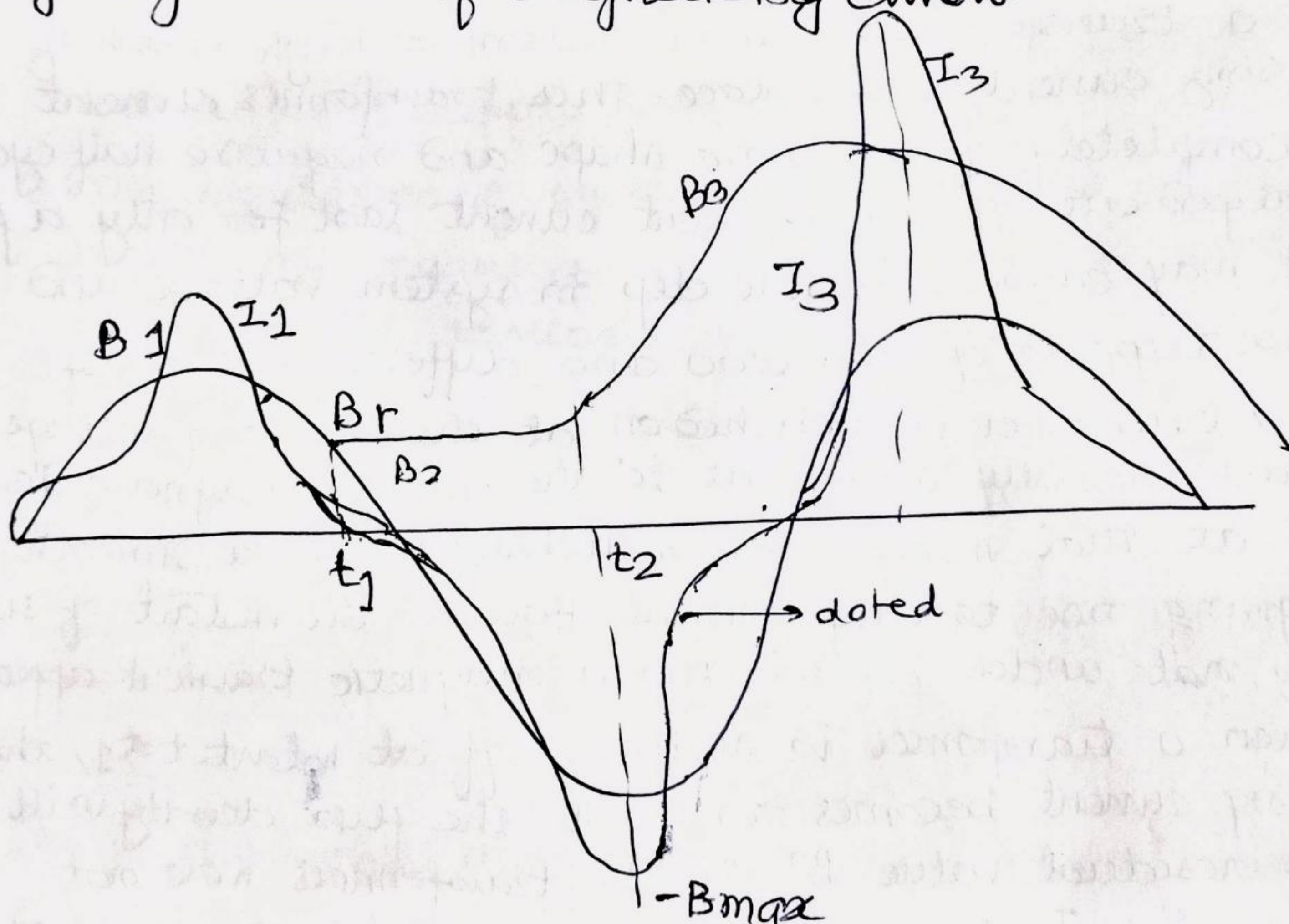
Inrush of magnetising current:-

When a transformer is switched on, a high inrush of magnetising current takes place. This transformer current has a completely offset wave shape and negative half cycle may be wiped out. Though transient current last for only a few cycles, it may cause a severe dip in system voltage and may cause tripping of over load and differential relay.

If a transformer is switched on at the instant of voltage wave, which normally corresponds to the actual magnetic density of core at that moment, the switching would be smooth without giving rise to any transient. However the instant of switching is not under control and a magnetic transient appears.

When a transformer is switched off at instant t_1 , the magnetising current becomes zero, but the flux density will have some residual value B_r . If the transformer were not switched off the I_1 and B should have followed the dotted lines. However after switching the current I_2 is zero and the flux density B_2 is equal to the residual density B_r . If the transformer is switched on again at the instant t_2 the flux density would normally be at its maximum value. Since, flux cannot be instantly created or destroyed, the

flux density wave instead of starting at $(-B_{max})$ starts at B_2 and traces the curve B_3 . The maximum theoretical value of B_3 is $(2B_{max} + B_r)$. Since the transformer is designed for flux density B_{max} , the crest B_2 will cause super saturation and magnetic circuit and result in a very high value of magnetising current.



The above mentioned crest value of $B_3 (= 2B_{max} + B_r)$ is the theoretical maximum value. The value of B_3 and therefore the magnetising current would always be much less than the theoretical maximum value.



COLLEGE OF ENGINEERING

TUTORIAL SHEETS

MAGNETIC CIRCUITS

TUTORIAL SHEET

SHEET No. 1A

Campus: PCE Course: B.Tech

Name of Faculty: Dr. C. Khemraj

Date of Tut. Sheet Preparation: 22-6-17

Class/Section: III sem/C

Name of Subject: Elec. M/C.-1

Scheduled Date of Tut.: 6-7-17

Date: 2

Code: 03EE5A

Actual Date of Tut.: 6-7-17

Name of Student: Scheduled & Actual Date of H.A. Submission: &

FIRST 20 MT. CLASS QUESTIONS

Q.1: Draw a schematic diagram indicating flow of energy in the conversion of mechanical energy to the electric energy.

Q.2 Define leakage flux, Explain that how does it take part in electromagnetic energy conversion process via the magnetic field

2 HRS. SOLVABLE HOME ASSIGNMENT (H.A.) QUESTIONS

1) A conductor carries a current of 150A. The length of conductor is 1m and is placed in a magnetic field of 0.35T. Determine the force.

2) Explain the principle of energy conversion

OTHER IMPORTANT QUESTIONS

1) The length of air core coil is 25cm and has a cross sectional area of 4 cm^2 , the coil is wound by 65 turns. Determine the inductance of the coil.

2) Discuss the energy stored in magnetic field in detail.



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COLLEGE OF ENGINEERING

TUTORIAL SHEETS

MAGNETIC CIRCUITS

TUTORIAL SHEET

SHEET No. 1B

Campus: PCE Course: B.Tech Class/Section: III sem/c Date:
Name of Faculty: Dr. C. K. Hemraj Name of Subject: EM-I Code: 03EE5
Date of Tut. Sheet Preparation: 22-6-17 Scheduled Date of Tut. 6-7-17 Actual Date of Tut. 6-7-17
Name of Student: Scheduled & Actual Date of H.A. Submission: &

FIRST 20 MT. CLASS QUESTIONS

1. Draw a schematic diag. indicating flow of energy in the conversion of mechanical energy to electrical energy.
2. Define leakage flux. Explain that how does it take part in electromagnetic energy conversion process in the magnetic field.

2 HRS. SOLVABLE HOME ASSIGNMENT (H.A.) QUESTIONS

3. The length of air core is 25cm and has a cross sectional area of 4cm^2 , the coil is wound by 65 turns. Determine the inductance of the coil.
4. Briefly explain the physical phenomena involved in energy conversion.

OTHER IMPORTANT QUESTIONS

5. Draw a schematic diag. indicating flow of energy conversion of mechanical energy to electrical energy.
6. Define leakage flux. Explain How does it take part in electromagnetic energy conversion process.



COLLEGE OF ENGINEERING

TUTORIAL SHEETS

MAGNETIC CIRCUITS

TUTORIAL SHEET

SHEET No. 1C

Campus: PCE Course: B.Tech Class/Section: III/C Date:
Name of Faculty: Dr. C. K. Hemraj Name of Subject: EM-I Code: 03EE5
Date of Tut. Sheet Preparation: 22-6-17 Scheduled Date of Tut.: 6-7-17 Actual Date of Tut.: 6-7-17
Name of Student: Scheduled & Actual Date of H.A. Submission:&.....

FIRST 20 MT. CLASS QUESTIONS	Q.1. Draw the schematic diagram indicating flow of energy in the conversion of electrical energy to mechanical energy. Q.2 Define leakage flux. Explain that how does it take part in electromagnetic energy conversion via magnetic field.
2 HRS. SOLVABLE HOME ASSIGNMENT (H.A.) QUESTIONS	Q.1 Explain the principle of energy conversion. Q.2 The area of hysteresis loop of the given magnetic material is 50 cm^2 with scales as $1 \text{ cm} = 20 \text{ AT}$ and $1 \text{ cm} = 50 \text{ mT}$. for a 50 Hz frequency, find the total hysteresis loss.
OTHER IMPORTANT QUESTIONS	Q.1. Draw a schematic diagram indicating flow of energy in the conversion of mechanical energy to electrical energy? Q.2 Define leakage flux. Explain how does it helps to EMEC conversion.



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TUTORIAL SHEETS

MAGNETIC CIRCUITS

TUTORIAL SHEET

SHEET No. 10

Campus: PCCO Course: B.Tech

Name of Faculty: Dr. C. Khemraj

Class/Section: III sem / C

Name of Subject: E.M.-I

Date: 1/

Code: 03EE3

Date of Tut. Sheet Preparation: 22-6-17

Scheduled Date of Tut: 6-7-17 Actual Date of Tut: 6-7-17

Name of Student: Scheduled & Actual Date of H.A. Submission: &

FIRST 20 MT. CLASS QUESTIONS

- Q.1 Draw the schematic dig. indicating flow of energy in the conversion of mechanical energy to electrical energy.
- Q.2 Define leakage flux. Explain in that how does it takes part in electromagnetic energy process.

2 HRS. SOLVABLE HOME ASSIGNMENT (H.A.) QUESTIONS

- Q.1 Show that the reaction of coupling magnetic field on the electrical or mechanical system is essential for electromechanical energy conversion.
- Q.2 Discuss the energy stored in magnetic field in detail.

OTHER IMPORTANT QUESTIONS

- Q.1 Draw a schematic dig. indicating flow of energy in conversion of mechanical energy to electrical energy.
- Q.2 Define leakage flux. Explain that how does it takes part in electromagnetic energy conversion process.

TUTORIAL SHEETS

MAGNETIC CIRCUITS

TUTORIAL SHEET

SHEET No. 1E

Campus: PCE Course: B.Tech

Name of Faculty: Dr. C. Khensraj

Class/Section: III sem/C

Name of Subject: EM-I

Date:

Date of Tut. Sheet Preparation: 29-6-17

Scheduled Date of Tut. 6-7-17

Actual Date of Tut. 6-7-17

Code: 03.EES

Name of Student:

Scheduled & Actual Date of H.A. Submission:&.....

FIRST 20 MT. CLASS QUESTIONS	Q.1. Draw a schematic dig. indicating of flow of energy in the conversion of mechanical energy to electrical energy. Q.2 Define leakage flux. Explain that how does it takes part in electromagnetic energy conversion process via magnetic field.
2 HRS. SOLVABLE HOME ASSIGNMENT (H.A.) QUESTIONS	Q.1: Derive the expression of torque developed in closed excited magnetic system. clearly explain the assumption made. Q.2: Two coils with self inductance 1H and 4H have actual inductance of 1H. The RMS value of current flowing in the two coils is 4A and 1A find a) coupling factor (ii) energy stored.
OTHER IMPORTANT QUESTIONS	Q.1 Draw a schematic dig indicating of flow of energy from electrical to mechanical energy. Q.2 Define leakage flux. Explain how does it takes part in electromagnetic energy conversion process.

COLLEGE OF ENGINEERING

TUTORIAL SHEETS

MAGNETIC CIRCUITS

TUTORIAL SHEET

SHEET No. 12

Campus: PCE Course: B.Tech

Name of Faculty: Dr. C. K. Sharma

Class/Section: III Sem/C

Date:

Date of Tut. Sheet Preparation: 22-6-17

Name of Subject: 03 EES Elect M/C - I

Scheduled Date of Tut: 6-7-17 Actual Date of Tut: 6-7-17

Name of Stu

FIRST 20 MT. CLASS QUESTIONS

- Q.1 Draw a schematic diagram indicating the flow of energy in the conversion of mechanical energy to electrical energy. 12
- Q.2 Define leakage flux. Explain that how does it takes part in electromechanical energy conversion process via the magnetic field.

2 HRS. SOLVABLE HOME

ASSIGNMENT (H.A.) QUESTIONS

- Q.1. Define leakage flux. Explain How does it takes part in electromagnetic energy conversion.
- Q.2 Describe the principle of energy conversion. Show that the reaction of coupling magnetic field on electrical or mechanical system is essential for EMEC - conversion.

OTHER IMPORTANT QUESTIONS

- Q.1. Discuss the energy stored in magnetic field in detail
- Q.2 Draw a schematic diagram indicating the flow of energy in the conversion of mechanical energy to the electrical energy.



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TUTORIAL SHEETS

MAGNETIC CIRCUITS

TUTORIAL SHEET

SHEET No. 2A

Campus: P.C.E. Course: B.Tech

Class/Section: III sem A&C

Date:

Name of Faculty: Dr. C. Khemsay

Name of Subject: EM-I

Code: 03EE5

Date of Tut. Sheet Preparation: 23-6-17

Scheduled Date of Tut. 13-7-17

Actual Date of Tut. 13-7-17

Name of Student: Scheduled & Actual Date of H.A. Submission:&.....

FIRST 20 MT. CLASS QUESTIONS

- Q.1: Two coils with self inductance $1H$ and $4H$ have a mutual inductance of $1H$. The RMS value of current flowing in two coils is $4A$ and $1A$ respectively. Find - (i) Coupling factor (ii) Energy stored in magnetic field.
- Q.2 Derive the expression of torque developed in closely excited magnetic system.

2 HRS. SOLVABLE HOME ASSIGNMENT (H.A.) QUESTIONS

- Q.3: Briefly explain the physical phenomena involved in energy conversion.
- Q.4 Discuss permanent magnets and their applications.

OTHER IMPORTANT QUESTIONS

- Q.5 The length of an air core coil is $25cm$ and has a cross sectional area of $4cm^2$. The coil is wound by 50 turns. Determine the inductance of the coil.
- Q.6 Define energy and co-energy. Prove that the field energy and co-energy in a linear magnetic circuit are given by identical expressions.

TUTORIAL SHEETS

TUTORIAL SHEET

SHEET No. 28

Campus: PCE Course: BTech

Course: B.Tech

Class/Section: III sem / A2C

Date:

Name of Faculty: Dr. Chelani Khemraj
Date of Tut. Sheet Preparation: 21/1/17

Name of Subject: EM-I

Code: 03EE5

Date of Tut. Sheet Preparation: 24-6-17

Scheduled Date of Tut. 13-7-17 Actual Date of Tut. 13-7-17

Name of Student:..

Scheduled & Actual Date of H.A. Submission:

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FIRST 20 MT. CLASS QUESTIONS

Q.1 Two coils with self inductance $1H$ and $4H$ have a mutual inductance of $1H$. The RMS value of current flowing in two coils are $4A$ and $1A$ respectively.

Find - (i) Coupling factor (ii) Energy stored in magnetic field.

Q.2 Derive the expression of torque developed in closely excited magnetic system.

**2 HRS. SOLVABLE HOME
ASSIGNMENT (H.A.) QUESTIONS**

Q.3: Give the importance of hysteresis loop with reference to the electrical machines.

Q.4 Give an analogy of electric and magnetic circuits.

OTHER IMPORTANT QUESTIONS

Q.5A Magnetic circuit is made of silicon steel and has a volume of $2 \times 10^3 \text{ m}^3$ area of hysteresis loop is 10 cm^2 , scale is $1 \text{ cm} = 25 \text{ AT}$ and $1 \text{ cm} = 10 \text{ Wb/m}^2$. Calculate the hysteresis losses.

Q.6 A horizontal straight wire 6cm long of mass 1.5g is placed perpendicular to uniform magnetic field 0.8

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TUTORIAL SHEETS

MAGNETIC CIRCUITS

TUTORIAL SHEET

SHEET No. 2C

Campus: P.C.E. Course: B.Tech Class/Section: III EE-A&C Date:
 Name of Faculty: Dr. C. K. Hemraj Name of Subject: EM-1 Code: 03EET
 Date of Tut. Sheet Preparation: 3-7-17 Scheduled Date of Tut.: 3-7-17 Actual Date of Tut.: 3-7-17
 Name of Student: Scheduled & Actual Date of H.A. Submission:&.....

FIRST 20 MT. CLASS QUESTIONS

- Q.1 Two coils with self inductance $1H$ and $4H$ have a mutual inductance of $1H$. The RMS value of current flowing in two coils are $1A$ and $4A$ respectively. Find (i) The coupling factor (ii) Energy stored in magnetic field.
- Q.2 Derive the expression of torque developed in closely excited magnetic system.

2 HRS. SOLVABLE HOME ASSIGNMENT (H.A.) QUESTIONS

- Q.3 Explain the phenomena of energy balance. Derive an expression for energy stored in magnetic circuit.
- Q.4 With the help of a suitable diagram explain hysteresis and eddy current losses as applied to magnetic circuit.

OTHER IMPORTANT QUESTIONS

- Q.5 A steel ring $30cm$ mean diameter and of circular section $2cm$ in diameter has an air gap of $1mm$ long. It has 600 turns of wire carrying $2.5A$. Find (i) total mmf (ii) total reluctance
- Q.6 The area of hysteresis loop obtained with a certain magnetic material was $9.3 cm^2$. The co-ordinates are $1cm = 1000A$ and $1cm = 0.2 Wb/m^2$. If the density of given material is $7.8 g/cm^3$. Calculate the hysteresis loss for $50Hz$ frequency.

TUTORIAL SHEETS

MAGNETIC CIRCUITS

TUTORIAL SHEET

SHEET No. 2.D

Campus: PCE Course: B.Tech Class/Section: III sem A & C
 Name of Faculty: Dr. Chetan K. Khemraj Name of Subject: E.M.-I Date:
 Date of Tut. Sheet Preparation: 23-6-17 Scheduled Date of Tut.: 13-7-17 Actual Date of Tut.: 13-7-17
 Name of Student: Scheduled & Actual Date of H.A. Submission: &

FIRST 20 MT. CLASS QUESTIONS

Q.1 Two closely with self inductance $1H$ and $4H$ have a mutual inductance of $1H$. The RMS value of current flowing in two coils are $4A$ and $1A$ respectively. Find - (i) coupling factor (ii) Energy stored in magnetic field.

Q.2 Derive the expression of torque developed in closely excited magnetic system

magnetic circuits.

2 HRS. SOLVABLE HOME ASSIGNMENT (H.A.) QUESTIONS

Q.3 Give the importance of hysteresis loop with reference to the electrical machines

Q.4 A magnetic circuit is made of silicon steel and has a volume of $2 \times 10^3 m^3$ area of hysteresis loop is $7.85 cm^2$, scales are $1cm = 10AT$ and $1cm = 4 wb/m^2$. Calculate the hysteresis power losses.

OTHER IMPORTANT QUESTIONS

Q.5: A Horizontal straight wire $5cm$ long of mass $1.2 g/m$ is placed perpendicular to uniform magnetic field of $0.6 T$. If the resistance of the wire is $3.8 \Omega/m$, calculate the potential difference that has to be applied between the ends of the wire to make it just self adjusting.

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MAGNETIC CIRCUITS

TUTORIAL SHEET

SHEET No. 8E

Campus: P.C.E. Course: B.Tech

Class/Section: III GE A & C

Name of Faculty: Dr. S. K. Hemraj

Name of Subject: E.M.-I

Date:

Code: 03EES

Date of Tut. Sheet Preparation: 8-7-17

Scheduled Date of Tut.: 13-7-17

Actual Date of Tut.: 13-7-17

Name of Student: Scheduled & Actual Date of H.A. Submission: &

FIRST 20 MT. CLASS QUESTIONS

- Q.1: Two coils with self inductance $1H$ and $4H$ have a mutual inductance of $1H$. The RMS value of current flowing in two coils is $4A$ and $1A$ respectively. Find - (i) Coupling factor (ii) Energy stored in magnetic field.
- Q.2 Derive the expression of torque developed in closely excited magnetic system.

2 HRS. SOLVABLE HOME ASSIGNMENT (H.A.) QUESTIONS

- cables when the current is $100A$ each.
- Q.3 A magnetic flux density of 1.2 wb/m^2 is required in 2mm air gap of an electromagnet of iron path 1m long. Calculate the mmf required, assuming a relative permeability of iron as 1500 . Neglect leakage.
- Q.4 Make an analogy between electric and magnetic circuits.

OTHER IMPORTANT QUESTIONS

- Q.5 Give the practical importance of hysteresis loop with reference with electric machines.
- Q.6 Explain the phenomena of energy balance. Derive an expressions for energy stored in magnetic circuit.

OF ENGINEERING

TUTORIAL SHEETS

TUTORIAL SHEET

MAGNETIC CIRCUITS

SHEET No. 20 F

Campus: ...P.C.E... Course B.Tech....

Name of Faculty: Dr. S. K. Hemraj

Class/Section: ...III EE A & C

Date of Tut. Sheet Preparation: 9-7-17

Name of Subject: ...E.M.-I...

Date:

Code: 03EES

Name of Student:

Scheduled Date of Tut.: 13-7-17

Actual Date of Tut.: 13-7-17

Scheduled & Actual Date of H.A. Submission:&.....

FIRST 20 MT. CLASS QUESTIONS

- Q.1 Two coils with self inductance 1H and 4H respectively have a mutual inductance of 1H respectively. The RMS value of current flowing in two coils are 4A and 1A respectively. Find - (i) the coupling factor (ii) Energy stored in magnetic field.
- Q.2 Derive the expression of torque developed in closely excited magnetic systems.

2 HRS. SOLVABLE HOME ASSIGNMENT (H.A.) QUESTIONS

- Q.2 Discuss the permanent magnets and their applications.
- Q.3 Define energy and co energy. Prove that the field energy and co energy in a linear magnetic circuit are given by identical expressions.

OTHER IMPORTANT QUESTIONS

- Q.4 With the help of suitable diagram explain hysteresis and eddy current losses as applied to magnetic circuits.
- Q.5 Give the importance of hysteresis loop with reference to the electrical machines.



COLLEGE OF ENGINEERING

TUTORIAL SHEETS

DC Generator

TUTORIAL SHEET

SHEET No. 3A

Campus: P.C.E. Course: B.Tech

Class/Section: III Sem A & C

Name of Faculty: Dr. CHETAN KHEMRAJ

Name of Subject: E.M.-I

Date: 17-7-15

Date of Tut. Sheet Preparation: 5-7-15

Scheduled Date of Tut: 17-7-15

Code: 3EE05

Actual Date of Tut: 17-7-15

Name of Student:

Scheduled & Actual Date of H.A. Submission:

FIRST 20 MT. CLASS QUESTIONS

- Q.1: A shunt generator of terminal voltage of 220V delivers a current of 250A to the load. The shunt field and armature resistances are 50Ω and 0.02Ω respectively. Calculate generated voltage.
- Q.2: A 6 pole lap wound DC generator has 600 conductors on its armature. The flux per pole is 0.05 Wb. Calculate generated voltage when the speed of generator is 1000 rpm. Also find the electromagnetic torque if generator supplies a current of 120A.

2 HRS. SOLVABLE HOME ASSIGNMENT (H.A.) QUESTIONS

- Q.1 Draw the various characteristics of shunt and series DC generators
- Q.2 How we can improve the commutation by different methods in DC generators. Explain it.

OTHER IMPORTANT QUESTIONS

- Q.1 List and explain the factors involved in voltage build up of DC generators
- Q.2 In a 110V compound generator, the armature shunt and series winding resistances are 0.6Ω , 25Ω and 0.04Ω respectively. The load consists of 200 lamps each rated 55W, 110V connected in parallel. Find the total emf and armature current when the M/C is connected for (a) long shunt (b) short shunt.



COLLEGE OF ENGINEERING

TUTORIAL SHEETS

DC GENERATORS

TUTORIAL SHEET

SHEET No. 3.B.

Campus: ...P.C.E. Course: B.Tech Class/Section: III

Name of Faculty: Dr. CHETAN KHEMUN Name of Subject: E.M.-1

Date:

Code: 3EE05

Date of Tut. Sheet Preparation: 5-7-15 Scheduled Date of Tut: 17-7-17 Actual Date of Tut: 17-7-15

Name of Student: Scheduled & Actual Date of H.A. Submission:&.....

FIRST 20 MT. CLASS QUESTIONS

- Q.1 A shunt generator of terminal voltage of 220V delivers a current of 250A to the load. The shunt field and armature resistances are 50Ω and 0.02Ω respectively. Calculate the generated voltage.
- Q.2 A 6 pole, lap wound DC generator has 600 conductors on its armature. The flux per pole is 0.05 wb. Calculate generated emf when the speed of generator is 1000 rpm.

2 HRS. SOLVABLE HOME ASSIGNMENT (H.A.) QUESTIONS

- Q.3 Obtain the emf equation of a DC Generator.
- Q.4 Explain Armature reaction in case of DC Generator.

OTHER IMPORTANT QUESTIONS

- Q.5 State the condition which determines if a DC machine is in generating or motoring mode.
- Q.6 Draw the power flow diagram of a DC Generator. Also discuss the condition of maximum efficiency.

COLLEGE OF ENGINEERING

TUTORIAL SHEETS

TUTORIAL SHEET

SHEET No. 3C

Campus: PCE Course: B.Tech

Class/Section: III EE ARC

Name of Faculty: Dr. Chetan Khosla

Name of Subject: E.M-I

Date:

Date of Tut. Sheet Preparation: 8-7-15

Scheduled Date of Tut: 17-7-17

Code: 03.EE03

Actual Date of Tut: 17-7-17

Name of Student:

Scheduled & Actual Date of H.A. Submission:&.....

FIRST 20 MT. CLASS QUESTIONS

- Q.1: A DC shunt generator of terminal voltage of 230V delivers a current of 250A to the load. The shunt field and armature resistances are 50Ω and 0.02Ω respectively. Calculate the generated emf.
- Q.2 A 6 pole, lap wound DC generator has 600 conductors on its armature. The flux per pole is 0.05 wb. Calculate the generated emf when the speed of generator is 1000 rpm.

2 HRS. SOLVABLE HOME ASSIGNMENT (H.A.) QUESTIONS

- Q.3 List and explain the factors involved in the voltage build up of shunt generator.
- Q.4 Explain the role of the dummy coils in the DC machine winding.

OTHER IMPORTANT QUESTIONS

- Q.5 In a 110V compound generator, the armature shunt and series winding resistances are 0.6Ω , 25Ω and 0.04Ω respectively. The load consists of 200 lamps each of rating 55W, 110V. Find the total emf and armature current when (i) long shunt (ii) short shunt
- Q.6 Derive an expression for generated emf in a DC generator.



POONIMA

COLLEGE OF ENGINEERING

TUTORIAL SHEETS

TUTORIAL SHEET

SHEET No. 3D

Campus: ...P.C.E. Course: B.Tech

Class/Section: ...III A & C

Name of Faculty: Dr. Chetan Khemraj

Name of Subject: ...E.M.-I

Date:

Date of Tut. Sheet Preparation: 8-7-15

Scheduled Date of Tut.: 17-7-17

Code: Q3EE05

Actual Date of Tut.: 17-7-17

Name of Student:

Scheduled & Actual Date of H.A. Submission:&.....

FIRST 20 MT. CLASS QUESTIONS

- Q.1 A DC shunt generator of terminal voltage of 220V delivers a current of 250A to the load. The shunt field and armature resistances are 50Ω and 0.02Ω respectively. Calculate the generated emf.
- Q.2 A 6 pole, lap wound DC generator has 600 conductors on its armature. The flux per pole is 0.05 Wb. Calculate the generated emf when the speed of generator is 1000 rpm.

2 HRS. SOLVABLE HOME ASSIGNMENT (H.A.) QUESTIONS

- Q.3 Draw the various characteristics of DC shunt and series generator.
- Q.4 What is commutation process? How we can improve the commutation by different methods in DC Generator. Explain it.

OTHER IMPORTANT QUESTIONS

- Q.5 Obtain the emf equation for a DC Generator.
- Q.6 Explain armature reaction process.

TUTORIAL SHEETS

TUTORIAL SHEET

Campus: ...P.C.E... Course: B.Tech
 Name of Faculty: ...Dr. Chetan Khemraj... Class/Section: ...III A & C...
 Date of Tut. Sheet Preparation: 9-7-17 Name of Subject: EM-I... Date:
 Name of Student: Scheduled Date of Tut.: 17-7-17 Actual Date of Tut.: 17-7-17
 Scheduled & Actual Date of H.A. Submission:&.....

FIRST 20 MT. CLASS QUESTIONS

- Q.1 A DC shunt generator of terminal voltage 250V delivers a current of 250A to the load. The shunt field and armature resistances are 50Ω and 0.02Ω respectively. Calculate the generated emf.
- Q.2 A 6 pole, lap wound DC generator has 600 conductors on its armature. The flux per pole is 0.05Wb . Calculate the generated emf when the speed is 1000 rpm.

2 HRS. SOLVABLE HOME ASSIGNMENT (H.A.) QUESTIONS

- Q.3 Explain the armature reaction process. What are various methods to improve it.
- Q.4 Obtain emf equation of a DC generator

OTHER IMPORTANT QUESTIONS

- Q.5 Draw the power flow diagram of a DC generator. Obtain the condition for maximum efficiency.
- Q.6 Draw the different characteristics of DC shunt and series generator.

COLLEGE OF ENGINEERING

TUTORIAL SHEETS

TUTORIAL SHEET

SHEET No. 3A

Campus: P.C.E. Course: B.Tech

Class/Section: III A & C

Name of Faculty: Dr. Chetan K. Hemraj

Name of Subject: E.M.-I

Date:

Date of Tut. Sheet Preparation: 10-7-17

Scheduled Date of Tut.: 17-7-17

Code: Q3EE05

Actual Date of Tut.: 17-7-17

Name of Student:

Scheduled & Actual Date of H.A. Submission:&.....

FIRST 20 MT. CLASS QUESTIONS

- Q.1 A DC shunt generator of terminal voltage of 200V delivers a current of 250A to the load. The shunt field and armature resistances are 50Ω and 0.02Ω respectively. Calculate the generated emf.
- Q.2 A 6 pole, lap wound DC generator has 600 conductors on its armature. The flux per pole is 0.05 Wb. Calculate the generated emf when the speed of generator is 1000 rpm.

2 HRS. SOLVABLE HOME ASSIGNMENT (H.A.) QUESTIONS

- Q.3 How we can improve the commutation by different methods in DC generators. Explain it.
- Q.4 List and explain the factors involved in voltage build up of DC generators.

OTHER IMPORTANT QUESTIONS

- Q.5 Explain the role of Dummy coils in DC Generator motors.
- Q.6 Derive an expression for generated emf in a DC Generator.



COLLEGE OF ENGINEERING

TUTORIAL SHEETS

DC Generator

TUTORIAL SHEET

SHEET No. 4A

Campus: P.C.E. Course: B.Tech

Class/Section: III sem A & C

Name of Faculty: Dr. CHETAN KHEMKA

Name of Subject: E.M.-I

Date: _____

Date of Tut. Sheet Preparation: 5-7-17

Scheduled Date of Tut: 2/8/17

Code: 03E005

Actual Date of Tut: _____

Name of Student: _____

Scheduled & Actual Date of H.A. Submission: _____ & _____

FIRST 20 MT. CLASS QUESTIONS

- Q-1 calculate the emf generated by 4 pole wave wound generator having 65 slots with 12 conductors per slot when driven at 1200 rpm. flux per pole is 0.02 mwb
- Q-2A 4 pole DC shunt generator with a wave wound armature has to supply a load of 500 lamps each of 100W at 250V. Allowing 10V for voltage drop in connecting leads and drop of 1V per brush.

2 HRS. SOLVABLE HOME ASSIGNMENT (H.A.) QUESTIONS

- calculate the speed at which generator must be driven. The magnetic flux per pole is 30 mwb and arm. and field resistances are 0.05 Ω and 65 Ω respectively. The number of armature conductors is 390.
- Q-3: The armature of a 6 pole, 600 rpm, Lap wound generator has 90 slots. If each coil has 4 turns, calculate the flux per pole to generate an emf of 288 volts.

OTHER IMPORTANT QUESTIONS

- Q-4 A 4 pole lap wound DC shunt generator has a useful flux per pole of 0.07 mwb. The armature windings consists of 220 turns, each of 0.004 Ω resistance. Calculate the terminal voltage when running at 900 rpm. If armature current is 50A.
- Q-5 what are the various methods of improving the emf generator for armature reaction.

$$2) \quad I_L = \frac{500 \times 100}{250} = 200 \text{ A}$$

$$\text{Voltage across shunt} = 250 + 10 = 260 \text{ V}$$

$$I_{sh} = \frac{260}{65} = 4 \text{ A}$$

$$I_a = I_L + I_{sh} = 200 + 4 = 204 \text{ A}$$

$$\text{Brush drop} = 2 \times 1 = 2 \text{ V}$$

$$E_g = \text{Voltage across shunt} + 2 + I_a R_a$$

$$= 260 + 2 + 204 \times 0.05$$

$$= 272.2 \text{ V}$$

$$E_g = \frac{P \phi Z N}{60 A}$$

$$N = 698 \text{ rpm. [for wave winding } A = 2]$$

3) Each turn has two active conductors and 90 coils.

$$\therefore Z = 90 \times 4 \times 2 = 720$$

$$E_g = \frac{N \phi Z P}{60 A}$$

$$\phi = \frac{E_g \times 60 A}{P Z N} = \frac{288 \times 60 \times 6}{6 \times 720 \times 600} = 0.04 \text{ wb.}$$

$$4) \quad E_g = \frac{P \phi Z N}{60 A}$$

$$Z = 220 \times 2 = 440, \quad \phi = 0.07 \text{ wb, } N = 900 \text{ rpm}$$

$$A = P = 4$$

$$E_g = \frac{4 \times 0.07 \times 440 \times 900}{60 \times 4} = 462 \text{ V}$$

$$\text{No. of parallel paths} = \frac{220}{4} = 55$$

$$\text{Resistance per parallel path} = 0.004 \times 55 = 0.22 \Omega$$

$$E_g = V + I_a R_a \rightarrow V = E_g - I_a R_a$$

$$462 =$$

$$= 462 - 50 \times 0.055$$

$$= 459.25 \text{ Volts}$$

COLLEGE OF ENGINEERING

TUTORIAL SHEETS

DC Generator

TUTORIAL SHEET

SHEET No. 4B

Campus: PCE Course: B.Tech Class/Section: III sem A & C Date:
Name of Faculty: Dr. CHEJAN KHEMBA Name of Subject: EM-1 Code: 03EE05
Preparation: 6-7-17 Scheduled Date of Tut: 9/8/17 Actual Date of Tut:
Name of Student: Scheduled & Actual Date of H.A. Submission:&.....

FIRST 20 MT. CLASS QUESTIONS	Q.1 Calculate the emf generated by 4 pole wave wound generators having 65 slots with 12 conductors per slot when driven at 1200 rpm, the flux per pole is 0.02 wb. Q.2 A 4 pole DC shunt generator with a wave wound armature has to supply a load of 500 lamps each of 100W at 250V. Allowing 10V for voltage drop in connecting leads and drop of 1V per brush. calculate the speed at which generator must be driven. The magnetic flux per pole is 30 mwb and the armature and field resistances are 0.05Ω and 65Ω respectively. The no. of armature conductors is 390.
2 HRS. SOLVABLE HOME ASSIGNMENT (H.A.) QUESTIONS	Q.3: Explain the meaning and significance of the critical field resistance of a shunt generator. Q.4 Draw the power flow diagram of a DC generator. Also, discuss the condition for the maximum efficiency.
OTHER IMPORTANT QUESTIONS	Q.5 List and explain the factors involved in the voltage build up of shunt generator. Q.6 Draw and explain the three characteristics of a DC shunt generator

COLLEGE OF ENGINEERING

TUTORIAL SHEETS

DC Generator

TUTORIAL SHEET

SHEET No. 4C

Campus: ...P.C.E. Course: B.Tech. Class/Section: III A & C Date:
 Name of Faculty: Dr. Chetan Khemraj Name of Subject: EM-I Code: Q3.EE05
 Date of Tut. Sheet Preparation: 6-7-17 Scheduled Date of Tut. 2/8/17 Actual Date of Tut. :
 Name of Student: Scheduled & Actual Date of H.A. Submission:&.....

FIRST 20 MT. CLASS QUESTIONS	Q.1 Calculate the emf generated by 4 pole wave wound generator having 65 slots with 12 conductors per slot. when driven at 1200 rpm. Flux per pole is 0.02 Wb. Q.2 A 4 pole DC shunt generator with a wave wound armature has to supply a load of 500 lamps each of 100W at 250V. Allowing 10V for brush drop in connecting leads and drop of 1V per brush. Calculate the speed at which the generator must be driven. The magnetic flux per pole is 30mWb and armature and field resistances are 0.05Ω and 65Ω respectively. The number of armature conductor is 390.
2 HRS. SOLVABLE HOME ASSIGNMENT (H.A.) QUESTIONS	Q.3 Draw and explain the three characteristics of DC series generators Q.4 Discuss the parallel operations of a DC generator.
OTHER IMPORTANT QUESTIONS	Q.5 How we can improve the commutation in DC generators by different methods. Q.6 What are the various methods of improving armature reaction explain.

TUTORIAL SHEETS

DC Generator

TUTORIAL SHEET

SHEET No. 4D.

Campus: PCE Course: B.Tech Class/Section: III A & C Date:
 Name of Faculty: Dr. CHEJAN KHEMRA Name of Subject: Dr. CHEJAN KHEMRA Code: 03EE05
 Date of Tut. Sheet Preparation: 10-7-17 Scheduled Date of Tut. 8/8/17 Actual Date of Tut. :
 Name of Student: Scheduled & Actual Date of H.A. Submission:&.....

FIRST 20 MT. CLASS QUESTIONS	Q.1: Calculate the emf generated by 4 pole wave wound generators having 65 slots with 12 conductors per slot. when driven at 1200 rpm flux per pole is 0.02 Wb. Q.2: 4 pole DC shunt generator with a wave wound armature has to supply a load of 500 lamps each of 100W at 250V. Allowing 10V for voltage drop in connecting leads and drop of 1V per brush. Calculate the speed at which generator must be driven. The magnetic flux per pole is 30mWb and armature and field winding resistances are 0.05Ω and 65Ω respectively. The number of armature conductors are 396.
2 HRS. SOLVABLE HOME ASSIGNMENT (H.A.) QUESTIONS	Q.3 Draw and explain the various characteristics of a compound generator Q.4 Explain the importance of improving the commutation. Give various methods
OTHER IMPORTANT QUESTIONS	Q.5 Draw and explain the characteristics of a DC compound generator. Q.6 List the factors and explain the process of voltage build up.



COLLEGE OF ENGINEERING

TUTORIAL SHEETS

DC Generators

TUTORIAL SHEET

SHEET No. 4E

Campus: P.C.E. Course: B.Tech Class/Section: III A & C

Date:

Name of Faculty: Dr. CHEJAN KUMAR Name of Subject: EM-I

Code: 03EE05

Date of Tut. Sheet Preparation: 11-7-17 Scheduled Date of Tut.: 28/17 Actual Date of Tut.:

Name of Student: Scheduled & Actual Date of H.A. Submission:&.....

FIRST 20 MT. CLASS QUESTIONS	Q.1 Calculate the emf generated by 4 pole wave wound generator having 65 slots, with 12 conductors per slot when driven at 1200 rpm. Flux per pole is 0.02 Wb Q.2 A 4 pole DC shunt generator with a wave wound armature has to supply a load of 500 lamps each of 100W at 250V. Allowing 10V for voltage drop in connecting leads and 1V per brush drop. Calculate the speed at which the generator must be driven. The magnetic flux per pole is 30mWb and armature & field resistances are 0.05Ω and 65Ω respectively. The no. of armature conductors are 390.
2 HRS. SOLVABLE HOME ASSIGNMENT (H.A.) QUESTIONS	Q.3 Explain the operation of Rosenberg generator by drawing neat diagram write its application. Q.4 Explain the compensating winding for a DC Machine.
OTHER IMPORTANT QUESTIONS	Q.5 Explain clearly the process of commutation in a DC machine. What causes sparking at the commutator surface. Q.6 Draw and explain the characteristics of a DC compound generator in detail.

TUTORIAL SHEETS

TUTORIAL SHEET

SHEET No. 4A

Campus: P.C.E. Course: B.Tech

Name of Faculty: Dr. C. Khennaj

Class/Section: III

Name of Subject: EM-I

Date:

Code: 03EE05

Date of Tut. Sheet Preparation: 12-7-17

Scheduled Date of Tut.: 2/8/17

Actual Date of Tut.:

Name of Student:

Scheduled & Actual Date of H.A. Submission:&.....

FIRST 20 MT. CLASS QUESTIONS	Q.1 Calculate the emf generated by 4 pole wave wound generator having 65 slots with 12 conductors per slot when driven at 1200 rpm with flux per pole is 0.02 Wb. Q.2: A 4 pole DC shunt generator with a wave wound armature has to supply a load of 500 lamps each of 55W, 110V. Allowing 10V for voltage drop in connecting leads and 1V per brush drop, calculate the speed at which the generator must be driven, $\phi = 30 \text{ mWb}$, $R_a = 0.05$ and $R_f = 65 \Omega$ and no. of arm. conductors is 390.
2 HRS. SOLVABLE HOME ASSIGNMENT (H.A.) QUESTIONS	Q.3 Explain how the effect of armature reaction can be neutralised by using interpoles and compensating windings. Q.4 Draw and explain the load characteristic of a DC compound generator.
OTHER IMPORTANT QUESTIONS	Q.5 Discuss the importance of parallel operation of a DC generator. Q.6 What are the various methods for improving the armature reaction?



POORNIMA

COLLEGE OF ENGINEERING

TUTORIAL SHEETS

TUTORIAL SHEET

DC Motor - 5A

SHEET No.

Campus: ...P.C.E. Course: B.Tech

Class/Section: III (A & C)

Date:

Name of Faculty: DR. CHETAN KHEMRA

Name of Subject: Elec. M/C - I

Code: 03EE05

Date of Tut. Sheet Preparation: 25/7/17

Scheduled Date of Tut.:

Actual Date of Tut.: 16/8/17

Name of Student:

Scheduled & Actual Date of H.A. Submission:

&

FIRST 20 MT. CLASS QUESTIONS

- Q.1: A shunt motor takes a total current of 20A from 250V supply. The shunt and field resistance are 200Ω and 0.3Ω respectively. Find
a) Back emf b) Mechanical power developed.
- Q.2: A DC shunt motor has a 230V has armature resistance 0.5Ω and field resistance 115Ω . At no load, the speed is 1200 rpm and arm. current 2.5A. The rated load drops to 1120 rpm. Determine the current and power input.

2 HRS. SOLVABLE HOME ASSIGNMENT (H.A.) QUESTIONS

- Q.3 what is meant by back EMF in a DC motor? Derive the equation for production of torque.
- Q.4 Draw the three characteristics for
a) DC shunt b) series c) compound.

OTHER IMPORTANT QUESTIONS

- Q.5 what is the effect of armature reaction on the performance of a DC motor?
- Q.6 Write the speed equation and hence explain the factors affecting the speed of a DC motor.

COLLEGE OF ENGINEERING

TUTORIAL SHEETS

DC Motor - 3B

TUTORIAL SHEET

SHEET No.

Campus: ...P.C.E.... Course: ...B.Tech...

Class/Section: ...III (A & C)...

Date:

Name of Faculty: DR. CHEJAN KHEMRA

Name of Subject: ...Elec. M/C. - I

Code: ...3EE05

Date of Tut. Sheet Preparation: 25/7/17

Scheduled Date of Tut.: Actual Date of Tut.: 16/8/17

Name of Student: Scheduled & Actual Date of H.A. Submission: &

FIRST 20 MT. CLASS QUESTIONS

- Q. 1: A shunt motor takes a total current of 20A from 250V supply. The shunt and armature resistance are 200Ω and 0.3Ω respectively. Find
a) Back emf b) Mechanical power developed.
- Q. 2: A DC shunt motor has a 230V has armature resistance 0.5Ω and field resistance 115Ω . At no load, the speed is 1200 rpm and arm. current 2.5A. The rated load drops to 1120 rpm. Determine the current and power input.

2 HRS. SOLVABLE HOME ASSIGNMENT (H.A.) QUESTIONS

- Q. 3 Why a DC series motor cannot be started on no-load condition.
- Q. 4 state the applications of the three types of DC motors.

OTHER IMPORTANT QUESTIONS

- Q. 5 Derive the expression of an electromagnetic torque developed in a DC motor.
- Q. 6 state the voltage and power equation of a DC motor explaining the importance of each?



COLLEGE OF ENGINEERING

TUTORIAL SHEETS

DC Motor - 5C

TUTORIAL SHEET

SHEET No.....

Campus: ...P.C.E.... Course: ..B.Tech Class/Section: III (A & C) Date:
Name of Faculty: DR. CHEJAN KHEIMRA Name of Subject: Elec. M/C - I Code: 03EE05
Date of Tut. Sheet Preparation: 25/7/17 Scheduled Date of Tut.: Actual Date of Tut. 16/8/17
Name of Student: Scheduled & Actual Date of H.A. Submission: &

FIRST 20 MT. CLASS QUESTIONS	Q.1: A shunt motor takes a total current of 20A from 250V supply. The shunt and armature resistance are 200Ω and 0.3Ω respectively. Find a) Back emf b) Mechanical power developed. Q.2: A DC shunt motor has a 230V has armature resistance 0.5Ω and field resistance 115Ω. At no load, the speed is 1200 rpm and arm. current 2.5A. The rated load drops to 1120 rpm. Determine the current and power input.
2 HRS. SOLVABLE HOME ASSIGNMENT (H.A.) QUESTIONS	Q.3 Explain the working principle of a DC motor. Q.4 What is a back EMF? Explain its significance.
OTHER IMPORTANT QUESTIONS	Q.5 What is the effect of armature reaction on the performance of a DC motor. Q.6 Write the speed equations and hence explain the factors affecting the speed of a DC motor.



COLLEGE OF ENGINEERING

TUTORIAL SHEETS

DC Motor - 3D

TUTORIAL SHEET

SHEET No.....

Campus: ...P.C.E.... Course: ..B.Tech Class/Section: III (A & C) Date:
Name of Faculty: Dr. CHEJAN KHEIMRA Name of Subject: Elec. M/C - I Code: Q3EE05
Date of Tut. Sheet Preparation: 25/7/17 Scheduled Date of Tut.: Actual Date of Tut.: 16/8/17
Name of Student: Scheduled & Actual Date of H.A. Submission:&.....

FIRST 20 MT. CLASS QUESTIONS

- Q.1: A shunt motor takes a total current of 20A from 250V supply. The shunt and armature resistance are 200Ω and 0.3Ω respectively. Find
a) Back emf b) Mechanical power developed.
- Q.2: A DC shunt motor has a 230V has armature resistance 0.5Ω and field resistance 115Ω . At no load, the speed is 1200 rpm and arm. current 2.5A. The rated load drops to 1120 rpm. Determine the current and power input.

2 HRS. SOLVABLE HOME ASSIGNMENT (H.A.) QUESTIONS

- Q.3 Draw and explain the torque-speed characteristics of
a) shunt b) series c) compound motor.
- Q.4 Why a DC series motor cannot be started without load?

OTHER IMPORTANT QUESTIONS

- Q.5 Derive the expression for electromagnetic torque developed in a DC motor.
- Q.6 State the voltage and power equation for a DC motor explaining the importance.

COLLEGE OF ENGINEERING

TUTORIAL SHEETS

DC Motor - 3E

TUTORIAL SHEET

SHEET No.....

Campus: ...P.C.E.... Course: B.Tech Class/Section: III (A & C) Date:
 Name of Faculty: Dr. CHEETAN KHEMRA Name of Subject: Elec. M/C - I Code: Q3EE05
 Date of Tut. Sheet Preparation: 25/7/17 Scheduled Date of Tut.: Actual Date of Tut.: 16/8/17
 Name of Student: Scheduled & Actual Date of H.A. Submission: &

FIRST 20 MT. CLASS QUESTIONS	Q.1: A shunt motor takes a total current of 20A from 250V supply. The shunt and field resistance are 200Ω and 0.3Ω respectively. Find a) Back emf ii) Mechanical power developed. Q.2: A DC shunt motor has a 230V has armature resistance 0.5Ω and field resistance 115Ω. At no load, the speed is 1200 rpm and arm. current 2.5A. The rated load drops to 1120 rpm. Determine the current and power input.
2 HRS. SOLVABLE HOME ASSIGNMENT (H.A.) QUESTIONS	Q.3 What is the difference between a motor and a generator? Q.4 Explain the working of a DC motor?
OTHER IMPORTANT QUESTIONS	Q.5 What is a back emf? Explain its significance. Q.6 Write the speed equation and hence give all the factors on which speed depends.



COLLEGE OF ENGINEERING

TUTORIAL SHEETS

DC Motor - 31

TUTORIAL SHEET

SHEET No.

Campus: ...P.C.E... Course: B.Tech Class/Section: III (A & C)

Date:

Name of Faculty: Dr. CHEJAN KHEIMRA Name of Subject: Elec. M/C - I

Code: 03EE05

Date of Tut. Sheet Preparation: 25/7/17 Scheduled Date of Tut.: Actual Date of Tut.: 16/8/17

Name of Student: Scheduled & Actual Date of H.A. Submission: &

FIRST 20 MT. CLASS QUESTIONS

Q.1: A shunt motor takes a total current of 20A from 250V supply. The shunt and field resistance are 200Ω and 0.3Ω respectively. Find
a) Back emf b) Mechanical power developed.

Q.2: A DC shunt motor has a 230V has armature resistance 0.5Ω and field resistance 115Ω . At no load, the speed is 1200 rpm and arm. current 2.5A. The rated load drops to 1120 rpm. Determine the current and power input.

2 HRS. SOLVABLE HOME ASSIGNMENT (H.A.) QUESTIONS

Q.3 What is the effect of armature reaction on the performance of a DC motor.

Q.4 Derive the expression of electromagnetic torque in a DC motor.

OTHER IMPORTANT QUESTIONS

Q.5 Draw and explain speed vs armature current for a) shunt b) series and c) compound motors.

Q.6 State the applications for the three types of DC motors.

COLLEGE OF ENGINEERING

TUTORIAL SHEETS

DC Motor

TUTORIAL SHEET

SHEET No... 6A

Campus: PCE Course: B.Tech Class/Section: II CA & C Date:
 Name of Faculty: Dr. Chetan Khemraj Name of Subject: Electrical M/C-I Code: 03EE05
 Date of Tut. Sheet Preparation: 31/7/17 Scheduled Date of Tut.: Actual Date of Tut.:
 Name of Student: 31/- Scheduled & Actual Date of H.A. Submission:&.....

FIRST 20 MT. CLASS QUESTIONS	Q.1 A 3KW series motor runs normally at 800 RPM on a 240V supply taking 16A; the field coils are connected in series. Estimate the speed and current taken by the motor. The load torque increases in square of the speed. Q.2 A shunt motor has an armature circuit resistance of 0.7Ω and applied voltage 240V. The no load and full load armature current is 5A and 30A respectively. Determine the change in back emf from no load to full load.
2 HRS. SOLVABLE HOME ASSIGNMENT (H.A.) QUESTIONS	Q.3 Sketch and explain the speed torque characteristics method of speed control of a DC series motor. Q.4 Enumerate and classify the losses in the DC motor.
OTHER IMPORTANT QUESTIONS	Q.5 Explain different methods of braking of DC motor. Q.6 Explain the Hopkinson method of testing of a DC motor. Differentiate with Swinburne's method of testing of DC machine.



COLLEGE OF ENGINEERING

TUTORIAL SHEETS

DC Motor

TUTORIAL SHEET

SHEET No. 6B

Campus: PCE Course: B.Tech Class/Section: III CA & C

Date:

Name of Faculty: Dr. Chetan Khemraj Name of Subject: Electrical M/C-I Code: 03EE05

Date of Tut. Sheet Preparation: 31/7/17 Scheduled Date of Tut.: Actual Date of Tut.:

Name of Student: 31/- Scheduled & Actual Date of H.A. Submission:

FIRST 20 MT. CLASS QUESTIONS

- Q.1 A 3KW series motor runs normally at 800 RPM on a 240V supply taking 16A; the field coils are connected in series. Estimate the speed and current taken by the motor. The load torque increases in square of the speed.
- Q.2 A shunt motor has an armature circuit resistance of 0.7Ω and applied voltage 240V. The no load and full load armature current is 5A and 30A respectively. Determine the change in back emf from no load to full load.

2 HRS. SOLVABLE HOME ASSIGNMENT (H.A.) QUESTIONS

- Q.3 Elaborate the Swinburn's test with a neat circuit diagram.
- Q.4 Explain the different braking technique for DC motor.

OTHER IMPORTANT QUESTIONS

- Q.5 Elaborate why a DC series motor cannot be started on no load condition?
- Q.6: Which method of speed control is used for DC shunt motor
- (i) above rated speed.
 - (ii) below rated speed

TUTORIAL SHEETS

DC Motor

TUTORIAL SHEETSHEET No. 6C

Campus: PCCOE Course: B.Tech Class/Section: II CA&C Date:
Name of Faculty: Dr. Chetan Khemraj Name of Subject: Electrical M/C-I Code: 03EE05
Date of Tut. Sheet Preparation: 31/7/17 Scheduled Date of Tut.: Actual Date of Tut.:
Name of Student: 31/- Scheduled & Actual Date of H.A. Submission:

FIRST 20 MT. CLASS QUESTIONS	Q.1 A 3KW series motor runs normally at 800RPM on a 240V supply taking 16A; the field coils are connected in series. Estimate the speed and current taken by the motor. The load torque increases in square of the speed. Q.2 A shunt motor has an armature circuit resistance of 0.7Ω and applied voltage 240V. The no load and full load armature current is 5A and 30A respectively. Determine the change in back emf from no load to full load.
2 HRS. SOLVABLE HOME ASSIGNMENT (H.A.) QUESTIONS	Q.3 Explain the various ways of controlling the flux of a DC series motor. Q.4 Explain the Ward Leonard system of control of speed.
OTHER IMPORTANT QUESTIONS	Q.5 Explain the Swinburn's test by giving its circuit diagram. Q.6 Explain the different techniques by which speed controlling can be done using variation by flux.

TUTORIAL SHEETS

DC Motor

TUTORIAL SHEET

SHEET No. 60

Campus: PCE Course: B.Tech Class/Section: II CA&C Date:
Name of Faculty: Dr. Chetan Khemraj Name of Subject: Electrical M/C-I Code: 03EE05
Date of Tut. Sheet Preparation: 31/7/17 Scheduled Date of Tut.: Actual Date of Tut.:
Name of Student: 31/- Scheduled & Actual Date of H.A. Submission:&.....

FIRST 20 MT. CLASS QUESTIONS

Q.1 A 3KW series motor runs normally at 800 RPM on a 240V supply taking 16A; the field coils are connected in series. Estimate the speed and current taken by the motor. The load torque increases in square of the speed.

Q.2 A shunt motor has an armature circuit resistance of 0.7Ω and applied voltage 240V. The no load and full load armature current is 5A and 30A respectively. Determine the change in back emf from no load to full load.

2 HRS. SOLVABLE HOME
ASSIGNMENT (H.A.) QUESTIONS

Q.3 Explain in detail the regenerative braking.

Q.4 State the advantage of potential divider arrangement used to control the speed.

OTHER IMPORTANT QUESTIONS

Q.5 Explain the Ward Leonard system of speed control.

Q.6 Explain the Swinburne's test by giving its circuit diagram.

COLLEGE OF ENGINEERING

TUTORIAL SHEETS

DC Motor

TUTORIAL SHEET

SHEET No. 6A

Campus: PCE Course: B.Tech Class/Section: II (A&C) Date: _____
 Name of Faculty: Dr. Chetan Khemraj Name of Subject: Electrical M/c-1 Code: 03EE05
 Date of Tut. Sheet Preparation: 31/7/17 Scheduled Date of Tut.: _____ Actual Date of Tut.: _____
 Name of Student: 31/- Scheduled & Actual Date of H.A. Submission: 2

FIRST 20 MT. CLASS QUESTIONS

- Q.1 A 3KW series motor runs normally at 800RPM on a 240V supply taking 16A; the field coils are connected in series. Estimate the speed and current taken by the motor. The load torque increases in square of the speed.
- Q.2 A shunt motor has an armature circuit resistance of 0.7Ω and applied voltage 240V. The no load and full load armature current is 5A and 30A respectively. Determine the change in back emf from no load to full load.

2 HRS. SOLVABLE HOME ASSIGNMENT (H.A.) QUESTIONS

- Q.3 Explain in detail the plugging method of braking.
- Q.4 state the advantages, disadvantages of flux, rheostatic and voltage control methods used for a DC shunt motor?

OTHER IMPORTANT QUESTIONS

- Q.5 Explain the Swinburne's method of testing the DC machines.
- Q.6 Explain the Ward Leonard system of speed control.

COLLEGE OF ENGINEERING

TUTORIAL SHEETS

DC Motor

TUTORIAL SHEET

SHEET No. 15

Campus: PCE Course: B.Tech Class/Section: III (A2C) Date: _____
Name of Faculty: Dr. Chandra K. Sharma Name of Subject: Electrical M/C-1 Code: 03EE05
Date of Tut. Sheet Preparation: 31/7/17 Scheduled Date of Tut. _____ Actual Date of Tut. _____
Name of Student: 31/- Scheduled & Actual Date of H.A. Submission: _____

FIRST 20 MT. CLASS QUESTIONS

Q.1 A 3KW series motor runs normally at 800 RPM on a 240V supply taking 16A; the field coils are connected in series. Estimate the speed and current taken by the motor. The load torque increases in square of the speed.

Q.2 A shunt motor has an armature circuit resistance of 0.7Ω and applied voltage 240V. The no load and full load armature current is 5A and 30A respectively. Determine the change in back emf from no load to full load.

Q.3 Explain in detail the rheostatic braking.

Q.4 Explain any two methods of speed control of a DC motor.

OTHER IMPORTANT QUESTIONS

Q.5 Which method is preferred when speed of a DC shunt motor is controlled above the rated value.

Q.6 Explain the various ways of controlling the flux of a DC series motor.



POONIMA

COLLEGE OF ENGINEERING

TUTORIAL SHEETS

TUTORIAL SHEET		SHEET No. <u>7A</u>
Campus: <u>PCE</u> Course: <u>B.Tech</u> Class/Section: <u>III (A&C)</u> Date:		
Name of Faculty: <u>Dr. Chetan Khemraj</u> Name of Subject: <u>Elec. M/C</u> Code: <u>03EE05</u>		
Date of Tut. Sheet Preparation: <u>23-9-17</u> Scheduled Date of Tut.: Actual Date of Tut.:		
Name of Student: Scheduled & Actual Date of H.A. Submission:&.....		
FIRST 20 MT. CLASS QUESTIONS	Q.1: A single phase transformer at unity power factor has an efficiency of 90% at both half load and at full load of 500W. Determine - (i) Iron loss (ii) full load copper loss (iii) efficiency at 75% of full load (iv) Maximum efficiency. Q.2: Calculate the regulation of a transformer in which the ohmic loss is 1% of the output and the reactance drop is 5% of the voltage, when the load power factor is (i) 0.8 lag (ii) 0.8 leading (iii) unity	
2 HRS. SOLVABLE HOME ASSIGNMENT (H.A.) QUESTIONS	Q.3 Describe the constructional features and principle of operation of a single phase transformer. Q.4 Define voltage regulation of transformer. Develop an expression for calculating voltage regulation for two winding transformer under (i) lagging pf (ii) unity pf (iii) leading pf	
IMPORTANT QUESTIONS	Q.5 Discuss in detail with proper circuit diagram about Sumpner's back to back test. Q.6 Explain why parallel operation of transformer is necessary. Give the various conditions.	



COLLEGE OF ENGINEERING

TUTORIAL SHEETS

TUTORIAL SHEET

SHEET No. 7A

Institution: P.C.E. Course: B.Tech. Class/Section: III (A&C)

Date:

Name of Faculty: Dr. Chetan Khemraj Name of Subject: Elec. M/C

Code: 03EE05

Preparation of Tut. Sheet: 23-9-17 Scheduled Date of Tut.: Actual Date of Tut.:

Name of Student: Scheduled & Actual Date of H.A. Submission:&.....

FIRST 20 MT. CLASS QUESTIONS

- Q.1: A single phase transformer at unity power factor has an efficiency of 90% at both half load and at full load of 500W. Determine - (i) Iron loss (ii) full load copper loss (iii) efficiency at 75% of full load (iv) Maximum efficiency.
- Q.2: Calculate the regulation of a transformer in which the ohmic loss is 1% of the output and the reactance drop is 5% of the voltage, when the load power factor is (i) 0.8 lag (ii) 0.8 leading (iii) unity

2 HRS. SOLVABLE HOME ASSIGNMENT (H.A.) QUESTIONS

- Q.3 Explain the principle of working of a transformer on load and discuss its operation on a lagging power factor.
- Q.4 Derive an expression for the emf induced in a transformer winding. Also give the equation for turns ratio.

OTHER IMPORTANT QUESTIONS

- Q.5 Draw an exact equivalent circuit diagram of 1 phase transformer. From this derive the approximate equivalent circuit diagram. State various assumptions made.
- Q.6 Define voltage regulation of a transformer. Derive conditions for (i) zero regulation (ii) Maximum regulation

COLLEGE OF ENGINEERING

TUTORIAL SHEETS

TUTORIAL SHEET

SHEET No. 7A

Campus: P.C.E. Course: B.Tech

Class/Section: III (A&C)

Date:

Name of Faculty: Dr. Chetan Khemraj

Name of Subject: Elec. M/C

Code: 03EE05

Date of Tut. Sheet Preparation: 23-9-17

Scheduled Date of Tut.: Actual Date of Tut.:

Name of Student:

Scheduled & Actual Date of H.A. Submission:&.....

FIRST 20 MT. CLASS QUESTIONS

Q.1: A single phase transformer at unity power factor has an efficiency of 90% at both half load and at full load of 500W. Determine - (i) Iron loss (ii) full load copper loss (iii) efficiency at 75% of full load (iv) Maximum efficiency.

Q.2: Calculate the regulation of a transformer in which the ohmic loss is 1% of the output and the reactance drop is 5% of the voltage, when the load power factor is (i) 0.8 lag (ii) 0.8 leading (iii) unity

2 HRS. SOLVABLE HOME ASSIGNMENT (H.A.) QUESTIONS

Q.3 Derive an expression for the emf equation of a transformer.

Q.4 Explain the process of finding efficiency using Sumpner's test.

OTHER IMPORTANT QUESTIONS

Q.5 Explain the parallel operation in details. Also describe the various conditions for parallel operations.

Q.6 In what way a practical transformer differs from an ideal transformer. Develop an equivalent circuit for practical transformer.

COLLEGE OF ENGINEERING

TUTORIAL SHEETS

TUTORIAL SHEET

SHEET No. 7A D

Campus: ...P.C.E... Course: B.Tech. Class/Section: III (A&C)....

Date:

Name of Faculty: Dr. Chetan Khemraj Name of Subject: Elec. M/C.

Code: 03EE05

Date of Tut. Sheet Preparation: 23-9-17 Scheduled Date of Tut.: Actual Date of Tut.:

Name of Student: Scheduled & Actual Date of H.A. Submission:&.....

FIRST 20 MT. CLASS QUESTIONS

Q.1: A single phase transformer at unity power factor has an efficiency of 90% at both half load and at full load of 500W. Determine - (i) Iron loss (ii) full load copper loss (iii) efficiency at 75% of full load (iv) Maximum efficiency.

Q.2: Calculate the regulation of a transformer in which the ohmic loss is 1% of the output and the reactance drop is 5% of the voltage, when the load power factor is (i) 0.8 lag (ii) 0.8 leading (iii) unity

2 HRS. SOLVABLE HOME ASSIGNMENT (H.A.) QUESTIONS

Q.3 Define an ideal transformer. Draw and explain the no-load phasor diagram of an ideal single phase transformer.

Q.4 Define voltage regulation of a transformer. Develop an expression for voltage regulation, when (i) lagging pf (ii) leading pf (iii) unity pf.

OTHER IMPORTANT QUESTIONS

Q.5 What are different types of losses in a transformer. Write an expression for efficiency and develop a condition for maximum efficiency.

Q.6 Describe the open circuit and short circuit test with all parameters for calculations.

PEERMA COLLEGE OF ENGINEERING

TUTORIAL SHEETS

TUTORIAL SHEET

Campus: P.C.E. Course: B.Tech SHEET No. 7A.E
 Name of Faculty: Dr. Chetan Khemraj Class/Section: III (A & C) Date:
 Date of Tut. Sheet Preparation: 23-9-17 Name of Subject: Elec. M/C Code: 03EE05
 Scheduled Date of Tut.: Actual Date of Tut.:
 Name of Student: Scheduled & Actual Date of H.A. Submission: &

FIRST 20 MT. CLASS QUESTIONS	<u>Q.1:</u> A single phase transformer at unity power factor has an efficiency of 90% at both half load and at full load of 500W. Determine - (i) Iron loss (ii) full load copper loss (iii) efficiency at 75% of full load (iv) Maximum efficiency. <u>Q.2:</u> Calculate the regulation of a transformer in which the ohmic loss is 1% of the output and the reactance drop is 5% of the voltage, when the load power factor is (i) 0.8 lag (ii) 0.8 leading (iii) unity
2 HRS. SOLVABLE HOME ASSIGNMENT (H.A.) QUESTIONS	<u>Q.3</u> Distinguish between core and shell type transformer. Why is low voltage winding placed near the core? Why core is laminated? <u>Q.4</u> Discuss about the sumpner's back to back test and method to calculate efficiency using it.
OTHER IMPORTANT QUESTIONS	<u>Q.5</u> Explain why parallel operation of a transformer is necessary. Give all conditions for parallel operations. <u>Q.6</u> Describe the constructional features and principle of operations of a single phase transformer.

COLLEGE OF ENGINEERING

TUTORIAL SHEETS

TUTORIAL SHEET

SHEET No. 74 P.

Campus: ... P.C.E. ... Course: B.Tech.

Class/Section: III (A & C)

Name of Faculty: Dr. Chetan Khemraj

Name of Subject: Elec. M/C.

Date:

Date of Tut. Sheet Preparation: 23-9-17

Scheduled Date of Tut.: Actual Date of Tut.:

Code: 03EE05

Name of Student: Scheduled & Actual Date of H.A. Submission: &

FIRST 20 MT. CLASS QUESTIONS	Q.1: A single phase transformer at unity power factor has an efficiency of 90% at both half load and at full load of 500W. Determine - (i) Iron loss (ii) full load copper loss (iii) efficiency at 75% of full load (iv) Maximum efficiency. Q.2: Calculate the regulation of a transformer in which the ohmic loss is 1% of the output and the reactance drop is 5% of the voltage, when the load power factor is (i) 0.8 lag (ii) 0.8 leading (iii) unity
2 HRS. SOLVABLE HOME ASSIGNMENT (H.A.) QUESTIONS	Q.3 Develop the exact equivalent circuit of an transformer. Q.4 Derive the equation of emf and turns ratio for a single phase transformer.
OTHER IMPORTANT QUESTIONS	Q.5 Define voltage regulation. Derive conditions for (i) Zero regulation (ii) Maximum regulation Q.6 Explain the method of finding efficiency using Sumpner's back to back test with suitable diagrams

COLLEGE OF ENGINEERING

TUTORIAL SHEETS

TUTORIAL SHEET

SHEET No. 8ACampus: P.C.E. Course: B.TechClass/Section: A & C

Date:

Name of Faculty: Dr. Chetan ChandraName of Subject: Electrical M/C - ICode: 03EE05Preparation: 23-9-17

Scheduled Date of Tut.: Actual Date of Tut.:

Name of Student: Pooja

Scheduled & Actual Date of H.A. Submission:&.....

FIRST 20 MT. CLASS QUESTIONS

Q.1: A 400/100V, 10KVA, 2 winding transformer is to be employed as an autotransformer to supply a 400V circuit from a 500V source. When tested as a 2 winding transformer at rated load, 0.85 pf lagging its efficiency is 0.97. (i) Determine its KVA ratings as autotransformer (ii) find its efficiency as an auto-transformer.

Q.2: Draw a phasor diagram of transformer supplying load at following power factors
(i) unity pf (ii) lagging pf (iii) leading pf.

2 HRS. SOLVABLE HOME ASSIGNMENT (H.A.) QUESTIONS

Q.3 What is an auto transformer? state its merits and demerits over a conventional transformer. Also give its applications.

Q.4 Discuss about the all day efficiency of transformer.

OTHER IMPORTANT QUESTIONS

Q.5 Explain the welding transformer. Draw its basic circuit diagram and VI curve.

Q.6 Consider a 20KVA, 2200/220V, 50Hz transformer. The OC/SC test results are -

OC test: - 220V, 4.2A, 148W (LV side)

SC test: - 86V, 10.5A, 360W (HV side)

Determine the regulation at 0.8 pf lag and at full load. What is the pf on short circuit?



COLLEGE OF ENGINEERING

TUTORIAL SHEETS

TUTORIAL SHEET

SHEET No. 8.B

Campus: P.C.E. Course: B.Tech

Class/Section: A & C

Date:

Name of Faculty: Dr. Chetan Chandra

Name of Subject: Electrical M/C - I

Code: 03EE05

Date of Tut. Sheet Preparation: 23-9-17

Scheduled Date of Tut.: Actual Date of Tut.:

Name of Student:

Scheduled & Actual Date of H.A. Submission:&.....

FIRST 20 MT. CLASS QUESTIONS

Q.1: A 400/100V, 10KVA, 2 winding transformer is to be employed as an autotransformer to supply a 400V circuit from a 500V source. When tested as a 2 winding transformer at rated load, 0.85 pf lagging its efficiency is 0.97.
i) Determine its KVA ratings as autotransformer ii) find its efficiency as an auto-transformer.

Q.2: Draw a phasor diagram of transformer supplying load at following power factors

i) unity pf ii) lagging pf iii) leading pf.

2 HRS. SOLVABLE HOME ASSIGNMENT (H.A.) QUESTIONS

Q.3 What is an auto transformer. state its merits and demerits over conventional transformer and also state its uses

Q.4 Explain why parallel operations of transformers are necessary.

OTHER IMPORTANT QUESTIONS

Q.5 The efficiency of a 20KVA, 2500/250V single phase transformer at unity pf is 98% at rated load and at half load. Determine the transformer core loss and ohmic loss and the value of equivalent resistance of transformer.

Q.6 Describe the welding transformers in details.

ENGINEERING

TUTORIAL SHEETS

TUTORIAL SHEET

SHEET No. 8.C

Campus: P.C.E. Course: B.Tech Class/Section: A & C Date:
 Name of Faculty: Dr. Chetan Kumar Name of Subject: Electrical M/C - I Code: 03EE05
 Date of Tut. Sheet Preparation: 23-9-17 Scheduled Date of Tut.: Actual Date of Tut.:
 Name of Student: Scheduled & Actual Date of H.A. Submission: &

FIRST 20 MT. CLASS QUESTIONS	<u>Q.1:</u> A 400/100V, 10KVA, 2 winding transformer is to be employed as an autotransformer to supply a 400V circuit from a 500V source. When tested as a 2 winding transformer at rated load, 0.85 pf lagging its efficiency is 0.97. (i) Determine its KVA ratings as autotransformer (ii) find its efficiency as an auto-transformer. <u>Q.2:</u> Draw a phasor diagram of transformer supplying load at following power factors (i) unity pf (ii) lagging pf (iii) leading pf.
2 HRS. SOLVABLE HOME ASSIGNMENT (H.A.) QUESTIONS	<u>Q.3</u> Explain the welding transformer. Draw its basic circuit diagram and VI characteristics. <u>Q.4</u> Explain in details (i) All day efficiency (ii) condition for maximum efficiency
OTHER IMPORTANT QUESTIONS	<u>Q.5</u> The primary and secondary winding of a 40KVA 6600/250V, single phase transformer has resistance of 10Ω and 0.02Ω respectively. The leakage reactance as referred to primary are 35Ω. Find the voltage regulation at full load with 0.8 pf lagging. <u>Q.6</u> Explain in detail the parallel operation of transformers with necessary conditions.

TUTORIAL SHEETS

TUTORIAL SHEET

SHEET No. 80

Campus: P.C.E. Course: B.Tech Class/Section: A & C Date:
 Name of Faculty: Dr. Chetan Kumar Name of Subject: Electrical M/C - I Code: 03EE05
 Date of Tut. Sheet Preparation: 23-9-17 Scheduled Date of Tut.: Actual Date of Tut.:
 Name of Student: Scheduled & Actual Date of H.A. Submission: &

FIRST 20 MT. CLASS QUESTIONS	<u>Q.1:</u> A 400/100V, 10KVA, 2 winding transformer is to be employed as an autotransformer to supply a 400V circuit from a 500V source. When tested as a 2 winding transformer at rated load, 0.85 pf lagging its efficiency is 0.97. (i) Determine its KVA ratings as autotransformer (ii) find its efficiency as an auto-transformer. <u>Q.2:</u> Draw a phasor diagram of transformer supplying load at following power factors (i) unity pf (ii) lagging pf (iii) leading pf
2 HRS. SOLVABLE HOME ASSIGNMENT (H.A.) QUESTIONS	<u>Q.3</u> Explain the parallel operations of transformer with the help of necessary conditions. <u>Q.4</u> Describe the welding transformer with VI curve in details.
OTHER IMPORTANT QUESTIONS	<u>Q.5</u> A 20KVA, 2500/250V, 50Hz transformer has OC test (LV side) - 250V, 1.4A, 105W SC test (HV side) - 104V, 8A, 320W Find all the parameters and also draw the exact equivalent circuit diagram referred to LV side. <u>Q.6</u> Explain following (i) Efficiency (ii) condition for maximum efficiency (iii) All day efficiency (iv) Transformer losses

COLLEGE OF ENGINEERING

TUTORIAL SHEETS

TUTORIAL SHEET

SHEET No. 8E

Campus: P.C.E. Course: B.Tech

Class/Section: A & C

Date:

Name of Faculty: Dr. Chetan Kumar

Name of Subject: Electrical M/C - I

Code: 03EE05

Date of Tut. Sheet Preparation: 23-9-17

Scheduled Date of Tut.: Actual Date of Tut.:

Name of Student:

Scheduled & Actual Date of H.A. Submission: &

FIRST 20 MT. CLASS QUESTIONS

Q.1: A 400/100V, 10KVA, 2 winding transformer is to be employed as an autotransformer to supply a 400V circuit from a 500V source. When tested as a 2 winding transformer at rated load, 0.85 pf lagging its efficiency is 0.97.
 (i) Determine its KVA ratings as autotransformer (ii) find its efficiency as an auto-transformer.

Q.2: Draw a phasor diagram of transformer supplying load at following power factors
 (i) unity pf (ii) lagging pf (iii) leading pf.

Q.3 A single phase transformer has 200 primary and 1200 secondary turns. The net crosssectional area of core is 50 cm². If the primary winding be connected to 50Hz supply at 440V. Calculate the peak value of flux density (ii) secondary induced emf.

Q.4. Define all day efficiency of a transformer.

Q.5 Describe the welding transformer in detail.

Q.6 Discuss about different types of cooling in transformer. Distinguished between the power and distribution transformers.

OTHER IMPORTANT QUESTIONS

COLLEGE OF ENGINEERING

TUTORIAL SHEETS

TUTORIAL SHEET

SHEET No. 8A

Campus: P.C.E. Course: B.Tech

Name of Faculty: Dr. Chetan Chandra Class/Section: A & C

Date:

Date of Tut. Sheet Preparation: 23-9-17 Name of Subject: Electrical M/C - I Code: 03EE05

Scheduled Date of Tut.: Actual Date of Tut.:

Name of Student: Scheduled & Actual Date of H.A. Submission:

FIRST 20 MT. CLASS QUESTIONS

Q.1: A 400/100V, 10KVA, 2 winding transformer is to be employed as an autotransformer to supply a 400V circuit from a 500V source. When tested as a 2 winding transformer at rated load, 0.85 pf lagging its efficiency is 0.97.
 (i) Determine its KVA ratings as autotransformer (ii) find its efficiency as an auto-transformer.
Q.2: Draw a phasor diagram of transformer supplying load at following power factors
 (i) unity pf (ii) lagging pf (iii) leading pf.

2 HRS. SOLVABLE HOME ASSIGNMENT (H.A.) QUESTIONS

Q.3 Explain the welding transformer. Draw its basic circuit and VI characteristics.
Q.4 Describe the parallel operations of transformer using the necessary conditions.

OTHER IMPORTANT QUESTIONS

Q.5: Write short notes on auto-transformer.
Q.6 A 20KVA, 2500/250V, 50Hz, single phase transformer gave following test results.
 Open circuit (LV side) - 250V, 1.4A, 105W
 Short circuit (HV side) - 104V, 8A, 320W
 Calculate all the parameters and hence draw an equivalent circuit referred to LV side.

COLLEGE OF ENGINEERING

TUTORIAL SHEETS

TUTORIAL SHEET

SHEET No. 9ACampus: PCE Course: B.TechClass/Section: III A & C

Date:

Name of Faculty: Dr. Chetan KhemrajName of Subject: Electrical M/C - ICode: 03.EE05

Date of Tut. Sheet Preparation:

Scheduled Date of Tut.:

Actual Date of Tut.:

Name of Student:

Scheduled & Actual Date of H.A. Submission:

&

FIRST 20 MT. CLASS QUESTIONS

Q.1 A 800 kVA, single phase transformer has 98.135% efficiency at full load and 0.8 pf lagging. The efficiency at half load and 0.8 pf lagging is 97.751%. Calculate the iron loss and full load copper loss.

Q.2: A 40 kVA, 1000/200V, single phase transformer has a core loss of 40W and full load copper loss of 50W. Calculate the efficiency at full load and 0.8 pf lagging. Also calculate the maximum efficiency at same power factor.

2 HRS. SOLVABLE HOME ASSIGNMENT (H.A.) QUESTIONS

Q.3 What is the difference between a 3 phase bank of transformer and 3 ϕ transformer unit? What are the advantages of both systems.

Q.4 Explain the various polyphase connection with their distinguishing features.

OTHER IMPORTANT QUESTIONS

Q.5 Explain the open delta connections for polyphase transformers.

Q.6 Explain the double star connection for obtaining phase supply from 3 phase supply.



COLLEGE OF ENGINEERING

TUTORIAL SHEETS

TUTORIAL SHEET

SHEET No. 9B

Campus: PCE Course: B.Tech

Class/Section: III A & C

Date:

Name of Faculty: Dr. Chetan Khosla

Name of Subject: Electrical M/C-I

Code: 03EE05

Date of Tut. Sheet Preparation:

Scheduled Date of Tut.:

Actual Date of Tut.:

Name of Student:

Scheduled & Actual Date of H.A. Submission:

&

FIRST 20 MT. CLASS QUESTIONS

Q.1 A 800kVA, single phase transformer has 98.135% efficiency at full load and 0.8 pf lagging. The efficiency at half load and 0.8 pf lagging is 97.751%. Calculate the iron loss and full load copper loss.

Q.2: A 40kVA, 1000/200V, single phase transformer has a core loss of 40W and full load copper loss of 50W. Calculate the efficiency at full load and 0.8 pf lagging. Also calculate the maximum efficiency at same power factor.

2 HRS. SOLVABLE HOME ASSIGNMENT (H.A.) QUESTIONS

Q.3 Explain the Scott connection with proper circuit diagram.

Q.4 Write short notes on inrush of magnetising current in polyphase transformer.

OTHER IMPORTANT QUESTIONS

Q.5: Describe the V-V connection in details.

Q.6 compare the bank of three single phase transformer and three phase core type transformer.

COLLEGE OF ENGINEERING

TUTORIAL SHEETS

TUTORIAL SHEET

SHEET No. 9C

Campus: PCE Course: B.Tech Class/Section: III A & C Date:
 Name of Faculty: Dr. Chetan Khensay Name of Subject: Electrical M/c - I Code: Q3.EE05
 Date of Tut. Sheet Preparation: Scheduled Date of Tut.: Actual Date of Tut.:
 Name of Student: Scheduled & Actual Date of H.A. Submission: &

FIRST 20 MT. CLASS QUESTIONS	Q.1 A 800kVA, single phase transformer has 98.135% efficiency at full load and 0.8 pf lagging. The efficiency at half load and 0.8 pf lagging is 97.751%. Calculate the iron loss and full load copper loss. Q.2: A 40kVA, 1000/200V, single phase transformer has a core loss of 40W and full load copper loss of 50W. Calculate the efficiency at full load and 0.8 pf lagging. Also calculate the maximum efficiency at same power factor.
2 HRS. SOLVABLE HOME ASSIGNMENT (H.A.) QUESTIONS	Q.3 Explain in detail the double star connection for obtaining phase supply from 3 phase supply. Q.4 Explain open delta connection for poly-phase transformer.
OTHER IMPORTANT QUESTIONS	Q.5 Explain the Scott connection in details. Q.6 write a short note on (Y-d) star-delta connection of a 3phase transformer.

COLLEGE OF ENGINEERING

TUTORIAL SHEETS

TUTORIAL SHEET

SHEET No. 9.D

Course: PCE..... Course: B.Tech..... Class/Section: III A & C..... Date:
 Name of Faculty: Dr. Chetan Khemraj..... Name of Subject: Electrical M/C - I Code: Q3.EE05
 Date of Tut. Sheet Preparation:..... Scheduled Date of Tut.:..... Actual Date of Tut.:
 Name of Student:..... Scheduled & Actual Date of H.A. Submission:.....&.....

FIRST 20 MT. CLASS QUESTIONS	Q.1 A 800kVA, single phase transformer has 98.135% efficiency at full load and 0.8 pf lagging. The efficiency at half load and 0.8 pf lagging is 97.751%. Calculate the iron loss and full load copper loss. Q.2: A 40kVA, 1000/200V, single phase transformer has a core loss of 40W and full load copper loss of 50W. Calculate the efficiency at full load and 0.8 pf lagging. Also calculate the maximum efficiency at same power factor.
2 HRS. SOLVABLE HOME ASSIGNMENT (H.A.) QUESTIONS	Q.3 Explain the use of tertiary windings in a transformer. Q.4 Discuss the open delta connection of a 3 phase transformer.
OTHER IMPORTANT QUESTIONS	Q.5 Discuss the various types of polyphase connections with their uses. Q.6 Explain the scott connection in detail.

TUTORIAL SHEETS

TUTORIAL SHEET

SHEET No. 9E

ampus: PCE Course: B.Tech

Faculty: Dr. Chetan Khemraj

Class/Section: III A & C

Name of Subject: Electrical M/C - I

Date:

Code: Q3.EE05

of Tut. Sheet Preparation:

Scheduled Date of Tut:

Actual Date of Tut:

of Student:

Scheduled & Actual Date of H.A. Submission:

&

FIRST 20 MT. CLASS QUESTIONS

Q.1 A 800 kVA, single phase transformer has 98.135% efficiency at full load and 0.8 pf lagging. The efficiency at half load and 0.8 pf lagging is 97.751%. Calculate the iron loss and full load copper loss.

Q.2: A 40 kVA, 1000/200V, single phase transformer has a core loss of 40W and full load copper loss of 50W. Calculate the efficiency at full load and 0.8 pf lagging. Also calculate the maximum efficiency at same power factor.

2 HRS. SOLVABLE HOME ASSIGNMENT (H.A.) QUESTIONS

Q.3 In a transmission system, the star delta transformer is the HV side while in a distribution system the star side is a LV side. Explain.

Q.4 What is the purpose of a tertiary winding in a polyphase transformer. To what additional use it can be put.

OTHER IMPORTANT QUESTIONS

Q.5 Explain the Scott connection for 3 phase to 2 phase conversion.

Q.6 Compare the bank of three single phase transformers and three phase transformer.

ENGINEERING

TUTORIAL SHEETS

TUTORIAL SHEET

SHEET No. 9A

Campus: PCE..... Course: B.Tech.....

Name of Faculty: Dr. Chelan Khensay

Class/Section: III A & C

Date:

Name of Subject: Electrical M/C - I Code: Q3.EE05

Date of Tut. Sheet Preparation:..... Scheduled Date of Tut.:..... Actual Date of Tut.:

Name of Student:..... Scheduled & Actual Date of H.A. Submission:.....&.....

FIRST 20 MT. CLASS QUESTIONS	Q.1 A 800 kVA, single phase transformer has 98.135% efficiency at full load and 0.8 pf lagging. The efficiency at half load and 0.8 pf lagging is 97.751%. Calculate the iron loss and full load copper loss. Q.2: A 40 kVA, 1000/200V, single phase transformer has a core loss of 40W and full load copper loss of 50W. Calculate the efficiency at full load and 0.8 pf lagging. Also calculate the maximum efficiency at same power factor.
2 HRS. SOLVABLE HOME ASSIGNMENT (H.A.) QUESTIONS	Q.3 Explain in detail the 3 phase to 2 phase conversion using scott connection. Q.4 Explain with neat diagram how to obtain three to six phase conversion.
OTHER IMPORTANT QUESTIONS	Q.5 What is the difference between a 3 phase transformer bank and a 3 phase transformer unit? What are the advantages of a 3 phase unit? Q.6 Write short note on open delta connection.

TUTORIAL SHEETS

TUTORIAL SHEET

SHEET No. 10ACampus: PCE Course: B.Tech Class/Section: III A & C

Date:

Name of Faculty: Dr. Chetan Khemraj Name of Subject: Elect. M/C-1Code: 08EE05

Preparation of Tut. Sheet: Scheduled Date of Tut.: Actual Date of Tut.:

Name of Student: Scheduled & Actual Date of H.A. Submission: &

FIRST 20 MT. CLASS QUESTIONS

- Q.1 An ideal 3 phase delta/star step down transformer delivers power to a balanced load of 120 kVA at 0.8 pf. The input line voltage is 11kV and the turns ratio of the transformer, phase to phase is 10. Determine the line voltage, line currents, phase voltages and phase currents on both primary and secondary side.
- Q.2 A 40kVA, 1 ϕ transformer has 200 turns on primary and 60 turns on secondary. The primary is connected to 1000V, 50Hz supply. Determine the secondary voltage on open circuit and current flowing in two windings?

ASSIGNMENT (H.A.) QUESTIONS

- Q.3 Explain with neat diagrams how to obtain three to six phase conversion.
- Q.4 Write in short the effect of a 3 phase windings connections on harmonics in case of polyphase transformers.

OTHER IMPORTANT QUESTIONS

- Q.5 Why do electric arc furnaces use a 2 phase supply and how is such supply arranged?
- Q.6 With the help of connection diagram the diametrical connection of 3 phase to six phase conversion.

COLLEGE OF ENGINEERING

TUTORIAL SHEETS

TUTORIAL SHEET

SHEET No. 10B

ampus: ...PCE... Course: B.Tech... Class/Section: III A&C

ie of Faculty: Dr. Chetan Khemra Name of Subject: Elect. M/C-1

Date:

Code: 08EE05

of Tut. Sheet Preparation:..... Scheduled Date of Tut.:..... Actual Date of Tut. :.....

e of Student:..... Scheduled & Actual Date of H.A. Submission:.....&.....

FIRST 20 MT. CLASS QUESTIONS

Q.1 An ideal 3 phase delta/star step down transformer delivers power to a balanced load of 120 kVA at 0.8 pf. The input line voltage is 11kV and the turns ratio of the transformer, phase to phase is 10. Determine the line voltage, line currents, phase voltages and phase currents on both primary and secondary side.

Q.2 A 40kVA, 1 ϕ transformer has 200 turns on primary and 60 turns on secondary. The primary is connected to 1000V, 50Hz supply. Determine the secondary voltage on open circuit and current flowing in two windings?

2 HRS. SOLVABLE HOME ASSIGNMENT (H.A.) QUESTIONS

Q.3 Why do electric arc furnaces use a 2 phase supply and how is this supply arranged?

Q.4 Explain the parallel operations of three phase transformers. Also list the conditions for parallel operation.

OTHER IMPORTANT QUESTIONS

Q.5 Write short notes on
(a) Switching current in transformer
(b) Magnetizing inrush current in transformer.

Q.6 What are the advantages and disadvantages of a 3 phase transformer.

TUTORIAL SHEETS

TUTORIAL SHEET

SHEET No. 10C

Institution: PCE Course: B.Tech

Class/Section: III A & C

Name of Faculty: Dr. Chetan Khemrao

Name of Subject: Elect. M/C-1

Date:

Code: 08EE05

Preparation of Tut. Sheet

Scheduled Date of Tut.:

Actual Date of Tut.:

Name of Student:

Scheduled & Actual Date of H.A. Submission:

&

FIRST 20 MT. CLASS QUESTIONS

Q.1 An ideal 3 phase delta/star step down transformer delivers power to a balanced load of 120 kVA at 0.8 pf. The input line voltage is 11kV and the turns ratio of the transformer, phase to phase is 10. Determine the line voltage, line currents, phase voltages and phase currents on both primary and secondary side.

Q.2 A 40kVA, 1 ϕ transformer has 200 turns on primary and 60 turns on secondary. The primary is connected to 1000V, 50Hz supply. Determine the secondary voltage on open circuit and current flowing in two windings?

2 HRS. SOLVABLE HOME ASSIGNMENT (H.A.) QUESTIONS

Q.3 Explain with neat diagram the method of a 3 phase to six phase conversion.

Q.4 What is a tertiary winding? How stabilisation can be achieved by using tertiary windings?

OTHER IMPORTANT QUESTIONS

Q.5 Explain the parallel operations in case of 3 phase transformers along various conditions to apply.

Q.6 Why do electric arc furnaces use a 2 phase supply and how is such supply arranged?

TUTORIAL SHEETS

TUTORIAL SHEET

SHEET No. 100

Student: PCE Course: B.Tech

Class/Section: III A & C

Date:

Faculty: Dr. Chetan Khemrao

Name of Subject: Elect. M/C-I

Code: 08.EE05

Preparation of Tut. Sheet:

Scheduled Date of Tut.: Actual Date of Tut.:

Signature of Student:

Scheduled & Actual Date of H.A. Submission:&.....

FIRST 20 MT. CLASS QUESTIONS

Q.1 An ideal 3 phase delta/star step down transformer delivers power to a balanced load of 120 kVA at 0.8 pf. The input line voltage is 11 kV and the turns ratio of the transformer, phase to phase is 10. Determine the line voltage, line currents, phase voltages and phase currents on both primary and secondary side.

Q.2 A 40 kVA, 1 ϕ transformer has 200 turns on primary and 60 turns on secondary. The primary is connected to 1000V, 50 Hz supply. Determine the secondary voltage on open circuit and current flowing in two windings?

Q.3 What is a tertiary winding?

How stabilisation can be achieved by using tertiary winding.

Q.4 With the help of connection and phasor diagram discuss the star-delta connection of 3 phase transformer.

ASSIGNMENT (H.A.) QUESTIONS

Q.5 Explain -

(a) Switching current,

(b) Magnetising inrush current,

OTHER IMPORTANT QUESTIONS

Q.6 Explain the method of parallel operations of three phase transformers with its conditions

TUTORIAL SHEETS

TUTORIAL SHEET

SHEET No. 10 E

ampus: ...PCE... Course: B.Tech.

Class/Section: III A & C

Date:

e of Faculty: Dr. Chetan Khemrao

Name of Subject: Elect. M/C-1

Code: 08EE05

of Tut. Sheet Preparation:

Scheduled Date of Tut.:

Actual Date of Tut.:

e of Student:

Scheduled & Actual Date of H.A. Submission:

&

FIRST 20 MT. CLASS QUESTIONS

Q.1 An ideal 3 phase delta/star step down transformer delivers power to a balanced load of 120 kVA. at 0.8 pf. The input line voltage is 11kV and the turns ratio of the transformer, phase to phase is 10. Determine the line voltage, line currents, phase voltages and phase currents on both primary and secondary side.

Q.2 A 40kVA, 1 ϕ transformer has 200 turns on primary and 60 turns on secondary. The primary is connected to 1000V, 50Hz supply. Determine the secondary voltage on open circuit and current flowing in two windings?

Q.3 Write short notes on

(i) Excitation phenomena of transformers

(ii) switching current in transformers

Q.4 Why do electric arc furnaces use a 2 phase supply and how is such supply arranged.

OTHER IMPORTANT QUESTIONS

Q.5 What is the magnetising current in a transformer? explain.

Q.6 Explain the parallel operation of a 3 phase transformer. list the conditions for parallel operations.

COLLEGE OF ENGINEERING

TUTORIAL SHEETS

TUTORIAL SHEET

SHEET No. 10F

Campus: PCE Course: B.Tech

Class/Section: III A & C

Date:

Name of Faculty: Dr. Chetan Khemrao

Name of Subject: Elect. M/C-1

Code: 08.EE05

Date of Tut. Sheet Preparation:

Scheduled Date of Tut.: Actual Date of Tut.:

Name of Student:

Scheduled & Actual Date of H.A. Submission:&.....

FIRST 20 MT. CLASS QUESTIONS	Q.1 An ideal 3 phase delta/star step down transformer delivers power to a balanced load of 120 kVA. at 0.8 pf. The input line voltage is 11kV and the turns ratio of the transformer, phase to phase is 10. Determine the line voltage, line currents, phase voltages and phase currents on both primary and secondary side. Q.2 A 40kVA, 1ϕ transformer has 200 turns on primary and 80 turns on secondary. The primary is connected to 1000V, 50Hz supply. Determine the secondary voltage on open circuit and current flowing in two windings?
2 HRS. SOLVABLE HOME ASSIGNMENT (H.A.) QUESTIONS	Q.3 Explain how to obtain six phase double delta transformation. Q.4 Explain the parallel operations of 3 phase transformers with necessary conditions.
OTHER IMPORTANT QUESTIONS	Q.5 Why do electric arc furnaces use a 2 phase supply and how is such supply arranged? Q.6 Explain (i) the switching current (ii) the magnetising rush current

TEST PAPER

UNIT-1 : MAGNETIC CIRCUITS

ELECTRICAL MACHINES-I, (3 EEO5)

III sem sec A & C

- Q.1 Give an analogy between electric and magnetic circuits in details.
- Q.2 Define leakage flux. How it is useful for the electrical machines concepts.
- Q.3 Explain the energy storage in the magnetic field.
- Q.4 Area of a hysteresis loop is 100 cm^2 with a scale on X axis $1 \text{ cm} \equiv 1000 \text{ AT}$, on Y axis as $1 \text{ cm} \equiv 30 \text{ mWb/m}^2$, the density of the given material is 7.8 g/cm^3 and the mass is 1 kg of the material.

If the frequency is 50 Hz , find the hysteresis loss in watts.

3E1645

Roll No. _____

Total No of Pages: 4

3E1645

B. Tech. III Sem. (Main / Back) Exam., Feb. 2015

Electrical & Electronic Engineering

3EX5A Electrical Machines - I

EE, EX

Time: 3 Hours

Maximum Marks: 80

Min. Passing Marks:

Main: 26

Back: 24

Instructions to Candidates:

Attempt any **five questions**, selecting **one question** from **each unit**. All questions carry **equal** marks. Schematic diagrams must be shown wherever necessary. Any data you feel missing suitably be assumed and stated clearly.

Units of quantities used/calculated must be stated clearly.

Use of following supporting material is permitted during examination.

(Mentioned in form No.205)

1. NIL

2. NIL

UNIT - I

Q. 1 (a) Explain the phenomenon of energy balance. Derive an expression for energy stored in magnetic circuit. [8]

(b) Discuss permanent magnets and their applications. [8]

OR

Q. 1 (a) With help of a suitable diagram explain hysteresis and eddy-current losses as applied to magnetic material. [8]

[3E1645]

Page 1 of 4

[15120]

- (b) The flux in a magnetic core is alternating sinusoidally at a frequency of 600Hz. The maximum flux density is 2T and the eddy-current loss is 15W. Find the eddy-current loss in the core if frequency is raised to 800Hz and the maximum flux density is reduced to 1.5 T. [8]

UNIT – II

- Q. 2 (a) Obtain EMF equation for a DC machine. [8]
- (b) Explain armature reaction process. [8]

OR

- Q. 2 (a) Explain the meaning and significance of the critical field resistance of a shunt generator. [4]
- (b) State the condition which determines if a DC machine is in generating or motoring mode. [4]
- (c) Draw the power flow diagram of a DC generator. Also discuss the condition for maximum efficiency. [8]

UNIT – III

- Q. 3 (a) Sketch the speed-torque characteristic method of speed control of a DC series motor. [8]
- (b) Enumerate and classify the losses in a DC shunt motor. [8]

OR

- Q. 3 (a) Explain different methods of braking of DC motors. [8]

- (b) A DC Shunt motor has speed control range of 1600 rpm to 400 rpm by rheostatic control. All losses and armature reaction effect may be neglected.
- The motor drives a constant power load. It has a speed of 1600 rpm drawing 120A armature current. What would be the armature current at 400 rpm?
 - Repeat part
 - If load is constant torque.
- (c) Repeat parts (a) and (b) if speed is controlled by armature voltage. [8]

UNIT – IV

- Q. 4 (a) Justify that under SC test the core losses are negligible. [4]
- (b) Discuss back – to – back (Sumpner's test) test on single – phase transformers. [4]
- (c) A transformer has its maximum efficiency of 0.98 at 15 kVA at upf. Compare its all – day efficiencies for the following load cycles: [8]
- Full load of 20kVA 12 hours/day and no-load rest of the day.
 - Full load 4 hours/day and 0.4 full load rest of the day.

Assume the load to operate on upf all day.

OR

- Q. 4 (a) Draw and explain the idea of a welding transformer. [8]
- (b) A 500 kVA transformer has an efficiency of 98% at full load and also at 65% full load: both at 0.7 Pf lagging.
- Separate out the losses of transformer
 - Determine the efficiency of transformer at $\frac{3}{4}$ th full load. [8]

UNIT – V

- Q. 5 (a) Discuss following with respect to three – phase transformers: [8]
- (i) Open delta connection
 - (ii) Scott connection
- (b) Explain parallel operations of three - phase transformers. Also list the conditions to be met for successful parallel operation [8]

OR

- Q. 5 Write notes on any two of the following: [8+8=16]
- (a) Excitation phenomenon of transformers .
 - (b) Switching currents in transformers
 - (c) Magnetizing inrush current in transformers.

-----X-----X-----

3E1484

Roll No. : _____

Total Printed Pages : **4**

3E1484

B. Tech. (Sem. III) (Main & Back) Examination, January - 2013

Electrical Engg.

3EE4 Electrical Machines - I

Time : 3 Hours]

[Total Marks : **80**

[Min. Passing Marks : **24**

Attempt any five questions, selecting one question from each unit. All questions carry equal marks. Schematic diagrams must be shown wherever necessary. Any data you feel missing suitably be assumed and stated clearly.

Units of quantities used/calculated must be stated clearly.

Use of following supporting material is permitted during examination.

(Mentioned in form No. 205)

1. Nil

2. Nil

UNIT - I

- 1 (a) Draw a schematic diagram indicating flow of energy in the conversion of mechanical energy to electrical energy. 6
- (b) Define leakage flux. Explain that how does it take part in electromagnetic energy conversion process via the magnetic field. 6
- (c) The area of the hysteresis loop of the given magnetic material is 50 cm^2 with the two axes scaled as $1 \text{ cm} = 20 \text{ AT}$ and $1 \text{ cm} = 50 \text{ m Wb}$, for 50 Hz frequency find the total hysteresis loss. 4

OR

- 1 Describe the principle of energy conversion. Show that the reaction of coupling magnetic field on the electrical or mechanical system is essential for the electro-mechanical energy conversion. 16

3E1484]



1

[Contd...

UNIT - II

- 2 (a) List and explain the factors involved in the voltage build up of short generator.

4

- (b) Explain the role/purpose of the dummy coils in the DC machine winding.

2

- (c) In a 110 V compound generator, the armature shunt and series winding resistances are 0.06Ω , 25Ω and 0.04Ω respectively. The load consists of 200 lamps each rated 55 W, 110 V connected in parallel. Find the total emf and armature current, when the machine is connected for :

- (i) Long shunt
(ii) Short shunt

Ignore the armature reaction and brush drop.

10

OR

- 2 (a) Derive the expression for generated emf in a dc generator.

8

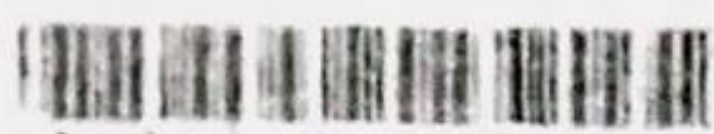
- (b) An 8 pole dc generator has 500 armature conductors and has a useful flux per pole of 0.065 web. What will be the emf generated if it is lap connected and runs at 1000 rpm? What must be the speed at which it is to be driven to produce the same emf if it is wave wound?

8

UNIT - III

- 3 (a) How do hysteresis, eddy current friction and windage losses depend upon the motor speed.

8



- (b) A 3 kW series motor runs normally at 800 RPM on a 240 V supply taking 16A; the field coils are connected in series. Estimate the speed and the current taken by the motor, if the coils are reconnected in two parallel groups of two in series. The load torque increases on the square of the speed.

8

OR

- 3 Explain the Hopkinson's method of testing of the dc machines. Differentiate this method with the Swinburne's method of testing of the dc machines. Can the Swinburne's method of testing of the dc machine be applied on dc series machine ? Explain whichever is the answer.

16

UNIT - IV

- 4 In what way a practical transformer differs from an ideal transformer? Develop an equivalent circuit for the practical transformer.

16

OR

- 4 (a) Explain the process of finding the efficiency of a transformer by Sumpner's test.

8

- (b) A single phase transformer working at unity power factor has an efficiency of 90% at both half load and at the full load of 500 W. Determine :

- (i) Iron loss
- (ii) Full load copper loss
- (iii) Efficiency at 75% of full load
- (iv) Maximum efficiency.

8

UNIT - V

- 5 (a) With the help of circuit and phasor diagram explain the 3 phase to 6 phase transformation using double star transformation method. What are their relative merits and demerits ?

8

(b) Write short note on open delta connection.

8

OR

5 (a) Compare Bank of three single phase transformers and three phase core type transformer.

8

(b) Explain scott connection for 3 phase to 2 phase conversion and show that the primary neutral divides the teaser primary winding in the ratio 2:1.

8



FIRST MID TERM EXAMINATION 2014-15
3EE05A – ELECTRICAL MACHINES-I
BRANCH – ELECTRICAL ENGINEERING

Max. Time: 2 hrs.

Max. Marks: 40

NOTE:- Attempt all four questions. There is internal choice in Q. 1 & 2, Q. 3 & 4, Q. 5 & 6, Q. 7 & 8.

- Q.1. (a) Describe the principle of energy conversion. Show that the reaction of coupling magnetic field on the electrical or mechanical system is essential for the electro-mechanical energy conversion. (6)
- (b) Define field energy and co-energy. Prove that field energy and co-energy in a linear magnetic system are given by identical expressions. (4)
- OR**
- Q.2. (a) Why most practical energy conversion devices use magnetic field as the coupling medium between electrical and mechanical systems? (6)
- (b) A toroid coil having 500 turns, average radius 10 cm and cross sectional radius of 2 cm. If the relative permeability is 1500, find the current required to establish a flux density of 0.5T. (4)
- Q.3. (a) What is commutation process? How we can improve the commutation by different methods in DC generator. Explain it. (6)
- (b) In a 110V compound generator, the armature, shunt and series winding resistance are 0.6Ω , 25Ω and 0.04Ω respectively. The load consists of 200 lamps each rated 55 KW. 110V connected in parallel. Find the total emf and armature current when the machine is connected for- (4)
- (i) Long Shunt (ii) Short Shunt
- OR**
- Q.4. (a) Draw the various characteristics of shunt and series DC generator. (6)
- (b) An 8 pole dc generator has 500 armature conductors and has a useful flux per pole of 0.065 wb. What will be the emf generated if it is lap connected and runs at 1000 rpm? What must be the speed at which it is to be driven to produce the same emf if it is wave wound? (4)
- Q.5. (a) Explain the different electrical braking techniques for DC motor and write advantages for mechanical braking over electrical braking. (6)
- (b) A shunt motor takes a total current of 20 A from 250 V supply. The shunt field and armature resistance are 200Ω and 0.3Ω respectively. Determine the – (4)
- (i) Value of Back emf and.
- (ii) Mechanical power developed in the motor armature.
- OR**
- Q.6. (a) Explain the Hopkinson's method of testing of the dc machine. Can the swinburnes method of testing of the dc machine be applied on dc series machine? Explain whichever the answer is. (6)
- (b) A 230V dc shunt motor has an armature resistance of 0.5Ω and field resistance of 115Ω . At no load, the speed is 1200 RPM and the armature current 2.5A. On application of rated load the speed drops to 1120 RPM. Determine the line current and power input when the motor delivers rated load. (4)
- Q.7. (a) Draw a neat sketch of dc generator with name of each part. Drive an equation for emf induced in a dc generator. (6)
- (b) A shunt generator of terminal voltage 220v delivers a current of 250 A to the load. The shunt field and armature resistance are 50Ω and 0.02Ω . Respectively calculate the generated voltage. (4)
- OR**
- Q.8. (a) What is meant by back emf in a dc motor? Derive the equation for torque produced in dc motor. (6)
- (b) Explain technical short notes on: (4)
- (i) Armature Reaction
- (ii) Lap & Wave winding
- (iii) Dummy coil & Equalizer Rings
- (iv) Interpoles
- (v) Compensating Windings

3E1645

B.Tech. (Sem.III) (Main/Back) Examination-2014
Electrical Engineering
3EE5 Electrical Machines-I

Time : 3 Hours]

[Total Marks : 80
 [Min. Passing Marks : 24

Instructions to Candidates :

Attempt any five questions, selecting one question from each unit. All questions carry equal marks. Schematic diagrams must be shown wherever necessary. Any data you feel missing suitably be assumed and stated clearly. Units of quantities used/calculated must be stated clearly.

UNIT - I

1. (a) The length of air - core coil is 25cm and has a cross sectional area of 4 cm^2 . The coil is wound by 65 turns. Determine the inductance of the coil. (4)
- (b) Briefly explain the physical phenomenon involved in energy conversion. (12)

OR

1. (a) A conductor carries a current of 150A. The length of the conductor is 2m and is placed in a magnetic field whose magnetic flux density is 0.35T. Determine the force. (4)
- (b) Discuss the energy stored in magnetic field in detail. (12)

UNIT - II

2. (a) A shunt generator of terminal voltage 220V delivers a current of 250A to the load. The shunt field and armature resistance are 50Ω and 0.02Ω respectively. Calculate the generated voltage. (6)
- (b) Draw the various characteristics of shunt and series DC generators. (10)

OR

2. (a) A 6 pole lap-wound dc generator has 600 conductors in its armature. The flux per pole is 0.05 wb. Calculate generated voltage when the speed of the generator is 1000 rpm. Also find the electromagnetic torque if the generator supplies a current of 120A. (4)
- (b) How we can improve the commutation by different methods in DC generators explain it. (12)

UNIT - III

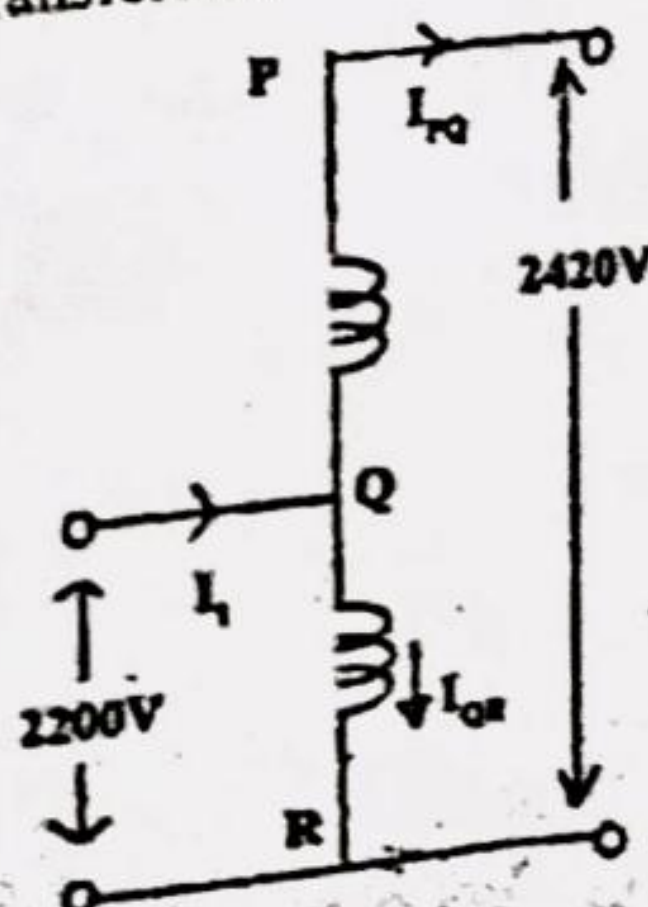
3. (a) A shunt motor takes a total current of 20A from 250V supply. The shunt field and armature resistance are 200Ω and 0.3Ω respectively. Determine the
 (i) Value of back emf and (8)
 (ii) Mechanical power developed in the motor armature. (8)
- (b) Elaborate the swinburne test with neat circuit diagram. (8)

OR

3. (a) A shunt motor has an armature circuit resistance of 0.7Ω and applied voltage 240V. The no-load and full load armature current is 5A and 30A respectively. Determine the change in back emf from no load to full load. (6)
- (b) Explain the different electric braking techniques for DC motor. (10)

UNIT - IV

4. (a) A single-phase 120KVA, 2200/220V transformer is connected as an autotransformer which is shown in figure. At the secondary, more than 2200V is obtained as an output. The upper portion coil voltage is 220V and lower portion coil voltage is 2200V. Find out the KVA rating of the autotransformer. (10)



(b) What is welding transformer?

OR

(a) Two transformer of 200KVA and 20KVA are connected in parallel and having the impedances of $Z_1 = 2 + j3\Omega$ and $Z_2 = 1.5 + j4\Omega$. Determine the load shared by each when the total load of 120kW at 0.6 power factor lagging.

(b) How the losses can be separate for the transformer?

UNIT - V

(a) With neat circuit diagram, explain the open delta connection in poly phase transformer.

(b) Briefly explain the magnetizing harmonic currents and their effects in transformer.

OR

(a) Explain the Scott connection with proper circuit diagram.

(b) Write short note on inrush of magnetizing current in poly phase transformer.

B.Tech. (Sem.III) (Main/Back) Examination, 2015
Electrical Engineering
3EE5 Electrical Machines-I

Time : 3 Hours]

[Total Marks : 80

[Min. Passing Marks : 26

Instructions to Candidates :

Attempt any five questions, selecting one question from each unit. All questions carry equal marks. Schematic diagrams must be shown wherever necessary. Any data you feel missing suitably be assumed and stated clearly. Units of quantities used/calculated must be stated clearly.

1. (a) Explain the phenomenon of energy balance. Derive an expression for energy stored in magnetic circuit.
 (b) Discuss permanent magnets and their applications.

UNIT - I

1. (a) With help of a suitable diagram explain hysteresis and eddy-current losses as applied to magnetic material.
 (b) The flux in a magnetic core is alternating sinusoidally at a frequency of 600Hz. The maximum flux density is 2T and the ed current loss is 15W. Find the eddy-current loss in the core if frequency is raised to 800Hz and the maximum flux density reduced to 1.5T.

OR

2. (a) Obtain EMF equation for a DC machine.
 (b) Explain armature reaction process.

UNIT - II

2. (a) Explain the meaning and significance of the critical field resistance of a shunt generator.
 (b) State the condition which determines if a DC machine is in generating or motoring mode.
 (c) Draw the power flow diagram of a DC generator. Also discuss the condition for maximum efficiency.

OR

3. (a) Sketch the speed-torque characteristics method of speed control of a DC series motor.
 (b) Enumerate and classify the losses in a DC shunt motor.

UNIT - III

3. (a) Explain different methods of braking of DC motors.
 (b) A DC shunt motor has speed control range of 1600 rpm to 400 rpm by rheostatic control. All losses and armature reaction effect may be neglected.
 (i) The motor drives a constant power load. It has a speed of 1600 rpm drawing 120 A armature current. What would be armature current at 400 rpm?
 (ii) Repeat part
 (iii) If load is constant torque.
 (c) Repeat parts (a) and (b) if speed is controlled by armature voltage.

OR

- (a) Justify that under SC test the core losses are negligible.

UNIT - IV

- (b) Discuss back-to-back (Sumpner's test) test on single-phase transformers. (4)
 (c) A transformer has its maximum efficiency of 0.98 at 15 kVA at upf. Compare its all day efficiencies for the following load cycles: (8)
 (i) Full load of 20 kVA 12 hours/day and no-load rest of the day.
 (ii) Full load 4 hours/day and 0.4 full load rest of the day.
 Assume the load to operate on upf all day.

OR

4. (a) Draw and explain the idea of a welding transformer. (8)
 (b) A 500 kVA transformer has an efficiency of 98% at full load and also at 65% full load; both at 0.7 Pf lagging.
 (i) Separate out the losses of transformer
 (ii) Determine the efficiency of transformer at $3/4^{\text{th}}$ full load. (8)

UNIT - V

5. (a) Discuss following with respect to three-phase transformers: (8)
 (i) Open delta connection (ii) Scott connection
 (b) Explain parallel operations of three-phase transformers. Also list the conditions to be met for successful parallel operation. (8)

OR

5. Write notes on any two of the following : (8 + 8 = 16)
 (a) Excitation phenomenon of transformers
 (b) Switching currents in transformers
 (c) Magnetizing inrush current in transformers.

□□□

3E1645

Roll No.

3E1645

[Total No. of Pages : 3]

B.Tech .III Semester (Main/Back) Examination -2014

Electrical Engineering

3EE5A Electrical Machines-I

Time : 3 Hours

Maximum Marks : 80

Min. Passing Marks : 24

Instructions to Candidates:

*Attempt any **five** questions, selecting **one** question from each **unit**. All questions carry **equal** marks. (Schematic diagrams must be shown wherever necessary. Any data you feel missing suitably be assumed and stated clearly. Units of quantities used/calculated must be stated clearly.)*

Unit - I

1. a) The length of air - core coil is 25cm and has a cross sectional area of 4 cm². The coil is wound by 65 turns. Determine the inductance of the coil (4)
- b) Briefly explain the physical phenomenon involved in energy conversion (12)

OR

1. a) A conductor carries a current of 150A. The length of the conductor is 2m and is placed in a magnetic field whose magnetic flux density is 0.35T. Determine the force (4)
- b) Discuss the energy stored in magnetic field in detail. (12)

Unit - II

2. a) A shunt generator of terminal voltage 220V delivers a current of 250A to the load. The shunt field and armature resistance are 50Ω and 0.02Ω respectively. Calculate the generated voltage. (6)
- b) Draw the various characteristics of shunt and series DC generators. (10)

OR

2. a) A 6 pole lap-wound dc generator has 600 conductors on its armature. The flux per pole is 0.05 wb. Calculate generated voltage when the speed of the generator is 1000 rpm. Also find the electromagnetic torque if the generator supplies a current of 120A. (4)
- b) How we can improve the commutation by different methods in DC generators explain it. (12)

Unit - III

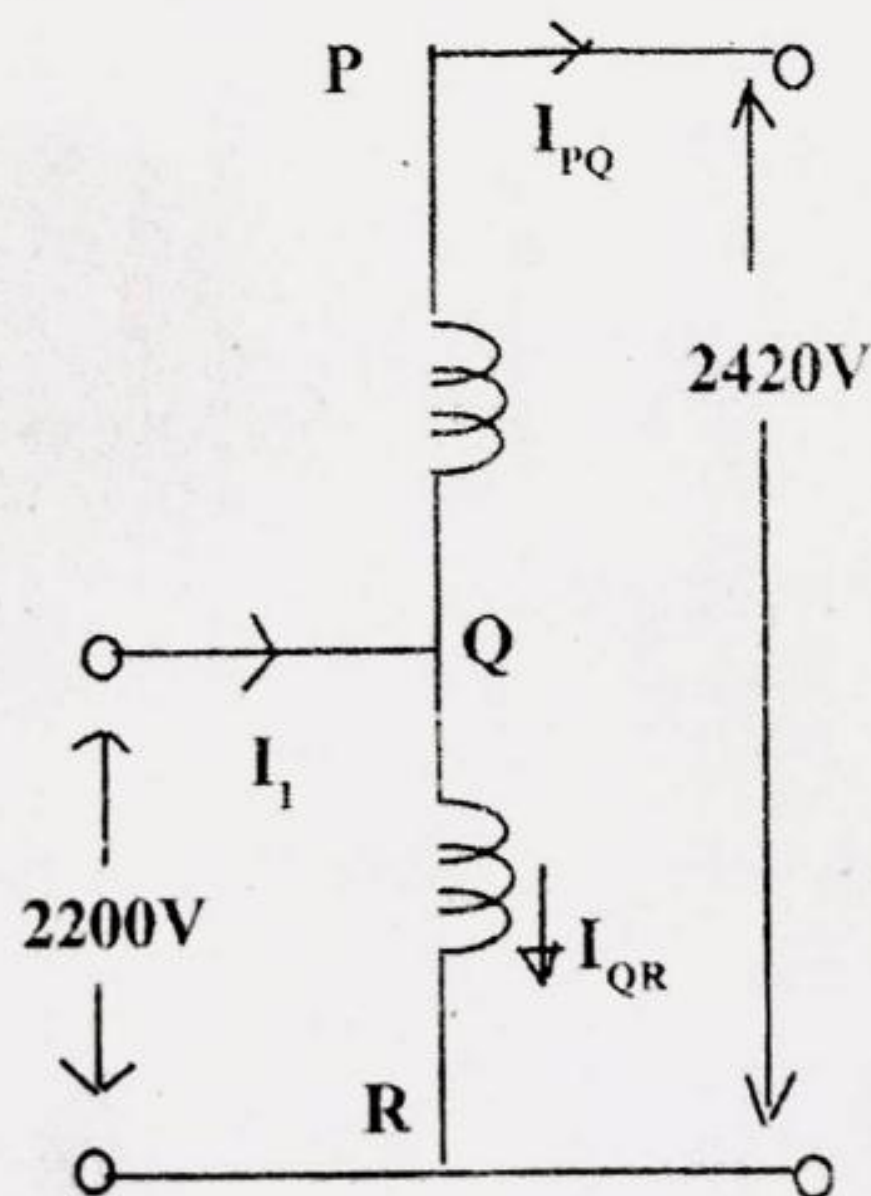
3. a) A shunt motor takes a total current of 20A from 250V supply. The shunt field and armature resistance are 200Ω and 0.3Ω respectively. Determine the
- i) value of back emf and
- ii) mechanical power developed in the motor armature (8)
- b) Elaborate the swinburne test with neat circuit diagram (8)

OR

3. a) A shunt motor has an armature circuit resistance of 0.7Ω and applied voltage 240V. The no-load and full load armature current is 5A and 30A respectively. Determine the change in back emf from no load to full load (6)
- b) Explain the different electric braking techniques for DC motor. (10)

Unit - IV

4. a) A single-phase 120 KVA, 2200/220V transformer is connected as an autotransformer which shown in figure(1). At the secondary, more than 2200V is obtained as an output. The upper portion coil voltage is 220V and lower portion coil voltage is 2200V. Find out the KVA rating of the autotransformer. (10)



Figure(1)

b) What is welding transformer?

(6)

OR

4. a) Two transformer of 200KVA and 20KVA are connected in parallel and having the impedances of $Z_1 = 2 + j3 \Omega$ and $Z_2 = 1.5 + j4 \Omega$. Determine the load shared by each when the total load of 120 kW at 0.6 power factor lagging

(8)

b) How the losses can be separate for the transformer?

(8)

Unit - V

5. a) With neat circuit diagram, explain the open delta connection in poly phase transformer.

(8)

b) Briefly explain the magnetizing harmonic currents and their effects in transformer

(8)

OR

5. a) Explain the Scott connection with proper circuit diagram

(8)

b) Write short note on inrush of magnetizing current in poly phase transformer

(8)

3E1484

Roll No. : _____

Total Printed Pages : **4**

3E1484

B. Tech. (Sem. III) (Main & Back) Examination, January - 2013
Electrical Engg.

3EE4 Electrical Machines - I

Time : 3 Hours]

[Total Marks : **80**

[Min. Passing Marks : **24**

Attempt any five questions, selecting one question from each unit. All questions carry equal marks. Schematic diagrams must be shown wherever necessary. Any data you feel missing suitably be assumed and stated clearly. Units of quantities used/calculated must be stated clearly.

Use of following supporting material is permitted during examination.
(Mentioned in form No. 205)

1. _____ Nil _____

2. _____ Nil _____

UNIT - I

- 1 (a) Draw a schematic diagram indicating flow of energy in the conversion of mechanical energy to electrical energy. 6
- (b) Define leakage flux. Explain that how does it take part in electromagnetic energy conversion process via the magnetic field. 6
- (c) The area of the hysteresis loop of the given magnetic material is 50 cm^2 with the two axes scaled as $1 \text{ cm} = 20 \text{ AT}$ and $1 \text{ cm} = 50 \text{ m Wb}$, for 50 Hz frequency find the total hysteresis loss. 4

OR

- 1 Describe the principle of energy conversion. Show that the reaction of coupling magnetic field on the electrical or mechanical system is essential for the electro-mechanical energy conversion. 16

3E1484]



1

[Contd...

UNIT - II

- 2 (a) List and explain the factors involved in the voltage build up of short generator. 4
- (b) Explain the role/purpose of the dummy coils in the DC machine winding. 2
- (c) In a 110 V compound generator, the armature shunt and series winding resistances are $.06 \Omega$, 25Ω and $.04 \Omega$ respectively. The load consists of 200 lamps each rated 55 W, 110 V connected in parallel. Find the total emf and armature current, when the machine is connected for :
- (i) Long shunt
- (ii) Short shunt
- Ignore the armature reaction and brush drop.

10

OR

- 2 (a) Derive the expression for generated emf in a dc generator. 8
- (b) An 8 pole dc generator has 500 armature conductors and has a useful flux per pole of $.065$ web. What will be the emf generated if it is lap connected and runs at 1000 rpm? What must be the speed at which it is to be driven to produce the same emf if it is wave wound?

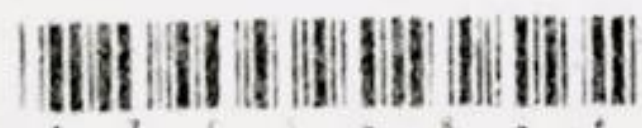
8

UNIT - III

- 3 (a) How do hysteresis, eddy current friction and windage losses depend upon the motor speed.

8

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2

[Contd...

- (b) A 3 kW series motor runs normally at 800 RPM on a 240 V supply taking 16A; the field coils are connected in series. Estimate the speed and the current taken by the motor, if the coils are reconnected in two parallel groups of two in series. The load torque increases on the square of the speed.

8

OR

- 3 Explain the Hopkinson's method of testing of the dc machines. Differentiate this method with the Swinburne's method of testing of the dc machines. Can the Swinburnes method of testing of the dc machine be applied on dc series machine ? Explain whichever is the answer.

16

UNIT - IV

- 4 In what way a practical transformer differs from an ideal transformer? Develop an equivalent circuit for the practical transformer.

16

OR

- 4 (a) Explain the process of finding the efficiency of a transformer by Sumpner's test.

8

- (b) A single phase transformer working at unity power factor has an efficiency of 90% at both half load and at the full load of 500 W. Determine :

- (i) Iron loss
- (ii) Full load copper loss
- (iii) Efficiency at 75% of full load
- (iv) Maximum efficiency.

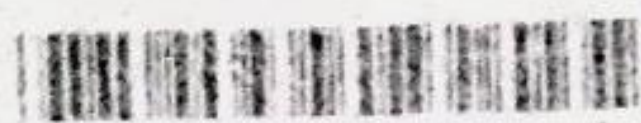
8

UNIT - V

- 5 (a) With the help of circuit and phasor diagram explain the 3 phase to 6 phase transformation using double star transformation method. What are their relative merits and demerits ?

8

3E1484]



3

[Contd...

(b) Write short note on open delta connection.

8

OR

5 (a) Compare Bank of three single phase transformers and three phase core type transformer.

8

(b) Explain scott connection for 3 phase to 2 phase conversion and show that the primary neutral divides the teaser primary winding in the ratio 2:1.

8

OR

- Q.1 (a) Derive the expression of torque developed in closely excited magnetic system. [8]
Clearly explain the assumptions made.
- (b) Two coils with self inductance $1H$ and $4H$ have a mutual inductance of $1H$. The RMS value of current flowing in the two coils is $4A$ and $1A$ respectively. [8]
Find-
- (i) The coupling factor
 - (ii) The energy stored in magnetic system

UNIT-II

- Q.2 Write short note on commutation in DC machine. Discuss the method of improving commutation? [16]

OR

- Q.2 What are the different types of dc generators according to the ways in which fields are excited? Show the connection diagram of each type. [16]

UNIT-III

- Q.3 Explain the Hopkinson's Method of testing of the dc machines. Differentiate this model with the Swinburne's method of testing of the dc machines. Can the Swinburne's method of testing of the dc machines be applied on dc series machines? [16]

OR

- Q.3 (a) Establish an expression for the speed of dc motor with the help of neat connection diagram. Explain the method of controlling the speed of dc motor below and above the rated speed. Justify the statement that dc series motors are never started at no load. [10]

- (b) A 250V dc shunt motor runs at 1000 rpm at no load & takes 5Amp. The total armature and shunt yield resistance are 0.2Ω & 250Ω respectively. Calculate the speed under loaded condition taking 50Amp. The armature reaction weakens the yield by 3%. [6]

UNIT-IV

- Q.4 In what way a practical transformer differ from an ideal transformer? Develop an equivalent circuit for the practical transformer. [16]

OR

- Q.4 (a) Explain the process of finding efficiency of transformer by Sumpher's test. [12]
(b) What is Welding Transformer? [4]

UNIT-V

- Q.5 (a) Explain the Scott connection with proper circuit diagram. [8]
(b) Write short note on open – delta connection. [8]

OR

- Q.5 (a) Explain in detail the double star connection for obtaining 6-phase supply from 3-phase supply. [8]
(b) Write short note on inrush of magnetizing current in poly phase transformer. [8]



COLLEGE OF ENGINEERING

DETAILED LECTURE NOTES

SOLUTIONS

Campus: PCCOE Course: B.Tech

Name of Faculty: Dr. Chetan Kharg

Class/Section: III - C

Name of Subject: EM-I

Date: 6-7-17

Code: B.E.E.S.

Soln for tutorial sheet 1A-1F

① $I = 150A$, $l = 2m$, $B = 0.35T$, $H = ?$
 $F = BIl = 150A \times 2 \times 0.35 = 105 \text{ Newtons.}$

② $l = 25cm$, $A = 4cm^2$, $N = 65$

$$L = \frac{N^2 \mu_0 \mu_r A}{l}$$

$$= \frac{(65)^2 \times 25 \times 10^{-4} \times 4\pi \times 10^{-7} \times 1}{25 \times 10^{-2}}$$

③ Area of loop = $50cm^2 = 50 \times 10^{-4} m^2$
 $= 50 \times 10^{-4} \times 20 \times 50 \times 10^{-3}$

Hysteresis loss =

$$P_h = \text{Volume} \times \text{area of loop} \times f$$

$$\frac{P_h}{\text{Volume}} = \text{W/m}^3$$

④ Area of hysteresis loop obtained with magnetic material was $9.3cm^2$. The coordinates are $1cm = 1000AT/m$ and $1cm = 0.2wb/m^2$. If density is $7.8g/cm^3$, calculate the hysteresis in watts/kg at $50Hz$.

Ans. $V = \frac{10^3}{7.8} \times 10^{-6} = 1.282 \times 10^{-4} m^3$

$$\text{Area} = 9.3 \times 1000 \times 0.2$$

$$\text{Hys. energy loss} = W_h = \gamma \times \text{area}$$

$$= 1.282 \times 10^{-4} \times 1860 = 0.238 \text{ J/cycle}$$

$$\text{Hys. Power loss} = P_h = W_h \times f = 0.238 \times 50 = 11.9 \text{ W}$$

Since we considered one kg of material = 11.9 W/kg



FIRST ASSESSMENT

Session 2017-18

B. Tech II year III Semester

3EE05A ELECTRICAL MACHINES-I

Max. Marks- 30

Time- 1Hr

Course Outcomes-

CO1: Students be able to understand the concept of electromechanical energy conversion and analogy between electrical and magnetic circuit.

CO2: Students visualizes the principle of operation, construction and different characteristics of DC generator and their applications.

CO3: Students will be able to understand the principle of operation, construction and different characteristics of DC motors and their applications.

Ques. No.	Questions	CO	Marks
1	What is the energy conservation principle, write an energy balance equation for a motor and generator?	CO1	10
	OR		
2	What is B-H curve and also explain eddy current and Hysteresis losses with the help of B-H curve.	CO1	10
3	With the help of neat diagram, explain the working principle of d.c. generator, explain clearly the function of commutator in d.c. machines.	CO2	10
	OR		
4	In a 120V compound generator the resistance of the armature, shunt and series field windings are 0.06Ω , 25Ω and 0.04Ω respectively. The load current is 100A at 120V. Find the induced e.m.f. and armature current when the machine is connected as – (i) Long shunt (ii) Short shunt.	CO2	10
5	What do you understand by demagnetizing and cross magnetizing effect of armature reaction in a d.c. machine? Derive the expression for calculation of demagnetizing and cross magnetizing ampere turn when brushes are given a shift from geometrical natural axis.	CO3	10
	OR		
6	Draw and explain the torque-speed characteristics of the following type of D.C. motor: (i) Shunt Motor (ii) Series Motor (iii) Cumulative compound motor.	CO3	10



POORNIMA

COLLEGE OF ENGINEERING

DEPARTMENT OF ELECTRICAL ENGINEERING

SECOND ASSESSMENT

Session 2017-18

B. Tech II year III Semester

3EE05A ELECTRICAL MACHINES-I

Max. Marks- 20

Time- 1Hr

Course Outcomes-

CO4: Students will be able to understand the connections and phase conversion in poly-phase transformers and their applications.

CO5: Students will be able to understand the starting, testing and braking of DC motor along with its applications.

CO6: Students will be able to understand the principle of operation, construction and different characteristics of transformers.

Ques. No.	Questions	CO	Marks
1	Discuss back to back single Phase transformer	CO4	10
	OR		
2	Explain the principle of transformer action.	CO4	10
3	Explain the different method of breaking DC Machine	CO5	
	OR		
4	Enumerate and classify in losses in a DC Shunt motor	CO5	
5	Explain why the core flux in a transformer is almost independent of load current	CO6	10
	OR		
6	What causes the magnetizing current of a transformer to have predominant 3 rd harmonic and yet the transformer model assumes the magnetizing current to be Sinusoidal.	CO6	10

Poornima College of Engineering													
Department of Electrical Engineering													
Year: 2017-18													
Assessment Evaluation Sheet													
Class & Section: 2nd year							Subject :Electrical Machine-I						
Faculty Name:							Code: 3EE5						
Sr.No.	Name Of Student	First Assessment						Second Assessment					
		Q1	Q2	Q3	Q4	Q5	Q6	Q1	Q2	Q3	Q4	Q5	Q6
		10	10	10	10	10	10	10	10	10	10	10	10
1	AAMIR RAZA .	5		6		5		7		5		8	
2	AASHOJ SAINI .	8			5		5	5		5		5	
3	ABHISHEK CHAUDHARY .		5	8		9			6		6		6
4	ABHISHEK CHAUDHARY .	7		7		7		7		5		7	
5	ABHISHEK JAIN .		8		8		5		5		5		7
6	ABHISHEK KUMAR .	8		7		5			7		5		6
7	ABHISHEK PANDEY .	7		6		5			5		5		5
8	ABHISHEK PRAJAPAT .	A											4
9	ABHISHEK SINGH .	5		8		6		8		6		8	
10	ABHISHEK SINGH RAO .	7		6		7		7		2		7	
11	ADITYA GAURAV .	5			5		7		8		5		7
12	ADITYA SINGH .	5		6			5	5		6		5	
13	AFTAB KHAN .		5		7		5		6		5		6
14	AJAY KATARIYA .	6		6			5	7		6		7	
15	AJAY MAHAWAR .	8		6		6		5		9		5	
16	AJAY SINGH .		8		7		7		7	8			7
17	AJAY SWAMI .	4		6		7		4		4		4	
18	AKASH TANWAR .	5		5		6		7			2	8	
19	AKSHAY GADHWAL .	7		5		7		5		5		5	
20	AMAN JAIN .	9		5		5			5		7		8
21	AMIT KUMAR MISHRA .	5		6			8	5		8		5	
22	AMIT MEENA .		8		5		8		5		5		4
23	ANCHAL BANWAL .		5		5		5		6		5		6
24	ANIMESH GAUTAM .	7		5		5			9		9		8
25	ANKIT .	4		5		5		7		6			
26	ANKIT KUMAR JANGID .		5		1	5		6		8		6	
27	ANOOP DADHICH .	7		5		7		5		5		5	
28	ANSHUMAN .		7		5		8		5	5			5
29	ANUJ KUMAR MEENA .	8		5			5		8		8		7
30	ARUN SINGHAL .	5		9		5		5		5		2	
31	ASHUTOSH KUMAR GUPTA .		6		3		4		4		5		4
32	AWANISH MISHRA .	7		5		5		4		5		4	
33	BABU LAL SHARMA .		8		7		9			9	8		
34	BANTI SAINI .	7		6		5		5		5		5	
35	BRAJDAS MEENA .		5		8		7		5		9		6
36	CHETAN NAWARIA .	7		6		5		5		4		2	
37	CHETANYA SINGH .	5		5		6		7		6		7	
38	CHINMAY JAIN .		6		6		4		6		6		2
39	DEEPESH GUPTA .	6		6		9		4			5	4	
40	DHRUTI PATEL .	8		6			5		6		6		6
41	DINESH KUMAR MEENA .	7						7		5		7	
42	EKAGRAVEER MEHTA .		6				8		5		6		7
43	GAURAV KUMAWAT .	9		7		8		5				5	
44	GAURAV SAINI .		6		4		6		6		4		6
45	GAURAV SHARMA .	8		5			4		5		6		4
46	GOLU KUMAR RAI .	6		5		4		5			9	2	
47	GOURANK NUWAL .		8		4			7		9		7	
48	GOURAV AGRAWAL .		2		4		5		1		9		4
49	HANSU BAGORIYA .	8			7		4		5	7			5
50	HARDIK AGRAWAL .		5		4	8		7		5		7	
51	HARSHAL CHOUDHARY .	7		7		7		4		8		4	
52	HARSHIT KUMAR SAINI .		4		8		8		9		7		9

53	HARSHIT SHRIVASTAVA	9		7		8			7		7		7
54	HARSHIT SRICHANDANI	5		4		5		4		7		4	
55	HEMANT PANWAR		8		8		7		4		5		4
56	HEMANT VERMA		8		8		5		5		9		5
57	HIMANI	6		9			6		5		7		8
58	HIMANSHU BHARTI	7		8			9		7		9		7
59	JAINUL ABIDDIN RANGREJ	6		9		5			8		7		8
60	JANVI PANWAR	5		8			9		9		6	0	
61	KAJAL SAINI	9		9		6		5		6		4	
62	KALPESH ROAT	AB											
63	KAVITA KUMARI	8			8		5		8		9	5	
64	KESHAV GAUTAM	8		3			0	9		8			8
65	KHUSHIRAM MEENA		5		8		6		6		1	9	
66	KISHAN LAL	8		5			4		5		6		7
67	KRISHAN KANT YADAV	AB											
68	KRISHANKANT NIRMAL		5		4			1		9			5
69	KRRISH PRATAP SINGH RATHORE	8		4		5		8		5		5	
70	KSHITIJ SHARMA	8			8		8	5		5		8	
71	KULDEEP SAINI		9		9		9		9		5	5	
72	KUSHPAL SINGH		8	8		5			6		6		5
73	LAKSHIT KUMAR LAKHARA	AB											
74	LIMKA MEENA		8		8		8		8		8	8	
75	MADHUP SINGHAL	5		8		7			7		5	5	
76	MAHENDRA SINGH DHAKAD	6		9		5			8		7		9
77	MAN MOHAN SINGH KALYANWAT	8		7		4		5			8		6
78	MANISH KUMAR	9		9		6		A			5		
79	MANISH KUMAR	5		5		7		4		7			8
80	MANSOON MANGAL		6		5		8		6		6		7
81	MANVENDRA SINGH RATHORE	8		4		9			9		9		8
82	MAYANK KUMAR PRAJAPAT	8		5		5		8		5		8	
83	MAYANK PURI		8		1	6		8		7		7	
84	MEGHA MISHRA	4		6		5		5		9		4	
85	MOHIT KUMAR MEENA		6		8		5		8	4			5
86	MOHIT MEENA	8		9			8		8		10		9
87	MUKUL SAINI	9		10		9		9		9		9	
88	MUSKAN JONWAL		8		4		5		7		8	8	
89	NAMAN KUMAR	8			4		8	7		9		5	
90	NAMAN KUMAR JAIN	8		8		8		5		7			7
91	NARENDRA KUMAR VERMA	2		4		4		9		8			6
92	NEHAL SAHU		9			8			7		4	8	
93	NIKHIL KUMAR SAIN	8		8		7		5		5			8
94	NIRMAL KUMAR SAINI	5			4		5	6		4			7
95	NISHA SAINI		8	8		5			6		6		8
96	NISHA SAINI	5		4		5		5		3			5
97	NITESH KUMAWAT		8		8		8		8		8	8	
98	NITIN JINDAL	5		8		7			7		5	4	
99	PANKAJ DARIYA	6		9		5			8		7		8
100	PANKAJ KUMAR LAKHARA	8			5		8		7		9	9	
101	PANKAJ KUMAR MEENA	9		9		6		8		6			6
102	PAVITRA DIXIT	5		8		7		5		7		0	
103	PRAMOD PRAJAPAT	8			0		3		2		9	6	
104	PRASHANT KUMAR KASOTIYA	8		3			5	9		8		5	8
105			5		8		8		6		1		6
106	PUNEET KUMAR SHARMA	8		5	5		4		5		5		8
107	PUNIT FAUJDAR	8		7		4		9			7	8	
108	PURU SRIVASTAVA		8		4			6		7		5	
109	RACHIT SHARMA		8		9		8		9		9		4
110	RAGHAV KASWAN	9			10		9		9	9			9
111	RAHUL CHOUDHARY		7		4	5		6		6		6	
112	RAHUL MEENA	7			8		2		7		7		9
113	RAHUL MEENA		4		6		5		3		8		5
114	RAHUL YADAV	8			7		9		8	7		1	
115	RAJNISH PUSHKARNA		7		8	9		7		8			5
116	RAMJEET BAIRWA	5		9		6		6		8			8

117	RAVINDRA YADAV .												
118	RISHAV KUMAR DUBEY .		6		3		7		8		7	5	
119	ROHAN SHARMA .	4		7			5		5		9	8	
120	ROHIT CHOUHAN .	9		8		5		7		8			8
121	ROHIT MANGAL .	8		4		7		8		4			8
122	SACHIN KUMAR YADAV .	3			5		8		9		8	8	
123	SACHIN SHARMA .		8		8		8		1		8	4	
124	SAJID ANWAR .	3			8	7		5		8		8	
125	SANJAY SAINI .		4		8		5		8		5	7	
126	SAURABH KESHRI .	8		8			6		5		4		5
127	SAURABH SHARMA .	AB											
128	SAURAV KUMAR DAS .	8		8			5		7		4		7
129	SHAMANK VAGORIA .	9		9		7		7		7		8	
130	SHEKHAR SHRINGI .		6		3			4			8	5	
131	SHINU KUNDU .	6		9		4		8		8		9	
132	SHIV PRASAD NAGAR .	9		8		8		7		6		7	
133	SHIVANSHU RATNAKAR .	5		6		9		5		7		9	
134	SHOBHRAJ KHICHI .		8		7		6		6		4		7
135	SRISHTI BANSAL .	7		8		4		5		9		5	
136	SHUBHAM KUDESHEIYA .		9		7		5		6		9		6
137	SHUBHAM KUMAR .	8		8		5		5		4		5	
138	SHUBHAM MALAV .		8	5		4		1		8		7	
139	SHUBHAM SHARMA .		5		4		6		5		8		5
140	SHUBHAM SHRINGI .	7		9		7			8		7		9
141	SHUBHAM YADAV .		4		8	5		5		8		5	
142	SHYAM MOHAN JANGID .	5		5		7		8			8	9	
143	SIDDHANT MISHRA .		9		7		5		8	7			8
144	SIDDHARTH BASWAL .	8		5			7		8		4		8
145	SIMRAN MANDIA .	9		9		7		8		7		9	
146	SONU KUSHWAH .		6		3		5	4			8	4	
147	SURYA PRAKASH MEENA .		9	7		4		8		5		8	
148	SWETA KUMARI .		9	8			5	7		9		7	
149	TANUJ VYAS .	5		6		9		5		7		8	
150	TARUN SHARMA .	AB											
151	UDDESHYA KUMAR .		8		8		8		1		8		8
152	UMESH KUMAR .	3		8		7		5		8		6	
153	UTSAV MAHARISHI .		4		4		5		8		5		7
154	UTTAM KUMAR .	8		5			4		6		8		8
155	VAIBHAV TIWARI .	3			5		8		9		7	7	
156	VARSHA SHARMA .		8		8		8		8		9	6	
157	VIKASH KUMAR .	3			7	9		9		8			8
158	VIKASH KUMAR PANDEY .		4		8		5		8		5	8	
159	VIKRAM KUMAR YADAV .	8		3			4		6		6		5
160	VIKRAM SAINI .		7		8		3		8		4		7
161	VIPIN GAUTAM .	8		4		7		8		4		7	
162	VISHNU VIJAY .	3			5		8		9		4	4	
163	VIVEK SHARMA .	9		8		6		9		7		8	
164	YATHARTH JOIYA .		8	3			1	5			8	7	
165	YOGITA SUTHAR		7	5		5		6			5	5	
166	HANSRAJ VISHNOI		8		5		7		7		4	9	
167	MANOJ KUMAR BAIRAW	6		8		5		6		9			7
168	NARNDRA KUMAR MEENA	8		9		6		5		8			8
169	RITIK VERMA	7		7		5			8		7	8	
170	SAHIL NEELGAR	6		3			5	8		9		6	
			8		9			8	8	7		5	8
	SUM	697	403	616	410	491	470	495	536	516	551	531	509
	PRESENT STUDENT	162	162	162	162	162	162	166	166	166	166	166	166
	>=60%	73	43	62	37	44	39	43	59	53	55	48	56
			116		99		83		102		108		104
	PERCENTAGE		68.2		58.2		48.8		60.0		63.5		61.2
	ATTAINMENT		1		0		0		1		1		1
	Overall Attainment		0.67										



POORNIMA

COLLEGE OF ENGINEERING

DEPARTMENT OF ELECTRICAL ENGINEERING

OBT I

Session 2017-18

Btech II YEAR III SEMESTER

3EE5A/ELECTRICAL MACHINES-I

Max. Marks- 40

Time- 1hr

Course Outcomes-

CO1: Students be able to understand the concept of electromechanical energy conversion and analogy between electrical and magnetic circuit.

CO2: Students visualizes the principle of operation, construction and different characteristics of DC generator and their applications.

CO3: Students will be able to understand the principle of operation, construction and different characteristics of DC motors and their applications.

CO4: Students will be able to understand the starting, testing and braking of DC motor along with its applications.

Ques . No.	Question	CO	Marks
1	Develop a model of an electromechanical energy-conversion device and explain the principle employed in it.	CO1	10
2	A series generator of total resistance 0.5 ohms is running at 1000 rpm and delivering 5 kW at a terminal p.d. of 100 V. If the speed is raised to 1500 rpm and the power is adjusted to 8kW, find the new current and terminal voltage. Assume that flux is proportional to the current.	CO2	10
3	A d.c. machine is connected across a 240 V line. It rotates at 1200 rpm and current is 40 A. Find the resistance of the armature circuit. If the load is thrown off, what will be the generated voltage and the speed of the machine assuming that there is negligible effect of armature reaction	CO3	10
4	Compare the merits and demerits of different methods of braking of dc motors.	CO4	10

References:

- 1 M. G. Say, The Performance and Design of AC machines, Pit man & Sons. 2003
- 2 Guru, Electric Machinery, 3e, Oxford 2000
- 3 R. K. Srivastava, Electrical Machines, Cengage Learning. 2013
- 4 P. S. Bimbhra, Electrical Machinery, Khanna Pub. 1995
- 5 Contents available on related websites



POORNIMA

COLLEGE OF ENGINEERING

DEPARTMENT OF ELECTRICAL ENGINEERING,

OBT II

Session 2017-18

Btech II YEAR III SEMESTER

3EES5A/ELECTRICAL MACHINES-I

Max. Marks- 20

Time- 1hr

Course Outcomes-

CO5: Students will be able to understand the principle of operation, construction and different characteristics of transformers.

CO6: Students will be able to understand the connections and phase conversion in poly-phase transformers and their applications.

Ques. No.	Question	CO	Marks
1	Explain why the transformer rating is expressed in kVA or VA. Describe the significance of all the items mentioned on the name plate of a single phase transformer.	CO5	10
2	A 3 phase load of 40 kW, 380 V having a p.f. of 0.8 (lagging) receives its power through a 3phase auto transformer from a 3 phase 440 V 3 ϕ supply. The auto transformer is connected in star. The neutral is NOT grounded. Neglect exciting current and impedance of the transformer winding. a) Draw the diagram depicting the above situation. Calculate the currents entering the load from the auto transformer. b) Calculate the currents entering the transformer from the supply side. c) Show the currents flowing in the transformer windings along with directions.	CO6	10

References:

- 1 M. G. Say, The Performance and Design of AC machines, Pit man & Sons. 2003
- 2 Guru, Electric Machinery, 3e, Oxford 2000
- 3 R. K. Srivastava, Electrical Machines, Cengage Learning. 2013
- 4 P. S. Bimbhra, Electrical Machinery, Khanna Pub. 1995
- 5 Contents available on related websites

OBT Evaluation Sheet

Class & Section: II A

Subject :Electrical Machine-I

Name of Faculty: Chetan Khemraj

Code: 3EE5

Sr.No.	Name Of Student	OBT I				OBT II	
		CO1	CO2	CO3	CO4	CO5	CO6
		10	10	10	10	10	10
1	AAMIR RAZA .	9	8	8	9	9	5
2	AASHUJ SAINI .	9	7	8	5	7	8
4	ABHISHEK CHAUDHARY .	7	8	7	8	6	7
5	ABHISHEK CHAUDHARY .	8	8	6	8	8	8
6	ABHISHEK JAIN .	7	7	10	7	6	6
7	ABHISHEK KUMAR .	7	8	8	8	9	5
8	ABHISHEK PANDEY .	10	8	6	7	10	6
9	ABHISHEK PRAJAPAT .	6	8	7	8	6	8
10	ABHISHEK SINGH .	10	7	9	6	Ab	Ab
11	ABHISHEK SINGH RAO .	9	8	10	9	8	8
12	ADITYA GAURAV .	10	8	10	9	7	7
13	ADITYA SINGH .	10	9	9	7	6	8
14	AFTAB KHAN .	9	10	9	8	9	9
15	AJAY KATARIYA .	10	8	9	10	9	5
16	AJAY MAHAWAR .	10	8	10	9	10	8
17	AJAY SINGH .	7	8	9	0	4	6
18	AJAY SWAMI .	7	5	9	8	7	8
19	AKASH TANWAR .	6	7	8	4	8	7
20	AKSHAY GADHWAL .	10	7	7	8	6	7
21	AMAN JAIN .	8	6	6	8	8	9
22	AMIT KUMAR MISHRA .	6	6	8	7	9	8
23	AMIT MEENA .	6	6	8	5	7	7
24	ANCHAL BANWAL .	9	8	8	9	8	8
25	ANIMESH GAUTAM .	8	7	8	8	Ab	Ab
26	ANKIT .	8	8	7	7	8	8
27	ANKIT KUMAR JANGID .	7	7	6	8	7	7
28	ANOOP DADHICH .	7	8	10	5	9	6
29	ANSHUMAN .	8	8	9	7	8	6
30	ANUJ KUMAR MEENA .	9	8	8	9	7	4
31	ARUN SINGHAL .	6	8	7	7	7	5
32	ASHUTOSH KUMAR GUPTA .	8	7	8	5	9	7
35	AWANISH MISHRA .	8	8	7	6	8	9
36	BABU LAL SHARMA .	8	9	7	7	10	6
37	BANTI SAINI .	Ab	Ab	Ab	Ab	10	5
39	BRAJDAS MEENA .	5	7	8	8	Ab	Ab
40	CHETAN NAWARIA .	8	7	6	7	9	5
41	CHETANYA SINGH .	8	10	0	4	7	8
42	CHINMAY JAIN .	8	8	7	5	Ab	Ab
44	DEEPESH GUPTA .	7	8	7	6	8	8
45	DHRUTI PATEL .	8	7	6	6	8	7
46	DINESH KUMAR MEENA .	8	5	8	8	5	6
47	EKAGRAVEER MEHTA .	10	8	8	5	7	8

Poornima College of Engineering
Department of Electrical Engineering
Year: 2017-18

OBT Evaluation Sheet

Class & Section: II A

Subject :Electrical Machine-I

Name of Faculty: Chetan Khemraj

Code: 3EE5

Sr.No.	Name Of Student	OBT I				OBT II	
		CO1	CO2	CO3	CO4	CO5	CO6
		10	10	10	10	10	10
48	GAURAV KUMAWAT .	9	8	8	7	7	8
49	GAURAV SAINI .	Ab	Ab	Ab	Ab	6	8
50	GAURAV SHARMA .	8	5	8	8	6	8
51	GOLU KUMAR RAI .	8	8	8	5	6	7
52	GOURANK NUWAL .	8	7	7	4	8	6
53	GOURAV AGRAWAL .	8	7	6	8	7	5
54	HANSU BAGORIYA .	6	5	7	8	8	8
55	HARDIK AGRAWAL .	9	8	8	5	7	6
56	HARSHAL CHOUDHARY .	7	7	8	6	8	4
57	HARSHIT KUMAR SAINI .	8	7	6	8	7	8
58	HARSHIT SHRIVASTAVA .	8	7	8	8	6	7
59	HARSHIT SRICHANDANI .	7	7	7	7	6	2
60	HEMANT PANWAR .	7	8	7	7	8	7
61	HEMANT VERMA .	9	0	8	5	6	5
62	HIMANI .	5	9	10	6	8	8
63	HIMANSHU BHARTI .	7	8	5	7	8	8
	Total	443	412	427	384	406	368

Average

7.03 6.54 6.78 6.10 6.44 5.84

%age

70% 65% 68% 61% 64% 58%

Rubrics for OBT Evaluation-2017-18

S.No.	Cos	Level of Achievements				
		Exemplary	Accomplished	Satisfactory	Promising	Not Achieved
		9-10	7-8	5-6	3-4	1-2
C205.1	Students be able to understand the concept of electromechanical energy conversion and analogy between electrical and magnetic circuit.		Assesment coordinated the objectives and accomplished the course results.			
C205.2	Students visualizes the principle of operation, construction and different characteristics of DC generator and their applications.			Assesment results are acceptable and outcome is moderate		
C205.3	Students will be able to understand the principle of operation, construction and different characteristics of DC motors and their applications.		Assesment coordinated the objectives and accomplished the course results.			
C205.4	Students will be able to understand the starting, testing and braking of DC motor along with its applications.			Assesment results are acceptable and outcome is moderate		
C205.5	Students will be able to understand the principle of operation, construction and different characteristics of transformers.			Assesment results are acceptable and outcome is moderate		
C205.6	Students will be able to understand the connections and phase conversion in poly-phase transformers and their applications.			Assesment results are acceptable and outcome is moderate		

3EE5A

3ee5a



POORNIMA

COLLEGE OF ENGINEERING

Department of Electrical Engineering
Technical Quiz

Subject Name & Code: 3EE05A	
Name of Faculty:	
Name of Student:	
Day & Date:	
Roll No:	

Q.1 The unit of inductance is :

- a. Meter
- b. Henry
- c. Henry per meter
- d. Weber

Q.2 The analogous quantity of EMF in magnetic circuit is :

- a. Reluctance
- b. Large
- c. Zero
- d. None of these

Q.3 Reciprocal of reluctance is :

- a. Reluctivity
- b. Permeance
- c. Permeability
- d. Resistivity

Q.4 Conductivity is analogous to :

- a. Reluctance
- b. Resistivity
- c. Permeability

d. Reluctivity

Q.5 The unit of magnetic flux is :

- a. Henry
- b. Meter
- c. Weber
- d. Tesla

Q.6 Relative permeability of vacuum is :

- a. Zero
- b. Ten
- c. One
- d. None of these

Q.7 Hysteresis loss least depend on :

- a. Volume of material
- b. Frequency
- c. Steinmetz coefficient of material
- d. Ambient temperature

Q.8 An air gap is usually insert in magnetic circuit to:

- a. Increase M.M.F.
- b. Increase the flux
- c. Prevent the saturation
- d. None to these

Q.9 Energy store by a coil is doubled when its currents is increase by percent :

- a. 25
- b. 50
- c. 41.4

d. 100

Q.10 Laminated cores, in electrical machine, are used to reduce:

- a. Copper loss
- b. Eddy current loss
- c. Hysteresis loss

Q11. The emf induced in the dc generator armature winding is

- A) DC B) AC C) AC and DC
- D) NONE OF THESE

Q12. Commutator in dc generator is used for

- A) Collection of current C) Increase efficiency
- B) Reduce losses D) Convert AC armature current into DC

Q13. A DC machine without commutator is.

- A) AC generator B) DC Motor
- C) DC generator D) Induction motor

Q14. Which of the following bearings and their uses are correct.

- A) Ball bearing - Small machine
- C) Neither A nor B
- B) Roller bearing - large machines
- D) Both A and B

Q15. Wave winding is preferred for which of the following ratings?

- A) Low current and low voltage
- C) High current and low voltage
- B) High current and high voltage
- D) Low current and high voltage

Q16. For a DC machine, shunt resistance and armature resistance values are

- A) High and high
- B) high and low
- C) low and high
- D) low and low

Q17. Series field consists of _____ No. of turns and _____ conductors respectively.

- A) Large and thick
- B) large and thin
- C) less and thick
- D) less and thin

Q18. No load saturation characteristics are plotted between

- A) No load voltage and field current
- B) NO load voltage and armature current.
- C) Short circuit current and field current.
- D) Short circuit current and armature current.

Q19. The effect of _____ on main field flux is armature reaction.

- A) Armature MMF B) Armature flux
- C) Armature current
- D) NONE OF THE ABOVE

Q20. Armature flux is _____ with respect to main field flux or main field poles?

- A) Rotates opposite direction
- C) stationary
- B) Rotates same direction
- D) NONE OF THE ABOVE

Q.21 Which of the following represent the commutator pitch?

- a) number of conductors spanned by one coil at the back end of the armature
- b) number of conductors spanned by one coil at the front end of the armature.
- C) the distance between the starting of first coil and its next successive coil.
- d) number of commutator segment between two successive coils.

Q.22 In a dc machine 4 pole lap winding is used. The number of parallel paths are?

- a) 2
- b) 4

- c) 1
- d) 8

Q.23 In a dc machine 6 pole wave winding is used .the bnumber of parallel paths are .?

- a) 6
- b) 4
- c) 2
- d) 1

Q.24 Inter pole winding is connected in

- a) series with armature
- b) series with main poles
- c) parallel with armature
- d) parallel with main poles

Q.25 Dummy coil are used for

- a)increasing efficiency
- b)reducing armature reaction
- c)mechanical balancing
- d) all of the above.

Q.26 In dc motors ,under leading pole tips flux dencity will.....?

- a)increase
- b) decrease
- c)either increase or decrease
- d) none of the above

Q.27 In dc motors, under trailing pole tips,flux dencity will

- a) Increase
- b) B)decrease
- c) Either increase or decrease
- d) None of the above

Q.28 Period for function $\sin(x)$ and $\cos(x)$ is?

- a) $3\pi/2$
- b) 2π
- c) $\pi/2$
- d) π

Q.29 The sum of a number of a periodic function will also be a

- a) yes
- b) no
- c) both are correct
- d) both are wrong

Q.30. $\cos(x)$ is a function

- a) even
- b)odd
- c) either even or odd
- d) none of these.

Q.31 If cu loss of a transformer at 7/8th full load is 4900 W, then its full-load cu loss would be..... Watt.

- a. 5600
- b. 6400
- c. 375
- d. 429

Q.32 When the turns ratio of the transformer is 20, and primary ac voltage is 12 v, what is the secondary voltage?

- a. 12
- b. 120
- c. 240
- d.2400

Q.33 A certain transformer has 400 turns in primary and 2000 turns in secondary. So what is the turn ration of that transformer?

- a. 0.8
- b. 0.4
- c. 5
- d. 2.5

Q.34 The ordinary efficiency of a given transformer is maximum when

- a.it runs at half of full load
- b. it runs at full load
- c. its cu loss equals iron loss
- d. it runs slightly overload

Q.35 A 200 KVA transformer has an iron loss of 1 kw and full load cu loss of 2 kw. Its load KVA corresponding to maximum efficiency is kVA.

- a. 100
- b. 141.4
- c. 50
- d. 200

Q.36 If field current is decreased in shunt dc motor, the speed of the motor

a. same b. increase c. decrease d.
None of the above

Q.37 What is the mechanical power developed by a DC series motor is maximum?

- a. Back emf is equal to half the applied voltage.
- b. Back emf is equal to the applied voltage.
- c. Back emf is equal to Zero
- d. None of the above

Q.38 Ward-Leonard control is basically a _____ control method.

- a. Field control.
- b. Armature resistance control.
- c. Armature voltage control.
- d. Field diverter control.

Q.39 For very sensitive and wide speed control, the preferable control method is

- a. Armature control. b. Ward-Leonard control.
- c. Multiple voltage control. d. Field control.

Q.40 In DC machine yoke offers

- a. mechanical protection to the machine
- b. flux path completion c. produce working flux d. both A and B

Q.41 A transformer transforms

- a. frequency b. voltage
- c. current d. voltage and current

Q.42 which of the following is not a basic element of transformer?

- a. core b. primary winding
- c. secondary winding d. mutual flux

Q.43 In an ideal transformer

- a. winding have no resistance
- b. core has no losses
- c. core has infinite permeability
- d. all of the above

Q.44 Transformer cores are laminated in order to

- a. simplify its construction
- b. minimize eddy current loss
- c. reduce cost
- d. reduce hysteresis loss

Q.45 A step-up transformer increases

- a. voltage b. current c. power
- d. frequency

Q.46 A transformer has negative voltage regulation when its load power factor is

- a. zero b. unity c. leading d. lagging

Q.47 The main purpose of performing open-circuit test on a transformer is to measure its

- a. cu loss b. core loss c. total loss
- d. insulation resistance

Q.48 At relatively light loads, transformer efficiency is low because _____ secondary

- a. output is low
- b. transformer losses are high
- c. fixed loss is high in proportion to the output
- d. cu loss is small

Q.49 No load test on a transformer is carried out to determine

- a. copper loss b. magnetizing current

- c. magnetizing current and no-load losses
- d. efficiency of transformer

Q.50 The all day efficiency of a transformer depends primarily on

- a. its copper loss b. the amount of load
- c. the duration of load d. both (b) and (c)

Q.51 if the load power factor is 0.866 then average power factor is the v-v bank is

- a 0.866 b 0.75 c 0.51 d 0.65

Q.52 A T-T connection has higher ratio of utilization than a V-V connection is only when

- a identical transformer are used.
- b load power factor is leading.
- c load power factor is unity.
- d non identical- transformer are used.

Q.53 Out of the following choice for poly phase transformer connection which one will you select for three-To-Two phase conversion?

- a acott
- b star/star
- c double acott
- d star/double-delta

Q.54 A T-T transformer can not be parallel with __ transformer.

- a v-v
- b star-delta
- c delta-delta
- d star-star

Q.55 Instrument transformer are used on on AC circuit for extending the range of

- a Ammeter
- b voltmeter
- c wattmeter
- d all of the above

Q.56 which of the following connection is best suited for 3-phase 4-wire service?

- a delta-delta
- b star-star
- c delta-star
- d star-delta

Q.57 As compared to delta-delta bank, the capacity of v-v bank transformer is.....

- a 57.7 b 66.7 c 50 d 86.6

Q.58 If the transformer in a delta-delta are delivering their rated load and one transformer is removed then overload on each of the remaining transformer is.....

- a 66.7 b 173.2 c 73.2 d 58

Q.59 the saving in cu achieved by converting a two winding transformer into an auto transformer is determine by

- a voltage transformation ratio
- b load on secondary
- c magnetic quality of the core material
- d size of transformer core

Q.60 When the turns ratio of the transformer is 20, and primary ac voltage is 12 v, what is the secondary voltage?

- a. 12
- b. 120
- c. 240
- d. 2400

Poornima College of Engineering
Department of Electrical Engineering

Year: 2017-18

Quiz Evaluation Sheet

Subject :Electrical Machine-I

Code: 3EE5

Class & Section: II A

Name of Faculty: Chetan Khemraj

Sr.No.	Name Of Student	Quiz Score					
		CO1	CO2	CO3	CO4	CO5	CO6
		10	10	10	10	10	10
1	AAMIR RAZA .	8	8	8	9	9	5
2	AASHOJ SAINI .	7	7	8	5	7	8
4	ABHISHEK CHAUDHARY .	8	8	7	8	6	7
5	ABHISHEK CHAUDHARY .	7	8	6	8	8	8
6	ABHISHEK JAIN .	5	7	6	7	6	6
7	ABHISHEK KUMAR .	2	8	8	8	9	5
8	ABHISHEK PANDEY .	4	8	6	7	9	6
9	ABHISHEK PRAJAPAT .	5	8	7	8	6	8
10	ABHISHEK SINGH .	AB	AB	AB	AB	AB	AB
11	ABHISHEK SINGH RAO .	6	8	7	9	8	8
12	ADITYA GAURAV .	7	8	8	9	7	7
13	ADITYA SINGH .	9	9	9	7	6	8
14	AFTAB KHAN .	8	8	9	8	9	9
15	AJAY KATARIYA .	7	8	9	10	9	5
16	AJAY MAHAWAR .	7	8	4	9	8	8
17	AJAY SINGH .	7	8	9	0	4	6
18	AJAY SWAMI .	7	5	9	8	7	8
19	AKASH TANWAR .	6	7	8	4	8	7
20	AKSHAY GADHWAL .	8	7	7	8	6	7
21	AMAN JAIN .	7	6	6	8	8	9
22	AMIT KUMAR MISHRA .	6	6	8	7	9	8
23	AMIT MEENA .	6	6	8	5	7	7
24	ANCHAL BANWAL .	8	8	8	9	8	8
25	ANIMESH GAUTAM .	8	7	8	8	8	7
26	ANKIT .	8	7	7	7	8	8
27	ANKIT KUMAR JANGID .	7	7	6	8	7	7
28	ANOOP DADHICH .	7	8	7	5	9	6
29	ANSHUMAN .	8	8	9	7	8	6
30	ANUJ KUMAR MEENA .	7	8	8	9	7	4
31	ARUN SINGHAL .	6	8	7	7	7	5
32	ASHUTOSH KUMAR GUPTA .	8	7	8	5	9	7
35	AWANISH MISHRA .	8	8	7	6	8	9
36	BABU LAL SHARMA .	8	9	7	7	9	6
37	BANTI SAINI .	AB	AB	AB	AB	AB	AB
39	BRAJDAS MEENA .	5	7	8	8	4	7
40	CHETAN NAWARIA .	8	7	6	7	9	5
41	CHETANYA SINGH .	5	7	2	4	7	8
42	CHINMAY JAIN .	4	8	7	5	4	5
44	DEEPESH GUPTA .	6	8	7	6	8	8
45	DHRUTI PATEL .	7	7	6	6	8	7
46	DINESH KUMAR MEENA .	5	5	8	8	5	6

47	EKAGRAVEER MEHTA .	8	8	8	5	7	8
48	GAURAV KUMAWAT .	6	8	8	7	7	8
49	GAURAV SAINI .	AB	AB	AB	AB	AB	AB
50	GAURAV SHARMA .	8	5	8	8	6	8
51	GOLU KUMAR RAI .	7	8	8	5	6	7
52	GOURANK NUWAL .	6	7	7	4	8	6
53	GOURAV AGRAWAL .	4	7	6	8	7	5
54	HANSU BAGORIYA .	5	6	7	8	8	8
55	HARDIK AGRAWAL .	6	8	8	5	7	6
56	HARSHAL CHOUDHARY .	7	7	8	6	8	4
57	HARSHIT KUMAR SAINI .	4	7	6	8	7	8
58	HARSHIT SHRIVASTAVA .	8	7	8	8	6	7
59	HARSHIT SRICHANDANI .	7	7	7	7	6	2
60	HEMANT PANWAR .	7	8	7	7	8	7
61	HEMANT VERMA .	AB	AB	AB	AB	AB	AB
62	HIMANI .	5	8	5	8	8	8
63	HIMANSHU BHARTI .	7	8	5	9	8	8
		33	47	41	38	41	35
	Absent	4	4	4	4	4	4
	Present	59	59	59	59	59	59
	PERCENTAGE	55.932203	79.661017	69.491525	64.40678	69.491525	59.322034
	ATTAINMENT	0	2	1	1	1	0
	FINAL ATTAINMENT	0.83					



POORNIMA

COLLEGE OF ENGINEERING

Department of Electrical Engineering Power Point Presentation Report

Semester: ...III...

Section: ...A.....

Session: 2017-18.....

Date: ..25-10-17

Duration of Lecture: - 1 Hour

Name of Subject with Code: Electrical Machines-I (3EE05).....

Topic:Transformer.....

Name of Faculty: Dr. Chetan Khemraj.....

Number of student present: 46.....

Outcome of lecture:-

a) Concept:- A transformer is an electrical device that transfers electrical energy between two or more circuits through electromagnetic induction

b) Communicative:- yes

c) Multi-disciplinary:- yes

Feedback from the students:- concept was explained well along with principle of operations and construction details. students found the explanation easy and conceptual.

Date:

Signature of Faculty

Signature of HOD



POORNIMA

COLLEGE OF ENGINEERING

Department of Electrical Engineering

Video Lecture Report

Semester: III Section A Session 2017-18

Date: 14-8-17 Duration of Lecture 1 hr

Name of Speaker: Dr. L. Umamand

URL of Video:

Name of Subject with Code: Electrical Machines-1 (03EE05)

Unit & Topic: Unit 2: DC Generators

Name of Faculty: Dr. CHETAN KHEMRAJ

Number of student present: 59

Outcome of lecture: Students will be able to learn the concepts of constructions, types, emf equations, lap and wave windings, armature reaction, commutation, equaliser rings in case of DC generators.

Feedback from the students: The explanation of video was so good that students were able to understand the topic very well. They also asked queries regarding the use of DC generators in day to day life & how it is beneficial in different fields.

Date:

Signature of Faculty

Signature of HOD