C24-CURRICULUM

DIPLOMA IN

ELECTRICAL AND ELECTRONICS ENGINEERING

Offered By

STATE BOARD OF

TECHNICAL EDUCATION AND TRAINING TELANGANA HYDERABAD

TEACHING AND EXAMINATION SCHEME

DEEE-V Semester

Sl No	Course Code	Course Name	Teaching Scheme				Credits	Examination Scheme						
			Instruction periods per week			Total Periods per semester		Continuous internal evaluation			Semester end examination			
			L	T	P			Mid Sem1	Mid Sem2	Internal evaluation	Max Marks	Min Marks	Total Marks	Min marks for Passing including internal
1	EC-501	Entrepreneurship & Startups	4	1	0	75	2.5	20	20	20	40	14	100	35
2	EE-502	Power Electronics	4	1	0	75	2.5	20	20	20	40	14	100	35
3	EE-503	AC Motors	4	1	0	75	2.5	20	20	20	40	14	100	35
4	EE-504	Electrical Utilization and Traction	4	1	0	75	2.5	20	20	20	40	14	100	35
5	EE-505A	Industrial Motor Controls	4	1	0	75	2.5	20	20	20	40	14	100	35
	EE-505B	Electric Vehicles												
6	EE-506A	Switchgear and Protection	4	1	0	75	2.5	20	20	20	40	14	100	35
	EE-506B	Advanced Protection of Power Systems												
7	EE-507	Power Electronics & Power Systems Lab	1	0	2	45	1.25	20	20	20	40	20	100	50
8	EE-508	A.C Motors LAB	1	0	2	45	1.25	20	20	20	40	20	100	50
9	EE-509	Programmable Logic Controllers & MAT Lab	1	0	2	45	1.25	20	20	20	40	20	100	50
10	EE-510	Project Work	1	0	2	45	1.25	20	20	20	40	20	100	50
			28	6	8	630	20	200	200	200	400	164	1000	410

EC-501 – ENTREPRENEURSHIP & STARTUPS

Course Title	**Entrepreneurship & Startups**	**Course Code**	**EC-501**
SEMESTER	**V SEMESTER**	**Course Group**	**Core**
Teaching Scheme in periods (L : T : P)	**4:1: 0**	**Credits**	**2.5**
Methodology	**Lecture + Tutorial**	**Total Contact Periods**	**75**
CIE	**60 Marks**	**SEE**	**40 Marks**

Pre requisites

Knowledge of Basic finance and business knowledge

Course Outcomes

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

Course Outcomes	
CO1	Identify the dynamic role of entrepreneurship and Startups in India and Telangana State by Acquiring Entrepreneurial spirit and resourcefulness, quality, competency, and motivation
CO2	Identify Business Ideas and Develop plans to implement
CO3	Identify and Assess the effectiveness and suitability of various support agencies and incubators in India and Telangana State
CO4	Comprehend different management practices like Leadership and Ownership, resource Institutes
CO5	Comprehend basic concepts of financial management and their application
CO6	Build Project Proposal and Understand CSR, Ethics, Ex-Im and Exit strategies

Course Contents

UNIT-1 Introduction to Entrepreneurship and Start – Ups Duration: 12 Periods (L: 9 – T:3)

Define Entrepreneurship- Discuss characteristics and functions of Entrepreneurship- Identify different types of Entrepreneurships-Compare the concepts of entrepreneur and intrapreneur and find out the motivation behind it -Distinguish between Entrepreneur and Managers - Identify 7-M Resources - Know MSME & Startup India –Startup Telangana, Start up Scheme- types, Importance, Features, Eligibility for Startup registration, Benefits

UNIT- 2 Business Ideas and their implementation Duration: 13 Periods (L: 10 – T:3)

Finding Ideas and making an activity map - Develop the plans for creating and starting the business - Identify business using the ideation canvas and the business model canvas- Discuss market research related terms- Outline market mix related terms - Define Product related terminologies - Emphasize on Innovation - Explain concept of Risk and SWOT

UNIT-3 Support Agencies and Incubators Duration: 15 Periods (L: 12 – T:3)

State level and National level sources of information- various central Government institutions and their functions (like NSIC,SIDO,SISI and SSIB)- Telangana State industry policy-Demographic merits of Telangana state to set up SSIs-Names of state level institutions and their functions(Like SSIDC,DIC,APIITCO)-Banks that support SSIs like SIDBI,APSFC-Thrust areas and core sector as per Telangana state industry policy-Classification of the projects as per TSIP-Special assistance schemes for women and SC/ST entrepreneurs Features of TS-IPASS. Legal Issues –Contracts-Copyrights –Insurance-IPR-Licensing-Patents-Trade Secrets-Trademarks.

UNIT- 4 Management Practices Duration: 10 Periods (L: 8 – T:2)

Explain the concept and differences between Industry - Commerce and Business - Describe various types of ownerships in the Organization - Explain different types of leadership models - Analyze the nature and importance of various functions of management.

UNIT-5 Finance Management Duration: 13 Periods (L: 10 – T:3)

Introduction – Objectives of Financial Management – Types of capitals – sources of raising capital – Start-ups funding types-venture capital funding-crowd funding-series funding- Types of budgets – production budgets – labour budgets – Concept of Profit and loss Account – Concept of balance sheet – proforma – types of taxes – brief concepts of – Excise Tax, Service Tax, Income Tax, GST and custom duty.

UNIT-6 - Project Proposal & Exit Strategy **Duration: 12 Periods (L: 10 – T:3)**

To work on the development of a project proposal - Describe social responsibility and relate with economic Performance. - Explain managerial ethics - To know Ex-Im Policies - Identify suitable strategies of succession and harvesting

Reference Books

S. No	Title of Book	Author	Publication with place, Year and ISBN
1	Entrepreneurship in Action	Coulter	PHI2nd Edition
2	Entrepreneurship Development	E.Gordon &K. Natarajan	Himalaya
3	Entrepreneurship	Robert D. Hisrich& Mathew J. Manimala	McGraw Hill Education; ISBN978-1259001635
4	Entrepreneurial Development	SS Khanka	S Chand & Company;ISBN:978-8121918015
5	Entrepreneurship Development and Management	A. K. Singh	Jain Book Agency(JBA) publishes, NewDelhi
6	The Startup Owner's Manual: The Step-by-Step Guide for Building a Great Company	Steve Blank and Bob Dorf	K&S Ranch ISBN– 978-0984999392
7	The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses	EricRies	Penguin UK ISBN– 978-0670921607
8	Entrepreneurship	Roy Rajeev	Oxford University Press; ISBN:978-0198072638
9	Industrial Engineering and Management	O.P.Khanna	Dhanpat Rai and Sons, Delhi
10	Industrial Organization and Management	Tara Chand	Nem Chand and Brothers; Roorkee
11	Industrial Management and Entrepreneurship	V.K. Sharma.	Scientific Publishers, New Delhi
12	Entrepreneurship Development and Small Business Enterprise	Poornima M Charantimath	Pearson Education;ISBN:978-8131759196
13	Entrepreneurship Development	S Anil kumar	NEWAGEIntern.Pvt Ltd;ISBN:978-8122414349

Suggested E-learning resources

Sr. No.	Topic Key Word	Link
1	MoCI	https://www.india.gov.in/website-ministry-commerce-and-industry
2	MSME	1)https://msme.gov.in/ 2) https://www.msmex.in/learn/government-schemes-for-startups-and-msmes-in-india/
3	Start-up, Stand-up India &start-up Telangana	1) https://www.startupindia.gov.in/ 2) https://www.standupmitra.in 3) https://udyamimitra.in/page/standup-india-loans 4) https://www.ssipgujarat.in/
4	Make in India	https://www.makeinindia.com/
5	Atmanirbhar Bharat Abhiyan Vocal for Local	https://indiancc.mygov.in›uploads›2021/08
6	Skill India	https://skillindia.gov.in
7	Start-ups telangana	https://startup.telangana.gov.in/government-policies/
8	MSDE	https://www.msde.gov.in/

Suggested Learning Outcomes

Upon completion of the course the student shall be able to

CO-1:- Identify the dynamic role of entrepreneurship and Startups in India and Telangana State by Acquiring Entrepreneurial spirit and resourcefulness, quality, competency, and motivation:-

1.1 Define Entrepreneurship
1.2 Explore characteristics and functions of entrepreneurship
1.3 Identify different types of Entrepreneurships
1.4 Compare the concepts of entrepreneur and intrapreneur and find out the motivation behind it
1.5 Distinguish between entrepreneur and managers
1.6 Identify 7-M Resources
1.7 Understand MSME & Start-up India
1.8 Identify Start-up schemes in Telangana
1.9 Interpret the importance of Start up Schemes
1.10 List the important features of Start-up schemes in Telangana State
1.11 Determine the Eligibility for start-up registration and understand the process
1.12 Explore the Benefits of Start-up registration

CO-2:- Identify Business Ideas and Develop plans to implement:-

2.1 List the steps in new business idea generation.
2.2 List the major steps involved in idea generation
2.3 Define brain storming, divergent thinking, creative Problem- solving.
2.4 Illustrate SCAMPER Technique.
2.5 List various steps involved in product Identification
2.6 Explain various phases of creating and starting the business
2.7 Explain marketing plan
2.8 List key components of Financial Plan.
2.9 List various Sources of Capital
2.10 Identify Business opportunity and evaluation.
2.11 Define market research related terms- Questionnaire design ,Sampling ,Market survey, Data analysis & interpretation
2.12 Outline Marketing Mix (4Ps- product, price, promotion, place)
2.13 Define Product Terms like PLC, Mortality Curve, New product Development Steps, Inventory, Supply Chain Management
2.14 State the Importance of Innovation,
2.15 Define concept of innovation
2.16 Describe the process of innovation.
2.17 Explain Risk analysis and mitigation by SWOT Analysis

CO-3:- Overview of Support Agencies and Incubators:-

3.1 Identify State level and national level sources of information on Start-ups
3.2 Detail functions of Various central Government institutions (like NSIC,SIDO,SISI and SSIB)
3.3 Detail important features of Telangana State industry policy.
3.4 List Demographic merits of Telangana state to set up SSIs.
3.5 List the Names of state level institutions that support SSIs
3.6 Explain the role of institutions like SSIDC, DIC, APIITCO in setting up SSIs.
3.7 Explain role of Banks that support SSIs like SIDBI, APSFC.
3.8 Identify Thrust areas and core sector as per Telangana state industry policy.
3.9 Classify the projects as per TSIP.
3.10 Explain Special assistance schemes for women and SC/ST entrepreneurers.
3.11 List Features of TS-IPASS.
3.12 Explain Legal Issues –Contracts-Copyrights –Insurance – IPR – Licensing-Patents-Trade Secrets-Trademarks.

CO-4:- Select suitable Management practices like leadership and Ownership, resource institutes :-

4.1 Differentiate industry, Commerce and business,
4.2 Demonstrate various types of ownerships in the organization,
4.3 Illustrate different types of leadership models,
4.4 List various functions of management
4.5 Explain the nature and importance of various functions of management.
4.6 State the need for Planning in management
4.7 Explain Staffing- Recruitment and management of talent.
4.8 List merits and Demerits of various functions of management.
4.9 Differences between Management and Administration

CO-5:-Comprehend basic concepts of financial management and their application

5.1 Define Finance Management
5.2 List Objectives of Financial Management,
5.3 List Types of capitals,
5.4 Identify Sources of raising capital
5.5 List Start-ups funding types
5.6 Explain Venture capital funding
5.7 Explain Series funding
5.8 Explain Crowd funding
5.9 List Types of budgets-production budget – labour budget
5.10 Explain Concept of Profit loss Account,
5.11 Illustrate Concept of balance sheet– proforma
5.12 List Types of taxes imposed by Central Government and State Government
5.13 Detail concepts of – Excise Tax, Income Tax, GST and custom duty.

CO-6:-Building Project Proposal & Understand CSR, Ethics, Ex-Im, & Exit strategies

6.1 Outline the steps involved in Project Planning and report
6.2 Explain Feasibility study of project
6.3 Explain the process of Project cost estimation
6.4 Define and explain Breakeven analysis
6.5 Define the terms Return on investment and Return on sales
6.6 Describe social responsibility and relate with economic Performance.
6.7 Explain Business Ethics
6.8 Describe Ex-Im Policies
6.9 Identify suitable strategies of succession and harvesting.
6.10 Explain Bankruptcy and avoidance

Suggested Student Activities

Other than the classroom learning, following are the suggested student-related co-curricular activities which can be undertaken to accelerate the attainment of the various outcomes in this course. Students should make a portfolio i.e. perform at least FIVE from following list of activities individually or in group (not more than 2 students). They should prepare reports of about 2-5 pages for each activity and collect/ record physical evidence for their portfolio which may be useful for their placement interviews:

i. Develop two products from household waste (attach photographs).
ii. Download product development and innovative films from internet
iii. Prepare a collage for "Traits of successful entrepreneurs."/ "Motivation & Charms of Entrepreneurship".
iv. Invite entrepreneurs, industry officials, bankers for interaction. Interview atleast four entrepreneurs or businessman and identify
v. Identify your hobbies and interests and convert them into business idea.
vi. Mock Business Model- Choose a product and design a unique selling preposition, brand name, logo, advertisement (print, radio, and television), jingle, packaging, and labelling for it.
vii. Develop your own website. Share your strengths and weakness on it. Declare your time bound goals and monitor them on the website.
viii. Choose any product / advertisement and analyse its good and bad points/ cost sheet/ supply chain etc. (individuals should select different ads).
ix. Compare schemes for entrepreneurship promotion of any bank.
x. Prepare sign boards representing safety measures.
xi. Prepare a project report on following policies implemented by Telangana under Start-ups
    ELECTRONICS POLICY-2016
    Innovation policy-2016
    Industrial policy-2014 etc.,

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

	Basic and Discipline Specific Knowledge	Problem Analysis	Design/Development of Solutions	Engineering Tools, Experimentation and Testing	Engineering Practices for Sustainability Society, and Environment	Project Management	Lifelong Learning	Linked PO
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO 7	
CO1	1	1			1	2	1	1,2,5,6,7
CO2	1	2	2		1	1	2	1,2,3,5,6,7
CO3	2				1		2	1,5,7
CO4	1					1		1,6
CO5	1					2	1	1,6,7
CO6	1				2	2	1	1,5,6,7

Blue Print of Marks for SEE:

Units		No of periods	Questions to be set for SEE					Remarks
			R			U	A	
Part-A	1.Introduction to Entrepreneurship and Start – Ups	13	Q4	Q1		Q9(a)	Q13(a)	
	2. Business Ideas and their implementation	12						
Part-B	3.Support Agencies and Incubators	13		Q2		Q10(a)	Q14(a)	
	4. Management Practices	12						
Part-C	5. Finance Management	12		Q3	Q5 Q6	Q9(b) Q11(a) Q11(b)	Q13(b) Q15(a) Q15(b)	
	6.Project Proposal & Exit Strategy	13			Q7 Q8	Q10(b) Q12(a) Q12(b)	Q14(b) Q16(a) Q16(b)	
TOTAL		**75**	**08**			**08**	**08**	

MODEL QUESTION PAPERS

STATE BOARD OF TECHNICAL EDUCATION & TRAINING:TS:HYDERABD

EC-501- ENTREPRENEURSHIP AND STARTUPS

V SEMESTER MID SEMESTER – I MODEL PAPER

Time: 1 hour **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. Define Entrepreneurship
2. Define start-ups.
3. What is the full form SWOT?
4. State need for business plan?

PART-B **2X3M=6 Marks**

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

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

5. (a) Discuss characteristics of entrepreneurship**.**

OR

(b) Illustrate about MSME?

6. (a) What is the need for planning?

OR

(b) What is mean by market planning?

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) Compare the concepts entrepreneur and intrapreneur

OR

(b) Identify 7-M Resources

8. (a) Identify different marketing mix and illustrate their importance

Or

(b) Examine different business opportunities

MODEL QUESTION PAPERS
STATE BOARD OF TECHNICAL EDUCATION & TRAINING:TS:HYDERABD
EC-501- ENTREPRENEURSHIP AND STARTUPS
V SEMESTER MID SEMESTER – II MODEL PAPER

Time: 1 hour **Max. Marks:20**

PART-A **4X1=04 Marks**

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. List any two support agencies promoting entrepreneurship ?
2. Mention any two features of TS-IPASS?
3. List the functions of management?
4. What is merits of managements ?

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) Outline the Telangana state industry policy.

OR

(b) Classification of the projects as per TSIP

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

OR

(b) Explain about staffing and need for recruitment .

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 Telangana state industry policy

OR

(b) Illustrate the special assistance schemes for women and SC/ST Entrepreurers

8. (a) Describe various types of ownerships in the organization,

OR

(b)Explain different types of leadership models,

MODEL QUESTION PAPERS
STATE BOARD OF TECHNICAL EDUCATION & TRAINING:TS:HYDERABD
EC-501- ENTREPRENEURSHIP AND STARTUPS
V SEMESTER END SEMESTER MODEL PAPE

Time: 2 Hours **Max. Marks:40**

PART-A 8 X 1 = 8

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

1. What is mean by MSME?
2. What is mean by Marketing plan?
3. Full form of TS-IPASS
4. Define crowd funding.
5. What is mean by balance sheet?
6. Mention types of taxes.
7. What is mean by breakeven?
8. Mention any two business ethics?.

PART-B 4 X 3 = 12

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

9. (a) List any six Telangana Start-ups schemes.

OR

9. (b) Explain about venture capital funding
10. (a) Illustrate about SSIDC.

OR

10. (b) Explain about return on investment .
11. (a) List out the element of cost?

OR

(b) What is buyer's market and seller's market.

11. (a) Mention the importance of Business Ethics?

OR

12. (b) Illustrate briefly about bankruptcy?

PART-C 4 X 5 = 20

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

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

13.(a) Discuss market research related terms- Questionnaire design ,Sampling ,Market survey, Data analysis & interpretation

OR

13.(b) Evaluate different types of budgets?

14 (a) Evaluate different types of leadership models,

OR

14(b) Evaluate different types of budgets

15 (a) Evaluate different types of capitals.

OR

15(b) Explain briefly about different taxes ?

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

OR

(b) Illustrate suitable strategies of succession and harvesting.

EE-502- POWER ELECTRONICS

Course Title:	**Power Electronics**	Course Code	**EE-502**
Semester	**V Semester**	Course Group	**Core**
Teaching Scheme in Periods (L:T:P)	**60:15:0**	Credits	**2.5**
Methodology	**Lecture + Tutorials**	Total Contact Periods	**75**
CIE	**60 Marks**	SEE	**40 Marks**

Pre requisites

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

Course Outcomes

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

CO1:	Compare different power electronic devices and select the device based on the requirement
CO2 :	Analyze the different Converters circuits and to select suitable converters based on applications field.
CO3:	Acquire the knowledge to construct AC Controllers 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 the Power electronic circuits for specific applications

Blue Print of Marks for SEE

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

Course Contents

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- 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 wavecontrolled 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 Controllersand Choppers Duration:13 Periods (L:10– T: 3)

Single phase half wave and full wave AC voltage controller with R load - Applications of AC voltage controller - 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.

Reference 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
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

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

CO1: Compare different power electronic devices and select the device based on the requirement

1.1 Introduction to Power Electronic Devices and their Importance
1.2 Difference between Electronic and Power Electronic Devices
1.3 Applications of Power Electronic Devices in Power Systems, Smart grids etc
1.4 List different devices of thyristor family.
1.5 Draw the ISI circuit symbols for each device in thyristor family.
1.6 Explain the constructional details of SCR
1.7 Explain the two transistor analogy of SCR.
1.8 Explain the static Volt – Ampere characteristics of SCR with the help of a diagram.
1.9 Draw the Gate characteristics of SCR
1.10 Explain SCR triggering by UJT.
1.11 Mention the ratings of SCR.
1.12 Give the advantages of SCR as a switch.
1.13 Explain the static Volt-ampere characteristics of DIAC with the help of diagram.
1.14 Explain the static Volt-ampere characteristics of TRIAC with the help of diagram.
1.15 Explain the working of Insulated gate Bipolar transistor (IGBT) by giving their static V-I Characteristics.
1.16 List applications of SCR, DIAC, TRIAC, IGBT, LASCR

C02: Use different Converters circuits as per requirement.

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

CO3: Acquire the knowledge to construct ACControllersand Choppers circuits.

3.1 Define AC voltage Controller.
3.2 Explain the working of single phase half wave AC voltageController.
3.3 Explain the working of single phase full wave AC voltage Controller.
3.4 List the applications of AC voltage Controller.
3.5 Define Chopper.
3.6 Classify choppers.
3.7 Explain the working principle of chopper (Step Down Chopper).
3.8 State the expression for R.M.S value of Voltage of Stepdown Chopper.
3.9 Describe the voltage control modes of chopper
3.10 Explain the operation of chopper in all four quadrants.
3.11 List the applications of choppers.

CO4: Acquire the knowledge to construct and use Inverters and Cyclo-converters circuits.

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.

C05: Apply the power electronic drives for speed control of DC / AC Motors and compare specific power electronics drives.

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.

C06: Apply Power electronic circuits for specific applications

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
CO\PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	Linked PO
CO1	3		1		3		2	1,3,5,7
CO2	3		3		3		2	1,3,5,7
CO3	3		3		3		2	1,3,5,7
CO4	3		3		3		2	1,3,5,7
CO5	3		3		3		2	1,3,5,7
CO6	3		3		3		2	1,3,5,7

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,1 page and 2 pages 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

STATE BOARD OF TECHNICAL EDUCATION &TRAINING,TELANGANA
DIPLOMA IN ELECTRICAL & ELECTRONICS ENGG.
SUB CODE: EE-502
POWER ELECTRONICS
MID SEM -I MODEL PAPER

TIME: 1HOUR. **TOTAL MARKS: 20**

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) SBS
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: 1HOUR. **TOTAL MARKS: 20**

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 controller.
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 Controllers.

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 Controller.

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**

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 controller.
3. List any two applications of choppers.
4. Classify inverters based on any one aspect.
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 Controllers

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 × 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-503- AC MOTORS

Course Title:	**AC Motors**	Course Code	**EE-503**
Semester	**V Semester**	Course Group	**Core**
Teaching Scheme in Periods (L:T:P)	**60:15:0**	Credits	**2.5**
Methodology	**Lecture + Tutorials**	Total Contact Periods	**75**
CIE	**60 Marks**	SEE	**40 Marks**

Pre requisites

This course requires the knowledge of Principles of Motors and starters.

Course Outcomes

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

CO1 :	Describe the construction, working and performance of Synchronous motor
CO2 :	Examine various types of starting methods and select a suitable synchronous motor for a particular application.
CO3 :	Describe the construction, working and performance of 3 phase induction motors
CO4 :	Evaluate the characteristics of 3 phase induction motors.
CO5 :	Identify different starting and speed control methods of 3- phase Induction Motors
CO6 :	Describe the construction, working and applications of Single-phase and special purpose motors

Blue Print of Marks for SEE

<table>
<tr><th rowspan="2">Unit No</th><th rowspan="2">Unit Name</th><th rowspan="2">Periods</th><th colspan="4">Questions to be set for SEE</th></tr>
<tr><th colspan="3">R</th><th>U</th><th>A</th></tr>
<tr><td>1</td><td>Synchronous Motors</td><td>15</td><td rowspan="6">Q4</td><td colspan="2" rowspan="2">Q1</td><td rowspan="2">Q9(a)</td><td rowspan="2">Q13(a)</td></tr>
<tr><td>2</td><td>Starting Methods and Applications of Synchronous Motors</td><td>10</td></tr>
<tr><td>3</td><td>3 phase Induction Motors</td><td>15</td><td colspan="2" rowspan="2">Q2</td><td rowspan="2">Q10(a)</td><td rowspan="2">Q14(a)</td></tr>
<tr><td>4</td><td>Characteristics of 3 phase Induction Motor</td><td>10</td></tr>
<tr><td>5</td><td>Starters and Speed Control of 3 phase Induction Motor</td><td>10</td><td rowspan="2">Q3</td><td>Q5,Q6</td><td>Q9(b), Q11(a), Q11(b)</td><td>Q13(b), Q15(a), Q15(b)</td></tr>
<tr><td>6</td><td>Single phase and Special purpose Motors</td><td>15</td><td>Q7,Q8</td><td>Q10(b), Q12(a), Q12(b)</td><td>Q14(b), Q16(a), Q16(b)</td></tr>
<tr><td colspan="2">Total</td><td>75</td><td colspan="2">8</td><td>8</td><td>8</td></tr>
</table>

Course Contents

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 change of Excitation at constant Load, Ph as or 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 on EMF- V – Curves and inverted V–curves, constant power lines.

UNIT-2 :Starting Methods and Applications of Synchronous Motors

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

Starting methods -necessity- phenomenon of hunting and its undesirable effects– Methods to prevent hunting - Speed control methods synchronous motor - synchronous condenser-Applications of synchronous motor.

UNIT–3:Three phase Induction Motors Duration:15 Periods(L:12-T:3)

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 – equivalent circuit of Induction motor - Losses and Power transfer stages - efficiency – derive a relation between rotor copper losses, rotor output and rotor input and simple problems

UNIT–4 : Characteristics of 3phase Induction Motor Duration:10 Periods(L:8- T: 2)

Torque equation –Starting torque - Torque slip curves - condition for maximum torque – Relation Between full load torque, starting Torque and maximum torque - effects of rotor resistance and reactance on starting, full load and maximum torque - problems - Types of tests - No load and blocked rotor tests.

UNIT- 5: Starters and Speed Control of 3-phase Induction Motor

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

Starters for Induction motor – necessity of starters - Direct Switching - D.O.L starter - Star / Delta starter- Auto Transformer starter -rotor resistance starters- Speed variation of induction motors - Application of induction motors

UNIT- 6: Single phase and Special purpose Motors

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

Necessity of single phase motors –reason for not self starting–starting methods- types of single phase motors-split phase-capacitor start - capacitor run - shaded pole induction motor- A.C series motor - Universal motor-principle of working–applications of single phase motors - Stepper motor- principle of working - applications of special purpose motors

Reference 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

Suggested Learning Outcomes

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

CO1 : Describe the construction, working and performance of synchronous motor

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 List the parts of synchronous motor

1.4 State the functions of all parts of synchronous motor

1.5 Explain the principle of working of synchronous motor.

1.6 Derive an expression for Back EMF of synchronous motor

1.7 State the effects of change of Excitation at constant Load with the help of Phasor diagrams at

(a) Normal (b)Under (c)Over excitation conditions

1.8 Explain the effects of excitation on armature current and power factor.

1.9 State the relation between Back EMF and applied voltage.

1.10 Solve simple problems on Back EMF.

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.

CO2: Examine various types of starting methods and select a suitable synchronous Motor for a particular application.

2.1 Discuss the necessity of starting methods for synchronous motor.
2.2 Demonstrate the starting of synchronous motor by Auxiliary motor method.
2.3 Demonstrate the starting of synchronous motor by Damper winding method.
2.4 Describe the phenomenon of HUNTING.
2.5 State the effects of HUNTING.
2.6 State "How HUNTING is prevented"?
2.7 Discuss how asynchronous motor can be used as asynchronous condenser.
2.8 List the applications of synchronous motor.

CO3: Describe the construction, working and performance of 3 phase induction motors

3.1 Discuss the advantages of Induction Motors over synchronous motor.
3.2 List the types of 3 phase induction motors.
3.3 Describe the construction of slip ring Induction motor.
3.4 Describe the construction of squirrel cage Induction motor.
3.5 State the working principle of 3 phase induction motor.
3.6 Define slip
3.7 Explain the working of 3phase induction motor on noload.
3.8 Explain the working of 3phase induction motor on Load.
3.9 Describe the impact of loading on slip.
3.10 Describe the impact of slip on EMF of rotor.
3.11 Describe the effect of slip on reactance of rotor.
3.12 Solve simple problems on frequency of rotor, EMF and reactance of rotor.
3.13 Derive a relation between rotor copper losses, rotor output and rotor input.
3.14 Solve simple problems on rotor copper losses, rotor output and rotor input.
3.15 Draw the equivalent circuit of an induction motor.
3.16 Draw the Power flow diagram of induction motor.
3.17 Define rotor efficiency and overall efficiency.
3.18 Solve simple problems on power and Efficiency.

CO4: Evaluate the characteristics of 3 phase induction motors.

4.1 Derive Torque Equation

4.2 Draw Torque-Slip characteristics of induction motor.

4.3 Explain the effect of resistance on Torque slip characteristics.

4.4 List various modes of operation of induction machine.

4.5 Derive the expression for full load torque.

4.6 Explain the expression for starting torque.

4.7 Derive the expression for maximum torque.

4.8 Derive the relation between full load torque and starting Torque.

4.9 Derive the relation between full load torque and maximum torque.

4.10 Derive the relation between starting Torque and maximum torque.

4.11 Solve simple problems on Torque.

4.12 Types of tests on induction motor

4.13 Explain No-load test on induction motor

4.14 Describe blocked rotor test on induction motor

CO5: Identify different starting and speed control methods of 3 phase induction motors

5.1 List different types of starters used for induction motors.

5.2 Describe the working of D.O.L. starter with the help of circuit diagram.

5.3 Explain the working of Star / Delta starter with the help of circuit diagram.

5.4 Explain the working of Auto-Transformer starter with the help of circuit diagram.

5.5 Explain the working of Rotor resistance starter with the help of circuit diagram.

5.6 List the types of speed control of induction motor.

5.7 Describe the speed control of inductor motors by Frequency changing method.

5.8 Describe the speed control of inductor motors by Pole changing method.

5.9 Describe the speed control of inductor motors by Injecting voltage in rotor circuit.

5.10 Explain the speed control of inductor motors by Cascading method.

5.11 State the applications of inductor motors

CO6: Describe the construction, working and applications of single phase and special purpose motors

6.1 State the necessity of single phase induction motors

6.2 Compare single phase with three phase induction motors

6.3 Discuss Why a Single-phase Induction motor is not Self starting.

6.4 Explain the principle of working of single phase induction motor by double filed revolving theory.

6.5 Describe the principle of working of single phase Induction motor by cross field theory.

6.6 State the types of single phase induction motors.

6.7 State the purpose of auxiliary winding.

6.8 Describe the working of split phase motor

6.9 Describe the working of capacitor start motor

6.10 Describe the working of capacitor run motor

6.11 Describe the working of shaded pole motor

6.12 Describe the working of single phase AC Series motor.

6.13 Explain the methods to eliminate sparking in AC series motor.

6.14 Explain the working of universal motor.

6.15 List the applications of single phase motors.

(i) plit phase motor (ii) Shaded pole motor (iii) Capacitor start (iv) Capacitor run motor (v) AC series motor (vi) Universal motor

6.16 Explain the principle of working of Stepper motor.

6.17 List the applications of special purpose single phase motors.

(i) Stepper Motor (ii) Servo motor (iii) BLDC (iv) PMDC

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	2	2		3		2	1,2,3,5,7
CO4	3	3	3		2		3	1,2,3,5,7
CO5	3	3	2		3		2	1,2,3,5,7
CO6	3	2	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,1 page and 2 pages 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

STATE BOARD OF TECHNICAL EDUCATION &TRAINING, TELANGANA

DIPLOMA IN ELECTRICAL & ELECTRONICS ENGG.

SUB CODE: EE-503

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 inverted 'V' curve.
2. Define on which parameters 'V' curve is drawn.
3. Which motor is called as constant speed motor.
4. Why damper winding is used

PART - B **Marks: 2 x 3 = 6**

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

5.(a) Draw the constant power lines of synchronous motor.

OR

5.(b) State the parts of synchronous motor

6.(a) Explain the necessity of startingmethodsfor synchronousmotor.

OR

6. (b) Statethe effects of HUNTING?

PART - C **Marks: 2 x 5= 10**

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

7.(a). Derive an expression for Back EMF of synchronous motor.

OR

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

8.(a). ExplainthestartingofsynchronousmotorbyDamperwinding method.

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 ENGG.
SUB CODE: EE-503
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. Define slip.
2. Write the types of three phase induction motors.
3. What is the slip value at the time of starting for three phase induction motor.
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). Define the rotor efficiency of three phase induction motors.

OR

5.(b). Draw the Power flow diagram of induction motor.

6.(a). Derive the expression for startingtorque.

OR

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

PART - C **Marks: 2 x 5 = 10**

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

7.(a). Derive the relation between rotor copper losses, rotor output and rotor input.

OR

7.(b). Explainworkingof 3phaseinductionmotor onnoload.

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

OR

8.(b).Explain the effect of resistance on Torque slip characteristics.

STATE BOARD OF TECHNICAL EDUCATION &TRAINING ,TELANGANA
DIPLOMA IN ELECTRICAL & ELECTRONICS ENGG.
SUB CODE: EE-503
AC MOTORS
SEMESTER END EXAM MODEL PAPER

TIME: 2 HOURS **TOTAL MARKS: 40**

PART - A **Marks: 8 × 1= 8**

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

1. State the types of starting methods for synchronous motor.
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. Write the necessity of starter for a three-phase induction motor.
6. List any two methods of speed control of three-phase squirrel cage induction motor.
7. Write the purpose of auxiliary windingin 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 relation between Back EMF and applied voltagefor synchronous motor

OR

9.(b) Write the types of speed control of three phase induction motor

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

OR

10.(b) Why a single-phase induction motor is not self starting.

11.(a) Draw the diagram of D.O.L starter

OR

11.(b) Write the types of speed control of three phase induction motor

12.(a) Describe the working of split phase motor

OR

12.(b) State the applications of A.C series motor.

PART – C **Marks: 4 × 5= 20**

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

13.(a) Explain the effects of excitation on armaturecurrent and power factor of synchronous motor.

OR

13. (b) Explain the speed control of inductor motors by Pole changing method.

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

OR

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

15.(a) Explain the speed control of induction motor by Pole changingmethod.

OR

15.(b) Explain the working of Star / Delta starter with the help of circuit diagram.

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

OR

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

EE-504 -Electrical Utilization and Traction

Course Title:	**Electrical Utilization and Traction**	Course Code	**EE-504**
Semester	**V Semester**	Course Group	**Core**
Teaching Scheme in Periods (L:T:P)	**60:15:0**	Credits	**2.5**
Methodology	**Lecture + Tutorials**	Total Contact Periods	**75**
CIE	**60 Marks**	SEE	**40 Marks**

Pre requisites

This course requires the knowledge of basic principles of electricity.. It also requires fundamental understanding of types of lamps, heating devices, welding meaning, various motors and their characteristics.

Course Outcomes

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

CO1 :	Design lighting systemsfor indoor and outdoor applications
CO2 :	Apply an electric heating method specific to industrial applications
CO3 :	Categorize the electric welding processes according to different engineering purposes.
CO4 :	Analyze theservices of traction system based on speed-time curves.
CO5 :	Compute the energy requirements of an electric locomotive
CO6 :	Explain the Overhead equipment used in Traction

Blue Print of Marks for SEE

<table>
<tr><th rowspan="2">Unit No</th><th rowspan="2">Unit Name</th><th rowspan="2">Periods</th><th colspan="4">Questions to be set for SEE</th></tr>
<tr><th colspan="3">R</th><th>U</th><th>A</th></tr>
<tr><td>1</td><td>Electrical Lighting</td><td>13</td><td rowspan="6">Q4</td><td colspan="2" rowspan="2">Q1</td><td rowspan="2">Q9(a)</td><td rowspan="2">Q13(a)</td></tr>
<tr><td>2</td><td>Electrical Heating</td><td>12</td></tr>
<tr><td>3</td><td>Electrical Welding</td><td>10</td><td colspan="2" rowspan="2">Q2</td><td rowspan="2">Q10(a)</td><td rowspan="2">Q14(a)</td></tr>
<tr><td>4</td><td>Electric Traction Properties</td><td>15</td></tr>
<tr><td>5</td><td>Tractive effort , Mechanics of Traction and specific energy consumption</td><td>13</td><td rowspan="2">Q3</td><td>Q5, Q6</td><td>Q9(b), Q11(a),Q11(b)</td><td>Q13(b), Q15(a), Q15(b)</td></tr>
<tr><td>6</td><td>Traction Equipment</td><td>12</td><td>Q7, Q8</td><td>Q10(b), Q12(a), Q12(b)</td><td>Q14(b), Q16(a), Q16(b)</td></tr>
<tr><td colspan="2">Total</td><td>75</td><td colspan="3">8</td><td>8</td><td>8</td></tr>
</table>

Course Contents

UNIT – 1 Electrical Lighting Duration: 13 Periods (L:10 – 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 -2 Electrical Heating 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.

UNIT - 3 Electrical Welding Duration: 10 Periods (L: 8 – T: 2)

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 -4 Electric Traction Properties Duration: 15 Periods (L:12 - 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

UNIT -5 Tractive effort, Mechanics of Traction and specific energy consumption
Duration: 13 Periods (L: 10 – T: 3)

Mechanics of train movement Coefficient of adhesion-factors affecting the coefficient of adhesion-Tractive effort -Derivation -Problems-Specific energy consumption- Problems on specific Energy consumption.

UNIT - 6 Traction Equipment Duration: 12 Periods (L: 10 – T: 2)

Traction motors A.C&D.C—control of traction motor by auto transformer-overhead equipment-Current collecting gears-Catenary-Droppers- Trolley wires-Bow collector-Pantograph collector-Booster transformer– Train lighting Systems-Types of Generations in Railways-MAGLEV

Reference Books

Applications of magnetic Levitation.

1. Electrical power by S.L.Uppal
2. Electrical power by J.B.Gupta
3. Electrical utlisation by-Gupta
4. Utilization of Electrical Energy by –R.K Garg
5. Electrical Technology VolIIIbyBLTheraja
6. Electric Traction by H.Partab
7. Electric Traction A.T. Dover
8. Electric Traction Hand Book Sir Isqqc Pitman & sons ltd., London
9. Utilisation of Electrical Energy.(in SI units) E.O. Taylor (Indian Edition)

Suggested E-learning references

1. http://electrical4u.com/
2. 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

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

CO1: Design lighting systems for indoor and outdoor applications

1.1 Explain the nature of light and its propagation
1.2 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

1.3 List the types of lamps used for illumination for different situations such as domestic, industrial, decoration, advertisement and street lighting schemes.
1.4 Define Glare.
1.5 Mention the methods to reduce glare.
1.6 State the requirements of good lighting
1.7 Explain different types of lamp fittings.
1.8 State the uses and advantages of each type of fitting
1.9 State and explain the laws of illumination
1.10 Solve problems on laws of illumination.
1.11 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
1.12 Calculate the number of lamps required for simple indoor lighting scheme
1.13 State the purpose of lux meter
1.14 Mention the illumination levels for indoor and outdoor applications
1.15 State the advantages of LED lighting over CFL lamps

CO2:Apply an electric heating method specific to industrial applications

2.1 State the advantages of electric heating
2.2 List the requirements of good heating material
2.3 State the materials employed for heating
2.4 Explain Direct Resistance heating
2.5 Explain indirect resistance heating .
2.6 List the industrial applications of resistance heating
2.7 Explain different methods of temperature control of resistance heating with diagrams
2.8 Explain direct arc heating
2.9 Explain indirect arc heating
2.10 List the industrial applications of arc heating.
2.11 Explain core type of induction heating
2.12 Explain coreless type of induction heating
2.13 Explain the principal of dielectric heating
2.14 List the industrial applications of dielectric heating

CO3: Categorize the electric welding processes according to different engineering purposes

3.0 State different types of electric welding.
3.1 Explain with sketches the principles of the following welding processes
- i) Resistance welding
- ii) Spot welding
- iii) Seam welding
- iv) Butt welding
- v) Arc welding
- vi) Metal Arc welding
- vii) Carbon arc welding

3.2 List the conditions of successful welding
3.3 Write the characteristics of a welding generator.
3.4 Explain with legible sketch the principle of operation of welding transformer with a reactance coil.
3.5 Explain different types of electrodes used in welding
3.6 Explain electronic circuits used in welding
3.7 Explain the `Sequence Weld' with a block diagram.

CO4: Analyze the services of traction system based on speed-time curves

4.1 List different types of traction systems.
4.2 State the advantages of electric traction.
4.3 State the disadvantages of electric traction.
4.4 List types of Track electrification systems.
4.5 Describe arrangement of D.C., A.C. 1-phase, AC 3-phase, Composite systems for track electrification systems.
4.6 Mention the Present scenario of Indian Railways High speed traction & Metro rail
4.7 List the latest trends in Electric traction.
4.8 List the types of services(main line, suburban and urban).
4.9 Sketch the speed time curves for i) Main Line ii) sub urban services iii) Urban services
4.10 State each stage of the speed time curve with appropriate speed used
4.11 State the importance of speed time curves
4.12 Define Maximum speed, Average speed and Scheduled speed
4.13 List the factors affecting the Scheduled Speed
4.14 Sketch the simplified Speed Time Curves.
4.15 Explain the practical importance of the simplified Speed Time Curves
4.16 Write the expression for Maximum Speed, Acceleration and Retardation for TrapezoidalSpeed - Time Curve
4.17 Solve simple problems on Trapezoidal Speed Time Curve

CO5: Compute the energy requirements of an electric locomotive

5.1 Explain the Tractive Effort
5.2 Write the expression for Tractive Effort for Acceleration, to overcome gravity pull and train resistance
5.3 Calculate the Tractive effort under given conditions.
5.4 Explain the mechanics of transfer of power from motor to driving wheel.
5.5 Define 'Coefficient of Adhesion'.
5.6 List the factors affecting the Coefficient of Adhesion.
5.7 State the methods of improving the Coefficient of Adhesion.
5.8 Explain the term specific energy consumption.
5.9 Derive the formulae for energy output of drive
- To Accelerate
- To overcome friction
- To overcome gradient.

5.10 List the factors affecting specific energy consumption.
5.11 Solve simple problems on Specific energy calculation under given conditions.

CO6: Explain the Overhead equipment used in traction

6.1 State the desirable features of traction motors.
6.2 Explain Significance of D.C. series motor as traction motor over D.C. Shunt motor.
6.3 Explain the suitability of AC motors for Traction.
6.4 Compare and contrast different traction motors.
6.5 Explain with neat sketch the control of traction motor by autotransformer method in Single phase 25 kV systems.
6.6 State the purpose and material used for catenary
6.7 State the purpose and material used droppers
6.8 State the purpose and material used trolley wires
6.9 State the purpose and material used bow collector
6.10 State the purpose and material used pantograph collector
6.11 State the Need of Booster Transformer
6.12 Draw the Connection diagram of booster transformer
6.13 State the requirements of train lighting.
6.14 Compare End-On Generation system with Mid-on Generation System
6.15 Explain the Concept of MAGLEV
6.16 State the applications of Magnetic Levitation

Suggested Student Activities

1. 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
2. Prepare a report on illumination required for both indoor and outdoor applications
3. Student visits Industries where Electrical heating methods are employed and their purpose of heating
4. Visit to a nearby Welding shop and also to industries which make use of Electric welding process
5. Visit to Traction workshop of Railway and understand its operation
6. Visit to nearby traction substation and prepare the observation report
7. Group Discussion
8. Surprise Test
9. Quiz

CO-PO Mapping Matrix

	Basic and Discipline specific Knowledge	Problem Analysis	Design/Development of solutions	Engineering Tools, Experimentation and testing	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	1		2		2		1	1,3,5,7
CO2	1				2		1	1,5,7
CO3	1				1		1	1,5,7
CO4	1				2		1	1,5,7
CO5	1		2		2		1	1,3,5,7
CO6	1		2		2		1	1,3,5,7

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,1 page and 2 pages 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

STATE BOARD OF TECHNICAL EDUCATION & TRAINING, TELANGANA
DIPLOMA IN ELECTRICAL & ELECTRONICS ENGG.
SUB CODE: EE-504
ELECTRICAL UTILIZATIONTRACTION

MID SEM -I MODEL PAPER

TIME: 1 HOUR **TOTAL MARKS: 20**

PART – A **Marks: 4 X 1=4**

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

1. Define MSCP.
2. Define glare.
3. State any two advantages of Electric Heating
4. Write any two applications of Dielectric heating

PART - B **Marks: 2 x 3 = 6**

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

5a) Define i) Solid Angle ii) Illumination

OR

5 b) State the requirements off good lighting

6 a) Draw a neat sketch of Resistance Heating

OR

6 b) List the industrial applications of Arc Heating

PART - C **Marks: 2 x 5= 10**

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

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

OR

7 b) State the uses and advantages of each type of fitting

8 a) Explain temperature control of resistance heating

OR

8 b) Explain the principle of working of indirect Arc heating with legible sketch

STATE BOARD OF TECHNICAL EDUCATION & TRAINING, TELANGANA

DIPLOMA IN ELECTRICAL & ELECTRONICS ENGG.
SUB CODE: EE-504
ELECTRICAL UTILIZATION AND TRACTION

MID SEM –II MODEL PAPER

TIME: 1 HOUR **TOTAL MARKS: 20**

PART – A **Marks: 4 X 1=4**

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

1. Define welding
2. List any two applications of Welding
3. Mention any two advantages of Electric traction
4. Write the expression for scheduled speed.

PART - B **Marks: 2 x 3 = 6**

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

5a) Write the principle of i) spot welding .

OR

5 b) Write the principle of i) Butt Welding

6 a) Draw the speed time curve of Main line service

OR

6 b) Define maximum speed and average speed.

PART - C **Marks: 2 x 5= 10**

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

7 a) Explain Spot welding

OR

7 b) Write the differences between Metal arc welding and carbon arc welding

8 a) Draw the speed time curves for 1) Urban services ii) Sub urban and iii) Main line service

OR

8 b) An electric Locomotive is travelling a distance of 3 km.The time taken is 120 seconds and the time taken for each stop is 30 Seconds .calculate i) Averrage speed ii) Scheduled Speed.

STATE BOARD OF TECHNICAL EDUCATION & TRAINING, TELANGANA
DIPLOMA IN ELECTRICAL & ELECTRONICS ENGG.
SUB CODE: EE-504
ELECTRICAL UTILIZATION AND TRACTION
SEMESTER END EXAM MODEL PAPER

TIME: 2 HOURS **TOTAL MARKS: 40**

PART – A

Instructions: (1) Answer all questions
(2) Each question carries **one** mark. **Marks: 8 X 1 = 8**

1. Define glare
2. Write any two advantages of electric heating
3. What is the purpose of welding?
4. Define schedule speed of an electric locomotive
5. Define Tractive effort
6. Write the expression for tractive effort when the locomotive is descending
7. List two applications of magnetic levitation
8. Mention the current collection devices used in traction.

PART - B

Instructions: (1) Answer the following questions
(2) Each question carries **three** marks. **Marks: 4 X 3 = 12**

9a) Write Five advantages of Electric Heating

OR

9b) Define specific energy consumption and mention its unit

10a) Write the working principle of welding generator with a neat sketch

OR

10b) what is the need for booster transformers in Traction systemss.

11a) Define tractive effort.

OR

11b) What are the factors affecting specific energy consumption?

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) Two lamps of 100 CP are hung at height of 10 m from the ground level.The distance between the posts is 25 m.calculate the Illumination a) Exactly below the lamp post b) Midway between the posts

.

OR

13b) Derive the formulae for energy output of drive to accelerate, to overcome friction and to overcome gradient

14 a) 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

OR

14b) Explain the Concept of Magnetic levitation MAGLEV

15a) Explain the Tractive Effort

OR

15b) Define co efficient of adhesion? Write the factors affecting coefficient of adhesion.

16a) Explain with neat sketch the control of traction motor by autotransformer method in Single phase 25 kV systems.

OR

16 b) Compare and contrast current collectors used in Traction.

EE-505A- Industrial Motor Controls

Course Title:	**Industrial Motor Controls**	Course Code	**EE-505A**
Semester	**V Semester**	Course Group	**Core**
Teaching Scheme in Periods (L:T:P)	**60:15:0**	Credits	**2.5**
Methodology	**Lecture + Tutorials**	Total Contact Periods	**75**
CIE	**60 Marks**	SEE	**40 Marks**

Pre requisites

This course requires knowledge on working of different types of motors and switches.

Course Outcomes

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

CO1	Use the general principles for installing motors and its control equipment.
CO2	Select the type of Relays and Contactors for given industrial applications.
CO3	Select switches and sensors for various applications.
CO4	Select valves and detectors used for given real time applications.
CO5	Develop control circuits of motor that are used for simple applications.
CO6	Apply various types of controls for different types of motors.

Blue Print of Marks for SEE

Unit No	Unit Name	Periods	Questions to be set for SEE				
			R			U	A
1	General principles of Motor control and Control transformer.	10	Q4	Q1		Q9(a)	Q13(a)
2	Different types of Relays and Contactors.	15					
3	Switches & Sensors	10		Q2		Q10(a)	Q14(a)
4	Valves & Detectors	15					
5	Basic control circuits & Wiring diagrams	10		Q3	Q5, Q6	Q9(b), Q11(a), Q11(b)	Q13(b), Q15(a), Q15(b)
6	Automatic controls, Forward-Reverse controls, Sequence controls, Jogging & Inching	15			Q7, Q8	Q10(b), Q12(a), Q12(b)	Q14(b), Q16(a), Q16(b)
Total		**75**	**8**			**8**	**8**

Course Contents

UNIT I: General principles of Motor control and Control transformer
Duration: 10 Periods (L: 8 - T: 2)

Installation of Motors – factors to be considered – Types of Motor Control systems – Functions of Motor Control – Surge protection of control system - Difference between manual and automatic motor control - Use of Control transformers in control circuit- power rating of Control transformer– Grounded & floating control systems.

UNIT II: Different types of Relays and Contactors
Duration: 15 Periods (L: 12 - T: 3)

Overload relays –Thermal Overload relays – Magnetic Overload relays – Motor relays – Electromagnetic relays –Solid state relays - Mercury relays – Timing relays: Different types – Advantages of Pneumatic relays & Clock timers– Capacitor time limit relay – Contactors.

UNIT III: Switches & Sensors **Duration: 10 Periods (L: 8 - T: 2)**

Pressure Switch & sensors - Mercury Bulb Float Switch -Bubbler system- Flow switch & sensors-Limit switch – types of limit switches & Limit switch applications - Hall Effect– principles of operation of Hall generator & its applications.

UNIT IV: Valves & Detectors **Duration: 15 Periods (L: 12 - T: 3)**

Valves: Two – Way Solenoid Valves-Motor operated Valves-Different methods of sensing Temperature - Smart temperature transmitter **–** Proximity detectors: Applications & operation of simple and tuned tank circuit of proximity detectors – Capacitive proximity detectors – Ultrasonic proximity detectors-Photo detectors – Types & Applications.

UNIT V: Basic control circuits & Wiring diagrams
Duration: 10 Periods (L: 8 - T: 2)

Symbols of different switches, contacts, overloads, circuit breakers, fuse, buzzer, Two wire and three wire basic motor control circuits – schematic diagram & Wiring diagram of start stop push button station - Alarm silencing circuit– Timed starting of three motors- Float switch control of pump and pilot lights.

UNIT VI: Automatic controls, Forward-Reverse controls, Sequence controls, Jogging & Inching **Duration: 15 Periods (L: 12 - T: 3)**

Operation of hand-off-automatic control switch –forward-reverse control – Interlocking method-Sequence control circuits-Operation of simple Jogging circuits & Inching circuits

Reference Books

1. INDUSTRIAL MOTOR CONTROL by Stephen L. Herman, Cengage Learning.
2. UNDERSTANDING MOTOR CONTROLS by Stephen L. Herman, Cengage Learning.
3. INDUSTRIAL ELECTRICITY AND MOTOR CONTROLS by Rex Miller.
4. ELECTRIC MOTOR CONTROLS by Rex Miller.
5. ELECTRICAL MOTOR CONTROL by Gary Rockis.

Suggested E-learning references

1. http://electrical4u.com/
2. www.nptel.ac.in
3. https://youtube.com
4. https://www.mouser.in/applications/industrial_motor_control_overview/
5. https://www.c3controls.com/white-paper/industrial-control-basics-motor-starters/
6. https://costrainingcenter.com/wp-content/uploads/2022/12/Industrial-Motor-Controls.pdf

Suggested Learning Outcomes

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

CO1 - Use the general principles for installing motors and its control equipment.

1.1 State the purpose of Motor control.
1.2 Discuss the factors to be considered while installing motors and its control equipment.
1.3 Summarize the functions of motor control system.
1.4 Explain the types of motor control systems.
1.5 Discuss the Surge protection of control system.
1.6 Compare manual and automatic motor control.
1.7 Make use of Control transformers in control circuit.
1.8 State the importance of the power rating of Control transformer.
1.9 Explain the Grounded & floating control systems.

CO2 - Select the type of Relays and Contactors for given industrial applications.

2.1 Compare Fuses and Overloads.
2.1 List different types of Overload relays.
2.2 Describe the construction of Solder melting type thermal overload relay.
2.3 Explain the working of Solder melting type thermal overload relay.
2.4 Describe the construction of Electronic type magnetic overload relay.
2.5 Summarize the working of Electronic type magnetic overload relay
2.6 Describe the construction of Dashpot type magnetic overload relay.
2.7 Discuss the working of Dashpot type magnetic overload relay.
2.8 Develop the schematic diagram of supplying power to Single phase motor control with single overload relay.
2.9 Explain the working of clapper type Electromagnetic motor relay with the help of legible sketch.
2.10 Discuss the working of Solid-state relays.
2.11 Explain the working of Mercury relays with the help of legible sketch.
2.12 List the primary types of timing relays.
2.13 Draw the symbols for
    a. On-delay timers and
    b. Off-delay timers.
2.14 Explain the working of Capacitor Time limit relays.
2.15 List the advantages of Pneumatic timers.
2.16 Write the advantages of Clock timers.
2.17 Define contactor and load contacts.
2.18 Explain the working of Vacuum contactors.

CO3 - Select switches and sensors for various applications.

3.1 State the difference between Switch and Sensor.
3.1 Discuss the working of Diaphragm type pressure switch.
3.2 Explain the working of Bellow type pressure switch.
3.3 Demonstrate the working of Piezo-resistive pressure sensor.
3.4 Summarize the working of Mercury bulb float switch.
3.5 Explain the working of Bubbler system.
3.6 Describe the operation of flow switches.
3.7 Explain the operation of Liquid flow sensor.
3.8 Discuss the operation of Electromagnetic flow sensor.
3.9 Describe the operation of Limit switches.
3.10 List the types of Limit switches.
3.11 List the applications of Limit switches.
3.12 State Hall Effect.
3.13 Explain the principle of operation of Hall generator and state its applications.

CO4 - Select valves and detectors used for a given real time applications.

4.1 State the purpose of Valves.
4.1 Discuss the working of 2-way Solenoid valves.
4.2 Explain the operation of Motor operated Valves.
4.3 List different methods of Sensing temperature.
4.4 Define Smart temperature transmitter.
4.5 State the uses of Smart temperature transmitter.
4.6 Define Proximity detector.
4.7 State the applications of Proximity detector.
4.8 Summarize the working principle of Simple proximity detector.
4.9 Discuss the working principle of Tuned tank circuit.
4.10 Detail the working of Capacitive proximity detectors.
4.11 Demonstrate the principle of operation of Ultrasonic proximity detectors.
4.12 List types of Photo operated devices.
4.13 Write the applications of Photo detectors.

CO5 - Develop control circuits of motor that are used for simple applications.

5.1 Draw the symbols of the following switches
   a) Normally open switch
   b) Normally closed switch
   c) Float switch
   d) Pressure switch
   e) Limit switch
   f) Normally open push button
   g) Normally closed push button
   h) Push-pull button.
5.2 Draw the symbol for
   a) Fuse
   b) Overload
   c) Control transformer
   d) Buzzer
   e) Thermostat
   f) Emergency stop

g) Circuit breaker.

5.3 Draw the symbol of the following contacts
   a) On-delay normally open contact
   b) On-delay normally closed contact
   c) Off-delay normally open contact
   d) Off-delay normally closed contact.

5.4 Discuss the operation of 2-wire control circuit of motor used for a simple application with schematic and circuit diagrams.

5.5 Demonstrate the operation of 3-wire control circuit of motor used for a simple application with schematic and circuit diagrams.

5.6 Explain the operation of circuit for start stop push button station to control a motor with schematic and wiring diagrams.

5.7 Describe the operation of circuit for Alarm silencing circuit using schematic diagrams.

5.8 Summarize the operation of circuit for Timed starting for three motors with schematic diagrams.

5.9 Explain the operation of circuit for Float switch control of a pump and pilot lights with schematic diagrams.

CO6 - Apply various types of controls for different types of motors.

6.1 Discuss the operation of Hands-off automatic control switch that provides manual control or auto control of motor with schematic diagrams.

6.1 Make use of interlocking for Forward reverse control of a motor.

6.2 List different methods of Interlocking.

6.3 Demonstrate the circuit used for Forward and reverse control of 3phase motor with schematic diagrams.

6.4 State the purpose for starting motors in a predetermined sequence.

6.5 Discuss the operation of Sequence control of three motors using a schematic diagram.

6.6 Explain the operation of Automatic sequence control of three motors using a schematic diagram.

6.7 Discuss the operation of stopping three motors in a sequence using a schematic diagram.

6.8 Define the term Jogging.

6.9 State the purpose of Jogging.

6.10 Distinguish between Jogging and Inching.

6.11 Explain the operation of simple Jogging circuit with schematic figure.

6.12 Demonstrate the operation of simple Inching circuit with schematic figure.

Suggested Student Activities

1. Visit nearby industry and analyse the type of motor control equipment used in the industry.
2. Visit to nearby field/house and understand the Irrigation/Water pump's control equipment.
3. Visit to small industry or workshop and estimate the load and rating of the accessories required
4. Group discussion
5. Surprise test
6. Quiz

CO-PO Mapping Matrix

	Basic and discipline specific knowledge	Problem analysis	Design / development of solutions	Engineering Tools, Experimentation and 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	PO 6	PO 7	
CO1	3				1		1	PO1,5,7
CO2	3	2		1			1	PO1,2,4,7
CO3	3	2		1			1	PO1,2,4,7
CO4	3	2		1			1	PO1,2,4,7
CO5	3	3	3		2		1	PO1,2,3,5,7
CO6	3	3	3		2		1	PO1,2,3,5,7

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,1 page and 2 pages 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

STATE BOARD OF TECHNICAL EDUCATION & TRAINING, TELANGANA
DIPLOMA IN ELECTRICAL & ELECTRONICS ENGG.
SUB CODE: EE-505 A
INDUSTRIAL MOTOR CONTROLS
MID SEM –I MODEL PAPER

TIME: 1 HOUR **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 motor control systems.
2. Compare manual and automatic motor control in any two aspects.
3.List different types of Overload relays.
4.Write any two advantages of clock timers.

PART - B **Marks: 2 x 3 = 6**

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

5 a) State the importance of the power rating of Control transformer.

OR

b) Draw schematic diagram of start-stop push button control of a Three phase motor.

.

6 a) What is the use of Control transformers in control circuit**?**

OR

b)Describe the working of Vacuum contactors.

PART - C **Marks: 2 x 5= 10**

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

7 a) Explain the factors considered while installing motors and its control equipment.

OR

b) Explain the Grounded & floating control systems with the help of neat circuit diagram.

8 a) Explain the construction and working of Mercury relays.

OR

b) Explain the construction and working of clapper type Electromagnetic motor relay.

STATE BOARD OF TECHNICAL EDUCATION & TRAINING, TELANGANA
DIPLOMA IN ELECTRICAL & ELECTRONICS ENGG.
SUB CODE: EE-505 A
INDUSTRIAL MOTOR CONTROLS
MID SEM –II MODEL PAPER

TIME: 1 HOUR **TOTAL MARKS: 20**

PART – A **Marks: 4 X 1=4**

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

1. State the difference between Switch and Sensor
2.List the types of Limit switches
3.State the purpose of Valves.
4.List types of Photo operated devices.

PART - B **Marks: 2 x 3 = 6**

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

5 a) Describe the operation of Limit switches.

. **OR**

b) Explain the operation of Electromagnetic flow sensors.

6 a) Define Proximity detector and state its applications.

OR

b) Write the applications of Photo detectors.

PART - C **Marks: 2 x 5= 10**

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

7 a) Explain the working of Piezo-resistive pressure sensor.

OR

b) Explain the principle of operation of Hall generator with a neat diagram.

8 a) Explain the working of 2-way Solenoid valves.

OR

b) Explain the principle of operation of Ultrasonic proximity detectors.

STATE BOARD OF TECHNICAL EDUCATION & TRAINING, TELANGANA
DIPLOMA IN ELECTRICAL & ELECTRONICS ENGG.
SUB CODE: EE-505 A
INDUSTRIAL MOTOR CONTROLS
SEMESTER END EXAM MODEL PAPER

TIME: 2 HOURS **TOTAL MARKS: 40**

PART – A

Instructions: (1) Answer all questions
(2) Each question carries **one** mark. **Marks: 8 X 1 = 8**

1. Draw the symbols of Normally open and normally closed switches
2. State the Hall Effect.
3. Draw the symbol of Fuse and emergency stop.
4. Define Jogging of motor.
5. Draw the symbol of control transformer and buzzer.
6. Draw the symbol of pressure switch and limit switch.
7. What is the meaning of forward-reverse control of a motor.
8. List different methods of Interlocking.

PART - B

Instructions: (1) Answer the following questions
(2) Each question carries **three** marks. **Marks: 4 X 3 = 12**

9a) Write the advantages of Pneumatic and Clock timers.

OR

9b) Draw the schematic diagram for start stop push button station to control a motor.

10a) List the difference between Jogging and Inching in any three aspects.

OR

10b) Draw the schematic diagram of Hands-off automatic control switch that provides manual control of motor.

11a) Draw the schematic diagram of 2-wire control circuit of motor used for a simple application.

OR

11b) Draw the schematic diagram of Alarm silencing circuit.

12a) Draw schematic diagram of simple Inching circuit.

OR

12b) Draw schematic diagram of Automatic sequence control of three motors.

PART - C

Instructions: (1) Answer the following questions
(2) Each question carries **five** marks. **Marks: 4 X 5 = 20**

13a) Explain the functions of motor control system.

OR

13b) Explain the operation of circuit for Timed starting for three motors with schematic diagrams.

14 a) Explain the working of Mercury bulb float switch

OR

14b) Explain the operation of stopping three motors in a sequence using a schematic diagram.

15a) Explain the operation of circuit for Float switch control of a pump and pilot lights with schematic diagrams.

OR

15b)Explain the operation of 3-wire control circuit of motor used for a simple application with schematic and circuit diagrams.

16a) Explain the operation of simple Jogging circuit with schematic figure

OR

16 b) Explain the operation of Hands-off automatic control switch that provides auto control of motor with schematic diagrams.

EE-505B- Electric Vehicles

Course Title:	**Electric Vehicles**	Course Code	**EE-505B**
Semester	**V Semester**	Course Group	**Elective**
Teaching Scheme in Periods (L:T:P)	**60:15:0**	Credits	**2.5**
Methodology	**Lecture + Tutorials**	Total Contact Periods	**75**
CIE	**60 Marks**	SEE	**40 Marks**

Pre requisites

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

Course Outcomes

Upon 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 :	Analyze and troubleshoot basic faults in different EV components and charging system.
CO4 :	Design/size the drive train for EV, Battery and charging station
CO5 :	Understand the necessities of installing of a Charging Station and Electric Vehicle to Grid Integration
CO6	Analyze the impact of EV integration with renewable energy sources and the battery troubleshooting.

Blue Print of Marks for SEE

Unit No	Unit Name	Periods	Questions to be set for SEE				
			R			U	A
1	Introduction to Electric Vehicles	10	Q4	Q1		Q9(a)	Q13(a)
2	EV Components	15					
3	Drive Train in EV & HEV	10		Q2		Q10(a)	Q14(a)
4	Battery charging Technologies and EV charging infrastructure	15					
5	Electric Vehicle Grid Integration	10		Q3	Q5, Q6	Q9(b), Q11(a), Q11(b)	Q13(b), Q15(a), Q15(b)
6	EVs and renewable energy (RE) integration, Troubleshooting	15			Q7, Q8	Q10(b), Q12(a), Q12(b)	Q14(b), Q16(a), Q16(b)
Total		**75**	**8**			**8**	**8**

Course Contents

UNIT-1 : Introduction to Electric Vehicles **Periods 10 (L: 08 – T: 02)**

Introduction to Electric Vehicle(EV) – Hybrid Electric vehicle(HEV) – Plug-in Hybrid Electric vehicle (PHEV) - Types of Electric vehicles based on drive train configuration – 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 - Differences between series hybrid and parallel HEV - Benefits of EV including environmental impacts – Single speed transmission - single and multi motor drivesin electric vehicles- Concept of 'In Wheel Drives' in EV.

UNIT-2 :EV Components **Periods 15 (L: 12 – T: 03)**

Various components of EV and their purpose - Introduce Electric motor as Propulsion unit - types of Electric motors AC/DC - advantages of DC motors over AC - construction and working of Induction motor - Permanent magnet motor - Switched reluctance motor - 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 - Definition of different battery parameters - effect of Temperature on battery performance - C-Rate parameter - main types of batteries used in EVs - Hybridization of different energy storage devices - types of fuel cells - Difference between Cell monitoring Controller and battery monitoring Controller - protective measures for EV batteries

UNIT-3 : Drive train in EV and HEV **Periods 10 (L: 08 – T: 02)**

Definition and purpose of charging station - Understand AC and DC Charging -Difference between

level 1, level 2 and level 3 Chargers - domestic and Public charging equipment - EV acceptance rate - on board and off board charging - power factor correction in an On-Board Charger (OBC) - types of Level 3 Chargers - bidirectional charging - Type-1, type-2 and type-3 connector - CHAdeMO connector - Combined charging system(CCS) Combo-1 and combo-2 connectors - charging time and charging cost - peak shaving - difference between charging station (EVCS) and charging point (EVSE) - Open Charge Point Protocol (OCPP) - Electric Vehicle Supply Equipment (EVSE) - battery swapping - Wireless charging- Indian Standards for AC and DC Charging

UNIT-4 : Battery charging Technologies and EV Charging Infrastructure

Periods 15 (L: 12 – T: 03)

general configuration of an electric vehicle - Difference between power train, drive train, and drive line - understand control philosophy of an EV - EV transmission - differentials used in EVs - difference between 4WD and AWD - components in a motor controller - Field Oriented Control (FOC) - components in an electric drive unit (EDU) - Differentiate between a mild hybrid and full hybrid - operating modes of power flow control in a Series HEV. Parallel HEV , ICE dominated power flow control modes in a Series Parallel HEV - mechanical coupling in Parallel HEV - Types of mechanical coupling – Dual transmission- Applications of different sensors , valves and actuators - cables used for various purposes inside and outside of an EV - pyrotechnic safety switch

UNIT-5: Electric vehicle grid integration **Periods 10 (L: 08 – T: 02)**

Load calculation of a charging station - effect of charging stations on the local grid - requirements for locating a charging station - International Electro technical Commission(IEC) - single and multiple charging station output - various modes of charging communication - wall and floor charging installation - charging station with and without cable - fast charging station and its advantages and limitations - Residual current devices and Over current protective devices - impact of EV charging on maximum power demand - different types of power management for EV charging station - smart charging and various options V2Xtech (V1G,V2G, V2V,V2H, V2B) - elements of an EV charging station.

UNIT-6 EVs and renewable energy (RE) integration, Troubleshooting

Periods 15(L:12 -T: 03)

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 MehardadEshani,YiminGao

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)
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)

Suggested E-learning references

1. https://nptel.ac.in/courses/108/106/108106170/
2. 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_VChtMGK8
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 Fasthttps://www.youtube.com/watch?v=KqXi6EkCdpQ

Suggested Learning Outcomes

Upon completion of the course the student shall be able to

C01 - Analyze the architecture of electric vehicle

1.1 Introduce Electric vehicles and latest technology.

1.2 Know BEV, HEV, and FCEV

1.3 List the three main types of HEVs

1.4 Calculate the MPGe of an EV.

1.5 Name 3 EV regulatory agencies.

1.6 List the advantages of BEV,HEV and PHEV

1.7 List disadvantages and limitations.

1.8 Know the effect of EV on the environment.

1.9 Compare BEV and ICE

1.10 Compare BEV and HEV.

1.11 Differentiate between series hybrid and parallel hybrid.

1.12 Classify an EV based on Drive trainConfiguration.

1.13 Contrast the Alternatives in EV Based on Power Source Configuration.

1.14 Explain the concepts of Single and Multi-motor Drives in EV.

1.15 Summarize the concept of 'In Wheel Drives' in EV.

2. C02 - Explain the working concept of different components of EV and charging station

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

2.10.6 State of health

2.10.7 Calendar life

2.10.8 Charge cycle

2.10.9 Cycle life

2.10.10 Battery capacity

2.10.11 Internal resistance

2.11 Know the effect of Temperature on battery performance

2.12 Understand the C-Rate parameter

2.13 List three main types of batteries used in EVs

2.14 Name three types of cathode materials in a lithium-ion battery

2.15 Know the advantages/Merits of Lithium battery asa energy source for EV.

2.16 Know the need and concept of Hybridization of various energy sources

2.17 List five types of fuel cells.

2.18 Describe the main components in a battery management system.

2.19 Differentiate between Cell monitoring Controller and battery monitoring Controller

2.20 Name five protective measures for EV batteries

3. CO3 - Analyze and troubleshoot basic faults in different EV components and charging system.

3.1 Definition and purpose of charging station

3.2 Understand AC and DC Charging

3.3 Differentiate between level 1, level 2 and level 3 Chargers.

3.4 Summarize the domestic and Public charging equipment

3.5 Define the term EV acceptance rate.

3.6 Know on board and off board charging.

3.7 Explain the purpose of power factor correction in an On-Board Charger (OBC)

3.8 Understand Indian Standards for AC and DC Charging (ex. IS17017).

3.9 Describe the principle of bidirectional charging.

3.10 List the five basic types of EV connectors.

3.11 Types of connectors to plug the charging cable to the vehicle inlet like Type-1, type-2 and type-3 connector.

3.12 Understand CHAdeMO connector , Combined charging system(CCS) Combo-1 and combo-2 connectors

3.13 Calculate charging time and charging cost.

3.14 Define the term peak shaving.

3.15 Know the difference between charging station (EVCS) and charging point (EVSE)

3.16 Explain the purpose of Open Charge Point Protocol (OCPP)

3.17 Identify the various parts and working of Electric Vehicle Supply Equipment (EVSE)

3.18 Understand Manual and automated battery swapping.

3.19 List merits and demerits of battery swapping.

3.20 Understand the Wireless charging.

4. CO4 - Design/size the drive train for EV, Battery and charging station.

4.1 Explain the general configuration of an electric vehicle.

4.2 Differentiate between powertrain, drivetrain, and driveline.

4.3 Describe the control philosophy of an EV.

4.4 Differentiate between Electronic Control Unit and Vehicle Control Unit.

4.5 Describe the operation of an EV transmission.

4.6 List the three types of differentials used in EVs.

4.7 Explain the difference between 4WD and AWD.

4.8 Name the main components in a motor controller.

4.9 Describe the purpose of Field Oriented Control in EV applications.

4.10 Explain how field weakening is used for regenerative braking.

4.11 Name the three main components in an electric drive unit (EDU).

4.12 Describe how unsprung weight affects in-wheel motors.

4.13 Differentiate between a mild hybrid and full hybrid.

4.14 Infer four operating modes of power flow control in a Series HEV.

4.15 Explain the operating modes of power flow control in a Parallel HEV.

4.16 Interpret the ICE dominated power flow control modes in a Series Parallel HEV.

4.17 Explain the basic concepts of mechanical coupling in Parallel HEV.

4.18 Outline concept of torque coupling in Parallel HEV.

4.19 Summarize the concept of speed coupling in Parallel HEV.

4.20 Summarize the concept of Dual transmission in Parallel HEV.

4.21 Name the applications for the following in EVs

4.21.1 Pressure sensors.

4.21.2 Ultrasonic sensors

4.21.3 Actuators

4.21.4 Solenoid valves

4.21.5 Temperature sensors

4.22 Describe the cables used for various purposes inside and outside of an EV.

4.23 Explain the operation of a pyrotechnic safety switch.

5. C05 - Understand the necessities of installing of a Charging Station and Electric Vehicle to Grid Integration

5.1 Know AC and DC Charging station and their specifications.

5.2 Know the load calculation of a charging station.

5.3 Analyze the effect of charging stations 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 V2Xtech (V1G,V2G, V2V,V2H, V2B)

5.15 Identify various elements of an EV charging station.

6. C06 - Analyze the impact of EV integration with renewable energy sources and the battery 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 Overcharge 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

S.l No	Description	Level	No. of Question	Marks of each Question	Questions to be attempted	Total Marks
01	Part-A	Remembering (R)	4	1	4	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 ElectricVehicles	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 Train 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	

Question Paper Blue Print for SEE

<table>
<tr><th rowspan="2">Unit no</th><th rowspan="2">Unit name</th><th colspan="4">Questions to be set for SEE</th></tr>
<tr><th colspan="3">R</th><th>U</th><th>A</th></tr>
<tr><td>1</td><td>Introduction to Electric Vehicles</td><td rowspan="6">Q4</td><td colspan="2" rowspan="2">Q1</td><td rowspan="2">Q9(a)</td><td rowspan="2">Q13(a)</td></tr>
<tr><td>2</td><td>EV Components</td></tr>
<tr><td>3</td><td>Drive Train in EV & HEV</td><td colspan="2" rowspan="2">Q2</td><td rowspan="2">Q10(a)</td><td rowspan="2">Q14(a)</td></tr>
<tr><td>4</td><td>Battery charging Technologies and EV charging infrastructure</td></tr>
<tr><td>5</td><td>Electric Vehicle Grid Integration</td><td rowspan="2">Q3</td><td>Q5,Q6</td><td>Q9(b), Q11(a), Q11(b)</td><td>Q13(b), Q15(a), Q15(b)</td></tr>
<tr><td>6</td><td>EVs and renewable energy (RE) integration, Troubleshooting</td><td>Q7,Q8</td><td>Q10(b), Q12(a), Q12(b)</td><td>Q14(b), Q16(a), Q16(b)</td></tr>
<tr><td colspan="2">Total Questions</td><td colspan="3">8</td><td>8</td><td>8</td></tr>
</table>

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

STATE BOARD OF TECHNICAL EDUCATION &TRAINING ,TELANGANA
DIPLOMA IN ELECTRICAL & ELECTRONICS ENGG.
SUB CODE: EE-505B
ELECTRIC VEHICLES
MID SEM -I MODEL PAPER
TIME: 60 MIN TOTAL MARKS: 20

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. What is Electric Vehicle?
2. Write any two advantages of EV.
3. Define an on-board charger.
4. List three main types of batteries used in EV.

PART – B **Marks: 2Q X 3= 06**

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

5(a) Explain the concept of In-wheel drives in EV

----OR----

5(b) Write the advantages of PHEV over HEV.

6(a) Which motor is commonly found in EV and why do manufacturers prefer them.

----OR----

6(b) Explain C-rate parameter of a battery.

PART – C **Marks: 2Q X 5= 10**

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

7(a) Explain the concepts of Single and Multi-motor Drives in EV.

----OR----

7(b) Explain different Drive train Configurations in EV.

8(a) Explain the following battery charging parameters

I. Depth of discharge
II. Battery state of charge
III. Self discharge rate
IV. Charge equalization
V. Daily depth of discharge

----OR----

8(b) Explain the need and concept of hybridization of various energy sources.

STATE BOARD OF TECHNICAL EDUCATION &TRAINING ,TELANGANA
DIPLOMA IN ELECTRICAL & ELECTRONICS ENGG.
SUB CODE: EE-505B
ELECTRIC VEHICLES
MID SEM -II MODEL PAPER

TIME: 60 MIN **TOTAL MARKS: 20**

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. Classify EV based on motor drives
2. Define the term EV acceptance rate.
3. What is FOC in Electric Vehicle?
4. Write any two applications of temperature sensor.

PART – B **Marks: 2Q X 3= 06**

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

5(a) Write about Onboard and Off Board charging

----OR----

5(b) Write the merits of battery swapping.

6(a) Explain the operating modes of power flow control in a Parallel HEV.

----OR----

6(b) List the Three different types of differentials used in EVs.

PART – C **Marks: 2Q X 5= 10**

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

7(a) Explain the working of Electric Vehicle Supply Equipment(EVSE).

----OR----

7(b) Explain various methods of AC charging for EV,

8(a) Differentiate between torque coupling and speed coupling in parallel HEV in any five aspects

----OR----

8(b) Describe the operation of an EV Transmission.

STATE BOARD OF TECHNICAL EDUCATION &TRAINING ,TELANGANA
DIPLOMA IN ELECTRICAL & ELECTRONICS ENGG.
SUB CODE: EE-505B
ELECTRIC VEHICLES
SEMESTER END EXAM MODEL PAPER
TIME: 2HOURSTOTAL MARKS: 40

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: 8Q X 1= 08**

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

1. What is differential in EV?
2. What is Power factor correction in EV..
3. Define the term smart charging.
4. Draw the symbol of CCS Combo-2 connector
5. List two IEC standards for establishing EV charging station.
6. Write any three different modes of charging communication
7. Write any two advantages of integrating Electric vehicle with solar energy
8. What are the primary types of software problems that occur in electric vehicle

PART – B **Marks: 4Q X 3= 12**

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

9(a) What are the advantages of switched reluctance motor over other types of electric motors in EV

----OR----

9(b) Write about wall and floor charging installation.

10(a) Write the differences between charging station and charging point.

----OR----

10(b) Explain the importance of integrating EV with renewable energy for grid stability

11(a) List different types of power management methods in EV

----OR----

11(b) Describe the key requirements for locating a EV charging station effectively

12(a) Describe the challenges associated with integrating Electric vehicles with renewable energy sources

----OR----

12(b) How an over charging and overheating impact the performance and safety of EV

PART – B **Marks: 4Q X 5= 20**

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

13(a) List and explain various components of EV.

----OR----

13(b) Explain the charging station with and without cable.

.

14(a) Write the difference between mild hybrid and full hybrid.

----OR----

14(b) Explain the OBD (On-board diagnostics) scanning tools and Remote diagnostics

15(a) Differentiate between AC and DC charging station

----OR----

15(b) “Accurate load calculations contribute to the efficient operation and management of charging infrastructure”, justify the statement and discuss various factors involved in load calculations

16(a) Explain how integrating EV with renewable resources increases grid stability

----OR----

16(b) Explain environmental impacts of dead battery disposal and importance of recycling the dead batteries of EV.

EE-506A -Switchgear and Protection

Course Title:	**Switchgear and Protection**	Course Code	**EE-506A**
Semester	**V Semester**	Course Group	**Core**
Teaching Scheme in Periods (L:T:P)	**60:15:0**	Credits	**2.5**
Methodology	**Lecture + Tutorials**	Total Contact Periods	**75**
CIE	**60 Marks**	SEE	**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

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

CO1:	Select Switchgear and Fuses for various applications
CO2:	Make use of Circuit breakers for Protection of power systems
CO3:	Use Relays as Protective equipment
CO4:	Illustrate the Schemes of Protection for Alternators and Transformers
CO5:	Apply various Protection Schemes for Transmission Lines and Feeders
CO6:	Elaborate the importance of Lightning Arresters and necessity of Neutral Earthing

Blue Print of Marks for SEE

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

Course Contents

UNIT I: 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-Application of fuses

UNIT II: Circuit Breakers& Reactors **Duration: 15 Periods (L: 12–T: 3)**

Circuitbreakers-phenomenonofarc–PrinciplesofArcExtinction–MethodsofArcExtinction-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 .-Reactors –their necessity – Scheme of Reactor connections– Percentage Reactance and Base KVA-Equation for short-circuit KVA.

UNIT III: Protective Relaying **Duration: 12Periods (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 IV: 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 V: Protection of Transmission Lines and Feeders Duration:12Periods (L:9 – T: 3)

Bus bar protection-Necessity-causes of faults-Transmission line and feeder protection-Pilot wires – Differential pilot wire protection, - 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 VI: Lighting Arresters and Neutral Grounding Duration:13Periods (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.

Reference Books

1. Principle of Power systems -V.K. Mehta
2. Electrical power systems -S.L.Uppal
3. Textbook of Electrical power systems-SONY, Gupta Bhatnagar
4. Electrical power systems- JB Gupta
5. Electrical power Systems-CLWadhwa
6. Switchgear and Protection by Sunil S. Rao
7. Power System Protection And Switch gear by Buvanesh A Oza, Nirmalkumar C Nair, Rases P Mehtaand Vijay H Makwana, McGraw HILL Education (India Pvt.Ltd) New Delhi
8. J.B.Gupta “Switchgear & Protection”, (edition), Katson Publisher, 2008
9. Madhava Rao T.S., 'Power System Protection-Static Relays', McGraw Hill, New Delhi,2nd Edition, 21st 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
3. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/
4. http://www.pdfsdocuments.com/testing-commissioning-operation-maintenanceelectricalequipments.pdf
5. YouTube videos on circuit breakers
6. YouTube videos on protective relays
7. Nptel videos on switchgear protection

Suggested Learning Outcomes

CO1: Select Switchgear and Fuses for various applications

1.1 Classify the types of faults in power system and their effects.
1.2 Explain symmetrical and Unsymmetrical faults
1.3 Identify 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 fuse as protective device.
1.8 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 timeVii) Arcing time
viii) Total operating time
1.9 Draw and explain cut-off characteristics of fuse
1.10 Draw and explain Time-current characteristics of a fuse
1.11 List types of fuses
1.12 Illustrate the working principle of HRC cartridge fuse
1.13 Explain the working principle of Liquid power fuse.
1.14 Applications of fuses.

CO2: Make use of Circuit breakers for Protection of power systems

2.1 State the phenomenon of Arc.
2.2 State factors responsible for arc formation and principle of Arc Extinction
2.3 Explain the methods of Arc Extinction.
2.4 Define the following terms (i) Arc Voltage ii) Restriking Voltage iii)Recovery Voltage
2.5 Classify the circuit breakers based upon medium of arc quenching.
2.6 Explain 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 Air blast circuitbreakers.
2.9 List the properties of SF_6 gas
2.10 Draw and explain the working principle of SF6 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 Draw and Explain the different types of reactor connections.
2.16 State the expressions of percentage reactance and BaseKVA
2.17 State the importance of short circuit KVA .
2.18 Solve simple problems on short circuit KVA

CO3: Use Relays as Protective equipment

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(i) Operating principles and (ii)Time of operation
3.5 Discuss the working of solenoid plunger type relay
3.6 Discuss the working of attracted armature relays.
3.7 Explain the construction and working of induction type over current relay.
3.8 Explain the principle of obtaining directional property in induction relays.
3.9 Discuss the working of directional over current induction relay.
3.10 State the important terms used in relays i)pick-up current ii)Current setting iii)Plug setting multiplier-PSM iv)Time setting multiplier-TSM
3.11 Explain the block diagram the working of numerical over current relay
3.12 Explain the principle of working of impedance relay.
3.13 List the applications of impedance relay.
3.14 Explain the current differential protection.
3.15 Discuss about voltage differential protection

CO4: Illustrate the Schemes of Protection for Alternators and Transformers

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.
4.5 Explain the earth fault protection for rotor and stator.
4.6 Discuss the split phase protection of alternator against interturn 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.

CO5: Apply various Protection Schemes for Transmission Lines and Feeders

5.1 State the necessity of bus bar protection
5.2 State the causes of bus bar faults
5.3 Explain the Differential Protection for Busbars
5.4 Explain the different schematic arrangements for single and duplicate bus bars.
5.5 State the necessity of transmission line and feeder protection.
5.6 Define pilot wire protection.
5.7 Explain the Differential Pilot wire protection for Merz-price voltage balanced 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

CO6: Elaborate the importance of Lightning Arresters and necessity of Neutral Earthing

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 cause**s** 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 Explain the following methods of neutral grounding
(i) Solid grounding ii)Resistance grounding iii)Reactance grounding

Suggested Student Activities

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

CO-PO Mapping Matrix

	Basic and discipline specific knowledge	Problem analysis	Design / development of solutions	Engineering Tools, Experimentation and Testing	Engineering practices for society sustainability and environment	Project Management	Lifelong learning	Linked PO
CO\PO	PO1	PO2	PO3	PO4	PO5	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	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,1 page and 2 pages 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

STATE BOARD OF TECHNICAL EDUCATION & TRAINING, TELANGANA

DIPLOMA IN ELECTRICAL & ELECTRONICS ENGG.

SUBCODE: 506A

SWITCH GEAR AND PROTECTION

MID SEM-I MODEL PAPER

TIME:60MIN **TOTALMARKS:20**

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 X1= 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 x3 = 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 SF6 gas

PART-C **Marks: 2Q x5= 10**

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

7(a) Explain the purpose of Isolators, Airbreak 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 HVside 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
DIPLOMA IN ELECTRICAL & ELECTRONICS ENGG.
SUB CODE: EE-506A SWITCH GEAR AND PROTECTION

MID SEM-II MODEL PAPER

TIME:60MIN **TOTAL MARKS: 20**

PART– A **Marks:4Q X1= 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 x3 = 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 x5= 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) Elaborate the working principle of Buchholz relay with neat sketch.

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-506A SWITCH GEAR AND PROTECTION
SEMESTER END EXAM MODEL PAPER

TIME:2HOURS **TOTALMARKS:40**

PART– A **Marks:8Q X1=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 earthling.

PART-C **Marks:4Qx5=20**

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

13(a) Elaborate 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) Draw and explain 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
16a) Explain reactance grounding
Or
16(b) Enumerate the working principle of expulsion type lighting arrester with diagram.

EE-506B- Advanced Protection of Power Systems

Course Title:	**Advanced Protection of Power Systems**	Course Code	**EE-506B**
Semester	**V Semester**	Course Group	**Core**
Teaching Scheme in Periods (L:T:P)	**60:15:0**	Credits	**2.5**
Methodology	**Lecture + Tutorials**	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 :	Enumerate the operation and application of various circuit breakers
CO3 :	Classify protective relays
CO4 :	Analyse the protection schemes of alternator and transformers
CO5 :	Explain the protection schemes for transmission lines and feeders
CO6 :	Construct and explain operation of basic elements needed for digital protection

Blue Print of Marks for SEE

<table>
<tr><th rowspan="2">Unit No</th><th rowspan="2">Unit Name</th><th rowspan="2">Periods</th><th colspan="4">Questions to be set for SEE</th></tr>
<tr><th colspan="2">R</th><th>U</th><th>A</th></tr>
<tr><td>1</td><td>Fundamentals of Protection</td><td>12</td><td rowspan="6">Q4</td><td colspan="2" rowspan="2">Q1</td><td rowspan="2">Q9(a)</td><td rowspan="2">Q13(a)</td></tr>
<tr><td>2</td><td>Circuit Breakers</td><td>13</td></tr>
<tr><td>3</td><td>Protective Relays</td><td>13</td><td colspan="2" rowspan="2">Q2</td><td rowspan="2">Q10(a)</td><td rowspan="2">Q14(a)</td></tr>
<tr><td>4</td><td>Protection of Alternators and transformers</td><td>12</td></tr>
<tr><td>5</td><td>Protection of Transmission Lines and Feeders</td><td>12</td><td rowspan="2">Q3</td><td>Q5, Q6</td><td>Q9(b), Q11(a), Q11(b)</td><td>Q13(b), Q15(a), Q15(b)</td></tr>
<tr><td>6</td><td>Basic Elements of Digital Protection</td><td>13</td><td>Q7, Q8</td><td>Q10(b), Q12(a), Q12(b)</td><td>Q14(b), Q16(a), Q16(b)</td></tr>
<tr><td colspan="2">Total</td><td>75</td><td colspan="2">8</td><td>8</td><td>8</td></tr>
</table>

Course Contents

Unit I - 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 II - 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 III - 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 IV - 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 V - 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 VI - 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

Reference 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 – 2nd 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
3. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/
4. http://www.pdfsdocuments.com/testing-commissioning-operation-maintenanceelectrical-equipments.pdf

Suggested Learning Outcomes

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

C01 - Recall the fundamentals of protection

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

C02 - Enumerate the operation and application of various circuit breakers

2.1 Define switch gear.
2.2Classify switch gear with respect to voltage level
2.3State 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_6 circuit breaker
2.11Explain 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

C03 - Classify protective relays

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

C04 - Analyse the protection schemes of alternator and transformers

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.

C05 - Explain the protection schemes for transmission lines and feeders

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.

C06 - Construct and explain operation of basic elements needed for digital protection

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 Draw and Explain 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 Discuss analogue filtering
6.9 Write about 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	2	1	1		1		1	PO1,2,3,5,7
CO2	1	2	3	-	1	1	-	PO1,2,3,5,6
CO3	1	1	1	2	2	-	-	PO1,2,3,4,5
CO4	2	1	3	1	1	-	1	PO1,2,3,4,5,7
CO5	2	1	2		1	1		PO1,2,3,5,6
CO6	1	-		1	1	1	-	PO1,4,5,6

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,1 page and 2 pages 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

STATE BOARD OF TECHNICAL EDUCATION &TRAINING ,TELANGANA
DIPLOMA IN ELECTRICAL & ELECTRONICS ENGG.
SUB CODE: EE-506B
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_6 circuit breaker.

OR

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

STATE BOARD OF TECHNICAL EDUCATION &TRAINING ,TELANGANA

DIPLOMA IN ELECTRICAL & ELECTRONICS ENGG.

SUB CODE: EE-506B

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.

STATE BOARD OF TECHNICAL EDUCATION &TRAINING ,TELANGANA
DIPLOMA IN ELECTRICAL & ELECTRONICS ENGG.
SUB CODE: EE-506B
ADVANCED PROTECTION OF POWER SYSTEMS
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. 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 × 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-507- Power Electronics and Power Systems Lab

Course Title:	**Power Electronics and Power Systems Lab**	Course Code	**EE-507**
Semester	**V Semester**	Course Group	**Core**
Teaching Scheme in Periods (L:T:P)	**15:0:30**	Credits	**1.25**
Methodology	**Lecture + Practical**	Total Contact Periods	**45**
CIE	**60 Marks**	SEE	**40 Marks**

Pre requisites

This course requires the knowledge of Power electronics and Power Systems

Course Outcomes

CO1	Analyze various switches in Thyristor family by drawing their characteristics.
CO2	Build Power electronic converters.
CO3	Make use of power electronic converters to control speed of various motors.
CO4	Protect the Power system Equipment

Suggested Learning Outcomes

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

C01 - Analyze various switches in Thyristor family by drawing their characteristics.

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.

C02 - Build Power electronic converters.

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.
2.3 Invert DC supply to AC supply using Series Inverter.

C03 - Make use of power electronic converters to control speed of various motors.

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.
3.3 Control the speed of 1 Φ induction motor using AC Voltage controller.

C04 - Protect the Power System Equipment

4.1 To study the performance of current and potential Transformers.
4.2 To study the Operation of a Non- Directional electromechanical type over current (I D M T relay) and plot the inverse time current characteristics.
4.3 To study the differential protection scheme for a single phase transformer.

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	1	PO 1,4,6,7
CO2	3	2	2	3		2	1	PO 1,2,3,4,6,7
CO3	3	2	2	3		3	1	PO 1,2,3,4,6,7
CO4	3	3	2	3	3	3	1	PO 1,2,3,4,5,6,7

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

Course Code: EE-507 **Duration: 1 Hour**
Course Name: Power Electronics and Power Systems Lab
Max.Marks: 20

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

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

Course Code: EE-507 **Duration: 1 Hour**
Course Name: Power Electronics and Power Systems Lab **Max. Marks: 20**

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. Invert DC supply to AC supply using Series Inverter.
4. Control the speed of DC shunt motor using single phase fully controlled full wave converter.
5. Control the speed of DC shunt motor using Chopper.
6. Control the speed of 1 Φ induction motor using AC Voltage controller.

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

Course Code: EE-507 **Duration: 1 Hour**
Course Name: Power Electronics and Power Systems Lab **Max. Marks: 40**

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. Invert DC supply to AC supply using Series Inverter.
8. Control the speed of DC shunt motor using single phase fully controlled full wave converter.
9. Control the speed of DC shunt motor using Chopper.
10. Control the speed of 1 Φ induction motor using AC Voltage controller.
11. To study the performance of current and potential Transformers.
12. To study the Operation of a Non- Directional electromechanical type over current (I D M T relay) and plot the inverse time current characteristics.
13. To study the differential protection scheme for a single phase transformer.

EE-508- AC MOTORS LAB

Course Title:	**AC Motors Lab**	Course Code	**EE-508**
Semester	**V Semester**	Course Group	**Core**
Teaching Scheme in Periods (L:T:P)	**15:0:30**	Credits	**1.25**
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

CO1	Identify the parts of A.C motor starters
CO2	Draw and interpret the performance characteristics of three phase AC Motors by Conducting load test.
CO3	Draw and interpret the performance characteristics of single phase AC Motors by Conducting load test.
CO4	Identify and rectify faults in AC motors

Suggested Learning Outcomes

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

C01 - 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.

C02 - Draw and interpret the performance characteristics of 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 Conduct load test on synchronous motor and draw V and inverted V curves

C03 - Draw and interpret the performance characteristics of single phase AC Motors by Conducting load test.

3.1. Perform load test on single phase split phase induction motor.

3.2. Perform load test on single phase universal motor

.

C04 - 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.

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	2	3	1,2,5,6,7
CO2	3	-	2	1	2	2	2	1,3,4,6,7
CO3	2	3	3	2	2	2	3	2,3,4,5,6,7
CO4	3	2	2	1	2	2	1	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-508 **Duration: 1 Hour**
Course Name: AC Motors Lab **Max. Marks: 20**

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.

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: AC Motors Lab **Max. Marks: 20**

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. Conduct load test on Synchronous motor and draw V and inverted V curves.

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: AC Motors Lab **Max. Marks: 40**

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. Identify the part of a given AC Motors.
7. Identify and rectify faults in AC Motors.
8. Identify the parts of a DOL starter, test its parts locate faults if any. Suggest remedies.
9. Identify the parts of a manual star-delta starter, test its parts and locate faults if any suggest remedies.
10. Identify the parts of automatic star-delta starter, test its parts and locate faults if any suggest remedies.
11. Identify the parts of autotransformer starters, test its parts locate faults if any. Suggest remedies.

EE-509-Programmable Logic Controllers and MAT LAB

Course Title:	**Programmable logic Controllers and MAT LAB**	Course Code	**EE-509**
Semester	**V Semester**	Course Group	**Core**
Teaching Scheme in Periods (L:T:P)	**15:0:30**	Credits	**1.25**
Methodology	**Lecture + Practical**	Total Contact Periods	**45**
CIE	**60 Marks**	SEE	**40 Marks**

Pre requisites

This course requires the knowledge of Digital Electronics and C language commands.

Course Outcomes

CO1	Perform Logical Operations on the PLC.
CO2	Develop the ladder logic program for timer & counter functions, download it to the PLC and run the program
CO3	Execute the ladder programs for PLC based model applications
CO4	Develop and Execute Mathematical expressions and draw Sinusoidal wave in MATLAB environment

Suggested Learning Outcomes

Upon completion of the course, the student shall be able to
C01 – Perform Logical Operations on the 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
1.7 Develop a ladder logic program for AND,OR and NOT gates, download the program and run it
1.8 Develop a ladder logic program for NAND,NOR, EX-OR and EX-NOR gates PLC, download the program and run it

C02 - Develop the ladder logic program for timer & counter functions, download it to the PLC and run the program

2.1 Execute the ladder logic program for T-ON(ON-Delay Timer)
2.2 Execute the ladder logic program for T-OFF(OFF-Delay Timer)
2.3 Execute the ladder logic program for RTON(Retentive on)
2.4 Execute the ladder logic program for CTU(count-Up counter)
2.5 Execute the ladder logic program for CTD(count-down Counter)

C03 - Execute the ladder programs for PLC based model applications

3.1 Execute the ladder logic program for stair case lighting
3.2 Execute the ladder logic program for DOL starter
3.3 Execute the ladder logic program for star delta starter

C04 - Practice with MATLAB Environment

4.1 To acquaint with MATLAB windows: Command window, Editor Window, Figure window, Command history window, Current directory window, Workspace window
4.2 Execute a Program to perform below Arithmetic Operators on real numbers
a) Addition b) Subtraction c) Multiplication d) Division
4.3 Develop and execute a Program to Implement below Conditional Statements

a) if-end b) if-else-end c) if-else if-else if-else-end

4.4 Develop and execute a Program to Implement below loop control statements
for loop b) while loop
4.5 Develop and execute a program to compute roots of a quadratic equation $ax^2+bx+c=0$ Given a, b and c.
4.6 Develop and Execute a MAT LAB Program to access elements of Array
4.7 Develop and Execute MAT LAB a program to add two Arrays
4.8 Plot a sine wave with title and labels

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	1	1,2,5,6,7
CO2	3	-	2	3	2	2	1	1,3,4,6,7
CO3	-	1	3	2	2	2	1	2,3,4,5,6,7
CO4	-	3	3	3	2	2	1	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-509 **Duration: 1 Hour**
Course Name: Programmable Logic Controllers and MATLAB **Max. Marks: 20**

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-509 **Duration: 1 Hour**
Course Name: Programmable Logic Controllers and MATLAB **Max. Marks: 20**

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)
4Execute the ladder logic program for CTU(count-Up counter)
5Execute 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-509 **Duration: 2 Hour**
Course Name: Programmable Logic Controllers and MATAB **Max. Marks: 40**

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

510- Project Work

Course Title:	**Project Work**	Course Code	**EE-510**
Semester	**V Semester**	Course Group	**Core**
Teaching Scheme in Periods (L:T:P)	**0:0:45**	Credits	**1.25**
Methodology	**Practical**	Total Contact Periods	**45**
CIE	**60 Marks**	SEE	**40 Marks**

SCHEME OF INSTRUCTIONS AND EXAMINATION

S. No	Subject	Duration	Items	Max Marks	Remarks
1	PROJECT WORK	6 Months	CIE		
			Mid sem-I Abstract submission	20	
			Mid sem-II Prototype project, content development, literature survey and submission of Draft copy	20	
			Internal Evaluation Final Report Internal viva and seminar	20	
			SEE		
			External exam Seminar	20	
			Viva Voice	20	
Total :				**100**	

The Project work shall carry 100 marks and pass marks are 50% a candidate failing to secure the minimum marks should repeat the Project work.

The project selected should be useful to the society.