

**C21\_ Curriculum**

**DIPLOMA IN ELECTRICAL AND ELECTRONICS  
ENGINEERING**



**OFFERED BY**

**STATE BOARD OF TECHNICAL EDUCATION & TRAINING,**

**TELANGANA: HYDERABAD**

## V SEMESTER

Sl No	Course Code	Course Name	Teaching Scheme				Credits	Examination Scheme						
			Instruction Periods per week			Total Period per semester		Continuous internal evaluation			Semester end examination			
			L	T	P			Mid Sem 1	Mid Sem 2	Internal evaluation	Max Marks	Min Marks	Total Marks	Min marks for Passing including internal
1	ME-501	Industrial Management and Entrepreneurship	4	1	0	75	3	20	20	20	40	14	100	35
2	EE-502	AC Motors	4	1	0	75	3	20	20	20	40	14	100	35
3	EE-503	Power Electronics	4	1	0	75	3	20	20	20	40	14	100	35
4	EE-574	Electrical Traction and Automation	4	1	0	75	3	20	20	20	40	14	100	35
	EE-584	Electrical Estimation and Utilization	4	1	0	75	3	20	20	20	40	14	100	35
	EE-594	Electric Vehicles	4	1	0	75	3	20	20	20	40	14	100	35
5	EE-575	Switchgear and Protection	4	1	0	75	3	20	20	20	40	14	100	35
	EE-585	Advanced Protection of Power Systems	4	1	0	75	3	20	20	20	40	14	100	35
6	EE-506	AC Motors Lab	1	0	2	45	1.5	20	20	20	40	20	100	50
7	EE-507	Power Electronics Lab	1	0	2	45	1.5	20	20	20	40	20	100	50
8	EE-508	Programmable Logic Controllers Lab	1	0	2	45	1.5	20	20	20	40	20	100	50
9	EE-509	Electrical Installation Lab	1	0	2	45	1.5	20	20	20	40	20	100	50
10	EE-510	Project Work	1	0	2	45	1.5	20	20	20	40	20	100	50
11	EE-511	Skill Upgradation	0	0	8	120	2.5	0	0	Rubrics		--	-	
	Activities: student performance is to be assessed through Rubrics													

## ME-501 - INDUSTRIAL MANAGEMENT AND ENTREPRENEURSHIP

Course title	Industrial Management and Entrepreneurship	Course code	ME-501
Semester	V	Course group	Core
Teaching scheme in periods (L:T:P)	4:1:0	Credits	3
Methodology	Lecture+ Tutorial	Total Contact Periods	75
CIE	60 Marks	SEE	40 Marks

**Prerequisites:** Knowledge of Basic Sciences.

### COURSE OUTCOMES

*On successful completion of the course, the students will be able to*

Course Outcomes	
<b>CO1</b>	Understand the principles and functions of management and Outline Organization structure& organizational behavior
<b>CO2</b>	Understand the Functions of Production Management
<b>CO3</b>	Analyse the functions of Materials Management.
<b>CO4</b>	Compare Marketing, sales & Feasibility study.
<b>CO5</b>	Know the use of ISO 9000 & T.Q.M
<b>CO6</b>	Understand Industrial legislation & safety and role of entrepreneur and entrepreneurial development

**Blue Print of Marks for SEE:**

Units		No of periods	Questions to be set for SEE				Remarks	
			R		U	A		
Part-A	1.Principles and functions of management and organisation structure and behaviour	13	Q4	Q1	Q9(a)	Q13(a)		
	2.Production management	12						
Part-B	3.Materials management	13		Q2	Q10(a)	Q14(a)		
	4.Marketing, sales & feasibility study	12						
Part-C	5.Introduction to ISO 9000 & T.Q.M	13		Q3	Q5 Q6	Q9(b) Q11(a) Q11(b)	Q13(b) Q15(a) Q15(b)	
	6.Industrial legislation & safety and Entrepreneurial development	12						
TOTAL		75	08		08	08		

**COURSE CONTENT****1. Principles and functions of management and organisation structure and behaviour**

Definitions of Industry, Commerce and Business, Evolution of management theories, Principles of Scientific Management, functions of management, Difference between administration and management, Role of industry, Types of ownership – Sole proprietorship, Partnership, Private limited, public limited company, Industrial Cooperatives, Philosophy, types of Organizations, Line and Staff and functional organizations, Advantages, limitations, departments in a large-scale industry, Effective organization, Motivation, different theories of motivation, leadership styles.

**2. Production management**

Production, planning and control, relation with other departments, need for planning and its advantages, Routing, scheduling, dispatching, PERT and CPM, simple problems.

**3. Materials management**

Materials in industry, inventory control model, ABC Analysis, Safety stock, re-order level, Economic ordering quantity, Stores layout, stores equipment, Stores records, purchasing procedures, purchase records, Bin card, Cardex.

**4. Marketing, sales & feasibility study**

Sellers and Buyers markets, Marketing, Sales, Market conditions, monopoly, oligopoly, perfect competition, Cost -Elements of Cost, Contribution, Break even analysis, Market Survey, Product and production Analysis, Materials input, Manpower, Location, Economic and Technical Evaluation, preparation of Feasibility study reports.

**5. Introduction to ISO 9000 & T.Q.M**

Concept of quality, Definition of the terms quality policy, quality management, quality systems, quality control and quality assurance, Elements of quality systems: Management responsibility, Quality system, contract review, design control, document control, purchasing, purchaser– supplied product, product identification and traceability, process control, Inspection and testing. Definition and Principles of quality assurance, Know the necessity of International standards –ISO- Evolution, Meaning, importance, Various standards under ISO, ISO 9000 series of standards- Features, series, Constituents, Advantages, Draw backs and beneficiaries (Whom does ISO 9000 help). 5-S principles-concept of zero defects. TQM-Meaning, Characteristics.

**6. Industrial legislation & safety and Entrepreneurial development**

Employer – Employee relations, Trade, Union Settlement of disputes, collective bargaining, Welfare activities, Total Welfare concept, rights and responsibilities of Employers and employees, Salient features of Indian Factories Act, Importance of Safety at work places, Hazards, causes of accidents, Entrepreneur and entrepreneurship -Concept, definition, role, expectation, Entrepreneurship Vs Management, promotion of S.S.I. Self –employment schemes, Product selection, site selection, Institutional support needed, financial assistance programs. Start up Scheme- Importance, Features and Eligibility for startup registration, Benefits

**REFERENCE BOOKS**

1. Industrial engineering and management by O.P Khanna.
2. Production management by Buffa
3. Industrial Engineering & Management Science by TR Banga
4. Engineering Economics and management science by Banga & Sharma
5. Personnel management by Flippo
6. Entrepreneurship by NITTTR Chennai.

## **ELECTRONIC RESOURCES**

1. <https://nptel.ac.in/courses/>
2. <https://www.slideshare.net/>
3. <https://en.wikipedia.org/wiki/>
4. <http://ndl.ethernet.edu.et/bitstream/>

## **SUGGESTED STUDENT ACTIVITIES**

1. Identify any 5 industries with different types of ownerships.
2. Prepare an organizational structure of institution
3. Make a survey on marketing a product.
4. Prepare a list of ISO 9000 series as well as latest quality standards
5. Prepare sign boards representing safety measures.
6. Role play as an entrepreneur

## **SUGGESTED LEARNING OUTCOMES**

*Upon completion of the course the student shall be able to*

### **1. Understand the principles and functions of management and Outline Organization structure& organizational behavior**

- 1.1 Define industry, commerce (Trade) and business.
- 1.2 Know the need for management.
- 1.3 Understand the evolution of management
- 1.4 Explain the principles of scientific management.
- 1.5 Understand functions of Management.
- 1.6 Differentiate between management and administration.
- 1.7 Understand types of ownerships
- 1.8 Differentiate types of ownerships.
- 1.9 Understand salient features of joint stock companies.
- 1.10 Understand the philosophy and need of organization structure of an industry.
- 1.11 Understand the line, staff and Functional organizations.
- 1.12 List the advantages and limitations of line, staff and functional organizations.
- 1.13 List different departments in a large scale industry.
- 1.14 Explain the factors of effective organization.
- 1.15 Understand organizational behaviour.
- 1.16 Explain job analysis.
- 1.17 State motivation theories.
- 1.18 State Maslow 's Hierarchy of needs.
- 1.19 List out different leadership models.
- 1.20 Explain the trait theory and behavior theory of leadership

### **2. Understand the Functions of Production Management**

- 2.1 Differentiate production, planning and control.
- 2.2 Relate the production department with other departments.

- 2.3 State the need for planning and its advantages.
- 2.4 Explain the stages of Production, planning and control.
- 2.5 Explain routing methods.
- 2.6 Explain scheduling methods.
- 2.7 Explain dispatching.
- 2.8 Draw PERT/CPM networks.
- 2.9 Identify the critical path
- 2.10 Problems on PERT & CPM.

### **3 Analyze the functions of Materials Management**

- 3.1 State the importance of material management.
- 3.2 Objectives and functions of material management.
- 3.3 Derive expression of EOQ for inventory control.
- 3.4 Explain ABC analysis.
- 3.5 Define safety stock, Buffer stock
- 3.6 Define reorder level.
- 3.7 Functions of stores department, duties of store keeper
- 3.8 Explain stores layout,
- 3.9 Explain the stores records.
- 3.10 Describe Cardex method.
- 3.11 Objectives and functions of purchasing department
- 3.12 Explain purchasing procedures.
- 3.13 List out purchase records.
- 3.14 Describe the stores equipments

### **4 Compare Marketing, sales & Feasibility study.**

- 4.1 Explain marketing functions.
- 4.2 Explain Sales function.
- 4.3 List out marketing conditions.
- 4.4 Differentiate Sellers and Buyers 'market.
- 4.5 Differentiate monopoly, oligopoly, and perfect competition.
- 4.6 Steps in conducting market and demand surveys.
- 4.7 Advantages and disadvantages of market and demand surveys
- 4.8 Differentiate product and production analysis.
- 4.9 Identify the input materials, i.e. Bill of materials
- 4.10 Explain the concept of cost..
- 4.11 Explain break-even analysis..
- 4.12 Evaluate Economic and Technical factors.
- 4.13 Preparation of feasibility study.
- 4.14 List out different products currently in demand with market or industry.

## **5 Know the use of ISO 9000 & T.Q.M**

- 5.1 Understand the concept of quality.
- 5.2 Know the quality systems and elements of quality systems.
- 5.3 Know the principles of quality Assurance.
- 5.4 Know the evolution of ISO standards.
- 5.5 Discuss ISO standards and ISO 9000 series of quality systems.
- 5.6 State the constituents of ISO 9000 series of standards for quality systems.
- 5.7 Benefits and Drawbacks of ISO 9000 series of standards.
- 5.8 List out the beneficiaries of ISO 9000.
- 5.9 Understand 5-S principles and ZERO DEFECT
- 5.10 Know TQM concept and elements.

## **6 Understand Industrial legislation & safety and role of entrepreneur and entrepreneurial development**

- 6.1 Describe employer and employee relations.
- 6.2 Objectives, functions, advantages and disadvantages of Trade Unions.
- 6.3 Explain Causes and settlements of industrial disputes..
- 6.4 List out Welfare activities..
- 6.5 List out the rights and responsibilities of employees and employers.
- 6.6 List out the salient features of Indian Factories Act.
- 6.7 Explain the importance of safety at Work place.
- 6.8 List out the important provisions related to safety.
- 6.9 Explain hazard and accident.
- 6.10 Explain the causes of accidents..
- 6.11 Define the word entrepreneur..
- 6.12 Difference between entrepreneurship and management.
- 6.13 Explain, expectations, role and qualities of an entrepreneur..
- 6.14 Determine the role of entrepreneurs in promoting Small Scale Industries.
- 6.15 Describe the details of self-employment schemes.
- 6.16 Explain the method of product selection.
- 6.17 Explain the method of site selection.
- 6.18 List the financial assistance programs.
- 6.19 List out the organizations that help an entrepreneur
- 6.20 Importance of Start-ups
- 6.21 Different Start-up schemes
- 6.22 Features and Eligibility for startup registration
- 6.23 Benefits of Start-ups



COURSE OUTCOMES		CL	Linked POs	Teaching Periods
CO1	Understand the principles and functions of management and Outline Organization structure& organizational behavior	R, U, A	5,6,7	13
CO2	Understand the Functions of Production Management	R, U, A	2,5,6	12
CO3	Analyse the functions of Materials Management.	U, A	1,6,7	13
CO4	Compare Marketing, sales & Feasibility study.	U, A	1,6,7,	12
CO5	Know the use of ISO 9000 & T.Q.M	U, A	1,6,7	13
CO6	Understand Industrial legislation & safety and role of entrepreneur and entrepreneurial development	R, U, A	1,6,7	12
			<b>Total Periods</b>	<b>75</b>

**Legends: R = Remember; U= Understand; A= Apply and above levels (Bloom's revised taxonomy)**

**CO-PO Attainment Matrix:**

COURSE OUTCOMES	PROGRAM OUTCOMES						
	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1					2	3	1
CO2		2			1	3	
CO3	1					2	3
CO4	1					3	2
CO5	2					3	1
CO6	1					2	3

Level 3- Highly Addressed, Level 2-Moderately Addressed, Level 1-Lowly Addressed.

**MID SEM-I EXAM**

<b>S.No</b>	<b>Unit Name</b>	<b>R</b>	<b>U</b>	<b>A</b>	<b>Remarks</b>
1	Principles and functions of management and organisation structure and behaviour	1, 2	5(a) 5(b)	7(a) 7(b)	
2	Production management	3, 4	6(a) 6(b)	8(a) 8(b)	
<b>Total Questions</b>		4	4	4	

**MID SEM-I EXAM**

<b>S.No</b>	<b>Unit Name</b>	<b>R</b>	<b>U</b>	<b>A</b>	<b>Remarks</b>
1	Materials management	1, 2	5(a) 5(b)	7(a) 7(b)	
2	Marketing, sales & feasibility study	3, 4	6(a) 6(b)	8(a) 8(b)	
<b>Total Questions</b>		4	4	4	

Legend	Remembering (R)	1 Mark
	Understanding (U)	3 Marks
	Application (A)	5 Marks

### MID SEM-I Model Paper

#### ME-501-INDUSTRIAL MANAGEMENT AND ENTREPRENEURSHIP

Time: 1 hr

Max. Marks:20

##### **PART-A**

**4x1=4Marks**

NOTE: 1) Answer all questions and each carries **one** mark.

2) Answers should be brief and straight to the point and shall not exceed three simple sentences.

1. Define Industry.
2. Write any two qualities of a leader.
3. What do you mean by Planning?
4. What does CPM Stand for.?

##### **PART-B**

**2X3M=6 Marks**

NOTE: 1) Answer all questions and each carries **three** mark.

2) Answers should be comprehensive and the criterion for valuation is the content but not length of the answer.

5.(a) what is administration

OR

5.(b) List out theories of motivation.

6.(a) what is the need for planning.

OR

6.(b) what is routing?

##### **PART-C**

**2X5M=10 Marks**

NOTE: 1) Answer all questions and each carries **five** mark.

2) Answers should be comprehensive and the criterion for valuation is the content but not length of the answer.

7.(a) Explain the principles of scientific management

OR

7.(b) a) Compare between PERT AND CPM.

b) Explain about Scheduling and Dispatching.

8.(a) Draw the project network of the given project and identify all paths through it. Find the critical path, TL and  $T_E$  on the network.

Activity	Optimistic Time(a)	Most likely Time (m)	Pessimistic Time (b)
1-2	1	1	7
1-3	1	4	7
1-4	2	2	8
2-5	1	1	1
3-5	2	5	14
4-5	2	6	10
5-6	3	6	15

OR

8.(b) State the ERG theory of motivation.

**MID SEM-II**  
**Model Paper:: ME-501**  
**INDUSTRIAL MANAGEMENT AND ENTREPRENEURSHIP**

Time: 1 hr

Max. Marks:20

**PART-A**

**4x1=4Marks**

NOTE: 1) Answer all questions and each carries **one** mark.

2) Answers should be brief and straight to the point and shall not be exceed three simple sentences.

1. Write the formula to calculate EOQ?
2. What is Buffer Stock?
3. What Is feasibility study?
4. What is Breakeven Point?

**PART-B**

**2X3M=6 Marks**

NOTE: 1) Answer all questions and each carries **three** mark.

2) Answers should be comprehensive and the criterion for valuation is the content but not length of the answer.

5.(a) List the advantages of ABC analysis.

OR

5.(b) State the functions of Material Management.

6.(a) List out the element of cost ?

OR

6.(b) what is buyer's market and seller's market.

**PART-C**

**2X5M=10 Marks**

NOTE: 1) Answer all questions and each carries **five** mark.

2) Answers should be comprehensive and the criterion for valuation is the content but not length of the answer.

7.(a) Explain the functions of Purchase management.

OR

7.(b) Explain various records used in stores.

8.(a) What is Break Even analysis? Illustrate graphically the concept of Break even point.

OR

8.(b) Differentiate product and product analysis.

**BOARD DIPLOMA EXAMINATION, (C-21)**  
**SEE-MODEL PAPER ME-501**  
**DME– V SEMESTER EXAMINATION**  
**INDUSTRIAL MANAGEMENT AND ENTREPRENEURSHIP**

**Time:** 2 Hours

**Max. Marks:** 40

**PART-A**

8 X 1 = 8

**Instructions:** 1. Answer **ALL** questions.  
2. Each question carries **ONE** mark.

1. Define Trade.
2. What is a bin card
3. List two benefits of ISO 9000 certification.
4. Define a Network.
5. Define quality control.
6. What is ISO.
7. What is the purpose of Trade unions.
8. Define an entrepreneur.

**PART-B**

4 X 3 = 12

**Instructions:** 1. Answer **ALL** questions.  
2. Each question carries **THREE** marks.

9. (a) State any three differences between share and debenture.  
OR
9. (b) What are the 5-S principles.
10. (a) List any three advantages of ABC analysis.  
OR
10. (b) Mention three qualities required for a good entrepreneur .
11. (a) List the beneficiaries of ISO 9000  
OR
11. (b) State the features of ISO 9000.
12. (a) What are the expectations of an entrepreneur  
OR
12. (b) Explain the significance of collective bargaining.

**PART-C**

4 X 5 = 20

**Instructions:** 1. Answer **ALL** questions.

2. Each question carries **FIVE** marks.

13. (a) Explain the principles of Scientific management stated by F.W. Taylor

OR

13(b) What is quality system? Explain various elements of quality systems.

14 (a) Explain ABC analysis in inventory control with graph.

OR

14( b) Explain the factors influencing the site selection for a plant location.

15 (a) What is TQM? Write the principles or elements of TQM.

OR

15(b) Explain the importance of certification of confirmation to ISO 9000 and the procedure of obtaining it ?

16(a) List out the three rights and responsibilities of Employees.

OR

16(b) State Indian electricity rules with regard to safety.

## EE-502-AC MOTORS

Course Title	AC Motors	Course Code	EE-502
Semester	V	Course Group	Core
Teaching Scheme in Periods (L: T: P)	4:1:0	Credits	3
Methodology	Lecture + Tutorial	Total Contact Periods	75
CIE (Continuous Internal Evaluation)	60 Marks	SEE (Semester End Examination)	40 Marks

### Pre requisites

This course requires the knowledge of Basic Principles of Electricity and Magnetism,

### Course Outcomes

CO1 :	Describe the construction and working of Synchronous Motor
CO2 :	Apply different starting methods and select a suitable 3 phase induction motor for particular application.
CO3 :	Describe the construction & working of 3 Phase Induction Motors
CO4 :	Draw the Torque-Slip curves and evaluate the performance of 3 phase induction Motor.
CO5 :	Apply different starting and speed control methods of 3 phase Induction Motor
CO6 :	Describe the construction & working of Single-Phase Motors

### Blue Print of Marks for SEE

Unit No	Unit Name	Periods	Questions to be set for SEE			
			R		U	A
1	Synchronous Motors	15	Q4	Q1	Q9(a)	Q13(a)
2	Starters and Applications of Synchronous Motors	10				
3	3 phase Induction Motors	10		Q2	Q10(a)	Q14(a)
4	Characteristics of 3 phase Induction Motor	15				
5	Starters and Speed Control of 3 phase Induction Motor	10		Q3	Q9(b), Q11(a), Q11(b)	Q13(b), Q15(a), Q15(b)
6	Single phase and Special purpose Motors	15			Q7,Q8	Q10(b), Q12(a), Q12(b)
Total		75	8		8	8

## **Course Content**

### **UNIT - 1 Synchronous Motors**

**Duration: 15 Periods (L: 12 -T: 3)**

Introduction - Rotating Magnetic field, synchronous speed, parts of synchronous Motor – Excitation of rotor -working Principle – Back EMF – Resistance and synchronous Reactance – Effects of Load, Phasor diagrams – Load Angle, power relation, Effects of change of Excitation at constant Load, Phasor diagrams for: (a) Normal, (b) Under and c) Over excitation conditions, Effects of Excitation on Armature current and power factor, Relation between Back EMF applied voltage, Simple problems - V – Curves and inverted V – curves ,constant power lines.

### **UNIT – 2 Starters and Applications of Synchronous Motors**

**Duration: 10 Periods (L: 8 -T: 2)**

Starting Device necessity – Methods of starting, phenomenon of hunting and its undesirable effects – Methods to prevent hunting - State the different speed control methods synchronous motor Explain with block diagram Inverter Fed Open Loop Synchronous Motor Drive Explain With block diagram Closed Loop Synchronous ( Self Synchronous) Motor Drive synchronous condenser- calculation of KVA / KVAR Rating – problems - Applications of synchronous motor.

### **UNIT – 3 Three phase Induction Motors**

**Duration: 10 Periods (L: 8 -T: 2)**

Introduction – Constructional features – types of rotors - Principle of working & self starting features, actual rotor speed - synchronous speed – slip - Effect of loading on slip – frequency and magnitude of rotor EMF and reactance – Expression for rotor current on no load and On Load – problems - Induction motor as a generalized transformer - Losses and Power transfer stages from stator to rotor - efficiency – Relation between rotor copper losses , Rotor output and rotor input derivation and problems.

### **UNIT – 4- Characteristics of 3 phase Induction Motor**

**Duration: 15 Periods (L: 12 - T: 3)**

Torque equation – Starting torque - condition for maximum torque – Relation Between full load torque, starting Torque and maximum torque – Torque slip curves – modes of operation of induction machine – braking of induction motor (no derivation and problems) - effects and variation of rotor resistance and reactance on starting, full load and maximum torque - Effect of supply voltage on torque and speed – problems

### **UNIT - 5 Circle diagram, Starters and Speed Control of 3-phase Induction Motor**

**Duration: 10 Periods (L: 8 -T: 2)**

No load and blocked rotor tests - circle diagram from test data – Evaluation of torque – efficiency - problems-Starters for Induction motor – necessity of starters - Direct Switching - D.O.L starter - Star / Delta starter- Auto Transformer starter -rotor resistance starters- Block Diagram of soft starter –Advantages and Disadvantages- Double cage rotor motor – Improvement in performance features - Speed variation of induction motors - Application of induction motors - Comparison of Synchronous and induction motors.



## **UNIT - 6 Single phase and Special purpose Motors**

**Duration: 15 Periods (L: 12 - T: 3)**

Essential parts and constructional features of single phase motors – self starting -split phase, capacitor start - capacitor run - shaded pole induction motor- Principle of working – Accessories like capacitors, centrifugal switch – function –reversal of rotation - Applications - relative merits - A.C series motor – principles of working – sparking elimination methods - applications - Universal motor- principle of working, speed control and applications- Stepper motor-principle of working and applications- Servo motor - principle of working and applications – linear induction motors – principle of working and applications – BLDC and PMDC motors – principle of working and applications

### **Recommended Books**

1. Electrical Technology by B.L. Theraja
2. Electrical Technology by J.B. Gupta
3. Electrical Technology by H. Cotton
4. Performance and design of A.C. Machines by M.G, Say
5. Performance of A.C. Machines by Langsdorf
6. Electrical motors applications and control by M.V. Deshpande

### **Suggested E-Learning references**

1. <http://electrical4u.com>
2. <https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/>
3. [www.nptel.ac.in](http://www.nptel.ac.in)

### **Suggested Learning Outcomes**

**After completion of the subject, the student shall be able to**

- 1.1 State the Principle of Production of Rotating Magnetic Field in 3-phase System.
- 1.2 Describe the construction of synchronous motor.
- 1.3 State the parts of synchronous motor and explain.
- 1.4 Explain the principle of working of synchronous motor.
- 1.5 Describe the performance of synchronous motor on Load with phasor diagrams.
- 1.6 Derive the expression for Back EMF in synchronous motor
- 1.7 Effects of change of Excitation at constant Load, Phasor diagrams for:  
(a) Normal, (b) Under and c) Over excitation conditions
- 1.8 Effects of Excitation on Armature current and power factor
- 1.9 Relation between Back EMF applied voltage
- 1.10 Simple problems on Back EMF applied voltage

- 1.11 Describe the significance of 'V' curve.
  - 1.12 Draw the 'V' curves for different loads.
  - 1.13 Describe the significance of inverted 'V' curve.
  - 1.14 Draw the inverted 'V' curve for different loads.
  - 1.15 Draw the constant power lines of synchronous motor
- 
- 2.1 Explain the starting method of synchronous motor by Auxiliary motor.
  - 2.2 Explain the starting method of synchronous motor by Damper winding.
  - 2.3 Describe the phenomenon of HUNTING.
  - 2.4 State "How HUNTING is prevented"?
  - 2.5 State the different speed control methods synchronous motor
  - 2.6 Explain with block diagram Inverter Fed Open Loop Synchronous Motor Drive
  - 2.7 Explain With block diagram Closed Loop Synchronous ( Self Synchronous) Motor Drive
  - 2.8 Explain how a Synchronous motor can be used as a Synchronous condenser.
  - 2.9 Solve simple problems on power factor correction.
  - 2.10 State the applications of synchronous motor.
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- 3.1 Explain the advantages of Induction Motors.
  - 3.2 Describe the construction of slip ring Induction motor.
  - 3.3 Explain the construction of squirrel cage Induction motor.
  - 3.4 State the working principle of 3 phase induction motor.
  - 3.5 Explain working of 3 phase induction motor on no load.
  - 3.6 Describe working of 3 phase induction motor on Load.
  - 3.7 Describe a Slip, Effect of loading on slip
  - 3.8 Frequency and magnitude of rotor EMF and reactance –
  - 3.9 Expression for rotor current on no load and On Load – problems
  - 3.10 Relation between rotor copper losses ,
  - 3.11 Rotor output and rotor input derivation and problems.
  - 3.12 Explain how an induction motor is treated as a generalized transformer.

- 3.13 Describe Power flow diagram and Efficiency.
- 3.14 Solve simple problems on Power and Efficiency.
  
- 4.1 Derive Torque Equation
- 4.2 Draw Torque – Slip characteristics of induction motor.
- 4.3 Explain effect of resistance on Torque slip characteristics.
- 4.4 List various modes of operation of induction machine.
- 4.5 Name different braking methods.
- 4.6 Describe the plugging of three phase induction motor.
- 4.7 Describe the Rheostatic braking of three phase induction motor.
- 4.8 Describe the regenerative braking of three phase induction motor.
- 4.9 Derive the expression for full load torque.
- 4.10 Explain the expression for starting torque.
- 4.11 Derive the expression for maximum torque.
- 4.12 Derive the relation between full load torque, starting Torque and maximum torque.
- 4.13 Solve simple problems on Torque.
  
- 5.1 Explain No-load test on induction motor
- 5.2 Describe blocked rotor test on induction motor
- 5.3 Draw circle diagram with the help of no-load and blocked rotor tests
- 5.4 Solve problems on circle diagram.
- 5.5 List different types of starters used for induction motors.
- 5.6 Sketch the circuit diagram and explain the working of D.O.L. starter.
- 5.7 Sketch the circuit diagram and explain the working of primary resistor starter
- 5.8 Sketch the circuit diagram and explain the working of Star/Delta Starter.
- 5.9 Sketch the circuit diagram and explain the working of Auto - Transformer starter.
- 5.10 Sketch the circuit diagram and explain the working of Rotor resistance starter.
- 5.11 Explain the working of Soft starter with block diagram
- 5.12 State the advantages of soft starter over conventional starters.
- 5.13 Explain construction features of double cage rotor motor.

- 5.14 Describe the speed control of inductor motors by Frequency changing.
- 5.15 Explain the speed control of inductor motors by Pole changing method.
- 5.16 Describe the speed control of inductor motors by Injecting voltage in rotor circuit.
- 5.17 Explain the speed control of inductor motors by Cascading method.
- 5.18 State the applications of inductor motors
- 5.19 Compare synchronous motors with induction motors.

- 6.1 State the types of single phase induction motors.
- 6.2 Describe the constructional features of single phase induction motor.
- 6.3 Explain the principle of working of single phase Induction motor by double field revolving theory.
- 6.4 Describe the principle of working of single phase Induction motor by cross field theory.
- 6.5 Why a Single-phase Induction motor is not Self starting?
- 6.6 Describe the working of split phase motor
- 6.7 Describe the working of capacitor start motor
- 6.8 Describe the working of capacitor run motor
- 6.9 Mention the differences between capacitor start and capacitor run induction motors
- 6.10 Describe the working of double value capacitor run motor.
- 6.11 Describe the working of shaded pole motor
- 6.12 State the applications of single phase induction motors
- 6.13 Compare single phase with three phase induction motors
- 6.14 Explain the working of linear induction motor.
- 6.15 State the applications of linear induction motor
- 6.16 Describe the working of single phase AC Series motor.
- 6.17 Explain the methods to eliminate sparking in AC series motor.
- 6.18 State the applications of single phase AC Series motor.
- 6.19 Explain the working of universal motor.
- 6.20 Explain the speed control of universal motor.
- 6.21 State the applications of single phase universal motor.

- 6.22 Explain the principle of working of Stepper motor.
- 6.23 State the applications of Stepper motor.
- 6.24 Describe the principle of working of Servo motor.
- 6.25 State the applications of Servo motor.
- 6.26 Describe the principle of working of PMDC motor.
- 6.27 State the applications of PMDC motor.
- 6.28 Describe the principle of working of BLDC motor.
- 6.29 State the applications of BLDC motor.

### Suggested Student Activities

1. Student visits Library to refer to Electrical Manuals
2. Student visits the Lab to identify the available electrical equipments.
3. Each Student has to prepare and submit at least 3 pages of self hand written report on (Construction details, type of windings used, Insulating materials used, applications etc.,) Preferably by visiting a nearby Substation/ Power station/ Industry/ Factory etc., considering any one of the following topics.
  - a) 3-ph Induction motor- Squirrel-cage and Slip-ring type.
  - b) Speed control of Induction motor.
  - c) Types of Starters.
  - d) 3-ph Synchronous Motors.
  - e) 1-ph motors...
4. Quiz
5. Group Discussion
6. Surprise Test

### CO-PO Mapping Matrix

	Basic and Discipline specific Knowledge	Problem Analysis	Design/Development of solutions	Engineering Tools	Engineering practices for society sustainability and environment	Project Management	Life-long learning	Linked PO
CO\PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	
CO1	3	2	2		3		3	1,2,3,5,7
CO2	3	3	3		3		3	1,2,3,5,7
CO3	3	3	3		3		3	1,2,3,5,7
CO4	3	3	3		3		3	1,2,3,5,7
CO5	3	3	3		3		3	1,2,3,5,7
CO6	3	3	3		3		3	1,2,3,5,7

**Internal Evaluation**

Test	Units	Marks
Mid Sem 1	1 and 2	20
Mid Sem 2	3 and 4	20
Slip Test 1	1 and 2	5
Slip Test 2	3 and 4	5
Assignments	-	5
Seminars	-	5
	Total	60

**QUESTION PAPER PATTERN FOR MID SEMESTER EXAMS**

Sl.No	Description	Level	No of Questions	Marks for each question	Choice	Total Marks
01	Part-A	Remembering(R)	4	1	Nil	4 Marks
02	Part-B	Understanding(U)	4	3	2	6 Marks
03	Part-C	Application(A)	4	5	2	10 Marks
Total Marks						20 Marks

**MID SEM-I EXAM**

S.No	Unit No	R	U	A	Remarks
1	Unit-I	1,2	5(a)	7(a)	
			5(b)	7(b)	
2	Unit-II	3,4	6(a)	8(a)	
			6(b)	8(b)	
Total Questions		4	4	4	

**MID SEM-II EXAM**

S.No	Unit No	R	U	A	Remarks
1	Unit-III	1,2	5(a)	7(a)	
			5(b)	7(b)	
2	Unit-IV	3,4	6(a)	8(a)	
			6(b)	8(b)	
Total Questions		4	4	4	

**The length of answer for each question framed in respect of Part-A, B&C shall not exceed ¼ of a page side, 1 page side and 2page sides respectively**

**QUESTION PAPER PATTERN FOR SEMESTER END EXAM**

Sl.No	Description	Level	No of Questions	Marks for each question	Choice	Total Marks
01	Part-A	Remembering(R)	8	1	Nil	8 Marks
02	Part-B	Understanding(U)	8	3	4	12 Marks
03	Part-C	Application(A)	8	5	4	20 Marks
Total Marks						40 Marks

Unit No	Questions to be set for SEE				
	R		U		A
I	Q4	Q1		Q9(a)	Q13(a)
II					
III		Q2		Q10(a)	Q14(a)
IV					
V		Q3	Q5,Q6	Q9(b), Q11(a), Q11(b)	Q13(b), Q15(a), Q15(b)
VI					
Total Questions	8		8	8	

**STATE BOARD OF TECHNICAL EDUCATION & TRAINING, TELANGANA**  
**DIPLOMA IN ELECTRICAL & ELECTRONICS ENGINEERING**

**SUB CODE: EE-502**

**AC MOTORS**

**MID SEM -I EXAM MODEL PAPER**

**TIME: 60 MIN.**

**TOTAL MARKS: 20**

**PART – A**

**Marks: 4 X 1= 4**

**Instructions:** (1) Answer all questions  
(2) Each question carries **one** mark.

1. Define 'V' curve.
2. On which parameters inverted 'V' curve is drawn.
3. Why damper winding is used.
4. List any two applications of synchronous motor.

**PART - B**

**Marks: 2 x 3 = 6**

**Instructions:** (1) Answer **all** questions.  
(2) Each question carries **three** marks.

5.(a) State the parts of synchronous motor

OR

5.(b) Describe the significance of inverted 'V' curve.

6.(a) Explain the phenomenon of HUNTING.

OR

6. (b) State "How HUNTING is prevented"?

**PART - C**

**Marks: 2 x 5= 10**

**Instructions:** (1) Answer **all** questions.  
(2) Each question carries **five** marks.

7.(a). Explain the principle of working of synchronous motor.

OR

7.(b). Describe the construction of synchronous motor.

8.(a). Explain the starting method of synchronous motor by Auxiliary motor.

OR

8.(b). Explain how a Synchronous motor can be used as a Synchronous condenser.



**STATE BOARD OF TECHNICAL EDUCATION & TRAINING, TELANGANA**  
**DIPLOMA IN ELECTRICAL & ELECTRONICS ENGINEERING**

**SUB CODE: EE-502**

**AC MOTORS**

**MID SEM -II EXAM MODEL PAPER**

**TIME: 60 MIN.**

**TOTAL MARKS: 20**

**PART – A**

**Marks: 4 X 1 = 4**

**Instructions:** (1) Answer all questions  
(2) Each question carries **one** mark.

1. Write the types of three phase induction motors.
2. In which type of three phase induction motor adding of external resistance is not possible.
3. Write the expression for starting torque.
4. Write the tests on three phase induction motor.

**PART - B**

**Marks: 2 x 3 = 6**

**Instructions:** (1) Answer all questions.  
(2) Each question carries **three** marks.

- 5.(a). Write the Power flow diagram of three phase induction motor.

OR

- 5.(b). Write the advantages of three phase induction motors.

- 6.(a). Draw the Torque - Slip characteristics of induction motor.

OR

- 6.(b). Derive the expression for maximum torque

**PART - C**

**Marks: 2 x 5 = 10**

**Instructions:** (1) Answer **all** questions.  
(2) Each question carries **five** marks.

- 7.(a). Explain the construction of slip ring Induction motor.

OR

- 7.(b). Explain the working principle of squirrel cage Induction motor

- 8.(a). Explain the procedure to conduct No-load test on induction motor.

OR

- 8.(b). Explain the procedure to conduct blocked rotor test on induction motor

**STATE BOARD OF TECHNICAL EDUCATION & TRAINING, TELANGANA**  
**DIPLOMA IN ELECTRICAL & ELECTRONICS ENGINEERING**

**SUB CODE: EE-502**

**AC MOTORS**

**SEMESTER END EXAM MODEL PAPER**

**TIME: 2 HOURS**

**TOTAL MARKS: 40**

---

**PART – A**

**Marks : 8 X 1 = 8**

**Instructions:** (1) Answer all questions  
(2) Each question carries **one** mark.

1. Draw inverted 'V' curves for different loads.
2. What are the types of three phase induction motors.
3. List any two starters used for three-phase induction motor.
4. Draw the graph between armature current and field current of three-phase synchronous motor.
5. List any two methods of speed control of three-phase squirrel cage induction motor.
6. Suggest suitable starter for a three-phase 10 HP induction motor.
7. Write the types of starting methods of single phase induction motor.
8. State any two applications of Stepper motor.

**PART - B**

**Marks: 4 × 3 = 12**

**Instructions:** (1) Answer all questions.  
(2) Each question carries **three** marks.

9.(a) State the parts of synchronous motor

OR

9.(b) Draw the sketch of D.O.L. starter

10.(a) Write any six advantages of Induction Motors

OR

10.(b) State the types of single phase induction motors.

11.(a) Draw the sketch of Auto - Transformer starter

OR

11.(b) State the applications of three phase inductor motors.

12.(a) State the working principle of single phase universal motor

OR

12.(b) State the applications of Stepper motor.

**PART – C**

**Marks:  $4 \times 5 = 20$**

**Instructions:** (1) Answer all questions.

(2) Each question carries **five** marks.

13.(a) Explain the performance of synchronous motor on Load with phasor diagrams

OR

13. (b) Sketch the circuit diagram and explain the working of Rotor resistance starter

14.(a) Derive the relation between full load torque, starting Torque and maximum torque.

OR

14.(b) Explain the working of capacitor start motor

15.(a) Explain the speed control of induction motor by change of frequency.

OR

15.(b) Compare synchronous motors with induction motors

16.(a) Explain the methods to eliminate sparking in single phase AC Series motor

OR

16.(b) Explain the working of PMDC motor.

## EE-503-POWER ELECTRONICS

Course title	Power Electronics	Course code	EE-503
Semester	V	Course group	Core
Teaching scheme in periods (L:T:P)	4:1:0	Credits	3
Methodology	Lecture + tutorial	Total contact periods	75
CIE (Continuous Internal Evaluation)	60 Marks	See (Semester End Examination)	40 Marks

### Pre requisites

This course requires the knowledge of Electronics engineering (Semiconductor devices and circuits) and Electrical Machines (DC and AC).

### Course Outcomes

CO1 :	Compare different power electronic devices and select the device based on the requirement
CO2 :	Use different Converters circuits as per requirement.
CO3 :	Acquire the knowledge to construct AC regulators and Choppers circuits.
CO4 :	Acquire the knowledge to construct and use Inverters and Cyclo-converters circuits.
CO5 :	Apply the power electronic drives for speed control of DC / AC Motors and compare specific power electronics drives.
CO6 :	Apply power electronic circuits for specific applications

### Blue Print of Marks for SEE

Unit No	Unit Name	Periods	Questions to be set for SEE				
			R		U	A	
1	Power Electronic Devices	13	Q4	Q1		Q9(a)	Q13(a)
2	Converters	12					
3	A.C Voltage regulators and Choppers	13		Q2		Q10(a)	Q14(a)
4	Inverters & Cyclo-converters	12					
5	Speed Control of DC and AC Motors	12		Q3	Q5,Q6	Q9(b), Q11(a), Q11(b)	Q13(b), Q15(a), Q15(b)
6	Applications of Power Electronic Circuits	13			Q7,Q8	Q10(b), Q12(a), Q12(b)	Q14(b), Q16(a), Q16(b)
Total		75	8		8	8	

## **Course Content**

### **UNIT 1 - Power Electronic Devices**

**Duration: 13 Periods (L: 10 - T: 3)**

ISI circuit symbols for each device in thyristor family – Construction, Working principle and static VI characteristics of devices: SCR, GTO SCR- comparison between SCR and GTO SCR- Two transistor analogy of SCR , Gate characteristics of SCR, Ratings of SCR: Forward break over voltage, latching current, holding current, turn on time, turn off time – advantages of SCR as switch -static VI characteristics and working of DIAC, TRIAC, IGBT - applications of SCR, GTO SCR, DIAC, TRIAC, IGBT, LASCR - triggering of SCR using UJT - Necessity of Commutation- various methods of Thyristor Commutation techniques.

### **UNIT 2– Converters**

**Duration: 12 Periods (L: 9 – T: 3)**

Classification of converters, Advantages and disadvantages of power electronic converters- single phase half wave controlled converter with R load, R-L load, Need of freewheeling diode- single phase half wave controlled converter with R-L load with freewheeling diode, single phase full wave full controlled converter with R load, R-L load - three phase half wave converter with R load.

### **UNIT 3 – A.C Voltage regulators and Choppers**

**Duration:13 Periods (L:10– T: 3)**

Single phase half wave and full wave AC voltage regulator with R load - Applications of AC voltage regulators - Choppers- Classification of Choppers, Four quadrant operation of a chopper, different voltage control modes of operation, Applications of choppers.

### **UNIT 4 – Inverters & Cyclo-converters**

**Duration: 12 Periods (L: 9 –T: 3)**

Classification of Inverters-basic series Inverter- parallel Inverter- single phase bridge Inverter – applications of inverters -Cyclo-converter – basic principle of operation- single-phase center tapped Cyclo-converter- applications of Cyclo-converters.

### **UNIT 5 - Speed Control of DC and AC Motors**

**Duration: 12 Periods (L: 9 –T: 3)**

Advantages of power electronic drives - DC Motor control - Speed control of DC shunt Motor and DC Series motor by using single phase converters and choppers-Compare chopper controlled drives and converter controlled drives - AC Motor Controls- speed control of 3 phase induction Motor by using AC voltage controllers.

## **UNIT 6 - Applications of Power Electronic Circuits**

**Duration: 13Periods (L: 10 –T: 3)**

Applications of power electronic circuits- Types of disturbances in commercial power supply - devices to suppress spikes in supply voltages – SMPS - On line and Off line UPS – advantages - applications – estimation of UPS rating and battery rating for a given load and backup time - Light dimmer Circuit- Burglar alarm Circuit- Emergency lamp Circuit using SCR—power control circuits using SCR – Protecting power devices.

### **Recommended Books**

1. Power Electronics– JameelAsghar PHI, New Delhi.
2. Electronics In Industry – George M. Chute & Robert D. Chute
3. Industrial Electronics – G.K.Mithal
4. Power Electronics - P.C.Sen.
5. Industrial Electronics – M.S. Berde
6. Industrial & Power Electronics- Harish Rai.
7. Industrial Electronics and Control - S.K.Bhattacharya&S.Chatterjee
8. Article by R.K.Sugandhi& KK Sugandhi -Thyristor( theory& applications)
9. Power electronics by M.D. Singh &K.B.kanchandani

### **Suggested E-Learning references**

1. <http://electrical4u.com/>
2. [www.nptel.ac.in](http://www.nptel.ac.in)
3. <https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/>
4. <http://www.eng.uwi.tt/depts/elec/staff/rdefour/ee33d/index.html>

### **Suggested Learning Outcomes**

**After completion of the subject, the student shall be able to**

- 1.1 List different devices of thyristor family.
- 1.2 Draw the ISI circuit symbols for each device in thyristor family.
- 1.3 Explain the constructional details of SCR
- 1.4 Explain the two transistor analogy of SCR.
- 1.5 Explain the static Volt – Ampere characteristics of SCR with the help of a diagram.
- 1.6 Draw the Gate characteristics of SCR
- 1.7 Explain SCR triggering by UJT.
- 1.8 Mention the ratings of SCR.

- 1.9 Give the advantages of SCR as a switch.
  - 1.10 Explain the construction of GTO SCR and its static VI characteristics with the help of diagram.
  - 1.11 Compare GTO SCR and SCR.
  - 1.12 Explain the static Volt-ampere characteristics of DIAC with the help of diagram.
  - 1.13 Explain the static Volt-ampere characteristics of TRIAC with the help of diagram.
  - 1.14 Explain the working of Insulated gate Bipolar transistor (IGBT) by giving their static V-I Characteristics.
  - 1.15 State the necessity of Commutation in SCR's
  - 1.16 Explain various methods of Commutation methods for SCR.
  - 1.17 List applications of SCR, GTO SCR, DIAC, TRIAC, IGBT, LASCR
- 
- 2.1. Classify converters.
  - 2.2. List the advantages and disadvantages of Power Electronic converters
  - 2.3. Explain the working of single-phase half wave controlled converter with Resistive load..
  - 2.4. Explain the working of single-phase half wave controlled converter with R-L load.
  - 2.5. State the need of freewheeling diode
  - 2.6. Explain the working of single-phase half wave controlled converter with R-L loads and freewheeling diode
  - 2.7. Explain the working of single phase full wave fully controlled converter with resistive load.
  - 2.8. Explain the working of single phase full wave fully controlled converter with R- L load.
  - 2.9. Explain the working of three-phase half wave controlled converter with Resistive load
  - 2.10. List the applications of Power Electronic converters
- 
- 3.1 Define AC voltage regulator.
  - 3.2 Explain the working of single phase half wave AC voltage regulator.
  - 3.3 Explain the working of single phase full wave AC voltage regulator.
  - 3.4 List the applications of AC voltage regulators.
  - 3.5 Define Chopper.
  - 3.6 Classify choppers.
  - 3.7 Explain the working principle of chopper.
  - 3.8 Describe the voltage control modes of chopper

- 3.9 Explain the working of step-down chopper.
- 3.10 Explain the operation of chopper in all four quadrants.
- 3.11 List the applications of choppers.
  
- 4.1 Define inverter.
- 4.2 Classify inverters.
- 4.3 Explain the working of series inverter.
- 4.4 Explain the working of parallel inverter
- 4.5 Explain the working of single-phase bridge inverter with R load.
- 4.6 List the applications of inverter.
- 4.7 Define Cyclo-converter.
- 4.8 Explain the basic principle of Cyclo-converter.
- 4.9 Explain the working of single-phase centre tapped Cyclo-converter.
- 4.10 List the applications of Cyclo-converter.
  
- 5.1 List the advantages of power electronic drives.
- 5.2 List the disadvantages of power electronic drives.
- 5.3 Mention the factors affecting the speed of DC Motors.
- 5.4 Explain the speed control for DC Shunt motor using single phase converters.
- 5.5 Explain the speed control for DC Series motor using single phase converters
- 5.6 Explain the speed control for DC Shunt motor and using chopper.
- 5.7 Explain the speed control for DC Series motor using chopper.
- 5.8 Compare chopper controlled drives and converter controlled drives
- 5.9 List the factors affecting speed of the AC Motors.
- 5.10 Explain the speed control of Induction Motor by using AC voltage controller.
  
- 6.1 List any six applications of power electronic circuits.
- 6.2 List the types of disturbances in commercial power supply.
- 6.3 List the devices used to suppress spikes in supply voltages.
- 6.4 Classify UPS
- 6.5 Draw and explain the block diagram of off-line UPS.
- 6.6 Draw and explain the block diagram of on-line UPS.
- 6.7 List the storage batteries used in UPS.
- 6.8 List the advantages of on-line and off-line UPS
- 6.9 List the applications of on-line and off-line UPS
- 6.10 Estimate the UPS rating and battery rating for a given load and backup time
- 6.11 Explain SMPS with block diagram.
- 6.12 List the advantages of SMPS.
- 6.13 Explain the Light dimmer circuit using DIAC/TRIAC with the help of a diagram.
- 6.14 Explain the power control circuits using SCRs.
- 6.15 Explain the mechanism of protecting power devices – overvoltage protection – crowbar circuit – Circuit breakers using SCRs.



- 6.16 Explain the Burglar alarm circuit using SCR with the help of a diagram.
- 6.17 Explain the Emergency lamp circuit using SCR with the help of a diagram.

### Suggested Student Activities

1. Student visits Library to refer to Electrical Manuals and IEEE papers on related topic
2. Student visits the Lab to experiment with converters, inverters and view the models of different applications of Power Electronics circuits
3. Visit nearby Industry to familiarize with applications of different power electronic circuits & drives
4. Quiz
5. Group discussion
6. Surprise test

### CO-PO Mapping Matrix

	Basic and Discipline specific Knowledge	Problem Analysis	Design/Development of solutions	Engineering Tools	Engineering practices for society sustainability and environment	Project Management	Life-long learning	Linked PO
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CO3	3	3	3		3		3	1,2,3,5,7
CO4	3	3	3		3		3	1,2,3,5,7
CO5	3	3	3		3		3	1,2,3,5,7
CO6	3	3	3		3		3	1,2,3,5,7

### Internal Evaluation

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	Total	60

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02	Part-B	Understanding(U)	4	3	2	6 Marks
03	Part-C	Application(A)	4	5	2	10 Marks
Total Marks						20 Marks

#### **MID SEM-I EXAM**

S.No	Unit No	R	U	A
1	Unit-I	1,2	5(a)	7(a)
			5(b)	7(b)
2	Unit-II	3,4	6(a)	8(a)
			6(b)	8(b)
Total Questions		4	4	4

#### **MID SEM-II EXAM**

S.No	Unit No	R	U	A
1	Unit-III	1,2	5(a)	7(a)
			5(b)	7(b)
2	Unit-IV	3,4	6(a)	8(a)
			6(b)	8(b)
Total Questions		4	4	4

The length of answer for each question framed in respect of Part-A, B&C shall not exceed  $\frac{1}{4}$  of a page side, 1 page side and 2page sides respectively

### **QUESTION PAPER PATTERN FOR SEMESTER END EXAM**

Sl.No	Description	Level	No of Questions	Marks for each question	Choice	Total Marks
01	Part-A	Remembering(R)	8	1	Nil	8 Marks
02	Part-B	Understanding(U)	8	3	4	12 Marks
03	Part-C	Application(A)	8	5	4	20 Marks
Total Marks						40 Marks

Unit No	Questions to be set for SEE				
	R		U		A
I	Q4	Q1		Q9(a)	Q13(a)
II					
III		Q2		Q10(a)	Q14(a)
IV					
V		Q3	Q5,Q6	Q9(b), Q11(a), Q11(b)	Q13(b), Q15(a),    Q15(b)
VI					
Total Questions	8		8	8	

**STATE BOARD OF TECHNICAL EDUCATION & TRAINING ,TELANGANA  
DIPLOMA IN ELECTRICAL & ELECTRONICS ENGG.**

**SUB CODE: EE-503**  
**POWER ELECTRONICS**  
**MID SEM -I MODEL PAPER**

**TIME: 1HOUR.**

**TOTAL MARKS: 20**

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**PART – A**

**Marks: 4Q X 1= 4**

**Instructions:** (1) Answer all questions  
(2) Each question carries **one** mark.

1. List different devices of thyristor family
2. Draw the ISI symbols for a) SCR, b) GTO SCR
3. Classify converters in any two aspects.
4. What is the need of freewheeling diode in converter

**PART - B**

**Marks: 2Q x 3 = 6**

**Instructions:** (1) Answer **all** questions.  
(2) Each question carries **three** marks.

- 5.(a) Define latching current and holding current of SCR.

OR

- 5.(b) Draw the static Volt-ampere characteristics of DIAC with the help of a diagram.

- 6.(a) Draw the input and output waveforms of single-phase half wave controlled converter with resistive load.

OR

6. (b) Write the advantages of Power Electronic converters

**PART - C**

**Marks: 2Q x 5= 10**

**Instructions:** (1) Answer **all** questions.  
(2) Each question carries **five** marks.

- 7.(a). Explain the two-transistor analogy of SCR with equivalent circuit.

OR

- 7.(b). Explain the static Volt-ampere characteristics of TRIAC with the help of a diagram.

- 8.(a). Explain the working of single phase full wave bridge converter with R- L load.

OR

- 8.(b). Explain the working of three-phase half wave controlled converter with Resistive load

**STATE BOARD OF TECHNICAL EDUCATION & TRAINING, TELANGANA**  
**DIPLOMA IN ELECTRICAL & ELECTRONICS ENGG.**

**SUB CODE: EE-503**  
**POWER ELECTRONICS**  
**MID SEM – II MODEL PAPER**

**TIME: 1 HOUR.**

**TOTAL MARKS: 20**

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**PART – A**

**Marks: 4Q X 1 = 4**

**Instructions:** (1) Answer all questions  
(2) Each question carries **one** mark.

1. Give the classification of choppers.
2. List any two applications of AC voltage regulators.
3. Classify inverters in any one aspect.
4. List any two applications of Cyclo-converters

**PART - B**

**Marks: 2Q x 3 = 6**

**Instructions:** (1) Answer all questions.  
(2) Each question carries **three** marks.

- 5.(a). Explain the working of single phase half wave AC voltage regulators.

OR

- 5.(b). Explain the working principle of chopper.
- 6.(a). Draw the input and output waveforms of series inverter.
- OR
- 6.(b). Draw the circuit of parallel inverter

**PART - C**

**Marks: 2Q x 5 = 10**

**Instructions:** (1) Answer **all** questions.  
(2) Each question carries **five** marks.

- 7.(a). Explain the working of single phase full wave AC voltage regulator.

OR

- 7.(b). Describe the voltage control modes of chopper

- 8.(a). Explain the working of single-phase bridge inverter with R load.

OR

- 8.(b). Explain the basic principle of Cyclo-converter

**STATE BOARD OF TECHNICAL EDUCATION & TRAINING, TELANGANA**  
**DIPLOMA IN ELECTRICAL & ELECTRONICS ENGG.**

**SUB CODE: EE-503**

**POWER ELECTRONICS**

**SEMESTER END EXAM MODEL PAPER**

**TIME: 2 HOURS**

**TOTAL MARKS: 40**

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**PART – A**

**Marks : 8Q X 1= 8**

**Instructions:** (1) Answer all questions  
(2) Each question carries **one** mark.

1. Draw the ISI symbols for a) TRIAC, b) LASCR
2. Define AC regulator
3. List any two applications of choppers.
4. Classify inverters based on any one aspects.
5. Draw the circuit of single phase full converter.
6. Write any two speed control methods of DC motor.
7. List any two types of UPS.
8. List any two advantages of SMPS.

**PART - B**

**Marks: 4Q×3=12**

**Instructions:** (1) Answer all questions.  
(2) Each question carries **three** marks.

9.(a). Draw the Gate characteristics of SCR.

OR

9.(b). List the factors affecting speed of the AC Motors.

10.(a). List the applications of AC voltage regulators

OR

10.(b). List any six applications of power electronic circuits

11.(a). List the advantages of power electronic drives.

OR

11.(b). Compare chopper controlled drives and converter controlled drives in any three aspects.

12.(a). List the types of disturbances in commercial power supply.

OR

12.(b). List the advantages of online UPS.

**PART – C**

**Marks:  $4Q \times 5 = 20$**

- Instructions:** (1) Answer all questions.  
(2) Each question carries **five** marks.

13.(a). Explain the static Volt-ampere characteristics of DIAC with the help of a diagram.

OR

13.(b). Explain the speed control of Induction Motor by using AC voltage controller.

14.(a). Explain the operation of chopper in all four quadrants.

OR

14.(b). Draw the block diagram of an off-line UPS.

15.(a). Explain the speed control for DC Series motor using chopper.

OR

15.(b). Explain the speed control of Induction Motor by using AC voltage controller.

16.(a). Explain the Burglar alarm circuit using SCR with the help of a diagram.

OR

16.(b). Explain the power control circuit using SCR.

## EE-574-ELECTRICAL TRACTION AND AUTOMATION

Course title	Electrical Traction and Automation	Course code	EE-574
Semester	V	Course group	Elective
Teaching scheme in periods (L:T:P)	4:1:0	Credits	3
Methodology	Lecture + tutorial	Total contact periods	75
CIE (Continuous Internal Evaluation)	60 Marks	See (Semester End Examination)	40 Marks

### Pre requisites

This course requires the knowledge of basic principles of electricity, Concept of motion, General mechanical engineering, AC and DC motors and their characteristics, Transducers, Sensors, Digital electronics.

### Course Outcomes

CO1:	Describe the present scenario of Traction Systems and Latest Trends in Electric Traction.
CO2:	Analyze Speed time curves of various services and explain the Mechanics of train movement.
CO3:	Compare different traction motors explaining their speed control and braking methods.
CO4:	Describe power transmission from Traction substation to locomotive and auxiliary equipments.
CO5:	Explain the concept of Automation and control systems with Controllers, input and output devices.
CO6:	Apply PLC for different applications and compare DCS and SCADA.



## Blue Print of Marks for SEE

Unit No	Unit Name	Periods	Questions to be set for SEE				
			R		U	A	
1	Traction Systems and Latest Trends	12	Q4	Q1	Q9(a)	Q13(a)	
2	Mechanics of Train Movement	13					
3	Traction Motors and their Control	12		Q2	Q10(a)	Q14(a)	
4	Electric Locomotives, Auxiliary Equipment and Traction Substation	13					
5	Concept of Automation	13		Q3	Q5, Q6	Q9(b), Q11(a), Q11(b)	Q13(b), Q15(a), Q15(b)
6	PLC & SCADA	12					
Total		75	8		8	8	

### Course Content

#### UNIT 1 – Traction Systems and Latest Trends

**Duration: 12Periods (L: 10 – T: 2)**

Traction systems - Steam, Diesel, Diesel-electric, Battery - electric traction systems – Significance of Diesel- Electric and Electric Traction system – Choose Diesel-Electric - Battery operated traction systems - General arrangement of D.C., A.C. single phase, 3 phase, Composite systems - Present scenario of Indian Railways: High speed traction, Metro - Latest trends in traction - Metro, monorail, Magnetic levitation Vehicle.

#### UNIT 2 – Mechanics of Train Movement

**Duration: 13Periods (L: 10 – T: 3)**

Analysis of speed time curves for main line, suburban and urban services - Simplified speed time curves. - Relationship between principal quantities in speed time curves – Problems - Requirement of tractive effort – Problems – Mechanics of transfer of power from motor to driving wheel - Coefficient of Adhesion – Problems .

### **UNIT 3 - Traction Motors and their Control**

**Duration: 12Periods (L: 10 – T: 2)**

Features of traction motors - Significance of D.C. series motor as traction motor - A. C. Traction motors-single phase, Three phase, Linear Induction Motor - Comparison between different traction motors – Starting & Control methods of traction motors - Series-parallel control - Open circuit, Shunt and bridge transition for Dc Motors - Pulse Width Modulation control of induction motors-- Types of electric braking system for traction motors.

### **UNIT 4 - Electric Locomotives, Auxiliary Equipment and Traction Substation**

**Duration: 13Periods (L: 10 – T: 3)**

Classify electric locomotives – Block diagram of Electric locomotive – Function of Auxiliaries - Current collecting equipment –OHE - Neutral section – Section Insulator –Booster transformer – Constituents of supply system in Traction sub-station - Protection of traction equipment - Transformer – 25KV Centenary Protection - Coach lighting systems-Method of obtaining Unidirectional polarity and constant output - Requirements of railway coach air conditioning.

### **UNIT 5 – Concept of Automation**

**Duration: 13Periods (L: 10 – T: 3)**

Automation – advantages of Automation- requirements for Automation - Control system - Significance of feedback - Block diagram of Open loop and closed loop control systems - Components of control systems – NO and NC contacts – Push buttons - Selector switches – Limit switches - Electrical Actuators and Controllers -AC and DC Solenoids – Output Devices - Electromagnetic Relay – Reed Relay – Potentiometers as an error detector- Synchros as error detector –Purpose of tachogenerator – Concept of Electrical, electronics and digital controllers .

### **UNIT 6 – PLC & SCADA**

**Duration: 12 Periods (L: 10 - T: 2)**

PLC Definition-advantages-Block diagram-Ladder diagrams for AND, OR, NOT, NAND, NOR, XOR, XNOR – Timers - Counters -Ladder diagram for DOL starter, Star-Delta Starter, Stair case lighting, Temperature controller-Special control systems-DCS, SCADA- its components.

#### **Recommended Books**

1. Electrical motors applications and control by M.V.Deshpande.
2. Electric Traction by H.Partab.
3. Electric Traction A.T. Dover.
4. Electric Traction Hand Book Sir Isaac Pitman & sons ltd., London.
5. Nagarath & Gopal- Control Systems.
6. Industrial Motor Control 7th Edition by Stephen L. Herman.
7. S.K.Bhattacharya -Control of Electrical Machines.
8. J. Michael Jacob -Industrial control engineering.
9. Jon Stenerson-Industrial automation and process control.
10. John W.Webb -Programmable Logic controllers.

## **Suggested E-Learning references**

1. <http://electrical4u.com/>
2. [www.nptel.ac.in](http://www.nptel.ac.in)
3. <https://youtube.com>

## **Suggested Learning Outcomes**

**After completion of the subject, the student shall be able to**

- 1.1 List different types of traction systems.
  - 1.2 Compare Diesel and Electric traction systems.
  - 1.3 List the types of Electric traction systems based on drive.
  - 1.4 Explain the Diesel-electric type of traction system with a block diagram.
  - 1.5 Explain the Battery - electric type of traction system with a block diagram.
  - 1.6 List the factors influencing the choice of an Electric traction drive - Diesel-Electric or Battery - Electric.
  - 1.7 State the advantages of electric traction.
  - 1.8 State the disadvantages of electric traction.
  - 1.9 List types of Track electrification systems.
  - 1.10 Describe arrangement of D.C., A.C. 1-phase, 3-phase, Composite systems for track electrification systems.
  - 1.11 Mention the Present scenario of Indian Railways: High speed traction & Metro.
  - 1.12 List the latest trends in Electric traction.
  - 1.13 State the difference between Metro and local train.
  - 1.14 Explain the Concept of Mono Rail.
  - 1.15 State the advantages of Monorail.
  - 1.16 List the drawbacks of Monorail.
  - 1.17 Explain the Concept of Magnetic levitation MAGLEV.
  - 1.18 State the advantages of MAGLEV.
  - 1.19 State the disadvantages of MAGLEV.
  - 1.20 State applications of MAGLEV.
- 
- 2.1 List the types of services (main line, suburban and urban).
  - 2.2 Sketch the speed time curves for i) Main Line ii) sub urban services iii) Urban services.

- 2.3 State each stage of the speed time curve with appropriate speed used.
- 2.4 State the importance of speed time curves.
- 2.5 Define Maximum speed, Average speed and Scheduled speed.
- 2.6 List the factors affecting the Scheduled Speed.
- 2.7 Sketch the simplified Speed Time Curves.
- 2.8 Explain the practical importance of the simplified Speed Time Curves.
- 2.9 Write the expression for Maximum Speed, Acceleration and Retardation for Trapezoidal Speed - Time Curve.
- 2.10 Solve simple problems on Trapezoidal Speed Time Curve.
- 2.11 Explain the Tractive Effort.
- 2.12 Write the expression for Tractive Effort for Acceleration, to overcome gravity pull and train resistance.
- 2.13 Calculate the Tractive effort under given conditions.
- 2.14 Explain the mechanics of transfer of power from motor to driving wheel.
- 2.15 Define 'Coefficient of Adhesion'.
- 2.16 List the factors affecting the Coefficient of Adhesion.
- 2.17 Solve problems on calculation of number of axels required.
- 2.18 State the methods of improving the Coefficient of Adhesion.
- 2.19 Explain the term specific energy consumption.
- 2.20 Derive the formulae for energy output of drive
  - To Accelerate
  - To overcome friction
  - To overcome gradient.
- 2.21 List the factors affecting specific energy consumption.
- 2.22 Solve simple problems on Specific energy calculation under given conditions.
  
- 3.1 State the desirable features of traction motors.
- 3.2 Explain Significance of D.C. series motor as traction motor over D.C. Shunt motor.
- 3.3 List the AC motors that are suitable for Traction.
- 3.4 Explain the suitability of AC motors for Traction.
- 3.5 Compare different traction motors.
- 3.6 List different starting and control methods of DC traction motors.

- 3.7 Explain the working of Series-parallel starting method – Open Circuit applied to DC traction motors.
- 3.8 List advantages of Series parallel starting.
- 3.9 Mention the difficulties associated to Series parallel starting.
- 3.10 Explain Drum controller: Series-parallel with shunt transition methods applied to DC traction motors.
- 3.11 Explain Contactor type: Series-parallel with Bridge transition methods applied to DC traction motors.
- 3.12 List different starting and control methods of AC traction motors.
- 3.13 Explain with neat sketch the control of traction motor by autotransformer method in Single phase 25 kV systems.
- 3.14 List different types of electric braking system applicable to different DC traction motors.
- 3.15 List different types of electric braking system applicable to different AC traction motors.
  
- 4.1 Classify Electric locomotives.
- 4.2 Explain the block diagram of an Electric Locomotive.
- 4.3 State the function of auxiliaries in traction system.
- 4.4 State the function of different control and auxiliary equipments used in the locomotive.
- 4.5 List the various current-collecting methods in Electric locomotives.
- 4.6 List various Overhead-Equipments (OHE).
- 4.7 Mention the purpose and material used for
  - a) Catenary
  - b) Droppers
  - c) Trolley wires
  - d) Bow collector
  - e) Pantograph collector.
- 4.8 State the importance of Neutral Section.
- 4.9 State the importance of Section Insulator.
- 4.10 State the need of Polygonal system OHE.
- 4.11 List the types of Polygonal OHE.
- 4.12 State the need for Booster Transformer.
- 4.13 List the various constituents of Supply systems in traction Substations.

4.14 State the function of various constituents of Supply systems listed below:

- i) Feeding Posts.
- ii) Feeding and Sectioning Arrangements.
- iii) Sectioning and Paralleling Post.
- iv) Sub sectioning and Paralleling Post.
- v) Sub sectioning Post.
- vi) Elementary Section.
- vii) Miscellaneous Equipments at Control Post or Switching Stations.

4.15 State the function of various Major Equipment at traction Substation:

- i) Transformer
- ii) Circuit Breaker
- iii) Interrupter.

4.16 Describe the Protective System for AC Traction – Transformer Protection.

4.17 Describe the Protective System for AC Traction –25 KV Centenary protection.

4.18 State the importance of Location and Spacing of Substations.

4.19 State the requirements of Train lighting.

4.20 Describe the concept of single battery system.

4.21 Describe the concept of Double battery parallel block system.

4.22 Describe the concept of End on Generation.

4.23 Describe the concept of Mid-on Generation

4.24 Describe the method of obtaining Unidirectional polarity.

4.25 Describe the method of obtaining constant output.

4.26 Mention the requirements of railway coach air conditioning.

5.1 State the need of Automation.

5.2 List the advantages of Automation.

5.3 State the requirements for Automation.

5.4 Define a Control system.

5.5 State the need for feedback in a control system.

5.6 Explain the Open loop control systems with a neat block diagram.

5.7 Explain the Closed loop control systems with a neat block diagram.

5.8 Compare Open loop control system and Closed loop control system.

- 5.9 List the types of contacts.
- 5.10 Explain the working of different types of Push button – NO, NC.
- 5.11 Draw the NEMA standard symbol of Normally open push button and Normally closed push button.
- 5.12 State the function of Selector switch.
- 5.13 Draw the NEMA standard symbols of Two position and Three position selector switches.
- 5.14 State the function of different types of limit switches - a) Normally closed limit switch, b) Normally open limit switch, c) Normally closed held open and d) Normally open held closed limit switches.
- 5.15 Draw the NEMA standard symbol of a) Normally closed limit switch, b) Normally open limit switch, c) Normally closed held open and d) Normally open held closed limit switches.
- 5.16 State the function of different types of Flow switches.
- 5.17 Draw the NEMA standard Symbols of different types of flow switches.
- 5.18 State the function of different types of Pressure switches.
- 5.19 Draw the NEMA standard Symbols of different types of Pressure switches.
- 5.20 State the function of different types of Temperature switches.
- 5.21 Draw the NEMA standard Symbols of different types of Temperature switches.
- 5.22 State the purpose of sensors in a control system.
- 5.23 Describe the working DC Solenoids.
- 5.24 Describe the working AC Solenoids.
- 5.25 List various output devices in a control system.
- 5.26 Explain the working of Electromagnetic relay and Reed Relay with a neat diagram.
- 5.27 Explain the working of Potentiometers as an error detector.
- 5.28 State the purpose of servomotors in a control system
- 5.29 Explain the working of Synchros - transmitter, control transformer and their use as error detector.
- 5.30 State the concept and purpose of a Tacho – generators.
- 5.31 State the concept of Electrical and Electronic controller.
- 5.32 State the concept of Digital controller.

- 6.1 Define Programmable Logic Controller (PLC).
- 6.2 State the advantages of PLC.
- 6.3 Explain the different parts of PLC by drawing the Block diagram.
- 6.4 State the applications of PLC.
- 6.5 State the purpose of Ladder diagram.
- 6.6 Explain the variable states for the following contacts and coils:  
i) Normally open      ii) Normally closed      iii) Energized output  
iv) latched Output      v) branching.
- 6.7 Draw ladder diagrams for      i) AND gate      ii) OR gate      and iii) NOT gate.
- 6.8 Draw ladder diagrams for i) NAND ii) NOR iii) Exclusive OR and iv) Exclusive NOR gates.
- 6.9 Explain the following Timers - i) T ON                      ii) T OFF      and      iii) Retentive timer.
- 6.10 Explain Counters-CTU, CTD.
- 6.11 Explain ladder diagrams for following applications  
(i) DOL starter  
(ii) STAR-DELTA starter  
(iii) Stair case lighting  
(iv) Temperature Controller.
- 6.12 Explain the hardware and software components of Distributed Control system (DCS) with a neat basic block diagram describing the function of each block.
- 6.13 Explain the hardware and software components of SCADA with a neat basic block diagram describing the function of each block.
- 6.14 Compare DCS and SCADA.
- 6.15 List the Applications of SCADA.

### **Suggested Student Activities**

1. Group discussion.
2. Surprise test.
3. Student visits to the Industries, Malls and software companies, to shops which Use/provides automation.
4. Visit to Traction workshop of Railway and understand its operation.
5. Visit to nearby traction substation and prepare the observation report.
6. Quiz.



## CO-PO Mapping Matrix

	Basic and Discipline specific Knowledge	Problem Analysis	Design/Development of solutions	Engineering Tools	Engineering practices for society sustainability	Project Management	Life-long learning	Linked PO
CO\PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	
CO1	3	2	2		3		3	PO1,2,3,5,7
CO2	3	3	3		3		3	PO1,2,3,5,7
CO3	3	3	3		3		3	PO1,2,3,5,7
CO4	3	3	3		3		3	PO1,2,3,5,7
CO5	3	3	3		3		3	PO1,2,3,5,7
CO6	3	3	3		3		3	PO1,2,3,5,7

## Continuous Internal Evaluation (CIE)

Test	Units	Marks
Mid Sem 1	1 and 2	20
Mid Sem 2	3 and 4	20
Slip Test 1	1 and 2	5
Slip Test 2	3 and 4	5
Assignments	-	5
Seminars	-	5
	Total	60

**QUESTION PAPER PATTERN FOR MID SEMESTER EXAMS**

Sl.No	Description	Level	No of Questions	Marks for each question	Choice	Total Marks
01	Part-A	Remembering(R)	4	1	Nil	4 Marks
02	Part-B	Understanding(U)	4	3	2	6 Marks
03	Part-C	Application(A)	4	5	2	10 Marks
Total Marks						20 Marks

**MID SEM-I EXAM**

S.No	Unit No	R	U	A
1	Unit-I	1,2	5(a)	7(a)
			5(b)	7(b)
2	Unit-II	3,4	6(a)	8(a)
			6(b)	8(b)
Total Questions		4	4	4

**MID SEM-II EXAM**

S.No	Unit No	R	U	A
1	Unit-III	1,2	5(a)	7(a)
			5(b)	7(b)
2	Unit-IV	3,4	6(a)	8(a)
			6(b)	8(b)
Total Questions		4	4	4

The length of answer for each question framed in respect of Part-A, B&C shall not exceed  $\frac{1}{4}$  of a page side, 1 page side and 2page sides respectively.

**QUESTION PAPER PATTERN FOR SEMESTER END EXAM**

Sl.No	Description	Level	No of Questions	Marks for each question	Choice	Total Marks
01	Part-A	Remembering(R)	8	1	Nil	8 Marks
02	Part-B	Understanding(U)	8	3	4	12 Marks
03	Part-C	Application(A)	8	5	4	20 Marks
Total Marks						40 Marks

Unit No	Questions to be set for SEE				
	R			U	A
I	Q4	Q1		Q9(a)	Q13(a)
II					
III		Q2		Q10(a)	Q14(a)
IV					
V		Q3	Q5,Q6	Q9(b), Q11(a), Q11(b)	Q13(b), Q15(a), Q15(b)
VI			Q7,Q8	Q10(b), Q12(a), Q12(b)	Q14(b), Q16(a), Q16(b)
Total Questions	8			8	8

**STATE BOARD OF TECHNICAL EDUCATION & TRAINING, TELANGANA**  
**DIPLOMA IN ELECTRICAL & ELECTRONICS ENGG.**

**SUB CODE: EE-574**

**ELECTRICAL TRACTION AND AUTOMATION**  
**MID SEM -I EXAM MODEL PAPER**

**TIME: 60 MIN.**

**TOTAL MARKS: 20**

**PART – A**

**Marks: 4 X 1 = 4**

**Instructions:** (1) Answer all questions  
(2) Each question carries **one** mark.

1. List different types of traction systems.
2. State any two advantages of Monorail.
3. List the types of services in traction.
4. Define 'Coefficient of Adhesion'.

**PART - B**

**Marks: 2 x 3 = 6**

**Instructions:** (1) Answer **all** questions.  
(2) Each question carries **three** marks.

5.(a) Compare Diesel and Electric traction systems in any three aspects.

OR

5.(b) Describe arrangement of 3-phase systems for track electrification systems.

6.(a) Sketch the speed time curves for i) Main Line ii) sub urban services iii) Urban services.

OR

6. (b) List the factors affecting the Coefficient of Adhesion.

**PART - C**

**Marks: 2 x 5 = 10**

**Instructions:** (1) Answer **all** questions.  
(2) Each question carries **five** marks.

7.(a). Explain the Diesel-electric type of traction system with a block diagram.

OR

7.(b). Explain the Concept of Magnetic levitation MAGLEV.

8.(a). Derive the formulae for energy output of drive to accelerate, to overcome friction and to overcome gradient.

OR

8.(b). A train accelerates to a speed of 48km/hr in 24sec. Then it coasts for 69sec under a constant resistance of 58 Newton / tonne and brakes are applied at 3.3km/hr/sec in 11sec. calculate (i) the acceleration (ii) the coasting retardation (iii) the scheduled speed if station stoppage is 20secs.

**STATE BOARD OF TECHNICAL EDUCATION & TRAINING, TELANGANA**  
**DIPLOMA IN ELECTRICAL & ELECTRONICS ENGG.**

**SUB CODE: EE-574**

**ELECTRICAL TRACTION & AUTOMATION**  
**MID SEM -II EXAM MODEL PAPER**

**TIME: 60 MIN.**

**TOTAL MARKS: 20**

**PART – A**

**Marks: 4 X 1 = 4**

**Instructions:** (1) Answer all questions

(2) Each question carries **one** mark.

1. List different types of electric braking system applicable to DC traction motors.
2. Name the AC motors that are suitable for Traction.
3. Mention the purpose and material used for Catenary.
4. State the importance of Neutral Section.

**PART - B**

**Marks: 2 x 3 = 6**

**Instructions:** (1) Answer all questions.

(2) Each question carries **three** marks.

5(a) Compare different traction motors.

OR

5.(b). List different starting and control methods of DC traction motors.

6.(a). List the various constituents of Supply systems in traction Substations

OR

6.(b). State the function of below Equipments that are used at traction Substation:

- i) Transformer
- ii) Circuit Breaker
- iii) Interrupter.

**PART - C**

**Marks: 2 x 5 = 10**

**Instructions:** (1) Answer **all** questions.

(2) Each question carries **five** marks.

7.(a). Explain Drum controller: Series-parallel with shunt transition method applied to DC traction motors.

OR

7.(b). Explain with neat sketch the control of traction motor by autotransformer method in Single phase 25 kV systems.

8.(a). Explain the block diagram of an Electric Locomotive.

OR

8.(b). Describe the concept of Double battery parallel block system.

**STATE BOARD OF TECHNICAL EDUCATION & TRAINING, TELANGANA**  
**DIPLOMA IN ELECTRICAL & ELECTRONICS ENGG.**

**SUB CODE: EE-574**

**ELECTRICAL TRACTION & AUTOMATION**  
**SEMESTER END EXAM MODEL PAPER**

**TIME: 2 HOURS**

**TOTAL MARKS: 40**

**PART – A**

**Marks: 8 X 1= 8**

**Instructions:** (1) Answer all questions  
(2) Each question carries **one** mark.

1. List the types of Electric traction systems based on drive.
2. List advantages of Series parallel starting.
3. State the need of Automation.
4. State the importance of speed time curves.
5. Define a Control system.
6. List any two examples of output devices in a control system.
7. State any two advantages of PLC.
8. Draw the ladder diagram of AND gate.

**PART - B**

**Marks: 4 × 3= 12**

**Instructions:** (1) Answer all questions.  
(2) Each question carries **three** marks.

9.(a) Explain the Tractive Effort.

OR

9.(b) Explain the working of Electromagnetic relay with a neat diagram.

10.(a) State the function of various constituents of Supply systems listed below:

- i) Feeding Posts.
- ii) Feeding and Sectioning Arrangements.
- iii) Sectioning and Paralleling Post.

OR

10.(b) Compare DCS and SCADA.

11.(a) Describe the working DC Solenoids.

OR

11.(b) State the concept and purpose of a Tacho – generator.

12.(a) List the Applications of SCADA.

OR

12.(b) Explain the Up Counters-CTU.

## PART – C

**Marks:  $4 \times 5 = 20$**

**Instructions:** (1) Answer all questions.  
(2) Each question carries **five** marks.

13.(a) Explain the Diesel-electric type of traction system with a block diagram.

OR

13. (b) Explain the Closed loop control systems with a neat block diagram.

14.(a) Explain the block diagram of an Electric Locomotive.

OR

14.(b) Explain the hardware and software components of SCADA with a neat block diagram describing the function of each block.

15.(a) Explain the working of Synchros - transmitter, Control transformer and their use as error detector.

OR

15.(b) Explain the working of Reed Relay with a neat diagram.

16.(a) Explain different parts of PLC by drawing the Block diagram.

OR

16.(b) Explain ladder diagrams for Star delta starter.

## EE-584-ELECTRICAL ESTIMATION AND UTILIZATION

Course Title	Electrical Estimation and Utilization	Course Code	EE-584
Semester	V	Course Group	Core
Teaching Scheme in Periods (L:T:P)	4:1:0	Credits	3
Methodology	Lecture + Tutorial	Total Contact Periods	75
CIE	60 Marks	SEE	40 Marks

### Prerequisites

This course requires the knowledge of basic principles of electricity, electrical workshop, types of loads in domestic and industrial use. It also requires fundamental understanding of types of lamps, heating devices, welding meaning, various motors and their characteristics.

### Course Outcomes

CO1 :	Infer various wiring systems and estimate the materials required for domestic wiring
CO2 :	Estimate the materials required for power loads, irrigation pumps and earthing system
CO3 :	Estimate materials required for over head line and distribution substations.
CO4 :	Perceive laws of illumination and requirements of good lighting
CO5 :	Analyze electric heating, methods of electric heating and welding
CO6 :	Analyze train electrification and speed time curves , tractive effort and various traction equipment used

### Blue Print of Marks for SEE

Unit No	Unit Name	Periods	Questions to be set for SEE				
			R		U	A	
1	Wiring Systems and Estimation of Lighting / Domestic Load	12	Q4	Q1	Q9(a)	Q13(a)	
2	Estimation of Power Loads, Irrigation Pumps and Earthing system	13					
3	Estimation of OH Lines and Distribution Substations	13		Q2	Q10(a)	Q14(a)	
4	Electrical Lighting	12					
5	Electrical Heating and Welding	12		Q3	Q5, Q6	Q9(b), Q11(a), Q11(b)	Q13(b), Q15(a), Q15(b)
6	Electric Traction	13			Q7, Q8	Q10(b), Q12(a), Q12(b)	Q14(b), Q16(a), Q16(b)
Total		75	8		8	8	



## **Course Content**

### **UNIT 1 – Wiring systems and Estimation of Lighting / Domestic Load**

**Duration: 12 Periods (L: 9 – T: 3)**

Types of house wiring systems - Various types of cables – Various types of Main switches - Different types of fuses , fuse carriers, isolators and MCBs -Types of service mains - Estimation of domestic lighting installation and their specifications - quantity of materials required – Estimation and selection of interior wiring system suitable to a given building

### **UNIT 2 – Estimation of Power Loads, Irrigation Pumps and Earthing system**

**Duration: 13 Periods (L: 10 – T: 3)**

Wiring layouts - Estimate for a small workshop - Estimate for the installation of Irrigation pump up to 10 HP - Estimate for the installation of submersible pump - estimation of materials required in electrical Earthing

### **UNIT 3 - Estimation of OH Lines and Distribution Substations**

**Duration: 13 Periods (L: 10– T: 3)**

Distribution lines of 11 kV and 400Volt OH lines - estimation - Cross arms - clamps - insulators - Estimation of quantity of materials required for structures- pole mounted substation and plinth mounted substation –Indian Electricity act 2003.

### **UNIT 4 - Electrical Lighting**

**Duration: 12 Periods (L: 9 – T: 3)**

Nature of light and its production, Terms and definitions plane and solid angle, luminous flux, Lumen, C.P. Illumination, brightness, polar curve, MHCP, MSCP, MHSCP, -Lux meter- types of lamps - Requirements of good lighting different types of lamp fittings- laws of illumination- Terms and factors used in design of lighting schemes for indoor –Illumination levels for indoor and outdoor applications- problems-LED lamps-Environmental aspects

### **UNIT 5 – Electrical Heating and Welding**

**Duration: 12 Periods (L: 9 – T: 3)**

Advantages of electric heating - requirements of good heating material and materials generally employed, resistance heating - Principle and applications - Electric arc furnaces - direct and indirect types - applications - Induction heating core type and coreless type - Applications - Dielectric heating – principle and applications.

Types of welding - Principle and applications of Resistance welding - spot welding -seam welding - butt welding - Arc welding -Metal Arc welding- Carbon Arc welding - Welding generator - welding transformer - Sequence welding circuits

#### **UNIT 6 - Electric Traction**

**Duration: 13 Periods (L:10 - T: 3)**

Introduction-different systems of train electrification-speed time curves different types of train services, urban and sub-urban-factors affecting scheduled speed -problems -Coefficient of adhesion-factors affecting the coefficient of adhesion-Tractive effort - Traction motors A.C&D.C—over head equipment-Current collecting gears-Booster transformer– MAGLEV

#### **Recommended Books**

1. Electrical motors applications and control by M.V.Deshpande
2. Electrical power by S.L.Uppal
3. Electrical power by J.B.Gupta
4. Electrical Technology Vol III by B.L. Theraja
5. Electric Traction by H. Partab
6. Electric Traction A.T. Dover
7. Electric Traction Hand Book Sir Isaac Pitman & sons Ltd., London
8. Utilisation of Electrical Energy.(in SI units) E.O. Taylor (Indian Edition)
9. A course in Electrical Power (in SI units) J.B. Gupta
10. S.L.Uppal-Electrical Wiring ,Estimating & costing Electrical wiring
11. Electrical Drawing – Balbir Singh
12. Electrical wiring – Aurora
13. J.B.Gupta -Estimating & costing

#### **Suggested E-Learning references**

1. <http://electrical4u.com/>
2. [www.nptel.ac.in](http://www.nptel.ac.in)
3. <https://youtube.com>
4. <https://3.imimg.com/data3/JA/HU/MY-7591709/copper-earthing-electrodes.pdf>

#### **Suggested Learning Outcomes**

**After completion of the subject, the student shall be able to**

- 1.1 List the different types of wires used in House wiring.
- 1.2 List the different types of single phase and three phase cables
- 1.3 State the uses of standard wire gauge.
- 1.4 Specify the gauge of wire and number of strands in a multi strand by giving its current carrying capacity
- 1.5 List the different types of wiring systems
- 1.6 Explain Surface conduit wiring system
- 1.7 Explain Concealed wiring system.

- 1.8 List the various types of Main Switches
  - 1.9 State the specifications of MCB
  - 1.10 State the types of MCBs
  - 1.11 State the applications of MCCB, ELCB and RCCB.
  - 1.12 State the applications of Distribution board
  - 1.13 Specify the fuse carrier material used and the applications of Rewirable (Kit Kat) fuses
  - 1.14 Specify the fuse carrier material used and the applications of Open type fuse
  - 1.15 Specify the fuse carrier material used and the applications of Cartridge fuses
  - 1.16 Explain different types of service mains
  - 1.17 Select the service main suited to the given situation
  - 1.18 List the schedule of rates used in preparing estimate.
  - 1.19 Estimate the material requirement for indoor wiring given the plan of a building and draw the Wiring Layout of a Single Room
  - 1.20 Estimate the material requirement for indoor wiring given the plan of a building and draw the Wiring Layout of a 2-BHK House
  - 1.21 Describe the test procedure to conduct Polarity Test of wiring in an electrical installation.
  - 1.22 Explain the procedure for conducting Insulation test before energizing a new domestic installation.
- 
- 2.1 Draw the wiring layout for an office building.
  - 2.2 Prepare layouts and draw single line wiring diagrams as per standard practice for a given set of machines in a workshop / electrical laboratory.(Upto 3 motors)
  - 2.3 Calculate the suitable wire sizes for various circuits
  - 2.4 Estimate the materials used for installation of 3 phase induction motor with DOL starter
  - 2.5 Estimate the materials used for installation of 3 phase induction motor with Y- $\Delta$  starter
  - 2.6 Select the type of wiring and service mains used for the irrigation pump set
  - 2.7 List the materials used in the installation of the irrigation pump set.
  - 2.8 Prepare an estimate for electrifying the irrigation pump set scheme
  - 2.9 Prepare estimation for submersible pump installation
  - 2.10 State the purpose of earthing
  - 2.11 State the types of earthing.
  - 2.12 Select the suitable type of earthing for a given installation as per IS3043.
  - 2.13 Prepare the estimate for pipe earthing.
  - 2.14 Prepare the estimate for plate earthing.
  - 2.15 State the concept of maintenance free chemical gel earthing.
  - 2.16 Explain the method of chemical gel earthing.

- 3.1 State the requirements of line supports used in overhead lines
- 3.2 List the factors influencing the selection of line supports
- 3.3 List the types of line supports
- 3.4 State the need for cross arms
- 3.5 State the types of cross arms
- 3.6 Calculate the total number of insulators required for the given scheme
- 3.7 Select the type of insulators to be used for overhead lines.
- 3.8 Select the type, size and number of cross arms required for the overhead line
- 3.9 Determine the size and total length of overhead conductor required for the line giving due consideration for the sag to be allowed
- 3.10 Estimate the quantity of all materials required for given 11 KV overhead lines as per standard practice followed by NEC
- 3.11 Estimate the quantity of all materials required for given 400V overhead lines as per standard practice followed by NEC
- 3.12 Estimate the quantity of material required for pole mounted transformer substations
- 3.13 Estimate the quantity of material required for plinth mounted transformer substation
- 3.14 State the salient features of Indian Electricity Act 2003
- 3.15 State the function of Central Electricity Authority.

- 4.1 Explain the nature of light and its propagation
- 4.2 Define the following terms.
 

a) Plane and solid angles	b) Luminous flux	c) Luminous intensity	d) Lumen
e) Candle power	f) Illumination	g) Brightness	
h) Polar curve	i) MHCP	j) MSCP	k) MHSCP
- 4.3 List the types of lamps used for illumination for different situations such as domestic, industrial, decoration, advertisement and street lighting schemes.
- 4.4 Define Glare.
- 4.5 State the requirements of good lighting
- 4.6 Explain different types of lamp fittings.
- 4.7 State the uses and advantages of each type of fitting
- 4.8 State and explain the laws of illumination
- 4.9 Solve problems on laws of illumination.
- 4.10 Define the terms:
 

a) Utilization factor	b) Depreciation factor	c) Waste light factor	d) Reflection factor
e) Reduction factor	f) Absorption factor	g) Luminous efficiency	
h) Specific energy consumption	i) Space -height ratio		
- 4.11 Calculate the number of lamps required for simple indoor lighting scheme
- 4.12 State the purpose of lux meter

- 4.13 Mention the illumination levels for indoor and outdoor applications
- 4.14 State the advantages of LED lighting over CFL lamps

- 5.1 State the advantages of electric heating
- 5.2 List the requirements of good heating material
- 5.3 State the materials employed for heating
- 5.4 Explain Resistance heating - direct and indirect
- 5.5 List the industrial applications of resistance heating.
- 5.6 Explain different methods of temperature control of resistance heating with diagrams.
- 5.7 Explain direct arc heating
- 5.8 Explain indirect arc heating
- 5.9 List the industrial applications of arc heating.
- 5.10 Explain induction heating – (core type and core less type)
- 5.11 Explain the principle of dielectric heating.
- 5.12 List the industrial applications of dielectric heating
- 5.13 State different types of electric welding.
- 5.14 Explain the principles of
  - i) Resistance Welding      ii) Spot Welding      iii) Seam Welding      iv) Butt Welding
  - v) Arc Welding      vi) Metal Arc Welding      vii) Carbon Arc Welding
- 5.15 List the conditions for successful welding.
- 5.16 Explain the characteristics of a welding generator.
- 5.17 Explain with legible sketch the principle of operation of welding transformer with a reactance coil.
- 5.18 Explain the 'Sequence Weld' with a block diagram.

- 6.1 Describe Single phase A.C. and Composite systems.
- 6.2 State the advantages and disadvantages of electric traction.
- 6.3 List the types of services (main line, suburban and urban),
- 6.4 Sketch the speed time curves for i) Main Line ii) sub urban services iii) Urban services.
- 6.5 State each stage of the speed time curve with appropriate speed used.
- 6.6 State the importance of speed time curves.
- 6.7 Define Maximum speed, Average speed and Scheduled speed.
- 6.8 List the factors affecting the Scheduled Speed.
- 6.9 Sketch the simplified Speed Time Curves.
- 6.10 Explain the practical importance of the above curves.
- 6.11 Write the expression for Maximum Speed, Acceleration and Retardation for Trapezoidal Speed Time Curve
- 6.12 Solve simple problems on Trapezoidal Speed Time Curve.
- 6.13 Explain the Tractive Effort.

- 6.14 Write the expression for Tractive Effort for Acceleration, to overcome gravity pull and train resistance.
- 6.15 Define 'Coefficient of Adhesion'.
- 6.16 List the factors affecting the Coefficient of Adhesion.
- 6.17 State the methods of improving the Coefficient of Adhesion.
- 6.18 State the important requirements of traction motors(A.C and D.C)
- 6.19 State the purpose and material used for catenary
- 6.20 State the purpose and material used droppers
- 6.21 State the purpose and material used trolley wires
- 6.22 State the purpose and material used bow collector
- 6.23 State the purpose and material used pantograph collector
- 6.24 State the Need of Booster Transformer
- 6.25 Draw the Connection diagram of booster transformer
- 6.26 Explain the Concept of MAGLEV and its applications

### **Suggested Student Activities**

1. Student visits to the houses which are under construction so as to visualize the pipe layout and accessories fixtures
2. Student visits Distribution Transformer i.e., Pole mount and Plinth mount
3. Visit to nearby field and understand the Irrigation pump estimation
4. Visit to small industry or workshop and estimate the load and rating of the accessories required
5. Group discussion
6. Surprise test
7. Student visits to the Industries, Malls and software companies which operate at night to understand the importance of Lighting , to shops which provide lighting solutions
8. Prepare a report on illumination required for both indoor and outdoor applications
9. Student visits Industries where Electrical heating methods are employed and their purpose of heating
10. Visit to nearby Welding shop and also to industries which make use of Electric welding process
11. Visit to Traction workshop of Railway and understand its operation
12. Quiz

**CO-PO Mapping Matrix****CO-PO Mapping Matrix**

	Basic and Discipline specific Knowledge	Problem Analysis	Design/Development of solutions	Engineering Tools	Engineering practices for society sustainability	Project Management	Life-long learning	Linked PO
CO\PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	
CO1	3	3	2	1	2		3	PO1,2,3,4,5,7
CO2	3	3	3	1	3		3	PO1,2,3,4,5,7
CO3	3	3	3	1	3		3	PO1,2,3,4,5,7
CO4	3	3	3		3		3	PO1,2,3,5,7
CO5	2	3	3		2		3	PO1,2,3,5,7
CO6	3	3	3		3		3	PO1,2,3,5,7

**Continuous Internal Evaluation (CIE)**

Test	Units	Marks
Mid Sem 1	1 and 2	20
Mid Sem 2	3 and 4	20
Slip Test 1	1 and 2	5
Slip Test 2	3 and 4	5
Assignments	-	5
Seminars	-	5
	Total	60

### **QUESTION PAPER PATTERN FOR MID SEMESTER EXAMS**

Sl.No	Description	Level	No of Questions	Marks for each question	Choice	Total Marks
01	Part-A	Remembering(R)	4	1	Nil	4 Marks
02	Part-B	Understanding(U)	4	3	2	6 Marks
03	Part-C	Application(A)	4	5	2	10 Marks
Total Marks						20 Marks

#### **MID SEM-I EXAM**

S.No	Unit No	R	U	A
1	Unit-I	1,2	5(a)	7(a)
			5(b)	7(b)
2	Unit-II	3,4	6(a)	8(a)
			6(b)	8(b)
Total Questions		4	4	4

#### **MID SEM-II EXAM**

S.No	Unit No	R	U	A
1	Unit-III	1,2	5(a)	7(a)
			5(b)	7(b)
2	Unit-IV	3,4	6(a)	8(a)
			6(b)	8(b)
Total Questions		4	4	4

**The length of answer for each question framed in respect of Part-A, B&C shall not exceed  $\frac{1}{4}$  of a page side, 1 page side and 2page sides respectively.**



**QUESTION PAPER PATTERN FOR SEMESTER END EXAM**

Sl.No	Description	Level	No of Questions	Marks for each question	Choice	Total Marks
01	Part-A	Remembering(R)	8	1	Nil	8 Marks
02	Part-B	Understanding(U)	8	3	4	12 Marks
03	Part-C	Application(A)	8	5	4	20 Marks
Total Marks						40 Marks

Unit No	Questions to be set for SEE				
	R			U	A
I	Q4	Q1		Q9(a)	Q13(a)
II					
III		Q2		Q10(a)	Q14(a)
IV					
V		Q3	Q5,Q6	Q9(b), Q11(a), Q11(b)	Q13(b), Q15(a), Q15(b)
VI			Q7,Q8	Q10(b), Q12(a), Q12(b)	Q14(b), Q16(a), Q16(b)
Total Questions	8			8	8

**STATE BOARD OF TECHNICAL EDUCATION & TRAINING, TELANGANA**  
**DIPLOMA IN ELECTRICAL & ELECTRONICS ENGG.**  
**SUB CODE: EE-584**  
**ELECTRICAL ESTIMATION AND UTILIZATION**

**MID SEM -I MODEL PAPER**

**TIME: 1 HOUR**

**TOTAL MARKS: 20**

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**PART – A**

**Marks: 4 X 1=4**

**Instructions:** (1) Answer all questions  
(2) Each question carries **one** mark.

1. State the uses of standard wire gauge.
2. What is a service main?
3. What is the purpose of earthing?
4. List the materials that are to be used in the Earth pit surrounding the Earth electrode

**PART - B**

**Marks: 2 x 3 = 6**

**Instructions:** (1) Answer the following questions.  
(2) Each question carries **three** marks.

- 5a) List the different types of single phase and three phase cables

**OR**

- 5 b) State the types of MCBs

- 6 a) State the types of earthing.

**OR**

- 6 b) Specify the different materials used in pipe earthing

**PART - C**

**Marks: 2 x 5= 10**

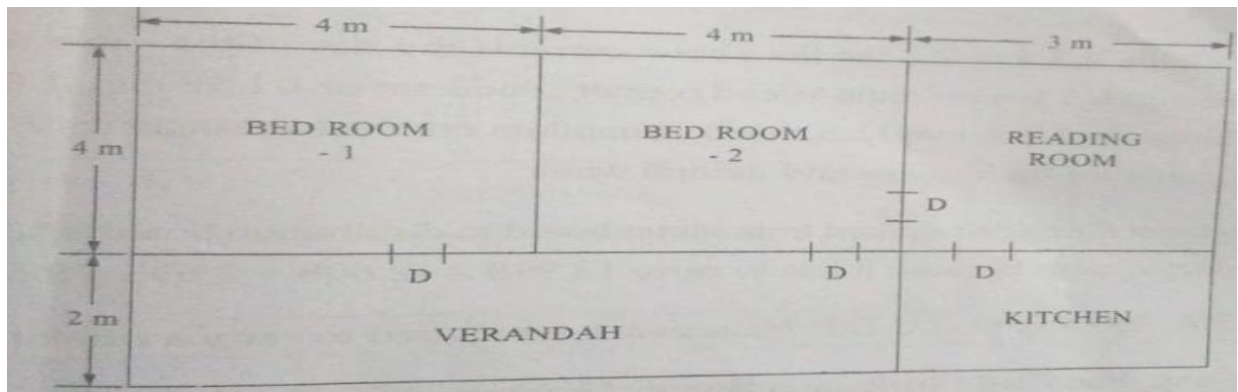
**Instructions:** (1) Answer the following questions.  
(2) Each question carries **five** marks

- 7 a) Explain Concealed wiring system

**OR**

- 6 b) Estimate the quantity of material required and the cost of materials for wiring a newly constructed residential building whose plan is shown in Fig below and details of load are given in table below. Assume any missing data

Location	Lamp(60W)	Tube light(40W)	Fan(80W)	5A socket outlet	15A socket outlet
Verandah	1	1	1	-	-
Reading room	1	1	1	1	1
Bed room-1	1	1	1	1	-
Bed room-2	1	1	1	1	-
Kitchen	1	1	-	1	1



Plan of the House

- 8 a) Prepare the Estimate of materials suitable for earthing for a 132/33KV substation  
**OR**  
8 b) Draw the wiring layout for a workshop

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**ELECTRICAL ESTIMATION AND UTILIZATION**

**MID SEM –II MODEL PAPER**

**TIME: 1 HOUR**

**TOTAL MARKS: 20**

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**PART – A**

**Marks: 4 X 1=4**

**Instructions:** (1) Answer all questions  
(2) Each question carries **one** mark.

1. State the need for cross arms
2. List the types of line supports
3. Define MHCP
4. Define illumination

**PART - B**

**Marks: 2 x 3 = 6**

**Instructions:** (1) Answer the following questions.  
(2) Each question carries **three** marks.

- 5a) List the factors influencing the selection of line supports

**OR**

- 5 b) State the types of cross arms required for overhead transmission lines

- 6 a) State the requirements of good lighting

**OR**

- 6 b) State the purpose of luxmeter.

**PART - C**

**Marks: 2 x 5= 10**

**Instructions:** (1) Answer the following questions.  
(2) Each question carries **five** marks.

- 7 a) Estimate the quantity of material required for pole mounted substation

**OR**

- 7 b) Estimate the quantity of material required for plinth mounted substation

- 8 a) State and explain Lambert's cosine law of illumination

**OR**

- 8 b) State the uses and advantages of each type of fitting

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**SUB CODE: EE-584**

**ELECTRICAL ESTIMATION AND UTILIZATION**  
**SEMESTER END EXAM MODEL PAPER**

**TIME: 2 HOURS**

**TOTAL MARKS: 40**

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**PART – A**

**Instructions:** (1) Answer all questions  
(2) Each question carries **one** mark.

**Marks: 8 X 1 = 8**

1. List the different types of wires used in house wiring
2. Define glare
3. State the purpose of using droppers in electric traction
4. Define schedule speed of an electric locomotive
5. List any two applications of direct resistance heating
6. List any two requirements of good heating material
7. List the applications of magnetic levitation
8. Define coefficient of adhesion

**PART - B**

**Instructions:** (1) Answer the following questions  
(2) Each question carries **three** marks.

**Marks: 4 X 3 = 12**

9a) State the purpose of earthing in electrical installations

**OR**

- 9b) List the industrial applications of Dielectric Heating  
10a) List the factors influencing the selection of line supports

**OR**

- 10b) State the methods of improving the Coefficient of Adhesion.  
11a) List the Conditions for Successful Welding.

**OR**

11b) Draw the Sequence Weld block diagram

12a) State the Need of Booster Transformer

**OR**

12 b) State the purpose and material used for pantograph collector

## **PART - C**

**Instructions:** (1) Answer the following questions  
(2) Each question carries **five** marks.

**Marks: 4 X 5 = 20**

13a) Prepare the Estimate for Plate Earthing.

**OR**

13b) Prepare the quantity estimate and cost of wiring material required for an agriculture pump set of 3.7 KW 3-Phase, 400 V motor. The distance between the LT pole and the Pump set shed (5x3x3m) is 12m. Assume missing data where ever necessary

14 a) State and explain the Laws of Illumination

**OR**

14b) Explain Single phase A.C. and Composite systems of electric traction

15a) With the help of a neat diagram explain the construction and working of vertical core type induction furnace

**OR**

15b) Explain with legible sketch the principle of operation of Welding Transformer with a reactance coil.

16a) State the important requirements of traction motors

**OR**

16 b) Draw and explain the connection diagram of booster transformer.

## EE-594-ELECTRIC VEHICLES

Course Title :	Electric Vehicles	Course Code	EE-594
Semester	V	Course Group	Core
Teaching Scheme in periods (L:T:P)	4:1:0	Credits	3
Methodology	Lecture + Assignments	Total Contact Periods :	75
CIE	60 Marks	SEE	40 Marks

### **Prerequisites**

Basic knowledge of electrical machines, electric circuit analysis, power electronic converters  
Battery technology, drive train, engines working principles of automobiles.

### **Course outcomes**

On Successful completion of the course, the student will be able to

CO1 :	Analyze the architecture of electric vehicle
CO2 :	Explain the working concept of different components of EV and charging station
CO3 :	Design/size the drive train for EV, Battery, and charging station
CO4 :	Analyze and troubleshoot basic faults in different EV components and charging system
CO5 :	Repair and retrofit different components of EV and the charging station
CO6	Analyze the impact of EV integration on distribution system

### Blue Print of Marks for SEE

Unit no	Unit name	Questions to be set for SEE (Q No)				Remarks	
		R		U	A		
1	Introduction to Electric Vehicles	4	1		9(a)	13(a)	
2	EV components						
3	Drive train in EV & HEV		2		10(a)	14(a)	
4	Battery charging Technologies and EV Charging Infrastructure						
5	Electric vehicle grid integration	3	5,6		9(b) 11(a) 11(b)	13(b) 15(a) 15(b)	
6	EVs and renewable energy (RE) integration, Troubleshooting		7,8		10(b) 12(a) 12(b)	14(b) 16(a) 16(b)	
Total questions		8		8	8		

**Legend: R; Remembering, U: Understanding A: Applying**

## COURSE CONTENT

### UNIT-1

**Periods 10 (L: 08 – T: 02)**

#### Introduction to Electric Vehicles

Introduction to Electric Vehicle(EV) – Hybrid Electric vehicle(HEV) – Plug-in Hybrid Electric vehicle (PHEV) - Types of Electric vehicles based on with and without differential – Types of HEV series, parallel, series-parallel and Complex - Fuel cell vehicles -Differences between EV and conventional vehicles - Differences between complete EV and Hybrid vehicles - Benefits of EV including environmental impacts – Single speed transmission - Government Schemes and Progress: FAME-1, FAME-2; Transformative -mobility and Energy Storage Mission, and other latest central level policies - State Policies, subsidies, and incentives - Global experiences and success stories on EV production

### UNIT-2

**Periods 15 (L: 12 – T: 03)**

#### EV Components

Main components of EV sub-systems and configuration – an introduction - **Motor drive Technologies** - Electric Propulsion unit - Configuration and control of DC Motor drives -



Induction Motor drives - Permanent Magnet Motor drives - Switched reluctance motor - **Energy storage technologies** – speed variation in EV - Introduction to energy storage devices in EV and HEV- Definition of different battery parameters - Lead Acid Battery – Nickel based batteries – Lithium based batteries - Fuel Cell - Super Capacitor - Super Flywheel based energy storage and its analysis - Hybridization of different energy storage devices.

### **UNIT-3**

**Periods 10 (L: 08 – T: 02)**

#### **Drive train in EV and HEV:**

Basic Architecture of Electric Drive Trains: General configuration of an electric vehicle, Alternatives Based on Drive train Configuration, Alternatives Based on Power Source Configuration, Single and Multi-motor Drives - In Wheel Drives.

Energy saving potential of Hybrid drive trains - Various HEV configurations and their operation modes - Power Flow in HEVs: Power Flow Control in Series Hybrid -Power Flow Control in Parallel Hybrid - Power Flow Control in Series-Parallel Hybrid - Power Flow Control in complex Hybrid - Torque Coupling and Analysis of Parallel Drive Train - Braking in EV – Regenerative braking – Hybrid braking.

### **UNIT-4**

**Periods 15 (L: 12 – T: 03)**

#### **Battery charging Technologies and EV Charging Infrastructure**

Methods of charging - Domestic Charging Infrastructure - Public Charging Infrastructure – Fast Charging Station - Battery Swapping Station - Move-and-charge zone - Battery Management System - Power electronics related to power conversion related to charging, drive and control - Control systems for EV - Sizing the drive system - Sizing the propulsion motor, sizing the power electronics - Selecting the energy storage technology - Communications - supporting subsystems

**EV Charging Infrastructure** - EV Charging Fundamentals - Onboard and off board charger - Electric Vehicle Supply Equipment (EVSE) Types Characteristics - EVSE Standards and Communication Protocols - Next Generation Technologies: Super Chargers - Wireless Chargers - EVSE Management and Settlement Solutions - Effect of EV charging on generation and load profile - Smart charging technologies - EV charging facility planning - Centralized charging schemes - Decentralized charging schemes - Energy storage integration into Microgrid

## **UNIT-5**

**Periods 10 (L: 08 – T: 02)**

### **Electric vehicle grid integration**

Introduction - Impact of EV charging on distribution system (congestion, power quality issues etc.) – Smart charging - Vehicle to anything (V2X) technology (V2G, V2V, V2H, V2B etc.) - Grid up gradation for fast charging stations - Cost estimate of an EV charging station - Demand response from EVs - Voltage/reactive power support from EVs - Frequency support (inertial, primary, and secondary) from EVs - Fleet aggregation approaches for grid support services

## **UNIT-6**

**Periods 15(L: 12 – T: 03)**

### **EVs and renewable energy (RE) integration, Troubleshooting**

Scheduling of EVs for increased RE generation uptake - RE based EV charging stations - Correlation between EV charging and RE integration - Coordinated operation of EVs and distributed generation - Cost comparison of RE based EV charging with other alternatives Maintenance, repairing and services Troubleshooting faults in different EV components (Motor, drive train, battery etc.) - Repairing and rectifying faults in EV motor and components - EV battery and battery management systems - EV charging device repairing - Battery disposal & recycling

## **REFERENCE BOOKS**

- 1 ATB on Modern EV,HEV and Fuel cell vehicles by Mehرداد Eshani,Yimin Gao
- 2 Hand book on EV charging Infrastructure Implementation by NITI Ayog, Govt Of India
- 3 NEPTel Notes on Introduction to EV & HEV
- 4 [Electric Vehicle trends - Electrical Installation Guide \(electrical-installation.org\)](http://electrical-installation.org)
- 5 Electric Vehicles Integrated with Renewable Energy Sources for Sustainable Mobility <https://www.intechopen.com>
- 6  [\(PDF\) A REVIEW ON RENEWABLE ENERGY INTEGRATION FOR ELECTRIC VEHICLES \(researchgate.net\)](https://www.researchgate.net/publication/317111111)

## **Suggested E-Learning references**

1. <https://nptel.ac.in/courses/108/106/108106170/>
2. [https://en.wikipedia.org/wiki/Category:Heavy\\_equipment](https://en.wikipedia.org/wiki/Category:Heavy_equipment)
3. How does an Electric Car work? | Tesla Model S <https://www.youtube.com/watch?v=3SAxXUIre28>
4. Tesla Model 3's motor - The Brilliant Engineering behind it <https://www.youtube.com/watch?v=esUb7Zy5Oio>
5. Toyota Hybrid System <https://www.youtube.com/watch?v=jNuixuVhc5E>
6. How Does It Work? Honda's 2 Motor Hybrid System Explained! [https://www.youtube.com/watch?v=-P\\_VChMGK8](https://www.youtube.com/watch?v=-P_VChMGK8)
7. Understanding the Honda Hybrid E-Drive <https://www.youtube.com/watch?v=QLUIExAnNcE>

8. Electric Engine PRODUCTION - Audi e-tron MOTOR  
<https://www.youtube.com/watch?v=uWBEPEspbWI>
9. BMW Electric Drive HOW IT'S MADE - Interior BATTERY CELLS Production Assembly Line  
<https://www.youtube.com/watch?v=xvaQMTcckSg>
10. How Tesla Builds Cars So Fast <https://www.youtube.com/watch?v=KqXi6EkCdpQ>

## **SUGGESTED LEARNING OUTCOMES**

Up on completion of the course the student shall be able to

### **1. Introduction to Electric Vehicles**

- 1.1 Introduce to Electric vehicle and latest technology.
- 1.2 Know BEV, HEV and PHEV
- 1.3 List the advantages of BEV, HEV and PHEV
- 1.4 List disadvantages and limitations
- 1.5 Classify an EV based on Drive train Configuration (In wheel drives)
- 1.6 Know the effect of EV on environment
- 1.7 Summarise the concept of 'In Wheel Drives' in EV
- 1.8 Compare BEV and ICE
- 1.9 Compare BEV and HEV

### **2. EV components**

- 2.1 List the various components of EV like
  - 2.1.1 Traction battery pack.
  - 2.1.2 DC-DC Converter.
  - 2.1.3 Electric motor.
  - 2.1.4 Power inverter.
  - 2.1.5 Charge Port.
  - 2.1.6 Onboard charger.
  - 2.1.7 Controller.
- 2.2 Know the purpose of each component
- 2.3 Introduce Electric motor as Propulsion unit
- 2.4 Know the types of Electric motors AC/DC
- 2.5 List the advantages of DC motors over AC
- 2.6 Know the construction and working of Induction motor
- 2.7 Explain the construction and working of Permanent magnet motor
- 2.8 Understand the construction and working of Switched reluctance motor

- 2.9 Know the various energy storage devices like Battery, Fuel cell, Super capacitor and super fly wheel
- 2.10 Know battery terminology like
  - 2.10.1 Depth of Discharge
  - 2.10.2 Daily Depth of Discharge
  - 2.10.3 Battery State of Charge (BSOC )
  - 2.10.4 self discharge rate
  - 2.10.5 Charge equalization
- 2.11 Know the effect of Temperature on battery performance
- 2.12 Understand the C- Rate parameter
- 2.13 Understand the Chemistry of Lead acid battery
- 2.14 Explain the construction and chemistry of Nickel based Battery
- 2.15 Know the complete details about Lithium based battery like Li-P and Lithium ion battery
- 2.16 Know the advantages/ Merits of Lithium battery as a energy source for EV
- 2.17 Know the need and concept of Hybridisation of various energy sources

### **3. Drive train in EV and HEV.**

- 3.1 Explain General configuration of an electric vehicle.
- 3.2 Classify an EV based on Drive train Configuration.
- 3.3 Contrast the Alternatives in EV Based on Power Source Configuration.
- 3.4 Explain the concepts of Single and Multi-motor Drives in EV.
- 3.5 Summarise the concept of 'In Wheel Drives' in EV.
- 3.6 List the conceptual advantages and limitations of HEV's in terms of overall energy efficiency.
- 3.7 Explain the conceptual advantages and limitations of HEV's in terms of overall energy efficiency.
- 3.8 List the various possible ways of combining the power flow to meet the driving requirements in HEV.
- 3.9 Name the various drivetrain configurations in HEVs.
- 3.10 Outline the various drivetrain configurations in HEVs.
- 3.11 Spell the goals in power flow control in HEV's.
- 3.12 Infer four operating modes of power flow control in a Series HEV.
- 3.13 Explain the operating modes of power flow control in a Parallel HEV.

- 3.14 Interpret the ICE dominated power flow control modes in a Series Parallel HEV.
- 3.15 Summarize the EM dominated power flow control modes in a Series Parallel HEV.
- 3.16 Explain the basic concepts of mechanical coupling in Parallel HEV.
- 3.17 Outline concept of torque coupling in Parallel HEV.
- 3.18 Summarize the concept of speed coupling in Parallel HEV.
- 3.19 Illustrate two-shaft configuration or Dual transmission of parallel HEV using torque coupler.
- 3.20 Rephrase the pre-transmission configuration of a parallel HEV with torque coupling
- 3.21 Summarise the pre-transmission configuration of a parallel HEV with speed coupling

#### **4. Battery charging Technologies and EV Charging Infrastructure**

- 4.1 Definition and purpose of charging station
- 4.2 Understand AC and DC Charging
- 4.3 Know methods of AC charging
- 4.4 Summarise the domestic and Public charging equipment
- 4.5 Understand Method-1, 2 & 3 charging techniques
- 4.6 Types of connectors to plug the charging cable to the vehicle inlet like Type-1, type-2 and type-3 connector
- 4.7 Understand CHAdeMO connector, Combined charging system(CCS) Combo-1 and combo-2 connectors
- 4.8 Know the DC Method-4 charging
- 4.9 List advantages of DC fast charging
- 4.10 Understand the draw backs of Method- 1 &2 charging
- 4.11 Know onboard and off board charging
- 4.12 Understand Manual and automated battery swapping
- 4.13 List merits and demerits of battery swapping
- 4.14 Know the Indian standards IS17017 for AC charging
- 4.15 Know the difference between charging station and charging point
- 4.16 Understand the Wireless charging
- 4.17 Identify the various parts and working of Electric Vehicle Supply Equipment (EVSE)

#### **5. Electric Vehicle Grid Integration**

- 5.1 Know AC and DC Charging station and their specificness

- 5.2 Know the load calculation of a charging station
- 5.3 Analyse the effect of charging station on the local grid
- 5.4 Understand the requirements for locating a charging station
- 5.5 Know the International Electro technical Commission (IEC) standards for establishing EV charging station
- 5.6 Understand charging station output, single and multiple output
- 5.7 Identify various modes of charging communication Like Ethernet, Wi-Fi, 3G/4G, Bluetooth, NFC and even dry contact.
- 5.8 Know wall and floor charging installation
- 5.9 Explain charging station with and without cable
- 5.10 Explain fast charging station along with advantages and disadvantages
- 5.11 Understand the functions of Residual current devices and Over current protective devices
- 5.12 Understand the impact of EV charging on maximum power demand
- 5.13 Explain different types of power management for EV charging station
- 5.14 Define smart charging and various options V2X tech (V1G ,V2G, V2V, V2H, V2B)
- 5.15 Identify various elements of a EV charging station

## **6. EVs and renewable energy (RE) integration, Troubleshooting**

- 6.1 List and understand various types of renewable energy sources
- 6.2 Know the term smart grid
- 6.3 Know the need of EV integration with renewable energy
- 6.4 Know advantages of EV integration with renewable energy
- 6.5 Know the safety aspects of EV
- 6.6 Understand the service and maintenance schedules of EV
- 6.7 Identify the challenges in EV integration with renewable energy
- 6.8 Explain EV integration with Wind energy
- 6.9 Explain EV integration with Solar energy
- 6.10 Know EV coordination
- 6.11 Identification of battery faults like
  - 6.11.1 Over charge and Over discharge
  - 6.11.2 Overheating and under cooling
  - 6.11.3 Short circuit or open circuit of inner cell

- |      |  |
|------|--|
| 6.12 | Know how to identify dead battery                    |
| 6.13 | Understand dead battery disposal and recycling       |
| 6.14 | Identification of Motor faults                       |
| 6.15 | Identification of software problems                  |
| 6.16 | Know using OBD (On-board diagnostics) scanning tools |
| 6.17 | Understand Remote diagnostics                        |
| 6.18 | Identify the Power electronics faults                |

## CO-PO Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	Mapping Pos
CO1	3	2	1	-	-	-	2	1,2,3,7
CO2	2	1	-	-	-	-	2	1,2,7
CO3	3	2	-	-	1	1	2	1,2,5, 6,7
CO4	3	2	1	-	-	1	3	1,2,3,6,7
CO5	3	2	1	-	-	1	2	1,2,3,6,7
CO6	1	1	1	-	-	-	2	1,2,3,7

### QUESTION PAPER PATTERN FOR MID SEMESTER EXAMS

Sl.No	Description	Level	No.of Questions	Marks for each question	Questions to be attempted	Total Marks
01	Part-A	Remembering(R)	4	1	Nil	4 Marks
02	Part-B	Understanding(U)	4	3	2	6 Marks
03	Part-C	Application(A)	4	5	2	10 Marks
Total Marks						20 Marks

### Question Paper Blue Print for CIE (MID I)

Unit no	Unit name	Questions to be set for MID-I			Remarks
		R	U	A	
1	Introduction to Electric Vehicles	1,2	5(a) 5(b)	7(a) 7(b)	
2	EV components	3,4	6(a) 6(b)	8(a) 8(b)	
Total questions		4	4	4	

### Question Paper Blue Print for CIE (MID II)

Unit no	Unit name	Questions to be set for MID-II			Remarks
		R	U	A	
3	Drive trains in EV & HEV	1,2	5(a) 5(b)	7(a) 7(b)	
4	Battery charging Technologies and EV Charging Infrastructure	3,4	6(a) 6(b)	8(a) 8(b)	
Total questions		4	4	4	



## EE-575-SWITCHGEAR AND PROTECTION

Course title	Switchgear and Protection	Course code	EE-575
Semester	V	Course group	Core
Teaching scheme in periods (L:T:P)	4:1:0	Credits	3
Methodology	Lecture + tutorial	Total contact periods	75
CIE (Continuous Evaluation)	Internal 60 Marks	See (Semester End Examination)	40 Marks

### Pre requisites

1. This course requires the basic knowledge of mathematics and science.
2. This course requires the knowledge of AC Machines, Transmission lines

### Course Outcomes

CO1 :	Classify Switchgear and Fuses
CO2 :	Describe the function of High Voltage Circuit Breakers and Evaluate the Short Circuit KVA
CO3 :	Classify Protective Relays
CO4 :	Describe the Schemes of Protection for Alternators and Transformers
CO5 :	Explain Protection Schemes for Transmission Lines and Feeders
CO6 :	Explain the importance of Lightning Arresters and necessity of Neutral Earthing

### Blue Print of Marks for SEE

Unit No	Unit Name	Periods	Questions to be set for SEE					
			R		U	A		
1	Switches & Fuses	10	Q4	Q1		Q9(a)	Q13(a)	
2	Circuit Breakers & Reactors	15						
3	Protective Relaying	12		Q2		Q10(a)	Q14(a)	
4	Protection of Alternators and Transformers	13						
5	Protection of Transmission Lines and Feeders	12		Q3	Q5,Q6		Q9(b), Q11(a), Q11(b)	Q13(b), Q15(a), Q15(b)
6	Lighting Arresters and Neutral Grounding	13			Q7,Q8		Q10(b), Q12(a), Q12(b)	Q14(b), Q16(a), Q16(b)
Total		75	8		8	8		

## **Course Content**

### **UNIT 1 -Switches & Fuses**

**Duration: 10 Periods (L: 8 – T: 2)**

Switch gear– Isolators, Load break switch, Air break switches, Earth Switches – Fuse -Important Terms used in the analysis of fuses - Fusing current, Fusing factor, cut-off characteristics- time current characteristics- Types of fuses based on fuse current rating—HRC cartridge fuse-Liquid power fuse- Current Carrying Capacity of Fuse Element -application of fuses

### **UNIT 2 – Circuit Breakers & Reactors**

**Duration: 15 Periods (L: 12 – T: 3)**

Circuit breakers - phenomenon of arc – Principles of Arc Extinction – Methods of Arc Extinction- Important Terms used in the Circuit breaker analysis- Circuit breakers classification based on the medium of arc quenching– Working of M.O.C.B, A.B. C.B, SF6 C.B & VCB and their comparisons.- Reactors –their necessity - Types of reactors– Percentage Reactance and Base KVA-Equation for short circuit KVA .

### **UNIT 3 – Protective Relaying**

**Duration: 12 Periods (L: 9 – T: 3)**

Relay Requirements - Features of relays – Classifications based on the Operating principles- Construction and working of solenoid plunger type relay- attracted armature relay- Induction type over current relay - Induction type Directional Over current relay Classifications based on the time of operation— Inverse Time relay –Important terms used in relays- Impedance distance relay- Differential Relays

### **UNIT 4 – Protection of Alternators and Transformers**

**Duration: 13 Periods (L: 10 – T: 3)**

Protection of Alternators Schemes - Probable faults- Differential protection of Alternator. – Balanced Earth fault protection – Stator Inter-turn protection - Field suppression protection - Protection of Transformer - Possible faults in the transformer – Precautions required for protection – Differential protections - Protection against excessive heating of transformer oil - Buchholz relay.

### **UNIT 5 - Protection of Transmission Lines and Feeders**

**Duration: 12 Periods (L: 9 – T: 3)**

Bus bar protection-Necessity-causes of faults-Transmission line and feeder protection- Pilot wires – Differential pilot wire protection, Translay scheme- Distance and impedance relays in Transmission lines - Combined protection using definite Time and Inverse time relays – Protection of radial feeders, parallel feeders, and ring main feeders- Merz price protection of the feeders

## **UNIT 6: Lighting Arresters and Neutral Grounding**

**Duration: 13 Periods (L: 10 – T: 3)**

Lightning concepts-harmful effects of Lightning-Surge Protection- Need for Surge Protection - Surge types and causes of surges – Scheme of surge protection with diagram - Various types of Lightning arresters –Rod gap, Horn gap, Expulsion type, valve type, metal oxide type Lightning arresters – Necessity of Neutral grounding - Methods of neutral grounding- Comparison of various neutral grounding systems.

### **Recommended Books**

1. Principle of Power systems - V.K. Mehta
2. Electrical power systems - S.L. Uppal
3. Text book of Electrical power systems - SONY, Gupta Bhatnagar
4. Electrical power systems- JB Gupta
5. Electrical power Systems - CL Wadhwa
6. Switch gear and Protection by Sunil S. Rao
7. Power System Protection And Switchgear by Buvanesh A Oza, Nirmalkumar C Nair, Rases P Mehta and Vijay H Makwana, McGraw HILL Education(India Pvt. Ltd) Newdelhi
8. J.B.Gupta “Switchgear & Protection”, (edition), Katson Publisher,2008
9. MadhavaRao T.S., 'Power System Protection - Static Relays', McGraw Hill, New Delhi, 2<sup>nd</sup> Edition, 21<sup>st</sup> reprinted, 2008.
10. Handbook of Switchgears by BHEL
11. Testing , commissioning , operation and maintenance of electrical equipment by Sunil S Rao ,Khanna Publications

### **Suggested E-Learning references**

1. electrical4u.com
2. [www.nptel.ac.in](http://www.nptel.ac.in)
3. <https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/>
4. <http://www.pdfdocuments.com/testing-commissioning-operation-maintenanceelectrical equipments.pdf>
5. youtube videos on circuit breakers
6. youtube videos on protective relays
7. nptel videos on switchgear protection

## Suggested Learning Outcomes

- 1.1 Classify the types of faults in power system and their effects.
  - 1.2 Explain symmetrical and Unsymmetrical faults
  - 1.3 Explain different types of open and short circuit faults
  - 1.4 Define switch gear.
  - 1.5 Classify switch gear with respect to voltage level
  - 1.6 State the purpose of isolators, load break switches, air break switches and earth switches
  - 1.7 Explain the working of different types of Isolators.
  - 1.8 Explain the working of air break switch.
  - 1.9 Explain the working of earth switch
  - 1.10 List the uses and limitations of different types of switches.
  - 1.11 Explain fuse as protective device.
  - 1.12 Define the following important terms in analysis of fuses
    - i) current rating of fuse element ii) Fusing current iii) Fusing factor
    - iv) Prospective Current v) Cut-off current vi) Pre-arcing time vii) Arcing time
    - viii) Total operating time ix) Breaking Capacity
  - 1.13 Draw and explain cut- off characteristics of fuse
  - 1.14 Draw and explain Time-current characteristics of a fuse
  - 1.15 List types of fuses
  - 1.16 Explain the working principle of HRC cartridge fuse
  - 1.17 Explain the working principle of Liquid power fuse.
  - 1.18 State the current carrying capacity of fuse element
  - 1.19 Applications of fuses
- 
- 2.1 Explain the phenomenon of Arc, Arc voltage, Arc current.
  - 2.2 State factors responsible for arc formation and principle of Arc Extinction
  - 2.3 Describe the methods of Arc Extinction.
  - 2.4 State the following important terms used in circuit breaker analysis
    - i) Arc Voltage ii) Restriking Voltage iii) Recovery Voltage
  - 2.5 Classify the circuit breakers based upon medium of arc quenching.
  - 2.6 Describe with neat diagram the working of Minimum oil circuit breaker(MOCB).
  - 2.7 List the different types of Air blast circuit breakers
  - 2.8 Explain with a legible sketch the principle of working of different Air blast circuit breakers.
  - 2.9 List the properties of SF<sub>6</sub> gas
  - 2.10 Explain with a legible sketch the principle of working of SF<sub>6</sub> circuit breaker.
  - 2.11 Explain with a legible sketch the principle of working of Vacuum circuit breaker.
  - 2.12 State the importance of current limiting reactors in power systems.
  - 2.13 State the functions of current limiting reactors
  - 2.14 List the types of reactors.

- 2.15 Describe the construction of the different types of reactors.
  - 2.16 Draw the schematic diagram of reactor connections.
  - 2.17 State the expressions of percentage reactance and Base KVA
  - 2.18 State the importance of short circuit KVA.
  - 2.19 Solve simple problems on short circuit KVA
- 
- 3.1 State the basic requirements of relays
  - 3.2 State the important features of relays.
  - 3.3 Explain the working principle of a relay
  - 3.4 Classify the relays based on operating principles - i) Electromagnetic Attraction ii) Electromagnetic Induction.
  - 3.5 Describe the working of solenoid plunger type relay
  - 3.6 Describe the working of attracted armature relays.
  - 3.7 List the uses of attracted armature relays.
  - 3.8 Describe the construction and working of induction type over current relay.
  - 3.9 Explain the principle of obtaining directional property in induction relays.
  - 3.10 Describe the working of directional over current induction relay.
  - 3.11 List the applications of directional over current induction relay.
  - 3.12 Classify the relays based on the time of operation. i) Inverse Time relay ii) Instantaneous relay
  - 3.13 State the important terms used in relays i) pick-up current ii) Current setting iii) Plug setting multiplier -PSM iv) Time setting multiplier-TSM
  - 3.14 Explain with block diagram the working of numerical over current relay
  - 3.15 Explain the principle of working of impedance relay.
  - 3.16 List the applications of impedance relay.
  - 3.17 Describe the current differential protection.
  - 3.18 Describe the voltage differential protection
- 
- 4.1 List the probable faults in Alternator Stator and rotor.
  - 4.2 State the effects of faults on Alternator Stator and rotor.
  - 4.3 Describe the scheme of protection against excessive heating of stator and rotor.
  - 4.4 Explain the differential protection for alternator stator.
  - 4.5 Explain the earth fault protection for rotor.
  - 4.6 Explain the split phase protection of alternator against inter turn short circuits.
  - 4.7 Explain the need and working of field suppression protection.
  - 4.8 List the possible faults in a transformer and mention their effects.
  - 4.9 List the precautions to be taken for applying differential protection to transformers.
  - 4.10 Explain differential protection of transformer.
  - 4.11 Explain the construction and working of Buchholz relay.

- 5.1 State the necessity of bus bar protection
  - 5.2 State the causes of bus bar faults
  - 5.3 Explain the different schemes of protection for bus bars
    - (i) Differential protection scheme (ii) Frame leakage protection scheme
  - 5.4 Explain the different schematic arrangements for single and duplicate bus bars.
  - 5.5 Describe the transmission line and feeder protection.
  - 5.6 Explain pilot wires and their effects.
  - 5.7 Explain the Differential Pilot wire protection
    - i) Merz-price voltage balanced scheme ii) Translay scheme
  - 5.8 Explain the protection of transmission lines using impedance relays.
  - 5.9 Explain combined protection of transmission line using definite distance and time distance relays
  - 5.10 Explain protection of radial feeders using time graded relays.
  - 5.11 Explain protection of parallel feeders using directional relays.
  - 5.12 Explain protection of ring main feeder using directional relays.
  - 5.13 Explain differential protection for parallel feeders using Merz price protection
- 
- 6.1 Explain the phenomenon of lightning
  - 6.2 State the harmful effects of lightning
  - 6.3 Define surge
  - 6.4 List the types of **Voltage** surges
  - 6.5 Give reasons for the causes of **Voltage** surges.
  - 6.6 State the necessity of Lightning arrester
  - 6.7 List the Characteristics of good lightning arrester
  - 6.8 Define the impulse ratio of Lightning Arrester
  - 6.9 Explain the principle of surge protection using Lightning arrester .
  - 6.10 List the six types of lightning arresters for outdoor applications
  - 6.11 Describe the construction and working of following types of lightning arresters.
    - i) Rod gap ii) Horn gap iii) Expulsion type iv) valve type v) Metal oxide
  - 6.12 List the applications of above lightning arresters.
  - 6.13 Explain the necessity of neutral grounding .
  - 6.14 Give the merits and demerits of neutral grounding.
  - 6.15 Describe the following methods of neutral grounding
    - i) Solid grounding ii) Resistance grounding iii) Reactance grounding iv) Voltage transformer grounding v) Zig-zag transformer grounding .
  - 6.16 Compare the different methods of neutral grounding systems

### Suggested Student Activities

1. Student visits Library to refer to Switchgear and Protection subject related books
2. Visit nearby substation and prepare a report
3. Quiz
4. Group discussion
5. Surprise test
6. Register for MOOCS courses

### CO-PO Mapping Matrix

Course outcomes	Basic and Discipline Specific knowledge	Problem Analysis	Design/Development of Solutions	Engineering Tools, Experimentation & Testing	Engineering practices for society, sustainability and environment	Project Management	Lifelong learning	Linked PO
CO\PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO6	PO7	
CO1	3	1	-	1	-	-	1	1,2,4,7
CO2	2	3	-	-	1	-	2	1,2,5,7
CO3	2	1	-	-	1	-	2	1,2,5,7
CO4	1	2	2	1	2	-	1	1,2,3,4,5,7
CO5	1	2	-	-	2	-	2	1,2,5,7
CO6	2	2	1	-	1	-	2	1,2,3,5,7

### Internal Evaluation

Test	Units	Marks
Mid Sem 1	1 and 2	20
Mid Sem 2	3 and 4	20
Slip Test 1	1 and 2	5
Slip Test 2	3 and 4	5
Assignments	-	5
Seminars	-	5
	Total	60

### **QUESTION PAPER PATTERN FOR MID SEMESTER EXAMS**

Sl.No	Description	Level	No of Questions	Marks for each question	Choice	Total Marks
01	Part-A	Remembering(R)	4	1	Nil	4 Marks
02	Part-B	Understanding(U)	4	3	2	6 Marks
03	Part-C	Application(A)	4	5	2	10 Marks
Total Marks						20 Marks

#### **MID SEM-I EXAM**

S.No	Unit No	R	U	A
1	Unit-I	1,2	5(a)	7(a)
			5(b)	7(b)
2	Unit-II	3,4	6(a)	8(a)
			6(b)	8(b)
Total Questions		4	4	4

#### **MID SEM-II EXAM**

S.No	Unit No	R	U	A
1	Unit-III	1,2	5(a)	7(a)
			5(b)	7(b)
2	Unit-IV	3,4	6(a)	8(a)
			6(b)	8(b)
Total Questions		4	4	4

**The length of answer for each question framed in respect of Part-A, B&C shall not exceed ¼ of a page side, 1 page side and 2page sides respectively**

### **QUESTION PAPER PATTERN FOR SEMESTER END EXAM**

Sl.No	Description	Level	No of Questions	Marks for each question	Choice	Total Marks
01	Part-A	Remembering(R)	8	1	Nil	8 Marks
02	Part-B	Understanding(U)	8	3	4	12 Marks
03	Part-C	Application(A)	8	5	4	20 Marks
Total Marks						40 Marks

Unit No	Questions to be set for SEE				
	R		U		A
I	Q4	Q1		Q9(a)	Q13(a)
II					
III		Q2		Q10(a)	Q14(a)
IV					
V		Q3	Q5,Q6	Q9(b), Q11(a), Q11(b)	Q13(b), Q15(a), Q15(b)
VI			Q7,Q8	Q10(b), Q12(a), Q12(b)	Q14(b), Q16(a), Q16(b)
Total Questions	8		8		8



**STATE BOARD OF TECHNICAL EDUCATION & TRAINING, TELANGANA**  
**DIPLOMA IN ELECTRICAL & ELECTRONICS ENGG.**

**SUB CODE: EE-575**

**SWITCHGEAR AND PROTECTION**

**MID SEM -I MODEL PAPER**

**TIME: 60 MIN**

**TOTAL MARKS: 20**

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**Important Note:** Wherever any question has choice, marks will be allotted only to first attempted question. **No marks will be allotted for extra questions answered**

**PART – A**

**Marks: 4Q X 1= 04**

**Instructions:** (1) Answer all questions  
(2) Each question carries **One** mark.

1. Define switchgear.
2. State the use of an isolator.
3. Define Arc.
4. State the use of a Reactor.

**PART - B**

**Marks: 2Q x 3 = 06**

**Instructions:** (1) Answer all questions  
(2) Each question carries **Three** marks.

- 5(a) List the types of fuses .  
or  
5(b) Write the differences between isolator and earth switch  
6(a) Classify circuit breakers based on arc quenching medium  
Or  
6(b) List the properties of SF<sub>6</sub> gas

**PART - C**

**Marks: 2Q x 5= 10**

**Instructions:** (1) Answer all questions  
(2) Each question carries **Five** marks.

- 7(a) Explain the purpose of Isolators, Air break switches and Earth switches  
or  
7(b) Explain operation of HRC cartridge fuse with diagram.  
8(a) An Vacuum circuit breaker is used on the HV side of the transformer in a substation  
. Explain why it is preferred over air blast circuit breaker.  
Or  
8(b) Draw the schematic diagram of reactor connections.

**STATE BOARD OF TECHNICAL EDUCATION & TRAINING, TELANGANA**  
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**SUB CODE: EE-575**

**SWITCHGEAR AND PROTECTION**

**MID SEM -II MODEL PAPER**

**TIME: 60 MIN**

**TOTAL MARKS: 20**

**PART – A**

**Marks: 4Q X 1= 04**

**Instructions:** (1) Answer all questions  
(2) Each question carries **One** mark.

1. Define Over Current Relay.
2. Define PSM.
3. List the protection schemes of Alternator.
4. List the possible faults in a transformer.

**PART - B**

**Marks: 2Q x 3 = 06**

**Instructions:** (1) Answer all questions.  
(2) Each question carries Three marks.

5(a) State the basic requirements of relays

or

5(b) List the applications of impedance relay

6(a) State the effects of faults on Alternator Stator

or

6(b) Describe the current differential protection of transformer

**PART - C**

**Marks: 2Q x 5= 10**

**Instructions:** (1) Answer all questions  
(2) Each question carries **Five** marks.

7(a) Describe the working of induction type over current relay

or

7(b) Explain the working of Buchholz relay

8(a) Explain the working of field suppression protection of alternator

or

8(b) Describe the working of solenoid plunger type relay

**STATE BOARD OF TECHNICAL EDUCATION & TRAINING , TELANGANA**  
**DIPLOMA IN ELECTRICAL & ELECTRONICS ENGG.**

**SUB CODE: EE-575**

**SWITCHGEAR AND PROTECTION**  
**SEMESTER END EXAM MODEL PAPER**

**TIME: 2 HOURS**

**TOTAL MARKS: 40**

**PART – A**

**Marks: 8Q X 1= 8**

**Instructions:** (1) Answer all questions  
(2) Each question carries **one** mark.

1. Distinguish between a fuse and a switch.
2. List the methods of arc quenching.
3. State the basic requirements of a relay.
4. List any four methods of Neutral grounding.
5. Mention the probable faults in alternator.
6. State the use of pilot wires in protection.
7. Draw the protection scheme for single bus bar arrangement.
8. Define surge.

**PART - B**

**Marks: 4Qx3=12**

**Instructions:** (1) Answer any Four Questions  
(2) Each question carries Three marks.

- 9(a) State the use of Air break Switch.  
Or  
9(b) State the uses of Distance Relay
- 10(a) Describe the arcing phenomenon.  
Or  
10(b) State the need for Surge Protection
- 11(a) State the types of Feeders  
Or  
11(b) Draw the protection scheme of radial feeders using time graded relays.
- 12(a) State the causes of surges  
Or  
12(b) Write the necessity of neutral earthing

**PART - C**

**Marks: 4Qx5=20**

**Instructions:** (1) Answer any Four Questions  
(2) Each question carries Five marks

- 13(a) Explain the working of minimum oil circuit breaker with a neat sketch.  
Or  
13(b) Explain protection of parallel feeders using directional relays.
- 14(a) Explain earth fault protection for stator of an alternator.  
Or  
14(b) Explain with a neat figure the working of Valve type Lighting Arrester.
- 15(a) Explain the protection of transmission lines by definite distance relay.  
Or  
15(b) Explain protection of ring main feeder using directional relays.
- 16(a) Explain reactance grounding  
Or  
16(b) Explain the working principle of expulsion type lighting arrester with diagram.

## EE-585-ADVANCED PROTECTION OF POWER SYSTEMS

Course Title	Advanced Protection of Power Systems	Course Code	EE-585
Semester	V	Course Group	Elective
Teaching Scheme in periods ( L : T : P)	4 : 1 : 0	Credits	3
Methodology	Lecture + Tutorial	Total Contact Periods	75
CIE	60 Marks	SEE	40 Marks

### Pre requisites

This course requires the basic knowledge of mathematics and science.

This course requires the knowledge of AC Machines, Transmission lines

### Course Outcomes

CO1 :	Recall the fundamentals of protection
CO2 :	Describe the operation and application of various circuit breakers
CO3 :	Classify protective relays
CO4 :	Describe the protection schemes of alternator and transformers
CO5 :	Explain the protection schemes for transmission lines and feeders
CO6 :	Describe operation of basic elements needed for digital protection

### Blue Print of Marks for SEE

Unit No	Unit Name	Periods	Questions to be set for SEE				
			R		U	A	
1	Fundamentals of Protection	12	Q4	Q1	Q9(a)	Q13(a)	
2	Circuit Breakers	13					
3	Protective Relays	13		Q2	Q10(a)	Q14(a)	
4	Protection of Alternators and transformers	12					
5	Protection of Transmission Lines and Feeders	12		Q3	Q5, Q6	Q9(b), Q11(a), Q11(b)	Q13(b), Q15(a), Q15(b)
6	Basic Elements of Digital Protection	13					
Total		75	8		8	8	

## **Course Contents**

### **Unit 1 - Fundamentals of Protection**

**Duration: 12Periods (L:9– T:3)**

Sources of Fault - Phenomena of Short Circuit - Types of faults & Harmful Effects of short circuit current - Calculation of Short Circuit Current - Percentage reactance and Base KVA – Current limiting of Reactor – arrangements

### **Unit 2 - Circuit Breakers**

**Duration: 13 Periods (L:10– T:3)**

Switchgear -classify switchgear -Arc formation process - methods of arc extinction - working of Circuit Breaker by Trip Circuit Mechanism - Circuit Breaker rating– classification based on the medium of arc quenching – Working of O.C.B, A.B..B, SF6C.B & VCB - their comparison – live tank and dead tank circuit breaker – HVDC circuit breaker.

### **Unit 3 - Protective Relays**

**Duration: 13 Periods (L:10– T:3)**

Requirements of relays - Necessity for Protection - Primary and Back up protection -Evolution of relays - Classification of protective Relaying - Important Terms: Pickup current, current setting, PSM, TSM - Construction and working of Induction type Non-directional over current relay– directional over current relay – impedance relay - Introduction of Static relay, merits and Limitations, Static Type Over Current Relay, Comparison of Static Relays with Electro-Magnetic Relays

### **UNIT 4 - Protection of Alternators and transformers      Duration: 12 Periods(L:9– T: 3)**

Protection of Alternators - Scheme of protection - probable faults in alternators - Differential protection - Earth fault protection for stator and rotor – Split phase protection - Field suppression protection -Protection of Transformer - Possible faults in the transformer – Precautions required for protection – Differential protections and Buchholz relay

### **UNIT 5 - Protection of Transmission Lines and Feeders**

**Duration: 12 Periods (L: 9 – T: 3)**

Transmission line and feeder protection- Pilot wires, protection of transmission lines - Combined protection using definite distance and time distance relays – Protection of radial feeders, parallel feeders, and ring main feeders - Bus bar protection-Single bus bar, duplicate bus bars- Causes of over voltages - Lighting phenomena - over voltage due to lightning - Types of lightning arresters and surge absorbers- Construction and principle of operation

### **UNIT 6: Basic Elements of Digital Protection**

**Duration: 13 Periods (L:10 -T:3)**

Application of Numerical relays for Interconnected power system – networks - Basic Components of a Digital Relay - Signal Conditioning – Subsystems – Transducers - Surge

Protection Circuits - Analog Filtering - Analog Multiplexers - Conversion Subsystem - Signal Aliasing Error - Sample and Hold Circuit - Digital Multiplexing - Digital-to-Analog Conversion -Analog-to-Digital Conversion -Digital Relay Subsystem - Benefits of digital relays-numerical relay applications

### **Recommended Books**

1. Principles of power systems- V.K. Mehta
2. Electrical power systems - S.L. Uppal
3. Text book of electrical power systems - SONY, Gupta Bhatnagar
4. Electrical power systems- JB Gupta
5. Electrical power Systems - CL Wadhwa
6. Switch gear and Protection - Sunil S. Rao
7. J.B.Gupta "Switchgear & Protection", (edition), Katson Publisher,2008
8. Power system protection and switchgear – Badriram, Vishwakarma – 2<sup>nd</sup> edition , McGraw Hill
9. Digital protection for power systems – A T Johns and S K Salman – IEE Power Series 15

### **Suggested E-Learning references**

1. electrical4u.com
2. [www.nptel.ac.in](http://www.nptel.ac.in)
3. <https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/>
4. <http://www.pdfdocuments.com/testing-commissioning-operation-maintenanceelectrical-equipments.pdf>

### **Suggested Learning Outcomes**

**After completion of the subject, the student shall be able to**

- 1.1 List various sources of faults in power systems
  - 1.2 State the phenomenon of short circuit in a power system
  - 1.3 State the types of faults in power system and their effects.
  - 1.4 Mention the effects of short circuit currents
  - 1.5 Simple problems on short circuit current calculation
  - 1.6 Define percentage reactance
  - 1.7 Define base kVA
  - 1.8 Define current limiting reactor
  - 1.9 Mention various arrangements of current limiting reactors
  - 1.10 Explain various arrangements of current limiting reactors
- 
- 2.1 Define switch gear.
  - 2.2 Classify switch gear with respect to voltage level
  - 2.3 State the purpose of isolators, load break switches, air break switches and earthing switches
  - 2.4 Explain the phenomenon of arc, arc voltage, arc current and its effects.
  - 2.5 State factors responsible for arc formation.

- 2.6 Describe the methods of arc quenching.
- 2.7 Classify the circuit breakers based upon medium of arc quenching.
- 2.8 State the principle of oil circuit breaker
- 2.9 Explain with legible sketch the working principle of Air blast circuit breaker
- 2.10 Explain with legible sketch working principle of SF<sub>6</sub> circuit breaker
- 2.11 Explain with legible sketch working principle of vacuum circuit breaker
- 2.12 Define live tank circuit breaker
- 2.13 Define dead tank circuit breaker
- 2.14 Explain the operation of HVDC circuit breaker
  
- 3.1 State the basic requirements of relays
- 3.2 State the important features of relays.
- 3.3 Classify the relays based upon
  - i) Principle of Operation ii) Time of operation.
- 3.4 Describe the working of solenoid plunger type relay
- 3.5 Describe the working of attracted armature relays.
- 3.6 List the uses of attracted armature relays.
- 3.7 Describe the construction and working of induction type over current relay.
- 3.8 Describe the current setting, time setting and application of above relays.
- 3.9 Explain the principle of obtaining directional property in induction relays.
- 3.10 Describe the working of directional over current induction relay.
- 3.11 List the applications of directional over current induction relay.
- 3.12 Explain the principle of working of definite time distance impedance relay.
- 3.13 List the applications of impedance relay.
- 3.14 Describe the current differential protection.
- 3.15 Describe the voltage differential protection
- 3.16 State the advantages of static relays over electromagnetic relays
- 3.17 Explain with block diagram the construction of static protective relays
- 3.18 List the advantages of static relays
- 3.19 List the limitations of static relays
  
- 4.1 State the probable faults in Alternator Stator and rotor.
- 4.2 State the effects of faults on Alternator Stator and rotor.
- 4.3 Describe the scheme of protection against excessive heating of stator and rotor.
- 4.4 Explain the differential protection for alternator stator.
- 4.5 Explain the earth fault protection for rotor.
- 4.6 Explain the split phase protection of alternator against inter turn short circuits.
- 4.7 Explain the need and working of field suppression protection.
- 4.8 List the possible faults in a transformer and mention their effects.
- 4.9 List the precautions to be taken for applying differential protection to transformers.

- 4.10 Explain differential protection of transformer.
- 4.11 Explain the working of Buchholz relay and its protection scheme for transformer.

- 5.1 Explain the different schemes of protection for single and duplicate bus bars.
- 5.2 Describe the transmission line and feeder protection.
- 5.3 Explain pilot wires and their effects.
- 5.4 Describe the protection of transmission lines using distance and impedance relays.
- 5.5 Explain the combined protection by using definite distance and time distance relays.
- 5.6 Describe about protection of radial feeders using time graded relays.
- 5.7 Explain protection of parallel feeders using directional relays.
- 5.8 Explain protection of ring main feeder using directional relays.
- 5.9 Explain differential protection for parallel feeders of transmission lines.
- 5.10 Define surge
- 5.11 List the types of surges
- 5.12 Give reasons for the causes of surges
- 5.13 Explain the working principle of Lightning arrester with diagram.
- 5.14 List the types of lightning arrestors for outdoor applications
- 5.15 Describe the construction and working of following types of lightning arrestors.
  - i) Rod gap ii) Horn gap iii) Expulsion type iv) valve type v) Metal oxide
- 5.16 List the applications of above lightning arrestors.

- 6.1 List the basic components of a digital relay
- 6.2 Explain with block diagram the working of numerical over current relay
- 6.3 Explain with block diagram the working of transformer numerical differential relay
- 6.4 List the applications of numerical relay for interconnected power system
- 6.5 List various signal conditioning subsystems
- 6.6 Explain the working of transducers
- 6.7 Explain the working of surge protection circuits
- 6.8 Explain analogue filtering
- 6.9 Explain analogue multiplexers
- 6.10 State sampling theorem
- 6.11 Define signal aliasing error
- 6.12 State the purpose of sample and hold circuit
- 6.13 With the help of a block diagram explain sample and hold circuit
- 6.14 Define digital multiplexing
- 6.15 Explain digital to analogue conversion
- 6.16 Explain analogue to digital conversion
- 6.17 Explain the working of digital relay as a unit
- 6.18 State the advantages of digital relay
- 6.19 State the limitations of digital relay



### Suggested Student Activities

1. Student visits Library to refer to Electrical Manuals
2. Visit nearby substation and prepare a report
3. Quiz
4. Group discussion
5. Surprise test

### CO-PO Mapping Matrix

	Basic and Discipline specific Knowledge	Problem Analysis	Design/Development of solutions	Engineering Tools	Engineering practices for society sustainability	Project Management	Life-long learning	Linked PO
CO\PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	
CO1	3	2	2		3		3	PO1,2,3,5,7
CO2	2	3	3		3		3	PO1,2,3,5,7
CO3	3	3	2		3		3	PO1,2,3,5,7
CO4	3	3	2		3		3	PO1,2,3,5,7
CO5	3	3	2		3		3	PO1,2,3,5,7
CO6	3	3	3		3		3	PO1,2,3,5,7

### Continuous Internal Evaluation (CIE)

Test	Units	Marks
Mid Sem 1	1 and 2	20
Mid Sem 2	3 and 4	20
Slip Test 1	1 and 2	5
Slip Test 2	3 and 4	5
Assignments	-	5
Seminars	-	5
	Total	60

**QUESTION PAPER PATTERN FOR MID SEMESTER EXAMS**

Sl.No	Description	Level	No of Questions	Marks for each question	Choice	Total Marks
01	Part-A	Remembering(R)	4	1	Nil	4 Marks
02	Part-B	Understanding(U)	4	3	2	6 Marks
03	Part-C	Application(A)	4	5	2	10 Marks
Total Marks						20 Marks

**MID SEM-I EXAM**

S.No	Unit No	R	U	A
1	Unit-I	1,2	5(a)	7(a)
			5(b)	7(b)
2	Unit-II	3,4	6(a)	8(a)
			6(b)	8(b)
Total Questions		4	4	4

**MID SEM-II EXAM**

S.No	Unit No	R	U	A
1	Unit-III	1,2	5(a)	7(a)
			5(b)	7(b)
2	Unit-IV	3,4	6(a)	8(a)
			6(b)	8(b)
Total Questions		4	4	4

**The length of answer for each question framed in respect of Part-A, B&C shall not exceed ¼ of a page side, 1 page side and 2page sides respectively.**

**QUESTION PAPER PATTERN FOR SEMESTER END EXAM**

Sl.No	Description	Level	No of Questions	Marks for each question	Choice	Total Marks
01	Part-A	Remembering(R)	8	1	Nil	8 Marks
02	Part-B	Understanding(U)	8	3	4	12 Marks
03	Part-C	Application(A)	8	5	4	20 Marks
Total Marks						40 Marks

Unit No	Questions to be set for SEE				
	R			U	A
I	Q4	Q1		Q9(a)	Q13(a)
II					
III		Q2		Q10(a)	Q14(a)
IV					
V		Q3	Q5,Q6	Q9(b), Q11(a), Q11(b)	Q13(b), Q15(a), Q15(b)
VI			Q7,Q8	Q10(b), Q12(a), Q12(b)	Q14(b), Q16(a), Q16(b)
Total Questions	8			8	8

**STATE BOARD OF TECHNICAL EDUCATION & TRAINING, TELANGANA**  
**DIPLOMA IN ELECTRICAL & ELECTRONICS ENGG.**

**SUB CODE: EE-585**

**ADVANCED PROTECTION OF POWER SYSTEMS**

**MID SEM -I EXAM MODEL PAPER**

**TIME: 60 MIN.**

**TOTAL MARKS: 20**

**PART – A**

**Marks: 4 X 1 = 4**

**Instructions:** (1) Answer all questions

(2) Each question carries **one** mark.

1. List various sources of faults in power systems
2. Define base kVA
3. State the purpose of isolators
4. Define switch gear

**PART - B**

**Marks: 2 x 3 = 6**

**Instructions:** (1) Answer **all** questions.

(2) Each question carries **three** marks.

- 5.(a) State the phenomenon of short circuit in a power system.

OR

- 5.(b) Define percentage reactance

- 6.(a) Classify the circuit breakers based upon medium of arc quenching.

OR

6. (b) Define dead tank circuit breaker.

**PART - C**

**Marks: 2 x 5 = 10**

**Instructions:** (1) Answer **all** questions.

(2) Each question carries **five** marks.

- 7.(a). Draw various arrangements of current limiting reactors.

OR

- 7.(b). Mention the effects of short circuit currents

- 8.(a). Explain with legible sketch working principle of SF<sub>6</sub> circuit breaker.

OR

- 8.(b). Explain the operation of HVDC circuit breaker.

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**DIPLOMA IN ELECTRICAL & ELECTRONICS ENGG.**  
**SUB CODE: EE-585**

**ADVANCED PROTECTION OF POWER SYSTEMS**  
**MID SEM -II EXAM MODEL PAPER**

**TIME: 60 MIN.**

**TOTAL MARKS: 20**

**PART – A**

**Marks: 4 X 1 = 4**

**Instructions:** (1) Answer all questions

(2) Each question carries **one** mark.

1. List the uses of attracted armature relays.
2. State the advantages of static relays over electromagnetic relays.
3. State the probable faults in Alternator Stator.
4. List the possible faults in a transformer.

**PART - B**

**Marks: 2 x 3 = 6**

**Instructions:** (1) Answer all questions.

(2) Each question carries **three** marks.

5(a) Classify the relays based upon principle of operation.

OR

5(b). List the limitations of static relays.

6(a). List the precautions to be taken for applying differential protection to transformers

OR

6(b). State the effects of faults on Alternator Stator

**PART - C**

**Marks: 2 x 5 = 10**

**Instructions:** (1) Answer **all** questions.

(2) Each question carries **five** marks.

7.(a). Describe the construction and working of induction type over current relay.

OR

7.(b). Explain with block diagram the construction of static protective relays

8.(a). Explain the earth fault protection for rotor.

OR

8.(b). Explain the working of Buchholz relay and its protection scheme for transformer.

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**DIPLOMA IN ELECTRICAL & ELECTRONICS ENGG.**  
**SUB CODE: EE-585**

**ADVANCED PROTECTION OF POWER SYSTEMS**  
**SEMESTER END EXAM MODEL PAPER**

**TIME: 2 HOURS**

**TOTAL MARKS: 40**

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**PART – A**

**Marks : 8 X 1 = 8**

**Instructions:** (1) Answer all questions  
(2) Each question carries **one** mark.

1. Define current limiting reactor
2. List the applications of impedance relay.
3. Define surge.
4. Define signal aliasing error.
5. List the types of lightning arrestors for outdoor applications.
6. List the applications of rod gap lightning arrestor.
7. Define digital multiplexing.
8. State the advantages of digital relay.

**PART - B**

**Marks: 4 × 3 = 12**

**Instructions:** (1) Answer all questions.  
(2) Each question carries **three** marks.

9.(a) State factors responsible for arc formation..

OR

9.(b) List the types of surges.

10.(a) List the possible faults in a transformer and mention their effects..

OR

10.(b) List various signal conditioning subsystems.

11.(a) List the types of surges.

OR

11.(b) Give reasons for the causes of surges.

12.(a) State sampling theorem.

OR

12.(b) State the limitations of digital relay.

### **PART – C**

**Marks:  $4 \times 5 = 20$**

**Instructions:** (1) Answer all questions.

(2) Each question carries **five** marks.

13.(a) Explain with legible sketch the working principle of Air blast circuit breaker.

OR

13. (b) Explain protection of ring main feeder using directional relays.

14.(a) Describe the construction and working of induction type over current relay.

OR

14.(b) Explain with block diagram the working of transformer numerical differential relay

15.(a) Describe the construction and working of expulsion type lightning arrestor.

OR

15.(b) Describe about protection of radial feeders using time graded relays.

16.(a) Explain the working of digital relay as a unit

OR

16.(b) With the help of a block diagram explain sample and hold circuit.

## EE-506-AC MOTORS LAB

Course Title	AC Motors Lab	Course Code	EE-506
Semester	V	Course Group	Core
Teaching Scheme in Periods(L:T:P)	1:0:2	Credits	1.5
Methodology	Lecture + Practical	Total Contact Periods	45
CIE	60 Marks	SEE	40 Marks

### Pre requisites

This course requires the skills of handling electrical tools, accessories and performing wiring connections

### Course Outcomes

Course Outcome	
CO1	Identify the parts of A.C motor starters
CO2	Draw and interpret the performance characteristics of single phase and three phase AC Motors by Conducting load test.
CO3	Draw the circle diagram on AC Motors by conducting suitable experiments.
CO4	Identify and rectify faults in AC motors
CO5	Prepare estimation for a given load by using Government SSR as per BIS norms.

### Suggested Learning Outcomes

#### 1.0. Identify the parts of A.C motor starters

- 1.1 Identify the parts of a DOL starter, test its parts locate faults if any. Suggest remedies.
- 1.2 Identify the parts of a manual star-delta starter, test its parts and locate faults if any. Suggest remedies.
- 1.3 Identify the parts of automatic star-delta starter, test its parts and locate faults if any. Suggest remedies.
- 1.4 Identify the parts of autotransformer starters, test its parts locate faults if any. Suggest remedies.

#### 2.0 Draw and interpret the performance characteristics of single phase and three phase AC Motors by Conducting load test.

- 2.1. Conduct brake test on 3-phase squirrel cage induction motor.
- 2.2. Conduct brake test on 3-phase slip ring induction motor
- 2.3. Perform load test on single phase split phase induction motor.
- 2.4. Perform load test on single phase universal motor
- 2.5 Conduct load test on synchronous motor and draw V and inverted V curves



### **3.0 Draw the circle diagram on AC Motors by conducting suitable experiments.**

3.1. Conduct suitable tests and draw circle diagram of squirrel cage induction motor.

3.2. Conduct suitable tests and draw circle diagram of slip ring induction motor

### **4.0. Identify and Rectify faults in AC motors.**

4.1 Identify the part of a given AC Motors.

4.2 Identify and rectify faults in AC Motors.

### **5.0 Prepare Estimation for a given load by using Government SSR as per BIS norms.**

5.1 (A list of Items and soft copy of SSR may be provided to student)

5.2 Wiring estimate for a Residential / Commercial building.

5.3 Prepare an estimate for wiring Irrigation pump set

Note:- The staff can give suitable problems.

### **CO-PO MAPPING MATRIX**

	Basic and Discipline Specific knowledge	Problem Analysis	Design/Development of Solutions	Engineering Tools, Experimentation & Testing	Engineering practices for society, sustainability and environment	Project Management	Lifelong learning	Linked PO
CO\PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO6	PO7	
CO1	3	1	-	-	2	2	3	1,2,5,6,7
CO2	3	-	2	3	2	2	3	1,3,4,6,7
CO3	-	1	3	2	2	2	3	2,3,4,5,6,7
CO4	-	3	3	3	2	2	3	2,3,4,5,6,7
CO5	3	2	3	3	2	2	3	1,2,3,4,6,7

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**DEEE V SEMESTER**  
**MID SEM I MODEL QUESTION PAPER**

**Course Code: EE-506**  
**Course Name: AC Motors Lab**

**Duration: 1 Hour**  
**Max. Marks: 20**

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**Note: Answer allotted Question.**

**Instructions to the Candidate:**

***(i) Record the results on a graph sheet if required, and conclude your observation of the experiment.***

***(ii) Draw the circuit diagram for illustration; choose appropriate values when not mentioned in the question.***

1. Identify the parts of a DOL starter, test its parts locate faults if any. Suggest remedies.
2. Identify the parts of a manual star-delta starter, test its parts and locate faults if any. Suggest remedies.
3. Identify the parts of automatic star-delta starter, test its parts and locate faults if any. Suggest remedies.
4. Identify the parts of autotransformer starters, test its parts locate faults if any. Suggest remedies.
5. Conduct brake test on 3-phase squirrel cage induction motor.
6. Conduct brake test on 3-phase slip ring induction motor

**STATE BOARD OF TECHNICAL EDUCATION AND TRAINING, TELANGANA**  
**DEEE V SEMESTER**  
**MID SEM II MODEL QUESTION PAPER**

**Course Code: EE-506**  
**Course Name: AC Motors Lab**

**Duration: 1 Hour**  
**Max. Marks: 20**

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**Note: Answer allotted Question.**

**Instructions to the Candidate:**

***(i) Record the results on a graph sheet if required, and conclude your observation of the experiment.***

***(ii) Draw the circuit diagram for illustration; choose appropriate values when not mentioned in the question.***

1. Perform Load test on Single phase split phase induction motor.
2. Perform Load test on Single phase universal motor
3. Conduct load test on Synchronous motor and draw V and inverted V curves.
4. Conduct suitable tests and draw circle diagram of squirrel cage induction motor.
5. Conduct suitable tests and draw circle diagram of slip ring induction motor

**STATE BOARD OF TECHNICAL EDUCATION AND TRAINING, TELANGANA**  
**MODEL QUESTION PAPER**  
**DEEE V SEMESTER**  
**SEMESTER END EXAMINATION**

**Course Code: EE-506**

**Duration: 2 Hour**

**Course Name: AC Motors Lab**

**Max. Marks: 40**

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**Note: Answer allotted Question.**

**Instructions to the Candidate:**

***(i) Record the results on a graph sheet if required, and conclude your observation of the experiment.***

***(ii) Draw the circuit diagram for illustration; choose appropriate values when not mentioned in the question.***

1. Conduct brake test on 3-phase squirrel cage induction motor.
2. Conduct brake test on 3-phase slip ring induction motor
3. Perform load test on single phase split phase induction motor.
4. Perform load test on single phase universal motor
5. Conduct load test on synchronous motor and draw V and inverted V curves.
6. Conduct suitable tests and draw circle diagram of squirrel cage induction motor.
7. Conduct suitable tests and draw circle diagram of slip ring induction motor
8. Identify the part of a given AC Motors.
9. Identify and rectify faults in AC Motors.
10. Identify the parts of a DOL starter, test its parts locate faults if any. Suggest remedies.
11. Identify the parts of a manual star-delta starter, test its parts and locate faults if any suggest remedies.
12. Identify the parts of automatic star-delta starter, test its parts and locate faults if any suggest remedies.
13. Identify the parts of autotransformer starters, test its parts locate faults if any. Suggest remedies.

## EE-507-POWER ELECTRONICS LAB

Course Title:	Power Electronics Lab	Course Code	EE-507
Semester	V	Course Group	Core
Teaching Scheme in Periods (L: T:P)	1:0:2	Credits	1.5
Methodology	Lecture + Practical	Total Contact /Periods	45
CIE	60 Marks	SEE	40 Marks

### Pre requisites

This course requires the knowledge of Power electronics

### Course Outcomes

Course Outcome	
CO1	Acquire knowledge on specified Power electronic devices and use them
CO2	Use Single phase Half wave and full wave converters for R loads
CO3	Control the speed of DC motors using converters and choppers
CO4	Control the speed of AC motors using AC voltage controller & V/F controller
CO5	Acquire knowledge on inverters

### Suggested Learning Outcomes

#### 1.0 Characteristics of different Power electronic devices

- 1.1 Draw the Static VI characteristics of SCR
- 1.2 Draw the Static VI characteristics of IGBT
- 1.3 Draw the Static VI characteristics of DIAC
- 1.4 Draw the Static VI characteristics of TRIAC

#### 2.0 Single phase Half wave and full wave converters for R loads

- 2.1 Verify the working of Single phase half wave controlled converter with R-load.
- 2.2 Verify the working of Single phase Full wave fully controlled converter with R-load

### 3.0 Speed Control of DC motors using converters and choppers

3.1 Control the speed of DC shunt motor using single phase fully controlled full wave converter

3.2 Control the speed of DC shunt motor using Chopper

### 4.0 Speed control of AC motors

4.1 Control the speed of 1  $\Phi$  induction motor using AC Voltage controller

4.2 Control the speed of 3  $\Phi$  induction motor using V/F controller

### 5.0 Inverters

5.1 Invert DC supply to AC supply using Series Inverter

5.2 Invert DC supply to AC supply using Parallel Inverter

### CO-PO MAPPING MATRIX

	Basic and Discipline Specific knowledge	Problem Analysis	Design/Development of Solutions	Engineering Tools, Experimentation & Testing	Engineering practices for society, sustainability and environment	Project Management	Lifelong learning	Linked PO
CO\PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO6	PO7	
CO1	3	1	-	-	2	2	3	1,2,5,6,7
CO2	3	-	2	3	2	2	3	1,3,4,6,7
CO3	-	1	3	2	2	2	3	2,3,4,5,6,7
CO4	-	3	3	3	2	2	3	2,3,4,5,6,7
CO5	3	2	3	3	2	2	3	1,2,3,4,6,7

**STATE BOARD OF TECHNICAL EDUCATION AND TRAINING, TELANGANA**  
**DEEE V SEMESTER**  
**MID SEM I MODEL QUESTION PAPER**

**Course Code: EE-507**

**Course Name: Power Electronics Lab**

**Duration: 1 Hour**

**Max.Marks: 20**

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**Note: Answer allotted Question.**

**Instructions to the Candidate:**

*(i) Record the results on a graph sheet if required, and conclude your observation of the experiment.*

*(ii) Draw the circuit diagram for illustration; choose appropriate values when not mentioned in the question.*

1. Draw the Static VI characteristics of SCR
2. Draw the Static VI characteristics of IGBT
3. Draw the Static VI characteristics of DIAC
4. Draw the Static VI characteristics of TRIAC

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**DEEE V SEMESTER**  
**MID SEM II MODEL QUESTION PAPER**

**Course Code: EE-507**

**Course Name: Power Electronics Lab**

**Duration: 1 Hour**

**Max.Marks: 20**

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**Note: Answer allotted Question.**

**Instructions to the Candidate:**

*(i) Record the results on a graph sheet if required, and conclude your observation of the experiment.*

*(ii) Draw the circuit diagram for illustration; choose appropriate values when not mentioned in the question.*

- 1 Verify the working of Single phase half wave controlled converter with R-load.
- 2 Verify the working of Single phase Full wave fully controlled converter with R-load
- 3 Control the speed of DC shunt motor using single phase fully controlled full wave converter
- 4 Control the speed of DC shunt motor using Chopper

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**MODEL QUESTION PAPER**  
**DEEE V SEMESTER**  
**SEMESTER END EXAMINATION**

**Course Code: EE-507**

**Course Name: Power Electronics Lab**

**Duration: 2 Hour**

**Max. Marks: 40**

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**Note: Answer allotted Question.**

**Instructions to the Candidate:**

***(i) Record the results on a graph sheet if required, and conclude your observation of the experiment.***

***(ii) Draw the circuit diagram for illustration; choose appropriate values when not mentioned in the question.***

- 1 Draw the Static VI characteristics of SCR
- 2 Draw the Static VI characteristics of IGBT
- 3 Draw the Static VI characteristics of DIAC
- 4 Draw the Static VI characteristics of TRIAC
  
- 5 Verify the working of Single phase half wave controlled converter with R-load.
- 6 Verify the working of Single phase Full wave fully controlled converter with R-load
  
- 7 Control the speed of DC shunt motor using single phase fully controlled full wave converter
- 8 Control the speed of DC shunt motor using Chopper
  
- 9 Control the speed of 1  $\Phi$  induction motor using AC Voltage controller
- 10 Control the speed of 3  $\Phi$  induction motor using V/F controller
  
- 11 Invert DC supply to AC supply using Series Inverter
- 12 Invert DC supply to AC supply using Parallel Inverter

## EE-508-PROGRAMMABLE LOGIC CONTROLLERS LAB

Course Title	Programmable Logic Controllers Lab	Course Code	EE-508
Semester	V	Course Group	Practical
Teaching Scheme in Periods(L:T:P)	1:0:2	Credits	1.5
Methodology	Lecture + Practical	Total Contact Periods	45
CIE	60 marks	SEE	40 Marks

### Pre requisites

This course requires the knowledge of Digital Electronics

### Course Outcomes

Course Outcome	
CO1	Identify the main components of the PLC module, configure the drivers and perform ON/OFF control logic task using PLC
CO2	Build the ladder logic program for logic gates, download it to the PLC and run the program
CO3	Develop the ladder logic program for timer & counter functions, download it to the PLC and run the program
CO4	Execute the ladder programs for PLC based model applications

### Suggested Learning Outcomes

#### 1.0 Identify the main components of the PLC module, configure the drivers and switching task using PLC

- 1.1 Identify the main components of the PLC module
- 1.2 Identify different input devices and output field devices used in Industrial automation
- 1.3 Perform the simple ON/OFF control task using the PLC.
- 1.4 Perform a relay switching logic task through a PLC unit
- 1.5 Develop a ladder logic program for Seal-In-circuit (Latch logic) using PLC, download and run the program.
- 1.6 Implement latch(Set) and unlatch(Reset) instructions

#### 2.0 Build the ladder logic program for logic gates, download it to the PLC and run the program

- 2.1 Develop a ladder logic program for AND,OR and NOT gates, download the program and run it
- 2.2 Develop a ladder logic program for NAND,NOR, EX-OR and EX-NOR gates PLC, download the program and run it



### 3.0 Develop the ladder logic program for timer & counter functions, download it to the PLC and run the program

- 3.1 Execute the ladder logic program for T-ON(ON-Delay Timer)
- 3.2 Execute the ladder logic program for T-OFF(OFF-Delay Timer)
- 3.3 Execute the ladder logic program for RTON(Retentive on)
- 3.4 Execute the ladder logic program forCTU(count-Up counter)
- 3.5 Execute the ladder logic program for CTD(count-down Counter)

### 4.0 Execute the ladder programs for PLC based model applications

- 4.1 Execute the ladder logic program for stair case lighting
- 4.2 Execute the ladder logic program for DOL starter
- 4.3 Execute the ladder logic program for star delta starter
- 4.4 Execute the ladder logic program for PLC Real time application for Speed control of DC motor
- 4.5 Execute the ladder logic program for Temperature Control
- 4.6 Execute the ladder logic program for Level control

### CO-PO Mapping Matrix

	Basic and Discipline Specific knowledge	Problem Analysis	Design/Development of Solutions	Engineering Tools, Experimentation & Testing	Engineering practices for society, sustainability and environment	Project Management	Lifelong learning	Linked PO
CO\PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO6	PO7	
CO1	3	1	-	-	2	2	3	1,2,5,6,7
CO2	3	-	2	3	2	2	3	1,3,4,6,7
CO3	-	1	3	2	2	2	3	2,3,4,5,6,7
CO4	-	3	3	3	2	2	3	2,3,4,5,6,7

**STATE BOARD OF TECHNICAL EDUCATION AND TRAINING, TELANGANA**  
**DEEE V SEMESTER**  
**MID SEM I MODEL QUESTION PAPER**

**Course Code: EE-508**

**Duration: 1 Hour**

**Course Name: Programmable Logic Controllers Lab**

**Max.Marks: 20**

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**Note: Answer allotted Question.**

**Instructions to the Candidate:**

***(i) Record the results on a graph sheet if required, and conclude your observation of the experiment.***

***(ii) Draw the circuit diagram for illustration; choose appropriate values when not mentioned in the question.***

1. Identify the main components of the PLC module
2. Identify different input devices and output field devices used in Industrial automation
3. Perform the simple ON/OFF control task using the PLC.
4. Perform a relay switching logic task through a PLC unit
5. Develop a ladder logic program for Seal-In-circuit (Latch logic) using PLC, download and run the program.
6. Implement latch(Set) and unlatch(Reset) instructions
7. Develop a ladder logic program for AND,OR and NOT gates, download the program and run it
8. Develop a ladder logic program for NAND,NOR, EX-OR and EX-NOR gates PLC, download the program and run it

**STATE BOARD OF TECHNICAL EDUCATION AND TRAINING, TELANGANA**  
**DEEE V SEMESTER**  
**MID SEM II MODEL QUESTION PAPER**

**Course Code: EE-508**

**Duration: 1 Hour**

**Course Name: Programmable Logic Controllers Lab**

**Max. Marks: 20**

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**Note: Answer allotted Question.**

**Instructions to the Candidate:**

***(i) Record the results on a graph sheet if required, and conclude your observation of the experiment.***

***(ii) Draw the circuit diagram for illustration; choose appropriate values when not mentioned in the question.***

- 1 Execute the ladder logic program for T-ON(ON-Delay Timer)
- 2 Execute the ladder logic program for T-OFF(OFF-Delay Timer)
- 3 Execute the ladder logic program for RTON(Retentive on)
- 4 Execute the ladder logic program for CTU(count-Up counter)
- 5 Execute the ladder logic program for CTD(count-down Counter)

**STATE BOARD OF TECHNICAL EDUCATION AND TRAINING, TELANGANA**  
**MODEL QUESTION PAPER**  
**DEEE V SEMESTER**  
**SEMESTER END EXAMINATION**

**Course Code: EE-508**

**Duration: 2 Hour**

**Course Name: Programmable Logic Controllers Lab**

**Max. Marks: 40**

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**Note: Answer allotted Question.**

**Instructions to the Candidate:**

***(i) Record the results on a graph sheet if required, and conclude your observation of the experiment.***

***(ii) Draw the circuit diagram for illustration; choose appropriate values when not mentioned in the question.***

1. Identify the main components of the PLC module
2. Identify different input devices and output field devices used in Industrial automation
3. Perform the simple ON/OFF control task using the PLC.
4. Perform a relay switching logic task through a PLC unit
5. Develop a ladder logic program for Seal-In-circuit (Latch logic) using PLC, download and run the program.
6. Implement latch(Set) and unlatch(Reset) instructions
7. Develop a ladder logic program for AND,OR and NOT gates, download the program and run it
8. Develop a ladder logic program for NAND,NOR, EX-OR and EX-NOR gates PLC, download the program and run it
9. Execute the ladder logic program for T-ON(ON-Delay Timer)
10. Execute the ladder logic program for T-OFF(OFF-Delay Timer)
11. Execute the ladder logic program for RTON(Retentive on)
12. Execute the ladder logic program for CTU(count-Up counter)
13. Execute the ladder logic program for CTD(count-down Counter)
14. Execute the ladder logic program for stair case lighting
15. Execute the ladder logic program for DOL starter
16. Execute the ladder logic program for star delta starter
17. PLC Real time application for Speed control of DC motor
18. Temperature Control
19. Level control
20. Star - Delta convertor

## EE-509-ELECTRICAL INSTALLATION LAB

Course Title	Electrical Installations Lab	Course Code	EE-509
Semester	V	Course Group	Core
Teaching Scheme in Periods(L:T:P)	1:0:2	Credits	1.5
Methodology	Lecture + Practical	Total Contact /Periods	45
CIE	60 Marks	SEE	40 Marks

### Prerequisites

This course requires the skills of handling electrical tools, accessories and performing wiring connections

### Course Outcomes

CO1 :	Identify, select necessary materials and perform electrical wiring for power circuits
CO2 :	Perform earthing and measure earth resistance
CO3 :	Identify and select the components, sensors and perform smart control of home electrical appliances.
CO4 :	Design and make calculations for establishing solar panels for lighting purpose and submersible pumps.

### Suggested Learning Outcomes

**After completion of the subject, the student shall be able to**

#### 1.0 Wiring power loads

- 1.1 Control two sub-circuits through Energy meter, MCB's and two 1way switches.
- 1.2 Control 1.5 ton capacity A/C equipment by MCB and stabilizer.
- 1.3 Connect the Inverter to power supply through 3 pin socket and 1way switch (Back up)
- 1.4 Prepare a board which supports the following devices and also connect the devices
  - a) The connection of 600VA UPS through which CPU and Monitor of a Computer System would be connected.
  - b) Connect a Printer also.
- 1.4 Connect Computer by main switch board with a Miniature Circuit Breaker (MCB)
- 1.5 Connect and test the given Public Address System
- 1.6 Prepare a meter board for lighting and power installation using MCB, energy meter, fuse unit, DP switch, indicators and bus bars.
- 1.8 Make necessary calculations for installing a Submersible pump supporting a requirement

- a) Consider the Size(dia) of Bore
- b) Height to be pumped
- c) Distance to be pumped.
- d) Cable requirement.
- e) No. of phases to be used ( i.e either 1-phase or 3-phases motor)

1.9 Study and calculate the rating of Diesel Generator set for providing backup power supply for Electrical Machines lab.

## **2.0 Earthing**

2.1 Demonstrate Pipe Earthing.

2.2 Demonstrate Plate Earthing.

2.6 Demonstrate the method to measure the value of Earth Resistance.

## **3. Smart Home Control**

3.1 Installation of Video Doorbell

3.2 Design an application using Motion Sensing switch.

3.3 Design an application using Touch sensitive switch

3.4 Installation of Wi-Fi enabled camera and viewing through mobile phone.

3.5 Remote controlled switching of lamps.

3.6 Remote controlled switching and speed control of fans.

3.6 Switching of various electrical devices using Mobile.

3.7 Switching of various electrical devices using IOT.

## **4. Solar Panels.**

4.1 Understand Solar Panels types, Specifications, Companies, Prices

4.2 Design and make calculations for establishing Solar panels for lighting purpose using Inverters and Batteries.

4.3 Design and make calculations for establishing Solar panels to provide a supply to a 5 H.P Submersible

pump and VFD drive and other accessories.

4.4 Understand the Pay back Calculation by using a Solar Scheme for any Installation.

## CO-PO Mapping Matrix

	Basic and Discipline Specific knowledge	Problem Analysis	Design/Development of Solutions	Engineering Tools, Experimentation & Testing	Engineering practices for society, sustainability and environment	Project Management	Lifelong learning	Linked PO
CO\PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO6	PO7	
CO1	3	-	-	3	2	-	3	1,4,5,7
CO2	3	-	2	3	3	-	3	1,3,4,5,7
CO3	-	-	3	2	2	-	3	3,4,5,7
CO4	-	-	3	3	2	-	3	3,4,5,7

**STATE BOARD OF TECHNICAL EDUCATION AND TRAINING, TELANGANA**  
**MODEL QUESTION PAPER**  
**DEEE V SEMESTER**  
**MID SEMESTER-I EXAMINATION**

**Course Code: EE-509**

**Course Name: Electrical Installations Lab**

**Duration: 1 Hour**

**Max.Marks: 20**

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**Note: Answer allotted Question.**

1. Control 1.5 ton capacity A/C equipment by MCB and stabilizer.
2. Connect the Inverter to power supply through 3 pin socket and 1way switch (Back up)
3. Control two sub-circuits through Energy meter, MCB's and two 1way switches.
4. Demonstrate Plate Earthing.
5. Prepare a meter board for lighting and power installation using MCB, energy meter, fuse unit, DP switch, indicators and bus bars.

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**MODEL QUESTION PAPER**  
**DEEE V SEMESTER**  
**MID SEMESTER-II EXAMINATION**

**Course Code: EE-509**

**Course Name: Electrical Installations Lab**

**Duration: 1 Hour**

**Max.Marks: 20**

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**Note: Answer allotted Question.**

1. Connect and test the given Public Address System.
2. Study and calculate the rating of Diesel Generator set for providing backup power supply for Electrical Machines lab.
3. Perform installation of Wi-Fi enabled camera and viewing through mobile.
4. Perform remote controlled switching and speed control of fans.
5. Design and make calculations for establishing Solar panels to provide a supply to a 5 H.P Submersible pump and VFD drive and other accessories.

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**MODEL QUESTION PAPER**  
**DEEE V SEMESTER**  
**SEMESTER END EXAMINATION**

**Course Code: EE-509**

**Course Name: Electrical Installations Lab**

**Duration: 2 Hour**

**Max. Marks: 40**

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**Note: Answer allotted Question.**

1. Make Control two sub-circuits through Energy meter, MCB's and two 1way switches.
2. Prepare a Board which supports the following devices and connect the devices
  - a) The connection of 600VA UPS through which CPU and Monitor of a Computer System would be connected.
  - b) Connect a Printer also.
3. Connect Computer by main switch board with a Miniature Circuit Breaker (MCB).
4. Prepare a meter board for lighting and power installation using MCB, energy meter, fuse unit, DP switch, indicators and bus bars.
5. Study and calculate the rating of Diesel Generator set for providing backup power supply for Electrical Machines lab.
6. Demonstrate the method to measure Earth Resistance.
7. Perform switching of various electrical devices using IOT.
8. Perform switching of various electrical devices using Mobile Phone.
9. Design and make calculations for establishing Solar panels for lighting purpose using Inverters and Batteries.
10. Design and make calculations for establishing Solar panels to provide a supply to a 5 H.P Submersible pump and VFD drive and other accessories.



### EE-510-PROJECT WORK

Course Title	Project Work	Course Code	EE-510
Semester	V	Course Group	Practical
Teaching Scheme in Periods(L:T:P)	1:0:2	Credits	1.5
Methodology	Practical	Total Contact Periods	45
CIE	60 Marks	SEE	40 Marks

#### Course out comes:

The student should be able to

1. Apply principles of Electrical engineering to solve real world problems
2. Demonstrate the knowledge and skills to assess safety, legal issues and consequent responsibilities.
3. To function effectively as an individual and as a member in a team
4. To communicate and collaborate effectively with the team
5. To engage in lifelong learning in the context of technological changes

Sl. No	Subject	Items	Max Marks
1	Project work	<b>CIE</b>	
		1. Mid - I: Abstract submission – (Marks awarded by the Guide)	20
		2. Mid – II: Content development/ literature survey, data collection/prototype etc. - (Marks awarded by the Guide)	20
		3.Internal evaluation - (Marks awarded by the Guide)	20
		<b>SEE</b>	
		4.a) Final report Submission b) Seminar /Viva Voce (Marks awarded by the External Examiner, Head of Section (i.e. Internal Examiner) and Guide).	20 20
Total			<b>100</b>

**Note:** The Project work carries 100 marks and pass marks are 50% and a minimum of 50% in SEE. Internal assessment is done by guide and external assessment is conducted by guide, head of section and external examiner.

A candidate failing to secure the minimum marks has to reappear for the project.

### **EE-511- SKILL UPGRADATION**

Course title	Skill Upgradation	Course code	EE-511
Semester	V	Course group	Practical
Teaching scheme in periods (L:T:P)	1:0:2	Credits	2.5
Methodology	Lecture + tutorial	Total contact periods	120

### **Suggested Course Outcomes**

**CO.1 Address the identified needs of the community collaboratively to facilitate positive social change.**

- Prepare a chart related to the topics covered in the present semester.
- Listen to expert talk, guest lecture, youtube video and write a summary.
- Participate in Haritha Haram and submit a small report about the activities.
- Prepare a report / PPT / poster on waste water recycling or any eco-friendly practices.
- Seminar on problems with possible solutions in the campus or nearby places
- Group discussions or enacting a play on topics creating awareness about socio-economic problems
- Take up a case study on identification of latest technologies to tackle day to day problems such as pollution control or traffic management and submit a report / PPT/ poster
- Participate in NCC

**(PO5, 6, 7)**

**CO.2 Listen attentively to others and respond appropriately**

- Listen to expert talk, guest lecture, youtube video and write a summary.
- Participating in Group discussions or enacting a play on topics creating awareness about socio-economic problems that can be mitigated by technologies.
- Participate in quiz on technical aspects or current affairs
- Participate in Mock Interview

**(PO5, 7)**

**CO.3 Adapt your style to the occasion, task, and audience**

- Group discussions or enacting a play on topics creating awareness about socio-economic problems that can be mitigated by technologies.
- Seminar on problems with possible solutions in the campus or nearby places
- Participate in Mock Interview

**(PO5, 6, 7)**

**CO.4      Articulate ideas in various formats including oral, written, nonverbal, visual, and electronic devices.**

- a. Prepare a chart related to the topics covered in the present semester.
- b. Refer to an e-journal and submit a summary report on upcoming technologies.
- c. Visit factory / industry and submit a report/PPT on the observations made.
- d. Prepare a mini project and submit report.
- e. Prepare a report / PPT / poster on waste water recycling or any eco-friendly practices.
- f. Take up a case study on identification of latest technologies to tackle day to day problems such as pollution control or traffic management and submit a report / PPT/ poster
- g. Seminar on problems with possible solutions in the campus or nearby places
- h. Participate in Mock Interview

**(PO5, 6, 7)**

**CO.5      Demonstrate ability to recognize and effectively manage ambiguous ideas, experiences and situations**

- a. Take up a case study on identification of latest technologies to tackle day to day problems such as pollution control or traffic management and submit a report / PPT/ poster
- b. Seminar on problems with possible solutions in the campus or nearby places

**(PO5, 6, 7)**

**CO.6      Analyze the interconnections between individuals and society as well as how individual actions have an impact on others.**

- a. Participate in Haritha Haram and submit a small report about the activities.
- b. Participate in Swatch Bharath and write an essay on the importance of the program
- c. Participate in NCC

**(PO5, 6, 7)**

**CO.7      Utilize others' ideas, strengths, knowledge, and abilities to foster an inclusive environment & Develop and sustain healthy and meaningful relationships with others**

- a. Prepare a mini project and submit report.
- b. Participate in Haritha Haram and submit a small report about the activities.
- c. Participate in Swatch Bharath and write an essay on the importance of the program
- d. Participate in NCC

**(PO5, 6, 7)**

**CO.8 Ability to recognize their strengths and those of others to work towards a shared vision.**

- a. Prepare a mini project and submit report.
- b. Participate in Haritha Haram and submit a small report about the activities.
- c. Participate in Swatch Bharath and write an essay on the importance of the program
- d. Participate in NCC

**(PO5, 6, 7)**

**CO.9 Act in alignment with one's own values to contribute to one's life-long growth and learning.**

- a. Physical activities such as sports, yoga, meditation and other relaxation techniques

**(PO5, 6, 7)**

**CO.10 Gain, process, and act upon knowledge regarding the effects of individual, community, national, and international level choices on ecosystems and people.**

- a. Prepare a report / PPT / poster on waste water recycling or any eco-friendly practices.
- b. Take up a case study on identification of latest technologies to tackle day to day problems such as pollution control or traffic management and submit a report / PPT/ poster
- c. Take up a case study on identification of latest technologies to tackle day to day problems such as pollution control or traffic management and submit a report / PPT/ poster
- d. Seminar on problems with possible solutions in the campus or nearby places

**(PO5, 6, 7)**

CO	Outcome	CO/PO Mapping
CO1	Address the identified needs of the community collaboratively to facilitate positive social change.	5, 6, 7
CO2	Listen attentively to others and respond appropriately	5, 6, 7
CO3	Adapt your style to the occasion, task, and audience	5, 6, 7
CO4	Articulate ideas in various formats including oral, written, nonverbal, visual, and electronic devices.	5, 6, 7
CO5	Demonstrate ability to recognize and effectively manage ambiguous ideas, experiences and situations	5, 6, 7
CO6	Analyze the interconnections between individuals and society as well as how individual actions have an impact on others.	5, 6, 7
CO7	Utilize others' ideas, strengths, knowledge, and abilities to foster an inclusive environment & Develop and sustain healthy and meaningful relationships with others	5, 6, 7
CO8	Ability to recognize their strengths and those of others to work towards a shared vision	5, 6, 7
CO9	Act in alignment with one's own values to contribute to one's life-long growth and learning.	5, 6, 7
CO10	Gain, process, and act upon knowledge regarding the effects of individual, community, national, and international level choices on ecosystems and people.	5, 6, 7

**Note:** The above COs may map to other POs from 1 to 4 apart from PO's 5 to 7 depending on the topic

### **Suggested Student Activities**

1. Prepare a chart related to the topics covered in the present semester.
2. Refer to an e-journal and submit a summary report on upcoming technologies.
3. Visit factory / industry and submit a report/PPT on the observations made.
4. Prepare a mini project and submit report.
5. Listen to expert talk, guest lecture, youtube video and write a summary.
6. Participate in Haritha Haram and submit a small report about the activities.
7. Prepare a report / PPT / poster on waste water recycling or any eco-friendly practices.
8. Take up a case study on identification of latest technologies to tackle day to day problems such as pollution control or traffic management and submit a report / PPT/ poster
9. Participate in Swatch Bharath and write an essay on the importance of the program
10. Group discussions or enacting a play on topics creating awareness about socio-economic problems

11. Physical activities such as sports, games, yoga, meditation and other relaxation techniques
12. Participate in quiz on technical aspects or current affairs
13. Seminar on problems with possible solutions in the campus or nearby places
14. Participate in NCC
15. Participate in Mock interviews

Note: The above student activities will be assessed using rubrics. A sample rubrics template is given below. The subject teacher can assess students using rubrics with atleast four relevant aspects.

**RUBRICS MODEL (For assessing Presentation skills)**

Aspects	Needs improvement	Satisfactory	Good	Exemplary
Collection of data	Collects very limited information	Collect much Information with very limited relevance to the topic	Collects some basic information with little bit of irrelevance	Collects a great deal of information with relevance
Presentation of data	Clumsy presentation of data	Presents data well; but presentation needs to be more meaningful	Presents data well but need to improve clarity	Presents data in an understandable yet concise manner
Fulfill team's roles & duties	Performs very little duties but Unreliable.	Performs very little duties and is inactive	Performs nearly all duties	Performs all duties of assigned team roles
Shares work equally	Rarely does the assigned work; often needs reminding	Usually does the assigned work; rarely needs reminding	Normally does the assigned work	Always does the assigned work without having to be reminded
Interaction with other team mates	Usually does most of the talking; rarely allows others to speak	Talks good; but never show interest in listening to others	Listens, but sometimes talks too much	Listens and speaks a fair amount
Audibility and clarity in speech	Hardly audible and unclear	Very little audibility and clarity	Audible most of the time with clarity	Audible and clear

Understanding content	Lacks content understanding and is clearly a work in progress	Little depth of content understanding	Some depth of content understanding is evident but needs improvement	Insight and depth of content understanding are evident
Content Presentation	Content is inaccurate and information is not presented in a logical order making it difficult to follow	Content is accurate and information is not presented in a logical order making it difficult to follow	Content is accurate but some information is not presented in a logical order but is still generally easy to follow	Content is accurate and information is presented in a logical order

**Suggested additional aspects for assessing Leadership Qualities:**

1. Carrying self
2. Punctuality
3. Team work abilities
4. Moral values
5. Communication skills
6. Ensures the work is done in time

Suggested additional aspects for assessing “Participation in social task”

- 1 Interested to know the current situation of society.
- 2 Shows interest to participate in given social task.
- 3 Reliable
- 4 Helping nature
- 5 Inter personal skills
- 6 Ensures task is completed

Suggested additional aspects for assessing “Participation in Technical task”

1. Updated to new technologies
2. Identifies problems in society that can be solved using technology
3. Interested to participate in finding possible technical solutions to identified project
4. Reliable
5. Interpersonal skills

Suggested additional aspects for Carrying Self:

- 1 Stand or sit straight.
- 2 Keep your head level.
- 3 Relax your shoulders.
- 4 Spread your weight evenly on both legs.

- 5 If sitting, keep your elbows on the arms of your chair, rather than tightly against your sides.
- 6 Make appropriate eye contact while communicating.
- 7 Lower the pitch of your voice.
- 8 Speak more clearly.

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