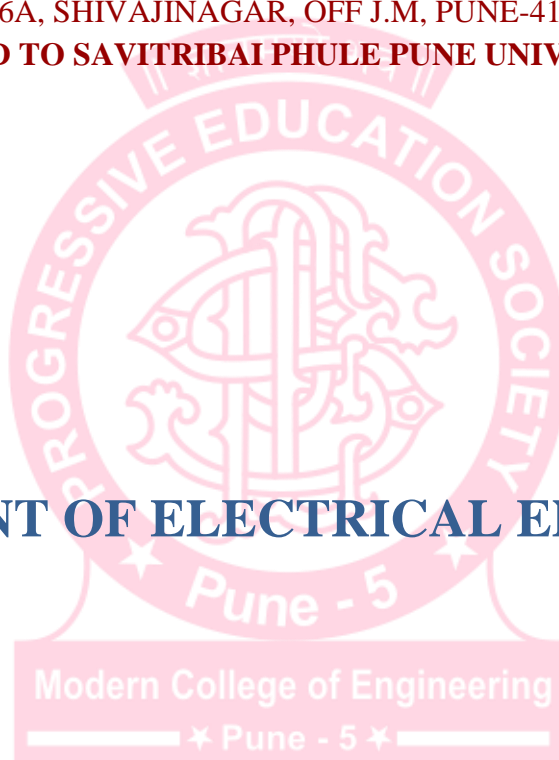




PROGRESSIVE EDUCATION SOCIETY'S
MODERN COLLEGE OF ENGINEERING

1186A, SHIVAJINAGAR, OFF J.M, PUNE-411005
(AFFILIATED TO SAVITRIBAI PHULE PUNE UNIVERSITY, PUNE)

DEPARTMENT OF ELECTRICAL ENGINEERING



E-CURRICULUM BOOKLET
(2015 Pattern)

FOR THE PROGRAMME
TE – ELECTRICAL ENGINEERING
(SEMESTER-I)



PROGRESSIVE EDUCATION SOCIETY'S
MODERN COLLEGE OF ENGINEERING
DEPARTMENT OF ELECTRICAL ENGINEERING

QUALITY POLICY OF THE INSTITUTE

We, PES Modern College of Engineering are committed to develop and foster cultured and promising professionals by imparting quality education in the field of Engineering and Management.

VISION OF THE INSTITUTION

To create a collaborative academic environment to foster professional excellence and ethical values

MISSION OF THE INSTITUTE

- 1. To develop outstanding engineers & professionals with high ethical standards capable of creating and managing global enterprises.**
- 2. To foster innovation and research by providing a stimulating learning environment.**
- 3. To ensure equitable development of students of all ability levels and backgrounds.**
- 4. To be responsive to changes in technology, socio-economic levels and environmental conditions.**
- 5. To foster and maintain mutually beneficial partnerships with alumni and industry.**



PROGRESSIVE EDUCATION SOCIETY'S
MODERN COLLEGE OF ENGINEERING
DEPARTMENT OF ELECTRICAL ENGINEERING

QUALITY POLICY OF THE DEPARTMENT

Electrical Engineering department is committed to develop promising engineers with ethical and social responsibility through excellence in academics, research, skill development and consultancy.

VISION OF THE DEPARTMENT

To build technically competent Electrical Engineers with ethical and social responsibility.

MISSION OF THE DEPARTMENT

- To develop abilities in students for acquiring knowledge and skills to flourish in dynamic technical environment.
- To nurture cultured professionals by providing facilities for their overall development.
- To motivate the students for research work and activities beneficial to society.
- To enhance strong bonding with various organization and alumni

Program Educational Objectives (PEOs)

Graduates will be able to:

PEO 1: Solve and analyze problems in Electrical Engineering using fundamental knowledge.

PEO 2: Adopt lifelong learning ability by acquiring various skills.

PEO 3: Practice ethically in their profession.

PEO 4: Achieve global competency through interactions with various industries, research and professional organizations.



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PROGRAM OUTCOMES (POs)

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

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

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

PO4. Conduct investigations of complex problems: The problems that cannot be solved by straight forward application of knowledge, theories and technique applicable to the engineering discipline that may not have a unique solution. For example, a design problem can be solved in many ways and lead to multiple possible solutions that require consideration of appropriate constraints/requirements not explicitly given in the problem statement. (Like: cost, power requirement, durability, product life, etc.). Which need to be defined (modeled) within appropriate mathematical framework that often requires use of modern computational concepts and tools.

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

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

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

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



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

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

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

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

PROGRAM SPECIFIC OUTCOMES:

PSO 1: Students will have skill set in Energy Audit, Design of Solar System, and Automation in PLC and SCADA Applications, Microcontroller and analysis for power quality in Power System.

PSO 2: Students will be capable of dealing with techno-commercial aspect in Electrical Engineering.



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CORE VALUES

- Excellence in the field of Electrical Engineering.
- Social responsibility with integrity.
- Lifelong Learning.
- Unity in Diversity.

SHORT TERM GOALS

- To enhance alumni interaction.
- To develop innovation lab to enhance research and entrepreneurship by providing various facilities.

LONG TERM GOALS

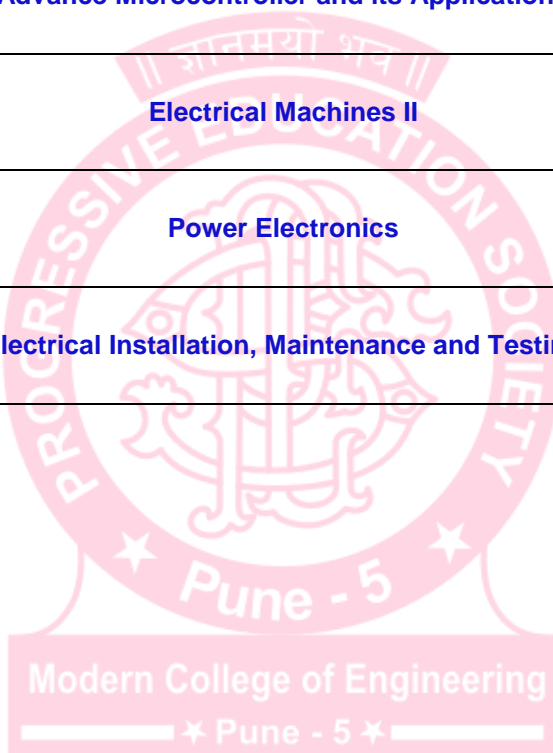
- To promote consultancy activity for revenue generation by developing high-tech standard laboratory.
- To encourage the faculty for research work and up gradation of qualifications.
- To enhance teaching-learning process through ICT.
- To establish competitive entrance exam cell in department.



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PROGRESSIVE EDUCATION SOCIETY'S
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DEPARTMENT OF ELECTRICAL ENGINEERING

Course Structure

Savitribai Phule Pune University
 FACULTY OF ENGINEERING
 T.E. Electrical Engineering (2015 Course)
 (w.e.f. 2017-2018)

(WINTER 2017-2018)													
SEMESTER-I													
Sr. No	Subject Code	Subject Title	Teaching Scheme			Examination Scheme					Total Marks	Credit	
			Th	Pr.	Tu.	PP		TW	PR	OR		TH/ TU	PR+OR
						In Sem	End Sem						
1	311121	Industrial and Technology Management	03	--	--	30	70	--	--	--	100	03	--
2	303141	Advance Microcontroller and its Applications	04	02	--	30	70	--	--	50	150	04	01
3	303142	Electrical Machines II	04	02	--	30	70	--	50	--	150	04	01
4	303143	Power Electronics	04	02	--	30	70	--	50	--	150	04	01
5	303144	Electrical Installation, Maintenance and Testing	03	02	--	30	70	50	--	--	150	03	01
6	303145	Seminar and Technical Communication	--	02	--	--	--	50	--	--	50	--	01
	303152	Audit Course III											
TOTAL			18	10	--	150	350	100	100	50	750	18	05

SEMESTER-II													
Sr. No.	Subject Code	Subject Title	Teaching Scheme			Examination Scheme					Total Marks	Credit	
			Th.	Pr.	Tu	PP		TW	PR	OR		TH/ TU	PR+OR
						In Sem	End Sem						
1.	303146	Power System II	04	02	--	30	70	--	50	--	150	04	01
2.	303147	Control System I	04	02	--	30	70	-	--	50	150	04	01
3.	303148	Utilization of Electrical Energy	03	--	--	30	70	--	--	--	100	03	--
4.	303149	Design of Electrical Machines	04	02	--	30	70	25	--	50	175	04	01
5.	303150	Energy Audit and Management	03	02	--	30	70	25	--	--	125	03	01
6.	303151	Electrical Workshop	--	02	--	--	--	50	--	--	50	--	01
	303153	Audit Course IV											
Total			18	10	--	150	350	100	50	100	750	18	05

Th: Theory lectures hours/week
 Pr: Practical hours/week
 Tu: Tutorial hours/week

TW: Term work
 PR: Theory
 OR: Oral
 PP: Paper- In semester and End Semester



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Industrial and Technology Management **(311121)**





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Name of the Subject: Industrial and Technology Management

Weekly Work Load(in Hrs)	Lecture	Tutorial	Practical
	03	-	-

Online/ In-sem	Theory	Practical	Oral	Term-work	Total Marks	Credit
30	70	-	-	-	100	03

Syllabus:

Unit 01: Introduction to managerial and economical demand (06Hrs)

Managerial Economics: Definition of economics, Demand and Supply concept, Law of demand and supply, Elasticity of demand and supply, Demand forecasting: Meaning and methods.

Management: Meaning, scope, function, and importance of management. Difference between administration and management. Types of business ownership: Sole proprietorship, Partnership (Act 1934), LLP (Limited Liability Partnership), (Act 2008). Business Organizations: Line organization, Line and Staff organization and Functional Organization. Joint Stock Company: Public Limited and Private Limited, Public Sector Undertaking (PSU)

Unit 2: Technology and Industrial Management (06Hrs)

Introduction to industrial management: Concept, development, application and its scope. **Introduction of Technology Management :** Definition of technology, Management and its relation with society, classification of technology, Management of technology at various levels- its importance on National Economy, Ethics in technology management, Critical Factors in technology management.

Unit 3: Quality Management (06Hrs)

Definition of Quality Management: Definition of quality, continuous improvement, Types of quality. Quality of design, Assistance Tools: Ishikawa diagram – Pareto Analysis. Pokka Yoke (Mistake Proofing) quality circles, Kaizen. TQM, 5S (Case study of Toyota, descriptive treatment). Six-Sigma, Quality Management Standards (Introductory aspects only) The ISO 9001:2000 Quality Management System Standard- The ISO 14001:2004. Environmental Management System Standard.

Unit 4: Marketing and Financial Management (06Hrs)

Marketing Management: Market, meaning, characteristics and its types: Perfect Competition, Monopoly, Monopolistic completion and Oligopoly. Marketing and selling, marketing planning. Market survey and market research, online Marketing.

Financial Management: Definition of financial management, cost. Types of costs, and methods of costing, price, capital. Debit, credit, books of accounts and final accounts.



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Unit 5: Human Resource Management

(06Hrs)

Motivation: Introduction to Motivation, theories of work motivation: Maslow Hierarchy of need's theory, Theory X, Theory Y and F. Herzberg's two factor theory. Group dynamics: Types and interactions of groups, stages of group dynamics: Norming, Storming, Forming, Performing and Adjourning. Leadership- Laissez-faire, importance, qualities of good leadership. Human Resource Management- Introduction, importance, scope. HR planning. Recruitment, selection, training and development, Performance management.

Unit 6: Entrepreneurship

(06Hrs)

Entrepreneurship- Definition, concept, traits, qualities of entrepreneur. Importance and limitations of rational decision making, Decision making under certainty, uncertainty and risk. Incentives for small business development, Government policies and incentives, Case study on Small scale industries in India. Introduction to Intellectual Property Rights (IPR), Meaning of IPR, Different forms of IPR, Patents, Criteria for securing Patents. Patent format and structure, Copy and trademark (Descriptive treatment only).

Text Books:

- [T1] O.P. Khanna, industrial engineering and management, Dhanpat Rai and sons, New Delhi.
- [T2] E. H. McGrah, S. J. Basic managerial skill for all.
- [T3] Tarek Khalil, Management of Technology Tata Mc Graw Hill Publication Pvt. Ltd.
- [T4] Prabuddha Ganguli Intellectual Property rights TATA McGraw-Hill Publishing Company
- [T5] Management Accounting and financial management by "M. Y. Khan and P. K. Jain", McGraw Hill-Tata-ISBN.

Reference Books:

- [R1] C. B. Mamoria and V.S.P.Rao- Personnel Management, Himalaya Publishing House, 30th Edition 2014
- [R2] Harold Koonlz and O D'onnel – Management. McGrawHill Publication 1980
- [R3] Philip Kotler- Marketing Management. Pearson Edition 2008
- [R4] Robert Heller, Managing Teams, Dorling Kindersley, London.
- [R5] Kelly John M, Total Quality Management, InfoTech Standard, Delhi.
- [R6] Joseph M. Juran Juran's Quality Handbook TATA McGraw-Hill.
- [R7] Dale H. Besterfield and Carol Besterfield Total Quality Management Prentice Hall of India Pvt. Ltd.
- [R8] Shiv Sahai Singh [Editor] The Law of Intellectual Property rights.
- [R9] N. R. Subbaram, What Everyone Should Know About Patents, Pharma Book Syndicate, Hyderabad.
- [R10] Principles and Practices of Management –Dr. P.C. Shejwalkar, Dr. Anjali Ghanekar, Prof. Deepak Bhivpathki.
- [R11] Financial Management by "I M Pandey", Vikas Publishing House Pvt. Ltd., Delhi Philip Kotler- Marketing Management



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Unit	Text Books	Reference Books
1	T1	R2,R10
2	T1, T2,T3	R5
3	-	R3,R5,R6
4	T5	R3, R11
5	T1	R1,R2
6	T4	R8

IS/IEEE Standards:

- 1) ISO 9001:2000 Quality Management System Standard- The ISO 14001:2004

Reference Web Links/ Research Paper/ Referred Book other than Mention in Syllabus:

1.

Course Objectives

The course aims to

- ☐ Possess knowledge of types of business organizations; explore the fundamentals of economics and Management.
- ☐ Understand the basic concepts of Technology management and Quality management.
- ☐ Analyse and differentiate between marketing management and financial management.
- ☐ Recognize the importance of Motivation, Group dynamics, Team work, leadership skill and entrepreneurship.
- ☐ Explain the fundamentals of Human Resource management.
- ☐ Identify the importance of Intellectual property rights and understand the concept of patents, copy rights and trademarks.

Course Outcomes

Upon successful completion of this course, the students will be able to

- Differentiate between different types of business organization and discuss the fundamentals of economics and management.
- Explain the importance of technology management and quality management.
- Describe the characteristics of marketing and its types.
- Discuss the qualities of a good leader.



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Academic Activity Planner

Units	Unit Test1 (10marks)	Unit Test2 (10marks)	Unit Test3 (10marks)	Unit Test4 (10marks)	Unit Test5 (10marks)	Unit Test6 (10marks)
1	✓					
2		✓				
3			✓			
4				✓		
5					✓	
6						✓

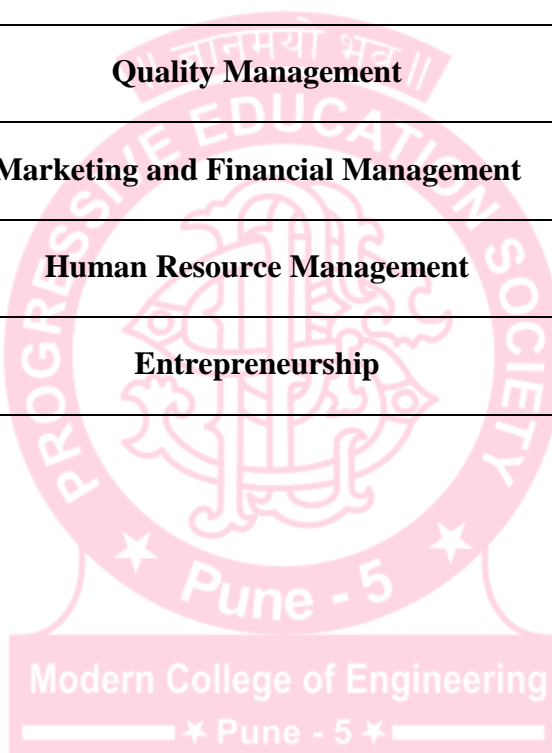




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DEPARTMENT OF ELECTRICAL ENGINEERING

Teaching Plan
Teaching plan as per University Syllabus

Sr.No.	Unit	Broad Topics to be Covered	Total Lecture Planned
1	I	Introduction to managerial and economical demand	06
2	II	Technology and Industrial Management	06
3	III	Quality Management	06
4	IV	Marketing and Financial Management	06
5	V	Human Resource Management	06
6	VI	Entrepreneurship	06





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DEPARTMENT OF ELECTRICAL ENGINEERING

Unit wise Lecture Plan

Unit No.-I: Introduction to managerial and economical demand

Pre-requisites:- Basic concepts of business, management, and concept of economics

Objectives:-

- To understand business organization types.
- To study the concept economics.
- To understand the concept of management and functions by different theories.

Outcomes:

- **Demonstrate** the knowledge of different business organization types.
- **Understand** the different economic concepts.
- **Understands the** concept of management and functions.

Lecture No.	Details of the Topic to be covered	References	Mode of Delivery
1	Introduction of subject	T1, T3	Chalk and talk
2	Business organizations -Types of business ownership- proprietary firm, partnership firm	T1, T3	Chalk and talk Discussion session
3	joint stock company, public sector under takings, cooperative society.	T1,T3	Chalk and talk Discussion session
4	Introduction to economics -Basic economics concepts- supply, demand, elasticity of supply, methods of demand forecasting, Role of government in macro economics	T1, T3	Chalk and talk
5	Management- Meaning, scope, function, and importance of management.	T1, T3	Chalk and talk Discussion session
6	Difference between administration and management, contribution of F.W.TAYLOR	T1	Chalk and talk
7	Types of business ownership	T1	Chalk and talk
8	meaning of organization, principles, types of organization structure.	T1	Chalk and talk
9	Rubrics		



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Question Bank: Theory

Unit: I

1. What is business organization? State and explain in short types of business organization.
2. Explain single ownership and partnership concept.
3. What is joint stock company ? explain in detail.
4. Difference between joint stock company and co-operative society.
5. What is mean by economics. Explain elasticity of demand.
6. What is mean by demand? Factors affecting on demand analysis.
7. What is mean by supply? Explain elasticity of supply.
8. Explain the concept of management and functions in detail.
9. Differentiate between management and administration.
10. State the different theories of management and explain any two.





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Unit No.-II: Technology and Industrial Management

Pre-requisites:- Basic concepts of quality and technology.

Objectives:-

- To learn different technology management techniques.
- To study ethics management techniques.

Outcomes:- After successfully completing this unit students will be able:
To understand the different technology and industrial management methods.

Lecture No.	Details of the Topic to be covered	References
1	Technology Management Introduction of Technology Management :Definition of technology ,Management and its relation with society,	R8, R10,T1
2	classification of technology, Management of technology at various levels- its importance on National Economy	R8, R10,T1
3	Ethics in technology management, Critical Factors in technology management.	R8, R10,T1
4	Concept, development, application and its scope.	R8, R10,T1
5	Industrial management	R8, R10,T1
6	Importance of Industrial management	R8, R10,T1

Question Bank: Theory

Unit 2:

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1. Define technology management and explain its relation with society.
2. Explain classification of technology management.
3. Which ethics are used in technology management.
4. Note on: Importance of technology management in national economy.



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Unit No.-III: Quality Management

Pre-requisites:- Basic concepts of quality .

Objectives:-

- To learn different technology management techniques.
- To study Quality management techniques.

Outcomes:-After successfully completing this unit students will be able:

To understand the different Quality management methods.

Lecture No.	Details of the Topic to be covered	References
1	Quality Management -Definition of quality, goalpost view of quality, continuous improvement definition of quality	R8, R10,T1
2	Types of quality – quality of design, conformance and performance phases of quality management,	R8, R10,T1
3	Juran's and Demings view of quality Quality Management Assistance Tools: Ishikawa diagram – Pareto Analysis – Pokka Yoke (Mistake Proofing) quality circles	R8, R10,T1
4	TQM, Kaizen, Five S (5S), Six sigma,	R8, R10,T1
5	Quality Management Standards (Introductory aspects only) The ISO 9001:2000 Quality Management System Standard- The ISO 14001:2004	ISO 9001:2000 Quality Management System Standard- The ISO 14001:2004
6	Environmental Management System Standard.	R8, R10,T1
7	Rubrics	

Modern College of Engineering

Question Bank: Theory

Unit 3:

1. Define quality. Give the performance phases of quality management.
2. Explain Juran's and Demings of quality management.
3. Write a note on: 1) pareto analysis 2) POKKA YOKE quality circle.
4. Write a note on six sigma.
5. Note on TQM.
6. Note on: Quality management standards.



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Unit No.-IV: Marketing and Financial Management

Pre-requisites :- Basic concepts of marketing, meaning of management, and financial terms like profit, loss etc

Objectives :- To learn the marketing management and financial management.

Outcomes:- After successfully completing this unit students will be able to:
Understand the difference between marketing management and financial management.

Lecture No.	Details of the Topic to be covered	References
1	Marketing Management – Marketing function, marketing and selling,	T1,T3, R3
2	marketing planning, market survey and market research,.	T1,T3, R3
3	online Marketing, Financial Management - Definition of financial management	T1,T3, R3
4	cost, types of costs, and methods of costing,	T1,T3, R3
5	price, capital, debit, credit	T1,T3, R3
6	books of accounts and final accounts	T1,T3, R3
7	Rubrics	

Question Bank: Theory

Unit 4:

- 1) What are different functions of marketing?
- 2) Difference between marketing and selling.
- 3) Note on:
 - a. Marketing planning
 - b. Market survey
 - c. Market research
 - d. Online marketing
- 4) What are the different types of costs involved in financial management?
- 5) Note on: methods of costing
- 6) Define:
 - a. Debit
 - b. Credit
 - c. Price
 - d. Capital
- 7) Note on book of accounts and final accounts.



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Unit No.-V: Human Resource Management

Pre-requisites:-

- Concept of motivation, leadership.
- concept of personality.

Objectives:-

- To learn the concept, need of motivation.
- To study group dynamics and different theories of it.
- Qualities of leader.
- To understand the basic concepts of human resource management.
- To understand need of personality development and labour welfare.
- To learn the business ethics.

Outcomes:-After successfully completing this unit students will be able to:

- Analyze the need of motivation
- How to work in group and team
- Become a good leader.
- Functions of human resource management.
- Improve the personality and understand the need of labour welfare.
- Work ethically in any type of business.

Lecture No.	Details of the Topic to be covered	References
1	Motivation, human needs	T1
2	theories of work motivation, Maslow of Hierarchy need theory of motivation	T1
3	Theory X, Theory Y and F.Herzberg's two factor theory of motivation.	T1
4	Group dynamics- theories of group formation	T1
5	types and interactions of groups, formation of teams and team work	T1
6	Leadership, importance, theories and styles, qualities of good leadership.	T1
7	Human Resource Management- introduction, importance	T1, T3
8	scope, HR planning, recruitment, selection, training and development	T1, T3
9	performance management., methods of performance appraisal	T1, T3



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10	Industrial Relations and Labor Welfare	T1, T3
11	Personality, development of personality, attitude	T1, T3
12	job satisfaction and organizational commitment, self-development	T1, T3
13	time, stress management and conflict	T1, T3
14	Professional and Business ethics.	T1, T3
15	Rubrics	

Question Bank: Theory
Unit 5:

- 1) Define motivation. Why it is needed?
- 2) Write a note on:
 - a. Maslow of hierarchy need theory of motivation
 - b. Theory X and theory Y
 - c. Herzberg's two factor theory
- 3) what is group dynamics?
- 4) Describe the team and team work in detail.
- 5) Define leadership and its importance.
- 6) Describe the qualities of good leadership.
- 7) Write a note on theories of leadership.
- 8) What is importance and scope of human resource management?
- 9) Note on:
 - a. HR planning
 - b. Recruitment and selection
 - c. Training and development
- 10) what is performance management? give the different methods of performance appraisal.
- 11) Note on labour welfare.
- 12) Short note on:
 - a. Personality development
 - b. Job satisfaction and organizational commitment
 - c. Self development
 - d. Time management
 - e. Stress management
 - f. Conflict management
 - g. Business ethics.



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Unit No.-VI: Entrepreneurship

Pre-requisites:-Basic concepts of patent.

Objectives: -To learn the IPR and criteria for patent.

Outcomes:-After successfully completing this unit, students will be able to:

Do the work for getting patent.

Lecture No.	Details of the Topic to be covered	References
1	Entrepreneurship-Definition, concept, traits, qualities of entrepreneur	Google search
2	Entrepreneurship- Definition, concept, traits, qualities of entrepreneur. Importance and limitations of rational decision making,	Google search
3	Decision making under certainty, uncertainty and risk. Incentives for small business development, Government policies and incentives	Google search
4	Case study on Small scale industries in India.	Google search
5	Introduction to Intellectual Property Rights(IPR), Meaning of IPR	Google search
6	Different forms of IPR	Google search
7	Patents, Criteria for securing Patents	Google search
8	Patent format and structure	Google search
9	Introduction to patents Laws	Google search
10	Trade mark and copy Right Laws	Google search
11	Rubrics	

Question Bank: Theory

Unit 6:

- 1) Note on IPR.
- 2) Define patent. What is the criteria for securing patent?
- 3) Write the patent format and structure.
- 4) Write a note on:
 1. Trademark
 2. Copyright law
 3. Patent law



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Advance Microcontroller and Its Applications (303141)





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Name of the Subject: Advance Microcontroller and Its Applications

Weekly Work Load(in Hrs)	Lecture	Tutorial	Practical
	04	-	-

Online/ In-sem	Theory	Practical	Oral	Term-work	Total Marks	Credit
30	70	-	50	-	150	

Syllabus:

Unit 01: PIC Architecture (08 hrs)

Comparison of CISC and RISC, RAM and Program memory organization, Program counters, Stack pointer, Bank Select Register, Status register, Data transfer instructions, Arithmetic and logical instructions. Assembly language programs.

Unit 02: Assembly language Programming (08 hrs)

Addressing Modes for PIC 18 microcontroller, Branch instruction, CALL, RETURN, Bit addressable instruction. Assembly language programs I/O ports, SFR related to PORTs, I/O port programming.

Unit 03: Programming of PIC microcontroller in C (08 hrs)

Embedded C concepts, Header and source files and pre-processor directives, Data types, data structures, Control loops, functions, bit operations. I/O port programming in C, Delay programming. PIC 18 Timer 0 Programming in C

Unit 04: Special Hardware features and Programming (08 hrs)

Timers required for CCP Applications, CCP module in PIC 18 microcontroller, Applications of CCP mode Generation of waveform using Compare mode of CCP module. Period measurement of a unknown signal using Capture mode in CCP module, Speed control of DC motor using PWM mode of CCP module

Unit 05: Interrupt programming (08 hrs)

Interrupt Programming, Programming of Timer interrupts, Programming of External interrupts, Serial port programming. Interfacing of PIC18F458 8 bit model LCD(16x2)

Unit 06: Interfacing of PIC Microcontroller (08 hrs)

PIC ADC, Programming of ADC using interrupts, Measurement of temperature and voltage Using PIC microcontroller. Interfacing DAC with PIC18F458, Interfacing of Electromechanical Relays and Opto-isolators.



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Text Books:

- [T1] PIC Microcontroller and Embedded Systems Using Assembly and C for PIC18 by Muhammad Ali Mazidi, Rolind D. McKinley, Danny Causey, Pearson Education.
- [T2] Fundamentals of Microcontrollers and Applications in Embedded Systems with PIC by Ramesh Gaonkar, Thomson and Delmar learning, First Edition.
- [T3] Programming And Customizing the PIC Microcontroller by MykePredko, TATA McGraw-Hill.
- [T4] PIC microcontroller: An introduction to software and Hardware interfacing by HanWay-Huang Thomson Delmar Learning.
- [T5] Microcontroller Theory and Applications with PIC18F, M.Rafiquzzaman, John Wiley and Sons

1.6 Reference Web Links/ Research Paper/ Referred Book other than Mention in Syllabus:

- [R1] PIC18F458 datasheet
- [R2] MPLAB IDE user guides
- [R3] MICROCHIP Technical Reference Manual of 18F4520 Embedded Design with PIC 18F452 -- Microcontroller by John B. Peatman, Prentice Hall
www.microchip.com
Embedded Design with PIC 18F452 Microcontroller by John.B.Peatman, Prentice Hall

Unit	Text Books	Reference Books
1	T1,T2,T3,T4	R1
2	T1, T2,T3,T4,T5	R1,R2
3	T1,T4,T5	R1
4	T1,T2,T3,T4	R1
5	T1,T2,T3,T4	R1
6	T1,T2,T3,T4	R1,R3



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COURSE OBJECTIVES

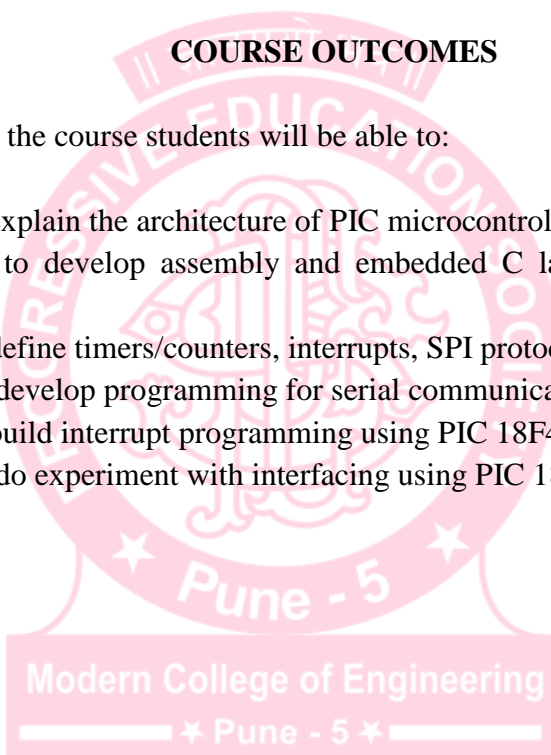
From the study of this course students will learn:

- PIC 18F458 Microcontroller architecture.
- Assembly and C language programming for PIC 18F458.
- Architecture and behavior of different ports of PIC18F458.
- Use of Timer in PIC 18F458.
- Serial port and Interrupt handling for PIC 18F458.
- ADC, DAC, and Sensor interfacing with PIC 18F458.

COURSE OUTCOMES

After successfully completing the course students will be able to:

- CO1.** Students will be able to explain the architecture of PIC microcontroller.
- CO2.** Students will be able to develop assembly and embedded C language programming for PIC 18F458.
- CO3.** Students will be able to define timers/counters, interrupts, SPI protocol for PIC18F458.
- CO4.** Students will be able to develop programming for serial communication using PIC18F458.
- CO5.** Students will be able to build interrupt programming using PIC 18F458.
- CO6.** Students will be able to do experiment with interfacing using PIC 18F458.





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Academic Activity Planner

Units	MCQTest1 (10 marks)	MCQ Test 2 (10marks)	MCQ Test 3 (10marks)	Tutorial (Each 10 marks)	End Term Test 2 (70marks)
I	✓			✓	✓
II		✓		✓	✓
III			✓	✓	✓
IV				✓	✓
V				✓	✓
VI			॥ ज्ञानमया भव ॥	✓	✓



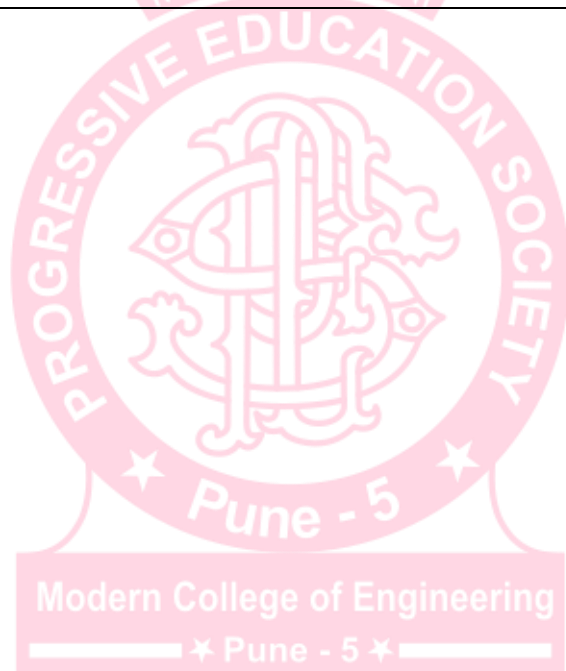


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Teaching Plan

Teaching plan as per University Syllabus

Sr.No.	Unit	Broad Topics to be Covered	Total Lecture Planned
1	I	PIC Architecture	08
2	II	Instruction Set and Programming	08
3	III	Development Tools and Hardware features	08
4	IV	Special Hardware features(CCP)	08
5	V	Interrupts and serial port programming	08
6	VI	Interfacing of PIC Microcontroller	08





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Unit wise Lecture Plan
Unit No.-I: PIC Architecture

Pre-requisites:- Microprocessor and Microcontroller Architecture.

Objectives :-

- PIC 18F458 Microcontroller architecture.

Outcomes :

- PIC 18F458 Microcontroller internal Architecture

Lecture No.	Details of the Topic to be covered	References	Mode of Delivery
1	Introduction about PIC microcontroller and comparison of some features with 8051	T1	Talk
2	CISC and RISC architecture, PIC18f458 block diagram	T1,T2,R2	Chalk and talk Discussion session
3	Explanation of pin diagram	T1,T2,R2	PPT
4	RAM & ROM organization, calculation of bank, explanation on access bank and bank select register.	T1,T2,R2	Chalk and talk
5	Status register with examples, Program counters, Stack pointer	T1,T2,R2	Chalk and talk Discussion session
6	Bank Select Register and instructions to select and access bank	T1,T2,R2	Chalk and talk Discussion session
7	Data transfer instructions and examples.	T1,T2,R2	Chalk and talk
8	Arithmetic and logical instructions and examples.	T1,T2,R2	Chalk and talk
9	Review on Unit I		

Question Bank: Theory

Unit : I

- 1 What is the difference between a microprocessor and a microcontroller?
- 2 Define the terms: bit, byte, and word.
- 3 Calculate the number of bits that can be stored in 1 KB memory.
- 4 If the address range of flash memory in a microcontroller is 00000 H to 1FFFFH, calculate the size of the memory.
- 5 Calculate the decimal value of the Hex integer 78H if it is an unsigned number.
- 6 Find the Hex equivalent of the negative decimal number -138 10 and show its binary representation in an 8-bit processor.
- 7 Find the ASCII codes for upper-case letters A and Z, and lower-case letters a and z from Appendix



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Unit No.-II: Assembly Language Programming

Pre-requisites:- Basics of Assembly Language programming

Objectives :-

- Assembly and C language programming for PIC 18F458.

Outcomes :

- C language programming for PIC 18F458.

Lecture No.	Details of the Topic to be covered	References	Mode of Delivery
1	Addressing Modes for PIC 18 microcontroller	T1,T2,R2	Talk
2	Branch instruction, CALL, RETURN & RETIE	T1,T2,R2	PPT
3	Bit addressable instruction with examples	T1,T2,R2	PPT
4	Assembly language programs.	T1,T2,R2	Chalk and talk
5	SFR related to PORTs	T1,T2,R2	PPT
6	Assembly language programs I/O ports	T1,T2,R2	PPT
7	Compare instructions, DAW, Rotate instructions	T1,T2,R2	Chalk and talk
8	Programming examples	T1,T2,R2	Chalk and talk
9	Revision of Unit II		

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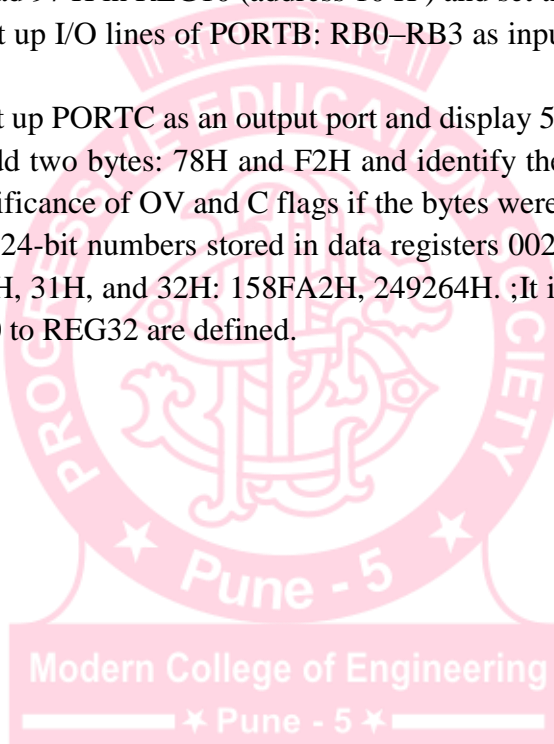


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Question Bank: Theory

Unit : II

- 1 Specify the result you expect in W register after the execution of the above instructions. Specify the flags that are set after the addition. MOVLW 0x89, ADDLW 0x77.
- 2 If the BSR register holds the byte 04, explain the result of the following instruction: MOVWF 0x7F, 1
- 3 Explain the result of the following instruction and the flags affected: MOVWF 0x80, 0 if W contains 00. Identify the device that is associated with the address 80 H.
- 4 Explain why one-word branch instructions require two cycles for execution.
- 5 Write instructions to load the byte 00 in WREG. Does the instruction set the Z flag? Copy the byte in REG1 and set the Z flag.
- 6 Write instructions to load 97 H in REG10 (address 10 H) and set the N flag.
- 7 Write instructions to set up I/O lines of PORTB: RB0–RB3 as input lines and RB4–RB7 as output lines.
- 8 Write instructions to set up PORTC as an output port and display 55 H at PORTC.
- 9 Write instructions to add two bytes: 78H and F2H and identify the status of all the flags. Explain the result and the significance of OV and C flags if the bytes were unsigned.
- 10 Add the following two 24-bit numbers stored in data registers 0020H to 0025H and store the sum in data registers 0030H, 31H, and 32H: 158FA2H, 249264H. ;It is assumed that registers REG20 to REG25 and REG30 to REG32 are defined.





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Unit No.-III: PROGRAMMING OF PIC MICROCONTROLLER IN C

Pre-requisites:- Basics C Language, Microprocessor and Microcontroller Architecture.

Objectives :-

- Software Development.

Outcomes :

- C language programming for PIC 18F458.

Lecture No.	Details of the Topic to be covered	References	Mode of Delivery
1	Development tools-Editors	T1,T2,R2	PPT
2	Assemblers, Compilers, Linkers, Emulators	T1,T2,R2	PPT
3	Debugger Programmers, Introduction to MPLAB, Data type, data structure	T1,T2,R2	PPT
4	Revision on Bit related instructions with examples	T1,T2,R2	Chalk and talk
5	Timers, I/O Port	T1,T2,R2	Chalk and talkDiscussion session
6	Programming in C	T1,T2,R2	PPT
7	Programming in C	T1,T2,R2	PPT
8	Programs Examples	T1,T2,R2	Chalk and talk
9	Review on Unit III		

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Question Bank: Theory

Unit: III

- 1 What is an assembler?
- 2 What is the function of a header file in an assembly language program?
- 3 What does a label (excluding labels used for equates) represent in a program?
- 4 What is the purpose of the List file of an assembled program and what does it include?
- 5 A free-running 16-bit timer has a clock frequency 5 MHz. The counter register in the timer is incremented every clock cycle. When the counter reaches FFFFH, it rolls over to 0000 and continues to count. If the timer reading at the beginning of the event is 1FF8H and at the end of the event is 3380 H, calculate the time delay between the two events.
- 6 In a pulse waveform, the on-time is 150 μ s and the off-time is 300 μ s. Calculate the duty cycle of the waveform.
- 7 Write instructions to initialize I/O pins of PORTB as follows: RB7 as an input and RB6 as an output. Read RB7. If it is grounded, turn on the LED connected to pin RB6. Otherwise, turn off the LED and continue.
- 8 Keys can be checked for a closure from 0 to F in a sequence. Rewrite the program to set up a counter starting from 0 and update the count as the keys are being checked and encode the keys.
- 9 Write instructions to initialize pins RB7 as an input and RB0 as an output of PORTB. Switch SW7 is used to turn on the solid-state relay (SSR) that starts the conveyer belt. Read the switch and continue to read it until it is closed. Once it is closed, turn on SSR0.
- 10 Calculate the time delay when Timer0 is loaded with the count of 676BH, the instruction cycle is 0.1 μ s, and the presale value is 128.
- 11 Write a program when the timer reaches five minutes, flash the LEDs on and off, simulating a buzzer
- 12 Assuming that PORTB is properly initialized, write instructions to read two switches connected to pins RB7 and RB6. If both of them are on, turn on the solid-state relay (SSR); otherwise, continue to monitor both switches.

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Unit No.-IV: SPECIAL HARDWARE FEATURES AND PROGRAMMING

Pre-requisites:- Microprocessor and Microcontroller Architecture.

Objectives:-

- Serial port and Interrupt handling for PIC 18F458.
- ADC, DAC, and Sensor interfacing with PIC 18F458.

Outcomes:

- Understanding of hardware connection with PIC 18F458.

Lecture No.	Details of the Topic to be covered	References	Mode of Delivery
1	Timers required for CCP Applications, CCP module in PIC 18 microcontroller	T1,T2,R2	PPT
2	Revision on Timers for the use of CCP to select mode	T1,T2,R2	Chalk and talk Discussion session
3	Applications of CCP mode Generation of waveform using Compare mode of CCP module.	T1,T2,R2	PPT
4	Period measurement of a unknown signal using Capture mode in CCP module	T1,T2,R2	Chalk and talk
5	Speed control of DC motor using PWM mode of CCP module	T1,T2,R2	Chalk and talk Discussion session
6	Programming on CCP	T1,T2,R2	PPT
7	Programs Examples	T1,T2,R2	Chalk and talk
8	Programs Examples	T1,T2,R2	Chalk and talk
9	Revision on Unit-IV		PPT



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Question Bank: Theory

Unit: IV

- 1 Write a subroutine to generate a 1.0-second delay using Timer0 with the clock frequency set at 10 MHz
- 2 Write a program to trigger a special event to start a conversion in the A/D module every second. Use Timer1 and CCP2 in the compare mode.
- 3 Write instructions to measure the pulse width of the input source connected to pin RC2 if the system clock frequency is 10 MHz Use the CCP1 module in capture mode and Timer1 as a clock source for the module.
- 4 Write instructions to set up CCP1 in the PWM mode to generate a 1-kHz pulse waveform with a 50% duty cycle, given a system clock frequency of 10 MHz





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Unit No.-V: INTERRUPT PROGRAMMING

Pre-requisites:- Microcontroller Architecture, Serial communication basics & C programming.

Objectives:-

- PIC 18F458 Microcontroller architecture.

Outcomes:

- Understanding of hardware connection with PIC 18F458.

Lecture No.	Details of the Topic to be covered	References	Mode of Delivery
1	Interrupt & Polling, steps to execute interrupts	T1,T2,R2	Talk
2	Interrupts in PIC18F458, Interrupt register	T1,T2,R2	Chalk and talk Discussion session
3	Programming of Timer interrupts	T1,T2,R2	PPT
4	Programming of External interrupts	T1,T2,R2	Chalk and talk
5	Revision on serial communication, Baud rate calculation, Register used for serial communication	T1,T2,R2	Chalk and talk Discussion session
6	Serial port programming	T1,T2,R2	PPT
7	Interfacing of PIC18F458 8 bit model LCD(16x2)	T1,T2,R2	PPT, Chalk and talk
8	Review on Unit V	T1,T2,R2	

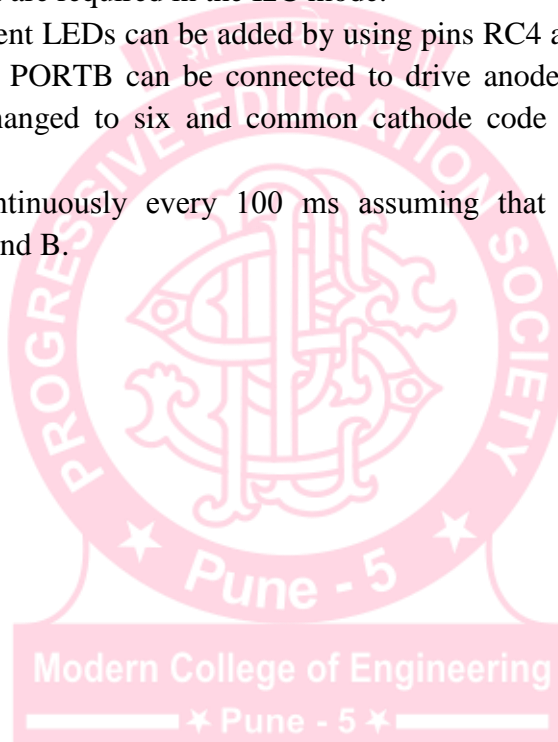


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Question Bank: Theory

Unit: V

- 1 Explain the difference between serial I/O and parallel I/O.
- 2 Explain the difference between asynchronous and synchronous data transmission.
- 3 Calculate the bit time when a fax machine transmits data at 1200 bps.
- 4 Calculate the byte to be loaded in the SPBRG register to set the baud in the asynchronous mode = 9600 if FOSC = 16 MHz and the BRGH bit is cleared in the TXSTA register.
- 5 Write a subroutine to initialize the EUSART in asynchronous mode to meet the following specifications: 1) 9600 baud with FOSC = 32 MHz, 2) one Start and Stop bits and 9 bits data, and 3) enable transmit and receive.
- 6 Identify the signals necessary to implement the SPI protocol.
- 7 Identify the signals that are required in the I2C mode.
- 8 Two more seven-segment LEDs can be added by using pins RC4 and RC5 to drive their cathodes, and all eight lines of PORTB can be connected to drive anode. To display six digit date, the counter should be changed to six and common cathode code should be stored in respective registers.
- 9 Flash letters 'FF' continuously every 100 ms assuming that subroutine DELAY_100ms is available. On port C and B.





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Unit No.-VI: INTERFACING OF PIC MICROCONTROLLER

Pre-requisites:- Microcontroller Architecture and C programming.

Objectives:-

- PIC 18F458 Microcontroller architecture.

Outcomes:

- Understanding of hardware connection with PIC 18F458.

Lecture No.	Details of the Topic to be covered	References	Mode of Delivery
1	ADC, DAC theory	T1,T2,R2	Talk
2	PIC ADC	T1,T2,R2	Chalk and talk Discussion session
3	Programming of ADC using interrupts	T1,T2,R2	PPT
4	Measurement of temperature and voltage Using PIC microcontroller	T1,T2,R2	Chalk and talk
5	Interfacing DAC with PIC18F458,	T1,T2,R2	Chalk and talk Discussion session
6	Interfacing of Electromechanical Relays and Opto-isolators	T1,T2,R2	PPT
7	Interfacing of Electromechanical Relays and Opto-isolators	T1,T2,R2	Chalk and talk
8	Review on Unit VI		

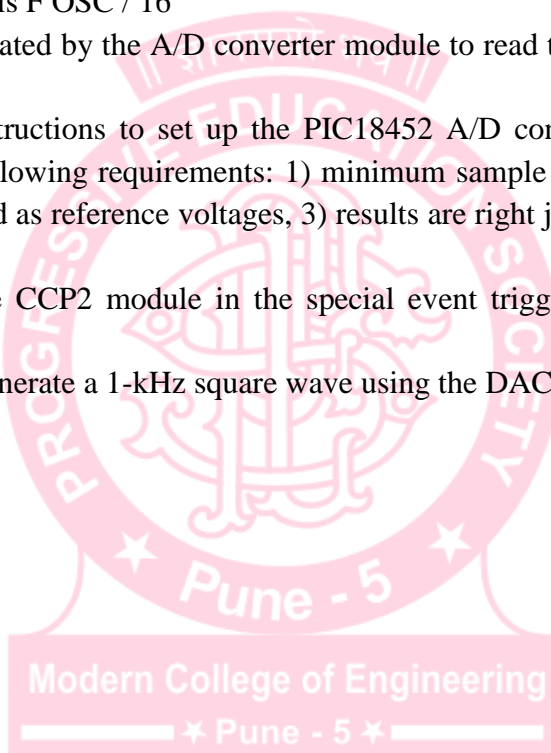


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Question Bank: Theory

Unit: VI

- 1 Explain the functions of a transducer, A/D converter, and D/A converter.
- 2 Calculate the resolution of a 16-bit A/D converter.
- 3 Given an analog signal from 0 to +10 V and a 12-bit A/D converter, calculate the values of LSB, MSB, and the full-scale output voltage.
- 4 If the reference voltages in PIC18 A/D module are $V_{REF-} = 0\text{ V}$ and $V_{REF+} = +5\text{ V}$, calculate the output voltages for the following digital values: 80H, 200 H, and 03FA H.
- 5 Write initialization instructions to set up PIC18 A/D converter module to read two channels AN0 and AN1 alternatively and meet the following requirements: the minimum sample time = $16\mu\text{s}$ if $F = 20\text{ MHz}$, 2) VDD and VSS are used as reference voltages, 3) results are right justified, and 4) frequency select ratio is $F_{OSC} / 16$
- 6 use the interrupts generated by the A/D converter module to read the channels 16 times instead of waiting in the loop.
- 7 Write initialization instructions to set up the PIC18452 A/D converter module to read channel AN0 and meet the following requirements: 1) minimum sample time = $16\mu\text{s}$ if $F = 10\text{ MHz}$, 2) VDD and Vss are used as reference voltages, 3) results are right justified, and 4) frequency select ratio is $F_{OSC}/16$
- 8 Set up Timer1 and the CCP2 module in the special event trigger mode, and read temperature reading every second.
- 9 Write instructions to generate a 1-kHz square wave using the DAC circuit if $F_{OSC} = 10\text{ MHz}$.

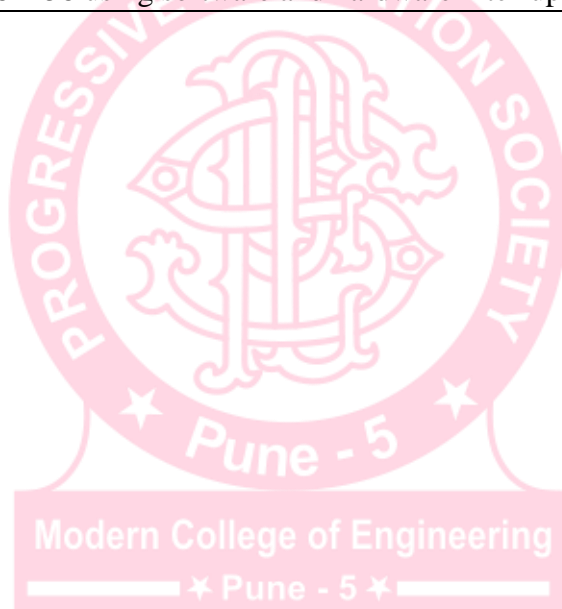




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Practical Assessment
List of Experiments

Sr.No.	Name of the Practical
1	Introduction to MPLAB. Addition, Subtraction and Multiplication
2	Data transfer to ports
3	Timer, Counter, Delay programming
4	Interfacing 18F458 to Keypad ,Switch and LED
5	Interfacing of LCD [16 X 2] with PIC 18F458
6	Interfacing DC motor with PIC 18F458
7	Interfacing Stepper motor with PIC 18F458
8	Interfacing of LM35 with PIC 18F458 and displaying of temperature
9	Generation of square, positive ramp, negative ramp, triangular waveforms using DAC interface
10	Driving relay from 18F458 using software and hardware interrupts

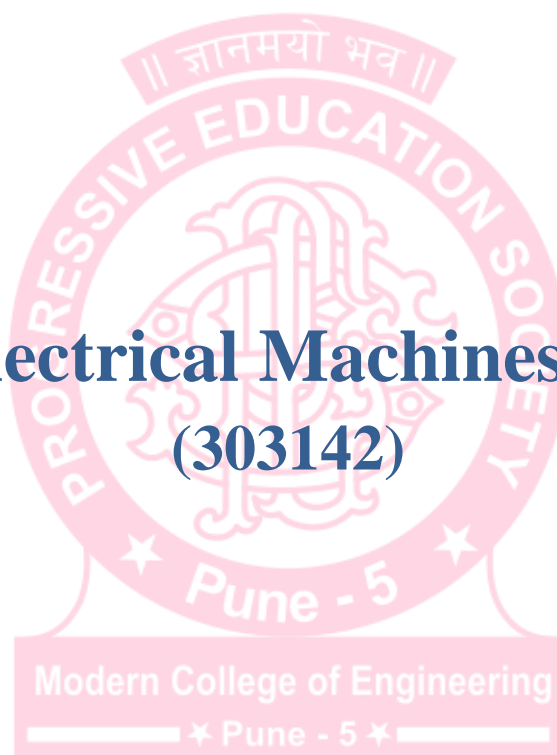




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Electrical Machines II

(303142)





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Name of the Subject – Electrical Machines II

Weekly Work Load(in Hrs)	Lecture	Tutorial	Practical
	04	-	02

Online/ In-sem	Theory	Practical	Oral	Term-work	Total Marks	Credit
30	70	50	-	-	150	

Syllabus:

Unit 01: Three phase Synchronous machines. (08Hrs.)

Three phase Synchronous machines: Construction, rotating-field type and rotating-armature type, salient-pole type and non-salient-pole type and their comparison. Excitation Methods.

Three phase Synchronous generator (cylindrical rotor type): Principle of operation. Emf equation and winding factors, rating of generator. Generator on no-load and on balanced load. Armature reaction and its effect under different load power factors. Voltage drop due to armature resistance, leakage flux and synchronous reactance. Per phase equivalent circuit and Phasor diagram. Power - power angle relation.

Three phase Synchronous generator (salient pole type): Armature reaction as per Blondel's two reaction theory for salient-pole machines, Direct-axis and quadrature-axis synchronous reactance's and their determination by slip test. Phasor diagram of Salient-pole generator and calculation of voltage regulation.

Unit 02: Voltage regulation of Three phase Synchronous generator: (08 Hrs.) Performance of open circuit and short circuit test on synchronous generator, determination of voltage regulation by emf, mmf, and Potier triangle methods. Determination of voltage regulation by direct loading. Short circuit ratio.

Parallel operation of 3-phase alternators: Necessity, conditions, Load sharing between two alternators in parallel. Parallel-Generator theorem. Process of synchronizing alternator with infinite bus-bar by lamp methods and by use of synchroscope. Synchronizing current, power and torque.

Unit 03: Three phase synchronous motor: (08 Hrs.)

Principle of operation. Methods of starting. Equivalent circuit, significance of torque angle, Losses, efficiency and Power flow chart. Operation of 3-phase Synchronous motor with constant excitation and variable load, Operation with constant load and variable excitation ('V' Curves and 'inverted V' curves). Phenomenon of hunting and its remedies. Applications of 3-phase synchronous motors. Introduction to synchronous – induction motor. Comparison of 3 phase synchronous motor with 3-phase induction motor.



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Unit 04: 3-ph induction motor, Induction generator and special purpose motors: (08 Hrs.)

Speed control of three phase induction motor by various methods (Stator side and rotor side controls). Action of 3-phase induction motor as induction generator, applications of induction generator. Introduction to Energy Efficient three phase Induction Motor and Super conducting Generator.

Special Purpose Motors (Descriptive Treatment Only): Construction, principle of working, characteristics ratings and applications of Brushless D.C. motors, Stepper motors (permanent magnet and variable reluctance type only), Permanent Magnet motor (A.C. & D.C.) and linear induction motors.

Unit 05: A.C. series motor (08 Hrs.)

Operation of D.C. series motor on a.c. supply, nature of torque developed, problems associated with AC. operation and remedies.

Plain Series motor: direct and quadrature axis fluxes. Transformer and rotational emfs in the field winding and the armature winding. Approximate Phasor diagram (Ignoring leakage fluxes, magnetizing current and currents in the short-circuited armature coils). Circle diagram, performance characteristics from circle diagram. Drawbacks of plain series motor.

Compensated series motor: Compensating winding, conductively and inductively compensated motor. Use of composites for improving commutation. Ratings and applications of Compensated Series motors.

Universal motors: ratings, performance and applications, comparison of their performance on A.C. and D.C. supply.

Unit 06: Single phase induction motor (08 Hrs.)

Construction of single phase induction motor, double field revolving theory. Equivalent circuit and torque-slip characteristics on the basis of double revolving field theory. Tests to determine the parameters of equivalent circuit and calculation of performance characteristics of motor. Methods of self-starting. Types of single phase induction motors: Split-phase motors (Resistor split-phase motor, Capacitor-start motor, Capacitor start and capacitor run motor and permanent capacitor motor). Shaded pole induction motor: their construction, operation, torque-slip characteristics and applications. Comparison of 1-phase induction motor with 3-phase induction motor.

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Text Books:

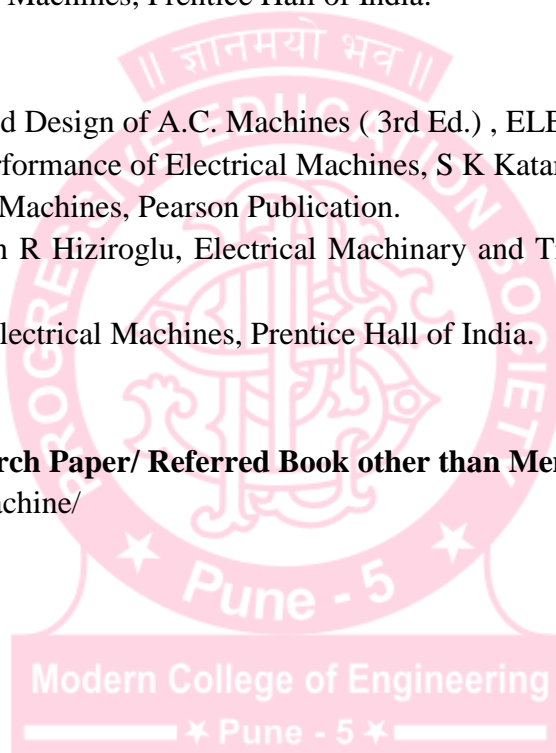
1. Nagrath and Kothari , Electrical Machines , 2nd Ed.,Tata McGraw Hill.
2. S. K. Bhattacharya, Electrical Machines, Tata McGraw Hill.
3. A.S. Langsdorf, Theory of Alternating Current Machinery , Tata McGraw Hill
4. P. S. Bimbhra, Electric Machinery, Khanna Publications.
5. B.R. Gupta and Vandana Singhal -Fundamentals of Electric Machines, New Age International (P) Ltd.
6. E.Openshaw Taylor, Performance and design of a.c. commutator motors, Wheeler Publishing.
7. V. K. Mehta and Rohit Mehta , Principles of Electrical Machines , S Chand Publications.
8. Krishna Reddy –Electrical Machines vol.II and III, SCITECH publications.
9. Ashfaq Husain, Electrical Machines, Dhanpat Rai and Co.
10. M V Deshpande, Electrical Machines, Prentice Hall of India.

References:

1. M.G. Say , Performance and Design of A.C. Machines (3rd Ed.) , ELBS
2. J B Gupta - Theory and performance of Electrical Machines, S K Kataria Publications
3. Samarjit Ghosh, Electrical Machines, Pearson Publication.
4. Bhag S Guru and Huseyin R Hiziroglu, Electrical Machinery and Transformer, 3rd Edition, Oxford University Press.
5. E G Janardanan, Special Electrical Machines, Prentice Hall of India.

Reference Web Links/ Research Paper/ Referred Book other than Mention in Syllabus:

1. www.nptel.in/electricalmachine/





PROGRESSIVE EDUCATION SOCIETY'S
MODERN COLLEGE OF ENGINEERING
DEPARTMENT OF ELECTRICAL ENGINEERING

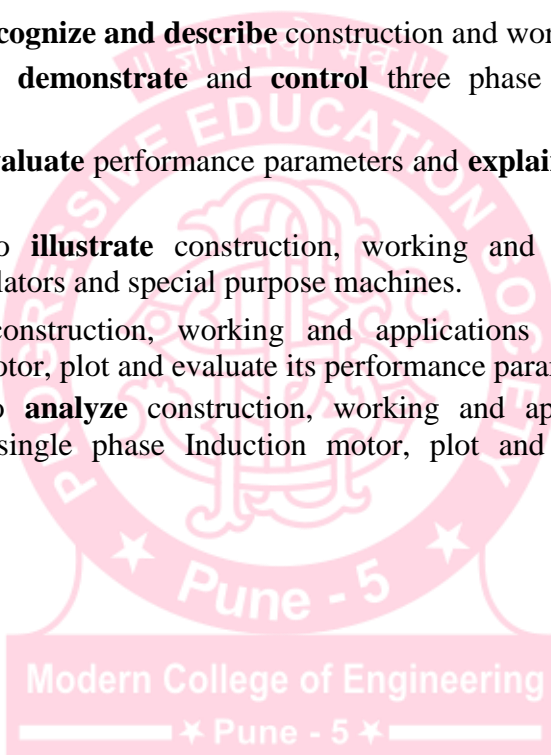
Course Objectives

- Learn construction & working principle of three phase synchronous machines.
- Define regulation of alternator & calculate it by direct and indirect methods.
- Study the methods of starting 3- phase synchronous motor, & its operation under Different conditions.
- Learn Speed control methods of three phase induction motor.
- Develop phasor diagram & circle diagram of a c series motor.
- Develop equivalent circuit of single phase induction motor.

Course Outcomes

After successfully completing the course students will be able to:

1. Students will be able to **recognize and describe** construction and working of alternators.
2. Students will be able to **demonstrate** and **control** three phase alternator under different operating conditions.
3. Students will be able to **evaluate** performance parameters and **explain** working and applications of synchronous motor.
4. Students will be able to **illustrate** construction, working and applications of Induction generators, Induction regulators and special purpose machines.
5. Students will **analyze** construction, working and applications under different operating conditions of a.c. series motor, plot and evaluate its performance parameters
6. Students will be able to **analyze** construction, working and applications under different operating conditions of single phase Induction motor, plot and evaluate its performance parameters.

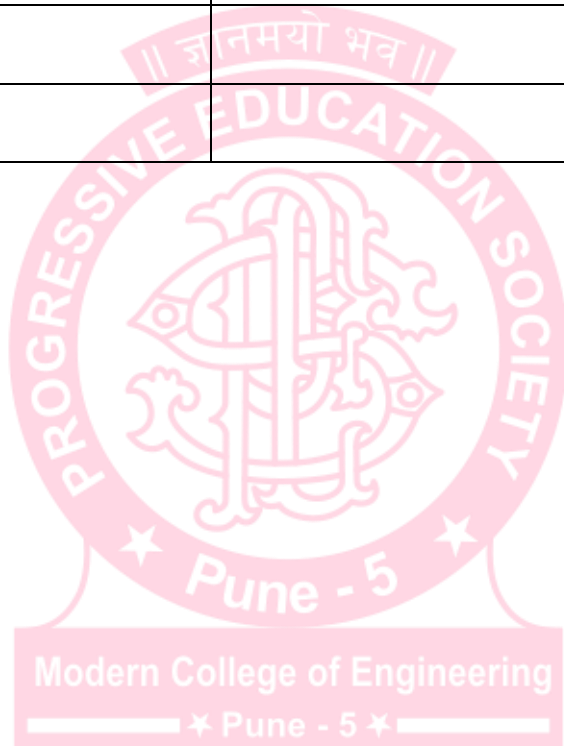




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DEPARTMENT OF ELECTRICAL ENGINEERING

Academic Activity Planner

Units	Unit Test-1 (30)	MCQ Test (30)	MCQ Test-II (30)
I	✓	✓	
II	✓	✓	
III		✓	
IV			✓
V			✓
VI			✓



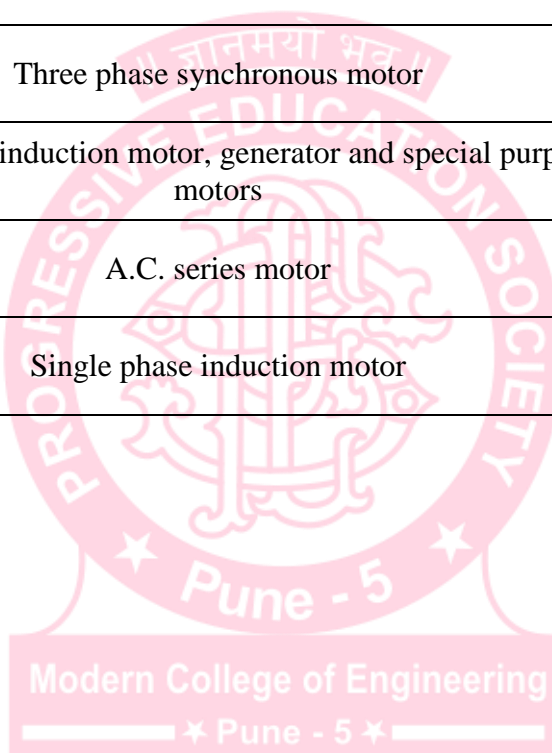


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DEPARTMENT OF ELECTRICAL ENGINEERING

Teaching Plan

Teaching plan as per University Syllabus

Sr. No.	Unit	Broad Topics to be Covered	Total Lecture Planned
1	I	Three phase Synchronous machines	08
2	II	Voltage regulation of Three phase Synchronous generator	08
3	III	Three phase synchronous motor	08
4	IV	Three phase induction motor, generator and special purpose motors	08
5	V	A.C. series motor	08
6	VI	Single phase induction motor	08





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Unit wise Lecture Plan

Unit No.-I: Three phase Synchronous machines

Pre-requisites:

- Basic working principle of machines and its rotating theory

Objective:

- To learn construction & working principle of three phase synchronous machines.

Outcome:

- Students will be able to **recognize and describe** construction and working of alternators.

Lecture No.	Details of the Topic to be covered	References	Mode of Delivery
1	Three phase Synchronous machines: Construction, rotating-field type and rotating-armature type, salient-pole type and non-salient-pole type and their comparison. Damper winding.	T2,T5,T7,R2	Chalk & Talk
2	Three phase Synchronous generator (cylindrical rotor type): Principle of operation. Emf equation.	T2,T5,T7,R2	Chalk & Talk
3	Winding factors, rating of generator	T2,T5,T7,R2	Chalk & Talk
4	Generator on no-load and on balanced load	T2,T5,T7,R2	Chalk & Talk
5	Armature reaction and its effect under different load power factors	T2,T5,T7,R2	Chalk & Talk
6	Voltage drop due to armature resistance, leakage flux and synchronous reactance. Per phase equivalent circuit and phasor diagram	T2,T5,T7,R2	Chalk & Talk
7	Power angle relation. Load characteristics. Losses and efficiency, power-flow chart.	T2,T5,T7,R2	Chalk & Talk
8	Direct-axis and quadrature-axis synchronous reactances and their determination by slip test. Phasor diagram of Salient-pole generator and emf equation.	T2,T5,T7,R2	Chalk & Talk



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Question Bank: Theory

1. Explain the construction of alternator
2. Why a 3-phase synchronous motor will always run at synchronous speed?
3. What are the two classification synchronous machines?
4. What are the advantages of salient pole type of construction used for synchronous machines?
5. Why do cylindrical rotor alternators operate with steam turbines?
6. Which type of synchronous generators are used in Hydroelectric plants and why
7. What is the relation between electrical degree and mechanical degree?
8. Why short-pitch winding is preferred over full pitch winding?
9. What do you mean by synchronous reactance?
10. Derive an expression for synchronizing power





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Unit No.-II: Voltage regulation and Parallel operation of Three phase Synchronous generator

Pre-requisites:

- Basic working principle of machines and its rotating theory

Objectives:

- To understand various methods to determine regulation and efficiency of a.c. machines

Outcomes: After successfully completing this unit students will be able to analyze working, controlling and applications of three phase alternators under different operating conditions.

Lecture No.	Details of the Topic to be covered	References	Mode of delivery
1	Performance of open circuit and short circuit test on synchronous generator	T9,T5,T7,R2,R3	Chalk & Talk
2	determination of bvoltage regulation by emf, mmf methods	T9,T5,T7,R2,R3	Chalk & Talk
3	Potier triangle method	T9,T5,T7,R2,R3	Chalk & Talk
4	Determination of voltage regulation by direct loading. Short circuit ratio	T9,T5,T7,R2,R3	Chalk & Talk
5	Parallel operation of 3-phase alternators: Necessity, conditions,	T9,T5,T7,R2,R3	Chalk & Talk
6	Load sharing between two alternators in parallel, Parallel-Generator theorem.	T9,T5,T7,R2,R3	Chalk & Talk
7	Process of synchronizing alternator with infinite bus-bar by lamp methods and by use of synchroscope	T9,T5,T7,R2,R3	Chalk & Talk
8	Synchronizing torque, power and current.		Chalk & Talk

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Question Bank: Theory

1. Explain any one method of predetermining the regulation of an alternator.
2. Explain why the potier reactance is slightly higher than leakages reactance.
3. Explain dark lamp method of synchronizing an alternator with the bus bar.
4. Explain Blondel's two-reaction theory,
5. Explain how will you determine the d and q axes reactance of a synchronous machine in your laboratory.
6. Derive an expression for synchronizing power
7. Explain synchronous impedance method
8. Explain AT method
9. Explain synchronization of 3 phase alternator
10. Explain Potier triangle method





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Unit No.-III: Three phase synchronous motor

Pre-requisites :-

- Basic working principle of machines and its rotating theory

Objectives :-

- To understand construction and working of synchronous machines
- To study various speed control methods of a.c. motors.
- To impart various applications of a.c. motors.

Outcomes:- After successfully completing this unit students will be able to:

- Students will evaluate performance parameters, working and applications of synchronous motor.

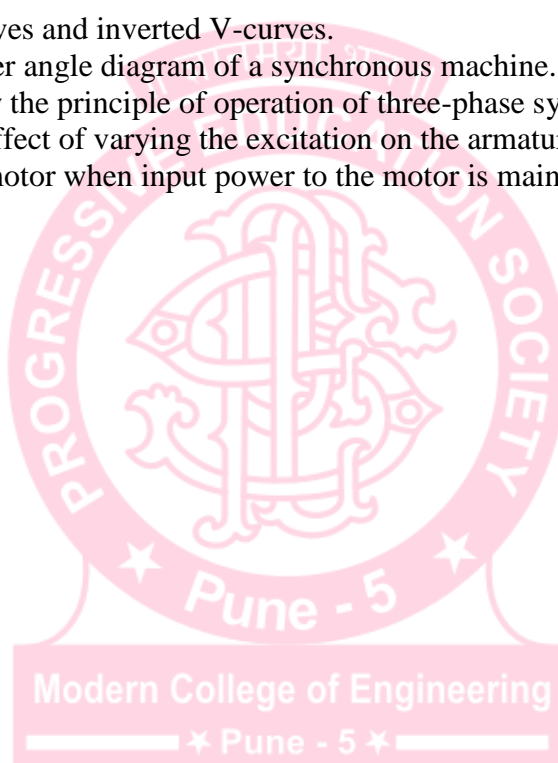
Lecture No.	Details of the Topic to be covered	References	Mode of Delivery
1	Principle of operation. Methods of starting	T9,T2,T7,T4,R2	Chalk & Talk
2	Pull-in and pull-out torques. Equivalent circuit	T9,T2,T7,T4,R2	Chalk & Talk
3	significance of torque angle and torque equation. Losses, efficiency and Power flow chart	T9,T2,T7,T4,R2	Chalk & Talk
4	Operation of 3-phase Synchronous motor with constant excitation and variable load. Operation with constant load and variable excitation ('V' Curves and 'inverted V' curves)	T9,T2,T7,T4,R2	Chalk & Talk
5	Phenomenon of hunting and its remedies	T9,T2,T7,T4,R2	Chalk & Talk
6	Applications of 3-ph synchronous motors. Introduction to synchronous – induction motor.	T9,T2,T7,T4,R2	Chalk & Talk
7	Comparison of 3 ph synchronous motor with 3-phase induction motor & Numericals	T9,T2,T7,T4,R2	Chalk & Talk
8	Rubrics		



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Question Bank: Theory

1. Explain why a synchronous motor does not have starting torque.
2. Explain one method of starting a synchronous motor.
3. Why does the power factor of industrial installation tend to be low? How can it be improved?
4. Does the change in excitation affect the p.f of the synchronous motor?
5. An over excited synchronous motor is called a synchronous condenser. Explain.
6. Mention some specific applications of synchronous motor.
7. Explain what happens when the load on a synchronous motor is changed.
8. What is meant by constant power circle for synchronous motor?
9. What is meant by hunting in a synchronous motor? Why is it undesirable? What is done to minimize it?
10. Explain V-curves and inverted V-curves.
11. Draw the power angle diagram of a synchronous machine.
12. Explain briefly the principle of operation of three-phase synchronous motor.
13. Describe the effect of varying the excitation on the armature current and power factor of a synchronous motor when input power to the motor is maintained constant





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Unit No.-IV: Three phase induction motor, generator and special motors

Pre-requisites:-

- Basic working principle of machines and its rotating theory

Objectives:-

- To study various speed control methods of a.c. motors.
- To impart various applications of a.c. motors/Special motors.

Outcomes:- After successfully completing this unit students will be able to:
recognize, construction, working and applications of Induction generators, Induction regulators
and special purpose machines.

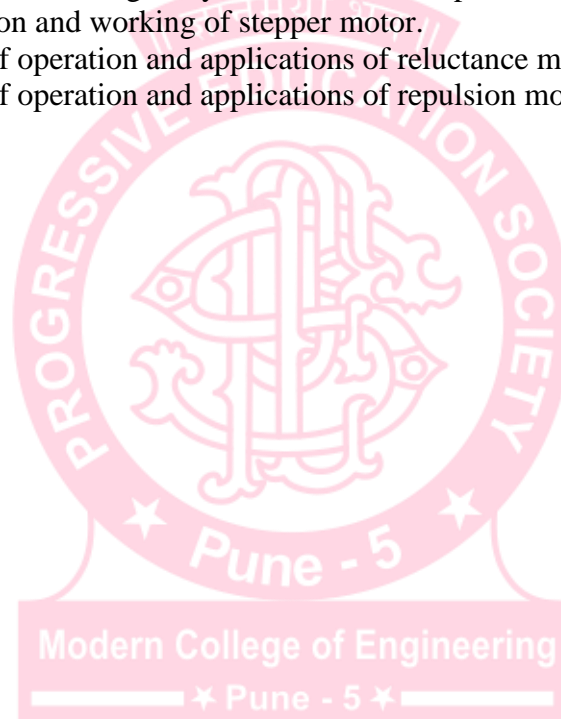
Lecture No.	Details of the Topic to be covered	References	Mode of Delivery
1	Speed control of three phase induction motor by various methods (Stator side and rotor side controls).	T2,T4,T7,T5,R3	Chalk & Talk
2	Action of 3-phase induction motor as induction generator, applications as induction generator	T2,T4,T7,T5,R3	Chalk & Talk
3	Single phase and three phase Induction voltage regulator: construction, principle of working and applications.	T2,T4,T7,T5,R3	PPT
4	Construction, principle of working, characteristics, ratings and applications of Brushless d.c. motors	T2,T4,T7,T5,R3	PPT
5	Stepper motors (only permanent and variable reluctance type),	T2,T4,T7,T5,R3	Chalk & Talk
6	Permanent Magnet motor and linear induction motors	T2,T4,T7,T5,R3	PPT
7	Rubrics		



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Question Bank: Theory

1. Develop the equivalent circuit for 3-phase induction motor?
2. Explain the different speed control methods of squirrel cage induction motor.
3. Describe the principle of operation of synchronous induction motor.
4. Explain any one method of speed control of three- phase induction motor
5. Draw the slip-torque characteristics for a three-phase induction motor and explain.
6. Explain how a rotating magnetic field is produced in a three-phase induction motor.
7. Draw and explain the equivalent circuit of a three-phase induction motor. Apr: 2000
8. Describe with a neat diagram, the principle of operation of induction generator Oct: 2000
9. Draw and explain the torque/slip curves of a three-phase induction motor for different values of rotor resistance. Oct: 2000
10. Starting from the first principles, develop the equivalent circuit of a 3- phase induction motor.
11. What is the principle and working of hysteresis motor? Explain briefly.
12. Explain the construction and working of stepper motor.
13. Explain the principle of operation and applications of reluctance motor.
14. Explain the principle of operation and applications of repulsion motor and hysteresis motor.





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Unit No.-V: A.C. series motor

Pre-requisites:-

- Construction working of DC series motor

Objectives:-

- To study various speed control methods of a.c. motors.
- To impart various applications of a.c. motors.

Outcomes:- After successfully completing this unit students will be able to:
 analyze construction, working and operation and applications under different operating conditions of a.c. series motor, plot and evaluate its performance parameters.

Lecture No.	Details of the Topic to be covered	References	Mode of delivery
1	Operation of d.c. series motor on a.c. supply, nature of torque developed, problems associated with a.c. operation and remedies.	T1,T2,T4,T7,R2	Chalk & Talk
2	Plain Series motor: direct and quadrature axis fluxes. Transformer and rotational emfs in the field winding and the armature winding.	T1,T2,T4,T7,R2	Chalk & Talk
3	Approximate phasor diagram (Ignoring leakage fluxes, magnetising current and currents in the short-circuited armature coils)	T1,T2,T4,T7,R2	PPT
4	Circle diagram, performance characteristics from circle diagram. Drawbacks of plain series motor	T1,T2,T4,T7,R2	PPT
5	Compensated series motor: Compensating winding, conductively and inductively compensated motor. Use of composites for improving commutation	T1,T2,T4,T7,R2	Chalk & Talk
6	Ratings and applications of Compensated Series motors. Universal motors: ratings, performance and applications, comparison of their performance on a.c. and d.c. supply	T1,T2,T4,T7,R2	PPT
7	Rubrics		



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Question Bank: Theory

1. How is the speed control affected in a 3-phase AC series commutator motor?
2. 3-phase ac series commutator motor does not need any protection against excessive speed. Why?
3. How is the speed control affected in a 3-phase AC shunt commutator motor?
4. What is a universal motor?
5. Why should a motor be named as universal motor?
6. What is the principle of operation of universal motor?
7. What is the necessity of having laminated yoke in an ac series motor?
8. Why compensating winding is provided in a universal motor for ac operation?
9. How speed variation is affected in a repulsion motor?
10. What are the specific characteristics of repulsion motor?





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Unit No.-VI: Single phase induction motor

Pre-requisites:-

- Basic working principle of machines and its rotating theory

Objectives: -

- To study various speed control methods of a.c. motors.
- To impart various applications of a.c. motors.

Outcomes:- After successfully completing this unit, students will be able to: analyze construction, working and operation and applications under different operating conditions of single phase Induction motor, plot and evaluate its performance parameters.

Lecture No.	Details of the Topic to be covered	References	Mode of Delivery
1	Construction of single phase induction motor, mmf produced by single phase stator winding carrying an alternating current	T1,T2,T9,T7,R2	Chalk & Talk
2	Its representation by two revolving fields. Equivalent circuit and torque-slip characteristics on the basis of double revolving field theory	T1,T2,T9,T7,R2	Chalk & Talk
3	Tests to determine the parameters of equivalent circuit and calculation of performance characteristics of motor	T1,T2,T9,T7,R2	PPT
4	Methods of self-starting. Types of single phase induction motors: Split-phase motors (Resistor split-phase motor	T1,T2,T9,T7,R2	PPT
5	Capacitor-start motor, Capacitor start and run motor and permanent capacitor). Shaded pole induction motor – their construction	T1,T2,T9,T7,R2	Chalk & Talk
6	operation, torque-slip characteristics and applications. Comparison of 1-phase induction motor with 3-phase induction motor	T1,T2,T9,T7,R2	PPT
7	Rubrics		



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Question Bank: Theory

1. Give the classification of single phase motors .Explain any two types of single phase induction motors.
2. Explain the double field revolving theory for operation of single phase
3. induction motor.
4. Explain the operation of shaded pole induction motor with diagram.
5. Develop equivalent circuit of a single phase induction motor ignoring core losses.
6. Explain the working principle of single phase induction motor .Mention its four applications.
7. Explain CSCR motor with circuit dig
8. Compare single phase and three phase IM
9. Explain the methods of self starting of single phase IM



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Practical Assessment

List of Experiments

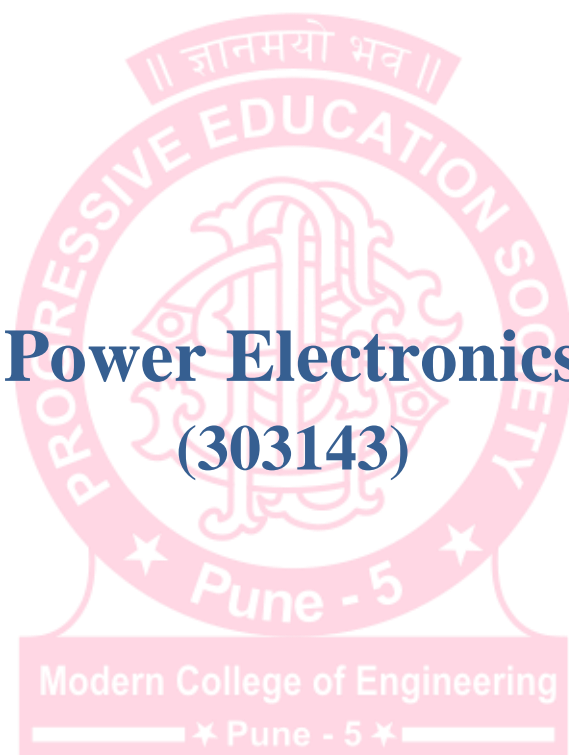
Sr.No.	Name of the Practical
1	Regulation of cylindrical rotor alternator by EMF and MMF method.
2	Regulation of cylindrical rotor alternator by direct loading method.
3	Regulation of cylindrical rotor alternator by potier triangle method.
4	Regulation of salient pole alternator by slip test.
5	V and inverted V curve of synchronous motor.
6	V/F method of speed control of 3 phase Induction Motor.
7	Load test on a.c. series motor
8	Load test on single phase CSCR Induction Motor
9	No load and blocked rotor test on single phase CSCR Induction Motor.

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Power Electronics
(303143)





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Name of the Subject –Power Electronics

Weekly Work Load(in Hrs)	Lecture	Tutorial	Practical
	04	02	02

Online/ In-sem	Theory	Practical	Oral	Term-work	Total Marks	Credit
30	70	50	-	-	150	-

Syllabus:

Prerequisite:

- Knowledge of semiconductor material, basic electronics, diode, BJT and its characteristics
- Working of Diode Rectifier, concept of rms and average value
- Use square notebooks for notes and plotting waveforms

Objectives: To enable students to gain knowledge and understanding in the following aspects:

- Fundamentals of power electronic devices and characteristics.
- The concepts and operating principles of power electronics circuits.
- Design procedures and techniques of power electronics systems.

Unit 01: Silicon Controlled Rectifier (08 hrs)

Construction, Static and dynamic Characteristics, specifications/rating of SCR Triggering Circuits (R, R-C, UJT), Commutation Circuits (class C&D), Protection (over voltage, over current, and Thermal), Gate Turn Off(GTO) Thyristor (Construction, Working and Application).

Unit 02: Transistor based Devices and DC-DC converter

Transistor based Devices: MOSFET, IGBT, Construction, working, Static and Dynamic Characteristics, specifications, safe operating area, Latching of IGBT.

DC-DC converter: Principle of operation of chopper, classification on the basis of Operating quadrants (A,B,C,D,E), Control techniques: CLC, TRC, PWM and FM Techniques. Analysis of Step up Chopper and Numerical with RLE load. Necessity of input filter, Areas of application, Buck Boost Chopper (Descriptive Treatment).

Unit 04:

Transistor based Devices: MOSFET, IGBT, Construction, working, transfer and VI characteristic, specifications, safe operating area, MCT construction and VI characteristics.

DC-DC converter: Principle of operation of chopper, classification on the basis of Operating quadrants. Control techniques: CLC, TRC, PWM and FM Techniques. Analysis of Step up Chopper and Numerical with RLE load. Necessity of input filter, Areas of application.



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Unit 05: Single phase DC-AC Inverter (08 hrs)
(Transistor based)

Half bridge voltage source inverter, full bridge VSI derivation of output voltage and current, current source inverter, Numerical. **PWM techniques:** Single pulse, multiple pulse and sinusoidal pulse modulation with Fourier analysis.

Unit 06: Three phase DC-AC Inverter (08 hrs)
(Transistor based)

Three phase VSI using 1200 and 1800 mode and comparison, PWM based CSI and VSI, voltage control and harmonic elimination techniques, Multilevel inverter concept, cascaded multilevel inverter, comparison of multilevel converters with multi-pulse inverter.

List of Experiments:

Group A: Perform any THREE experiments (Hardware)

1. Static VI characteristic of SCR and TRIAC (Both)
2. Single phase fully controlled converter with R and RL load
3. Single phase A.C. voltage regulator
4. Static VI characteristic of GTO

Group B: Perform any THREE experiments (Hardware)

1. VI Characteristic of MOSFET and IGBT (Both)
2. DC step down chopper
3. 1- phase full bridge type PWM based VSI using transistor devices
4. 3-phase full bridge type PWM based VSI using transistor devices

Group C: Perform any THREE experiments (Hardware/Software)

1. Three phase AC-DC fully controlled bridge converter
2. Three phase voltage source inverter using 1200 and 1800 mode
3. Study of cascaded type multilevel inverter
4. Harmonic analysis of three phase VSI inverter with different PWM techniques.
5. Single phase half controlled converter with R and RL load
6. Design of snubber circuit and verification using simulation



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Text Books:

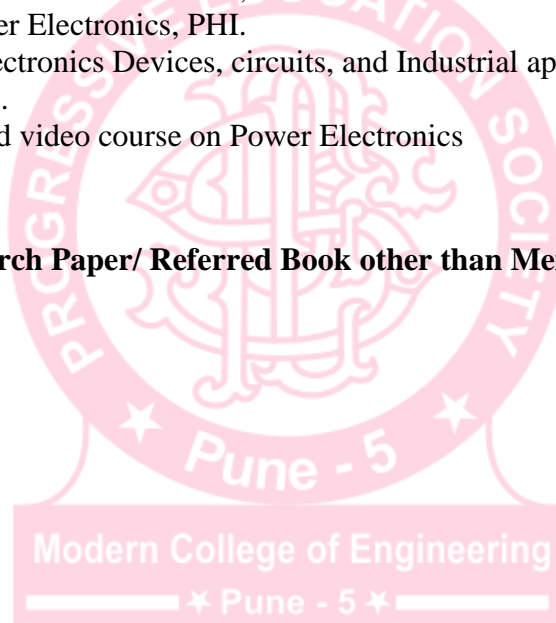
1. M.H.Rashid - Power Electronics 2nd Edition, Pearson publication
2. Ned Mohan, T.M. Undeland, W.P. Robbins - Power Electronics, 3rd Edition, John Wiley and Sons
3. B.W. Williams: Power Electronics 2nd edition, John Wiley and sons
4. Ashfaq Ahmed- Power Electronics for Technology, LPE Pearson Edition.
5. Dr. P.S. Bimbhra, Power Electronics, Third Edition, Khanna Publication.
6. K. Hari Babu, Power Electronics , Scitech Publication.

References:

1. Vedam Subramanyam - Power Electronics , New Age International , New Delhi
2. Dubey, Donald, Joshi, Sinha, Thyristorised Power controllers, Wiley Eastern New Delhi.
3. M. D. Singh and K. B. Khandchandani, Power Electronics, Tata McGraw Hill
4. Jai P. Agrawal, Power Electronics systems theory and design LPE, Pearson Education, Asia.
5. L. Umanand, Power Electronics – Essentials and Applications Wiley Publication.
6. J. Michael Jacob – Power Electronics Principal and Applications.
7. M.H.Rashid - Power Electronics Handbook, Butterworth-Heinemann publication, 3 edition
8. M.S. Jamil Asghar, Power Electronics, PHI.
9. V.R. Moorthi, Power Electronics Devices, circuits, and Industrial applications, Oxford University Press.
10. NPTEL Web course and video course on Power Electronics

Reference Web Links/ Research Paper/ Referred Book other than Mention in Syllabus:

1. www.nptel.co.in
2. www.electrical4u.com





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Course Objectives

- Fundamentals of power electronic devices and characteristics.
- The concepts and operating principles of power electronics circuits.
- Design procedures and techniques of power electronics systems.

Course Outcomes

After successfully completing the course students will be able to:

1. Understand the fundamental principles and applications of power electronics circuits in ac and dc drives, energy conservation, renewable energy, transportation etc.
2. Solve problems and design switching regulators according to specifications
3. Use Computer-aided techniques for the design of power converter circuits
4. Appreciate the latest developments in power electronics.
5. Communicate effectively, think critically and creatively.
6. Assimilate new technological development in related field

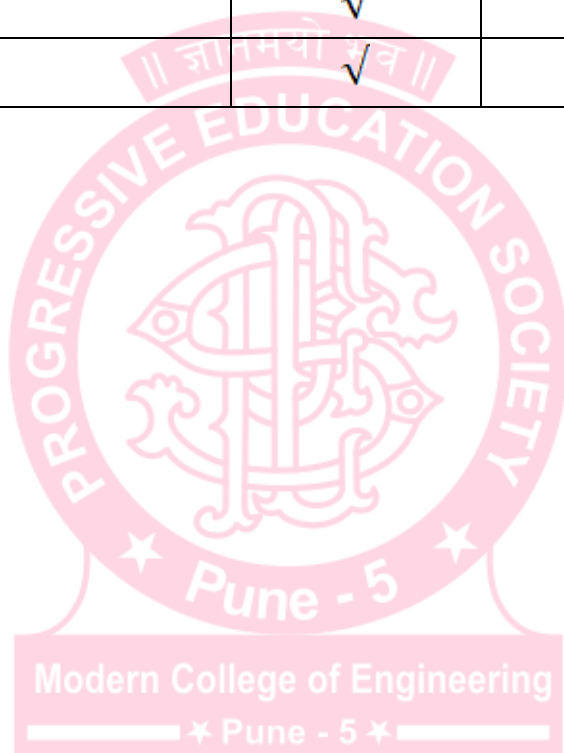




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Academic Activity Planner

Unit	Unit Test1 (15marks)	Unit Test2 (20marks)	MCQ (20marks)	Tutorial (Each 20 marks)	Unit Test3 (70marks)
I	✓		✓	✓	✓
II		✓	✓	✓	✓
III		✓	✓	✓	✓
IV			✓	✓	✓
V			✓	✓	✓
VI			✓	✓	✓



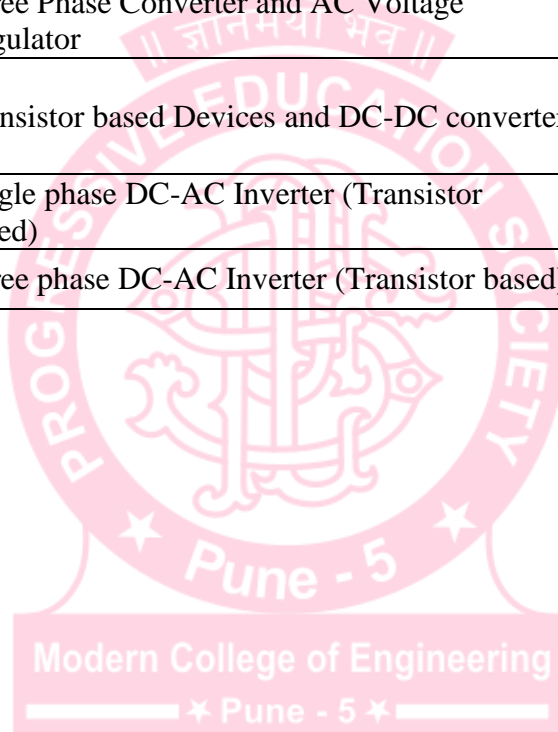


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Teaching Plan

Teaching plan as per University Syllabus

Sr.No.	Unit	Broad Topics to be Covered	Total Lecture Planned
1	I	Silicon Controlled Rectifier	08
2	II	Single Phase AC-DC Converter	08
3	III	Three Phase Converter and AC Voltage Regulator	08
4	IV	Transistor based Devices and DC-DC converter	08
5	V	Single phase DC-AC Inverter (Transistor based)	08
6	VI	Three phase DC-AC Inverter (Transistor based)	08





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Unit wise Lecture Plan
Unit No.-I: Silicon Controlled Rectifier

Pre-requisites:-

- Knowledge of semiconductor material, basic electronics, diode, BJT and its characteristics
- Working of diode Rectifier

Objectives :-

- To understand construction, working principle and static and dynamic characteristics of SCR
- To study turn on methods of SCR and different protection circuits of SCRtenance strategies.
- To understand construction, working principle and characteristics of GTO.

Outcomes :

Students will be able to

- Diffrentiate between working of diode bridge rectifier and SCR
- Design gate triggering circuits of SCR at low rating.

Lecture No.	Details of the Topic to be covered	References	Mode of Delivery
1	Importance and significance of power electronics subject, its use in electrical and multidisciplinary areas, Discussions about course objectives and course outcomes	T1,T4,T5,T6	PPT
2	Construction , working principle and static VI characteristics of SCR	T1,T4,T5,T6	Chalk and Talk
3	Dynamic Characteristics(Turn on and turn off)	T1,T4,T5,T6	Chalk and Talk
4	Gate Characteristics, Triggering Circuits (R, R-C, UJT)	T1,T4,T5,T6	Chalk and Talk
5	specifications/rating of SCR	T1,T4,T5,T6	Chalk and Talk
6	Protection (over voltage, over current, and Thermal) of SCR	T1,T4,T5,T6	Chalk and Talk
7	GTO continued and difference between SCR and GTO	T1,T4,T5,T6	Chalk and Talk
8	Commutation Circuits (class C&D),	T1,T4,T5,T6	Chalk and Talk

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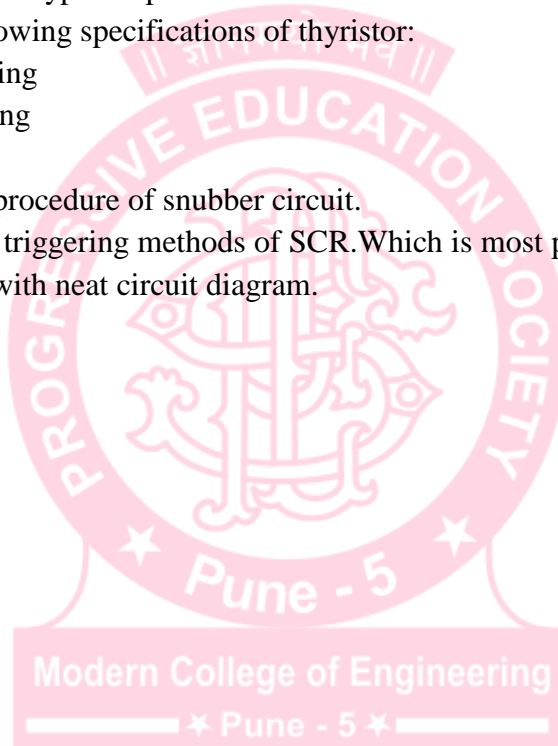


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Question Bank: Theory

Unit :I

- Q. 1 Explain construction, working and static VI characteristics of SCR. Discuss holding and latching current of SCR.
- Q.2 Explain dynamic characteristics of SCR in terms of turn on and turn off time.
- Q.3 Why is reverse breakdown voltage greater than the forward breakdown voltage in SCR?
- Q.4 Explain Class C and Class D commutation in SCR.
- Q.5 Explain construction, working and static and dynamic VI characteristics of GTO. Compare GTO with SCR
- Q.6 What are the applications of SCR. Explain one of them in detail
- Q.7 What are different types of protection circuits of SCR.
- Q.8 Explain the following specifications of thyristor:
- 1) dv/dt rating
 - 2) di/dt rating
 - 3) I_{Tt} rating
- Q.9 Explain design procedure of snubber circuit.
- Q.10 Explain various triggering methods of SCR. Which is most preferred? Explain UJT triggering with neat circuit diagram.





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Unit No.-II: Transistor based Devices and DC-DC converter

Pre-requisites:-

- Basic knowledge of Different types of Transistors
- Basic concept of DC-DC converters.

Objectives:-

- To learn construction and working of MOSFET, IGBT and also get the knowledge of principle of operation of Choppers.

Outcomes:- After successfully completing this unit students will be able to:
Understand the working of Transistors and also Analyze Step up Chopper.

Lecture No.	Details of the Topic to be covered	References	Mode of Delivery
1	Transistor based Devices: MOSFET, IGBT, Construction, working	T1,T4,T5	Chalk & Talk
2	transfer and VI characteristic, specifications, safe operating area,	T1,T4,T5	Chalk & Talk
3	Construction and VI characteristics of MCT.	T1,T2,T4,T5	Chalk & Talk
4	DC-DC converter: Principle of operation of chopper,	T1,T4,T5	Chalk & Talk
5	classification of chopperd on the basis of Operating quadrants.	T1,T4,T5	Chalk & Talk
6	Control techniques of chopper: CLC, TRC, PWM and FM Techniques..	T1,T4,T5	Chalk & Talk
7	Analysis of Step up Chopper and Numerical with RLE load.	T1,T4,T5	Chalk & Talk
8	Necessity of input filter, Areas of application	T1,T4,T5	Chalk & Talk



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Question Bank: Theory
Unit No.-II

1. What are the differences between MOSFET & IGBT?
2. With a neat diagram explain switching action of power MOSFET.
3. Explain transfer and output characteristics of MOSFET?
4. Explain transfer and output characteristics of IGBT?
5. Explain switching characteristics of IGBT and compare MOSFET and IGBT.
6. Explain the principle of operation of step down chopper?
7. Explain how choppers are classified? Draw neat circuit diagram and explain the working of class C chopper feeding a motor load.
8. Explain working of class E chopper feeding a motor load with the help of a circuit diagram.
9. Explain the Control techniques: CLC & TRC?
10. In a step up chopper applied voltage is 200 V and output voltage is 600 V. If conducting time of a thyristor is 200 μ sec, compute:
 - a) Chopper frequency
 - b) Find output voltage for when pulse width is half for constant frequency operation.
11. A step up chopper has a supply voltage of 250 V while the output voltage is 400 V. If the total time period of chopper is 100 μ sec, determine,
 - a) Pulse width of the output voltage
 - b) If the pulse width is reduced to 1/3 for constant frequency operation find the output voltage

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Unit No.-III: Single Phase AC TO DC Converter

Pre-requisites:-

- Basic concepts of SCR covered in Unit I

Objectives:-

- **To study** AC to DC conversion with SCR
- **To understand** working and waveforms and derivations of half and full wave converter with R and R-L load
- **To understand** working and waveforms and derivations of half and full wave controlled converter with R, R-L load
- **To study** the concept of an overlap angle and working single phase dual converter with R and R-L load.

Outcomes:-

Students will be able to:

- Differentiate between working of half and full wave converter with half and full wave controlled converter for R,R-L load.

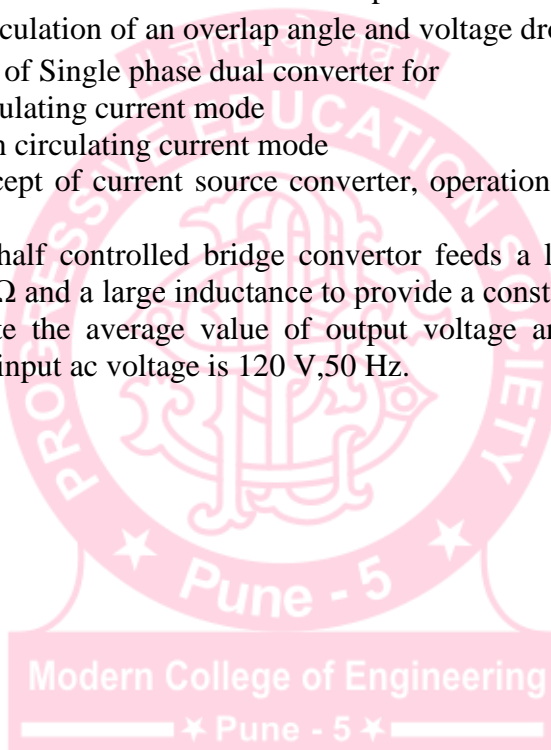
Lecture No.	Details of the Topic to be covered	References	Mode of Delivery
1	Classification of Converters, Single phase Converter: Diagram, working operation and waveforms of Half wave converter, Mid-point converter,. Numerical based on output voltage and current calculations,	T1,T4,T5,T6	Chalk & Talk
2	Construction Half controlled converter (Semicoverter) with R, RL and RLE load, derivation of Average and RMS output voltage, power factor, THD, TUF	T1,T4,T5,T6	Chalk & Talk
3	Fully controlled converter (rectification and inversion mode), with R, RL and RLE load, derivation of Average and RMS output voltage, power factor, THD, TUF	T1,T4,T5,T6	Chalk & Talk
4	Effect of source inductance on operation of converter, Concept of overlap angle and voltage drop calculation.	T1,T4,T5,T6	Chalk & Talk
5	Single phase dual converter (Descriptive treatment only),	T1,T4,T5,T6	Chalk & Talk
6	Current source converter: Concept of current source converter, operation with and without overlap angle (Descriptive treatment only)	T1,T4,T5,T6	Chalk & Talk
7	Numericals based on Half controlled and full controlled converters, Calculations of an overlap angle and voltage drop calculations	T1,T4,T5,T6	Chalk & Talk
8	Numericals based on Half controlled and full controlled converters, Calculations of an overlap angle and voltage drop calculations	T1,T4,T5,T6	Chalk & Talk



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Question Bank: Theory
Unit III

- Q. 1 Write the classification of AC-DC power conversion using SCR
- Q.2 Explain working of single phase half wave converter with R and R-L load. Derive expressions for V_L
- Q.3 Explain working of single phase mid point converter with R and R-L load. Derive expressions for V_L
- Q.4 Explain working of single phase half controlled (semi converter) with R and R-L load
- Q.5 Explain working of single phase full controlled converter with R, R-L load
- Q.6 Explain the effect of source inductance on operation on converter. Derive an expression of calculation of an overlap angle and voltage drop
- Q.7 Explain working of Single phase dual converter for
1. With circulating current mode
 2. With non circulating current mode
- Q.8 Explain the concept of current source converter, operation with and without overlap angle
- Q.9 A single phase half controlled bridge convertor feeds a load comprising a resistance of 10Ω and a large inductance to provide a constant and ripple free current. Calculate the average value of output voltage and current. Firing angle is 45° and input ac voltage is 120 V, 50 Hz.





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Unit No.-IV: Three phase converters and AC voltage regulators

Pre-requisites :-

- Concept of working of single phase converter with R,R-L load

Objectives :-

- To understand working of three phase semi and full converter with R,R-L load
- To study single phase and two stage converter.

Outcomes:-

Students will be able to:

- **Design** small rating AC voltage regulators for simple applications

Lecture No.	Details of the Topic to be covered	References	Mode of Delivery
1	Drawbacks of single phase converter and advantages of Three phase converter over single phase converter, Three phase half and full wave converter with R and R-L load ,	T1,T4,T5,T6	Chalk & Talk
2	Half controlled converter (Semicoverter), Operation of all converters with R, RL and RLE load, derivation of Average and RMS output voltage, power factor, THD, TUF.	T1,T4,T5,T6	Chalk & Talk
3	Fully controlled converter, rectification and inversion mode with R, RL and RLE load, derivation of Average and RMS output voltage, power factor, THD, TUF.	T1,T4,T5,T6	Chalk & Talk
4	Numericals based on output voltage and current calculations of three phase half and full controlled converter	T1,T4,T5,T6	Chalk & Talk
5	Numericals based on output voltage and current calculations of three phase half and full controlled converter	T1,T4,T5,T6	Chalk & Talk
6	AC voltage regulator: DIAC, TRIAC- four mode operation, triggering of TRIAC using DIAC;	T1,T4,T5,T6	Chalk & Talk
7	Single phase AC Voltage regulator principle with R and RL Load, derivation of Average and RMS output voltage,	T1,T4,T5,T6	Chalk & Talk
8	Concept of two stage AC voltage regulator, Three phase A.C. voltage regulator (Descriptive)	T1,T4,T5,T6	Chalk & Talk



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Question Bank: Theory

Unit 4

- Q. 1 Explain advantages of Three phase converter over single phase converter, Discuss working of Three phase half and full wave converter with firing angle of 30° with R and R-L load. Derive an expressions for $V_L(\text{rms})$ and $I_L(\text{rms})$.
- Q.2 Explain three phase half controlled converter (Semicoverter) with R, RL and RLE load and derive Average and RMS output voltage, power factor, THD, TUF.
- Q.3 Explain three phase Fully controlled converter, rectification and inversion mode with R, RL and RLE load and derive Average and RMS output voltage, power factor, THD, TUF.
- Q.4 State and explain effect of source inductance on performance of convertor.
- Q.5 A three phase half wave controlled convertor is fed from 3 phase 440 V 50Hz source and is connected to resistive load of $10\ \Omega$ per phase. Calculate the average value of load voltage and current for a firing angle of 30° and 60°
- Q.6 What is AC voltage regulator. Explain construction, working ,characteristic and applications of DIAC
- Q.7 Explain construction, four mode operations ,characteristic and applications of TRIAC
- Q.8 Discuss Single phase AC Voltage regulator principle with R and RL Load, Derive Average and RMS output voltage and draw its waveforms



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Unit No.-V: Single phase DC-AC Convertor (Transistor based)

Pre-requisites:- Basic Principle of operation of DC-AC converters

Objectives:-

- To learn the switching techniques for inverters and the type of inverters.
- To study the operation of inverters.

Outcomes:- After successfully completing this unit students will be able to:
Derive output voltage and current equations for VSI and CSI.

Lecture No.	Details of the Topic to be covered	References	Mode of Delivery
1	Half bridge voltage source inverter	T1,T2,T5	Chalk & Talk
2	Full bridge VSI derivation of output voltage and current,	T1,T2,T5	Chalk & Talk
3	Full bridge VSI derivation of output voltage and current,	T1,T2,T5	Chalk & Talk
4	Current source inverter	T1,T2,T5	Chalk & Talk
5	NumericalS.	T1, T5	Chalk & Talk
6	NumericalS.	T1, T5	Chalk & Talk
7	PWM techniques: Single pulse, multiple pulse	T1,T2,T5	Chalk & Talk
8	PWM techniques:sinusoidal pulse modulation with Fourier analysis.	T1,T2,T5	Chalk & Talk



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Question Bank: Theory
Unit No.-V

1. Explain the principle of operation of an inverter?
2. What are the differences between half bridge & full bridge inverters?
3. Derive the output voltage equation for half bridge inverter?
4. Derive the output voltage equation for full bridge inverter with R-L load.
5. Explain with circuit diagram and waveforms operation of single phase current source inverter.
6. Explain single pulse, multiple pulse and sinusoidal pulse width modulation techniques?
7. Compare between VSI and CSI.





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Unit No.-VI: Three phase DC-AC Inverter (Transistor based)

Pre-requisites:-

Basic concepts of three phase converters and harmonics in it.

Objectives: -

- To learn the modes of operation of three phase inverters.
- To acquire knowledge multilevel inverters.

Outcomes:- After successfully completing this unit, students will be able to:

- Compare the 120° and 180° modes of operation of three phase inverters.
- Analyse the multilevel inverters.

Lecture No.	Details of the Topic to be covered	References	Mode of Delivery
1	Three phase VSI using 120° mode of conduction	T1,T4,T5	Chalk & Talk, PPT
2	Three phase VSI using 180° mode of conduction and comparison of both modes	T1,T4,T5	Chalk & Talk, PPT
3	PWM based CSI	T1,T4,T5	Chalk & Talk
4	PWM based VSI	T1,T4,T5	Chalk & Talk
5	voltage control and harmonic elimination techniques,	T1,T4,T5	Chalk & Talk
6	Multilevel inverter concept, cascaded multilevel inverter	T1,T4,T5	Chalk & Talk, PPT
7	comparison of multilevel converters with multi-pulse inverter.	T1,T4,T5	Chalk & Talk
8	PWM based CSI	T1,T4,T5	Chalk & Talk, PPT



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Question Bank: Theory

1. Explain 120° mode of operation of three phase inverter with waveforms?
2. Explain 180° mode of operation of three phase inverter with waveforms?
3. Explain phase Displacement Control.
4. Explain harmonics elimination in three phase inverter?
5. Explain the concept of multilevel inverter ?
6. Compare multilevel inverter with multipulse inverter?



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Practical Assessment
List of Experiments

Sr.No.	Name of the Practical
1	Group A : Hardware Experiments (Any Six) 1. Static VI characteristic of SCR /GTO 2.Static VI characteristic of TRIAC 3. Single phase Half controlled converter with R and RL load 4. Single phase fully controlled converter with R load. 5. Single Phase fully controlled converter with and without Free Wheeling diode with RL load 6. Single phase A.C. voltage regulator with R load 7.Study of DC step down chopper 8. Output and Transfer Characteristic of MOSFET and IGBT (Both) 9. Three phase voltage source converter using 120^0 and 180^0 mode
2	Group B: Perform any THREE experiments based on Software 1. Three phase AC-DC fully controlled bridge converter R and RL load 2. Three phase voltage source inverter using 120^0 and 180^0 mode 3. Study of DC step down chopper 4. Single phase A.C. voltage regulator R and RL load 5. Study and Design of single phase VSC 6. Design of snubber circuit and verification using simulation

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Electrical Installation, Maintenance and Testing (303144)





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Name of the Subject –Electrical Installation, Maintenance and Testing.

Weekly Work Load(in Hrs)	Lecture	Tutorial	Practical
	03	-	02

Online/ In-sem	Theory	Practical	Oral	Term-work	Total Marks	Credit
30	70	-	-	50	150	

Syllabus

Unit 01: Distribution Systems: (06 Hrs.)

Classification of supply systems (State Only)

(i) DC, 2-wire system, (ii) Single phase two wire ac system, (iii) Three phase three wire ac supply system, iv) Three phase four wire ac supply system. Comparison between overhead and underground systems (For above mentioned systems) on the basis of volume requirement for conductor. AC Distribution System: Types of primary and secondary distribution systems, calculation of voltage drops in ac distributors (Uniform and Non Uniform Loading) (Numerical) Economics of power transmission: Economic choice of conductor (Kelvin's law) (Derivation and Numerical) Distribution Feeders: Design considerations of distribution feeders; radial and ring types of primary feeder's voltage levels, energy losses in feeders.

Unit 02: Substation and Earthing: (06 Hrs.)

Substation: Classification of substations, Various equipments used in substation with their specifications, Bus bar arrangements in the substation: Simple arrangements like single bus bar, sectionalized single bus bar, main and transfer bus bar system with relevant diagrams.

Earthing: Necessity of Earthing, Types of earthing system (Equipment and Neutral), and Maintenance Free Earthing system. Methods of testing earth resistance, Different electrode configurations (Plate and Pipe electrode), Tolerable step and touch voltages, Steps involved in design of substation earthing grid as per IEEE standard 80 – 2000.

Unit 03: Maintenance and Condition (06 Hrs.)

Monitoring:

Importance and necessity of maintenance, different maintenance strategies like breakdown maintenance, planned/preventive maintenance and condition based maintenance. Planned and preventive maintenance of transformer, Induction motor and Alternators. Insulation stressing factors, Insulation deterioration, polarization index, dielectric absorption ratio. Concept of condition monitoring of electrical equipments. Advance tools and techniques of condition monitoring, Thermography.



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Unit 04: **Condition Monitoring and Testing of Electrical Equipment:** (06 Hrs.)

Failure modes of transformer, Condition monitoring of oil as per the IS/IEC standards, Filtration/reconditioning of insulating oil, Condition monitoring of transformer bushings, On load tap changer, dissolved gas analysis, degree of polymerization. Induction motor fault diagnostic methods – Vibration Signature Analysis, Motor Current Signature Analysis.

Testing of Power cables – Causes of cable failure, fault location methods and Remedial actions. Testing of Transformer - Type tests and Routine tests.

Unit 05: **Estimation and Costing:** (06 Hrs.)

Introduction, HT, LT overhead lines and underground cables, cable sizing, price catalogue, labour rates, schedule of rates and estimating data (only theory), Estimation and conductor size calculations of internal wiring for Residential and Commercial (Numericals) installations and estimate for underground LT service lines.

Unit 06: **Electrical Safety:** (06 Hrs.)

Causes of Accidents, Prevention of Accidents & precautions to be taken. Dangers arising as a result of faulty Equipments and tools, chemicals, water, poor joints and insulation strains and moving machines. Contents of first aid box, treatment for cuts, burns and electrical shock. Procedures for first aid (e.g. removing casualty from contact with live wire and administering artificial respiration). Various statutory regulations (Electricity supply regulations, factory acts and Indian electricity rules of Central Electricity Authority (CEA), Classification of hazardous area.

Industrial Visit:

Visit to repair workshop (Any One).

i) Three phase induction motor ii) Transformer iii) Power Cable.

List of Experiments :

Compulsory experiments:

(Drawing sheets for 1 and 2 using AutoCAD or other CAD software)

1. Single Line diagram of 132 or 220 or 400 kV substation (based on actual field visit) Symbols, Plate or Pipe earthing.
2. Estimation for 11 kV feeders and substation.
3. Assignment on design of earthing grid for 132/220 kV substation.

Any five experiments are to be performed out of following :

1. Measurement of Dielectric Absorption Ratio and Polarization Index of insulation.
2. Study of troubleshooting of electrical equipment based on actual visit to repair workshop (Any One).i) Three phase induction motor ii) Transformer iii) Power Cable
3. Study of thermograph images and analysis based on these images.
4. Assignment – Construction, working and troubleshooting of any two household Electrical equipments (Fan, Mixer, Electric Iron, Washing Machines, Electric Oven, Microwave - Limited to electrical faults)
5. Study the various types of earthing for electrical appliances/systems, Practice of earthing and Measurement of Earth resistance of Campus premises.
6. Design, Estimation and costing of earthing pit and earthing connection for computer lab, Electrical Machines Lab, HT Substation.
7. Project design and estimation of power circuit of labs/industry.
8. Measurement of insulation resistance of motors and cables



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Text Books:

- [T1] B. R. Gupta- Power System Analysis and Design, 3rd edition, Wheelers publication.
- [T2] S. Rao, Testing Commissioning Operation and Maintenance of Electrical Equipment, Khanna publishers.
- [T3] S. L. Uppal - Electrical Power - Khanna Publishers Delhi.
- [T4] Hand book of condition monitoring by B. K. N. Rao, Elsevier Advance Tech., Oxford (UK).
- [T5] S. K. Shastri – Preventive Maintenance of Electrical Apparatus – Katson Publication House.
- [T6] B. V. S. Rao – Operation and Maintenance of Electrical Equipment – Asia Publication.
- [T7] Hand book on Electrical Safety.

Reference Books:

- [R1] P.S. Pabla –Electric Power Distribution, 5th edition, Tata McGraw Hill.
- [R2] S. L. Uppal, Electrical Wiring and Costing Estimation, Khanna Publishers, New Delhi.
- [R3] Surjit Singh, Electrical wiring, Estimation and Costing, Dhanpat Rai and company, New Delhi.
- [R4] Raina K.B. and Bhattacharya S.K., Electrical Design, Estimating and Costing, Tata McGraw Hill, New Delhi
- [R5] B.D. Arora-Electrical Wiring, Estimation and Costing, - New Heights, New Delhi.
- [R6] M.V. Deshpande, Elements of Power Station design and practice, Wheelers Publication.
- [R7] S. Sivanagaraju and S. Satyanarayana, Electric Power Transmission and Distribution, Pearson Publication .

IS/IEEE Standards:

- 1. IS : 1180 – Distribution Transformer.
- 2. IS : 2026 – Power Transformer.
- 3. IS: 4029 – Testing of 3 Phase Induction Motor.
- 4. IS : 694:1986 – PVC insulated cables for working voltages up to and including 1100 V.
- 5. IS : 900:1992 – Code of practice for installation and maintenance of Induction Motors.
- 6. IEEE 80:2000 – IEEE Guide for Safety in AC Substation Grounding.
- 7. IEEE 142 Guide for Earthing.
- 8. Indian Electricity Rules.

Unit	Text Books	Reference Books
1	T1	R2, R7
2	T2	R7
3	T3,T4	R6,R1
4	T5,T6	R6,R1
5	-	R3, R4,R5
6	T7	-

Reference Web Links/ Research Paper/ Referred Book other than Mention in Syllabus:



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Course Objective:

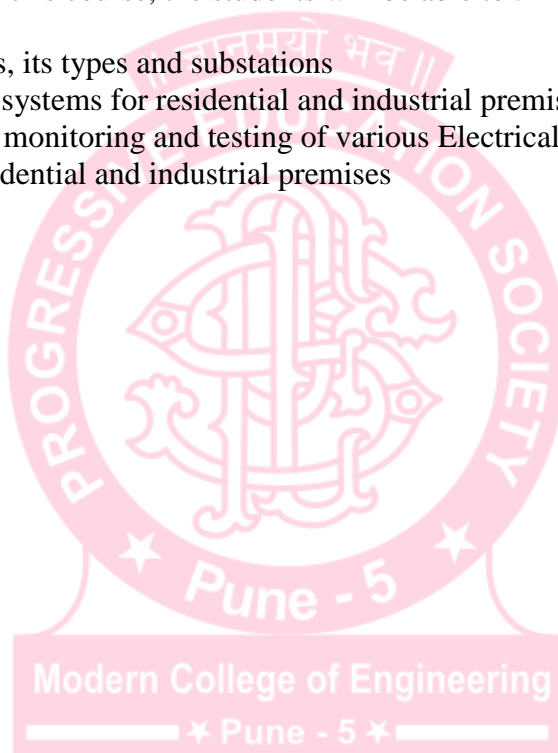
The course aims :-

1. To understand the basic concepts, design and estimation of distribution systems & substation
2. To enable candidate to design earthing system for residential and industrial premises
3. To understand practical aspects of condition monitoring and maintenance of various electrical equipment
4. To learn testing methods of various electrical equipment.

Course Outcome:

Upon successful completion of this course, the students will be able to :-

1. Classify distribution systems, its types and substations
2. Design of different earthing systems for residential and industrial premises
3. Select methods of condition monitoring and testing of various Electrical Equipments
4. Estimate and Costing of residential and industrial premises





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Academic Activity Planner

Units	Unit Test1 (10marks)	MCQ Test2 (10marks)	Assignment (10marks)	Power point Presentation (10marks)	OBT (10marks)	Seminar along with ppt, chart and Report
1	✓					
2		✓				
3			✓			
4				✓		
5					✓	
6						✓





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Teaching Plan
Teaching plan as per University Syllabus

Sr.No.	Unit	Broad Topics to be Covered	Total Lecture Planned
1	I	Distribution Systems	06
2	II	Substation and Earthing	06
3	III	Maintenance and Condition Monitoring	06
4	IV	Condition Monitoring and Testing of Electrical Equipment	06
5	V	Estimation and Costing	06
6	VI	Electrical Safety	06



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Unit wise Lecture Plan
Unit No.-I: Distribution Systems

Pre-requisites:-

Introduction of Electrical supply system, typical A.C power supply scheme, Classification of Supply systems.

Objectives:-

To understand the basic concepts, design and estimation of distribution systems, substation.

Outcomes:-After successfully completing this unit students will be able to:

Define and compare the Distribution systems, and substations

Lecture No.	Details of the Topic to be covered	References	Mode of Delivery
1	Classification of Supply systems. (State only) i) DC 2-wire system ii) 1 Phase 2 wire AC Distribution system	T1,T2,R1	Chalk and Talk
2	Classification of Supply systems: 3 Phase 3 wire systems, 3 Phase 4 wire systems, Comparison between overhead and underground systems (for above mentioned systems) on the basis of volume requirement for conductor.	T1,T2,R1	Chalk and Talk
3	Types of secondary distribution systems, Voltage drops in ac distributors (uniform and non-uniform loading)	T1,T2,R1	Chalk and Talk
4	Types of primary distribution systems, , (Numerical), Economics of power transmission- Economic choice of conductor size (kelvins law), (numerical)	T1,T2,R1	Chalk and Talk
5	Economic choice of AC transmission voltage Distribution, Feeders: Design Considerations of Distribution Feeders	T1,T2,R1	Chalk and Talk
6	Radial and Ring types of primary feeders, AC Distribution system :Design voltage levels, energy losses in feeders.	T1,T2,R1	Chalk and Talk



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Question Bank
Unit No.-I

- Q.1 Differentiate between:
- a) Feeder and Distributor.
 - b) Overhead line and Underground line.
- Q.2 Explain the general design consideration of distribution feeder.
- Q.3. A single phase distributor has a resistance of 0.2Ω and reactance of 0.3Ω . At far end the voltage 'Vb' is 240 V. and current is 100 Amp at 0.8 p. f. lagging. At midpoint 'a' the current is 100 Amp at 0.6 p. f. lagging with respect to voltage 'Va' at 'a'. Find supply voltage and phase angle between 'Vs' and 'Vb'.
- Q.4 Compare overhead and underground supply system stating their advantages and disadvantages.
- Q.5 The cost /KM for each conductor of a section 'a' m² for transmission line is $(2800 + 1300a)$ the load factor of load current is 80% and the load factor for the loss is 65%. The rate of interest and depreciation is 10% and the cost of energy is 5 paisa/kwh. Find the most economical current density for transmission line by use of Kelvin's law.
- Q.6 State and explain Kelvin's law. State limitations of Kelvin's law.
- Q.7 A 3 phase 4 wire distributor supplies a balanced voltage of 400/230V to a load consisting of 80A at p.f. 0.8 lagging, 70A at p.f. 0.9 lagging and 50A at unity p.f. for R, Y and B phase respectively. Calculate the voltage drop in neutral conductor and hence calculate voltage at supply end of 'R' phase considering load voltage as reference. The resistance of each phase and neutral is 0.2 ohms.
- Q.8 How the D.C. Distribution is classified?
- Q.9 Compare 3-phase, 4-wire A. C. underground system with 3-phase 3-wire system on the basis of volume required for the conductor material.
- Q.10 How to Approach the Problems on A. C distribution when P.F. is referred to the respective load voltages?

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Unit No.-II: Substation and Earthing

Pre-requisites:-

Basic knowledge of electrical equipment and earthing used in substation .

Objectives:- -To enable candidate to evaluate substation equipment and earthing system for different area.

Outcomes:- -After successfully completing this unit, students will be able to: Calculate requirement of substation equipment and required earthing system.

Lecture No.	Details of the Topic to be covered	References	Mode of Delivery
1	Classification and types of substation, Indoor and Outdoor substations, Various equipment's used in substation with their specifications	T1,T3,R1	Chalk and Talk, PPT
2	Bus bar arrangements in the Sub-Stations	T1,T3,R1	Chalk and Talk, PPT
3	Single bus bar, sectionalized single bus bar, main and transfer bus bar system with relevant diagrams.	T1,T3,R1	Chalk and Talk, PPT
4	Substation earthing system i) Types of earthing (Equipment and Neutral)	T1,T3,R1	Chalk and Talk, PPT
5	Maintenance free earthing system. ii) Different electrode configuration (Plate and Pipe Electrode)	T1,T3,R1	Chalk and Talk, PPT
6	Tolerable step and touch voltages, Steps involved in design of substation earthing grid as per IEEE standard 80 – 2000.	T1,T3,R1	Chalk and Talk, PPT



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Question Bank
Unit No.-II

- Q.1 Explain in detail the function of the equipment's used in substation.
- Q.2 State and explain the factors which affect the soil resistivity.
- Q.3 Draw the single line diagram of 11kV outdoor substation. Explain its earthing system.
- Q.4 List the various bus bar systems and with neat sketch explain the single bus bar system with sectionalization.
- Q.5 Explain the Following terms with their equivalent circuit
- i) Step Potential.
 - ii) Touch Potential.
- Q.6 Explain in detail the earthing grid of substation w.r.t. IEEE standard 80-2000.





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Unit No.-III: Maintenance and Condition Monitoring.

Pre-requisites:- Basic concepts of Maintenance and Importance of Condition Monitoring

Objectives:-

- To understand different maintenance strategies.
- To study the concept of condition monitoring of electrical equipments. Advanced tools and techniques of condition monitoring

Outcomes:

- **Demonstrate** the knowledge of different maintenance strategies.
- **Understand** practical aspects of condition monitoring and maintenance of various electrical equipments.

Lecture No.	Details of the Topic to be covered	References	Mode of Delivery
1	Importance and necessity of maintenance.	T3	Chalk and Talk
2	Different maintenance strategies like Breakdown maintenance, planned maintenance and condition based maintenance	T3,T4	Chalk and Talk
3	Planned and preventive maintenance of transformer, induction motor	T3,T4	Chalk and Talk
4	Planned and preventive maintenance of alternators. Insulation stressing factors and, insulation deterioration.	T3,T4	Chalk and Talk
5	Polarization index, dielectric absorption ratio, Concept of condition monitoring of electrical equipments	T3,T4	Chalk and Talk
6	Advanced tools and techniques of condition monitoring	T3,T4	Chalk and Talk

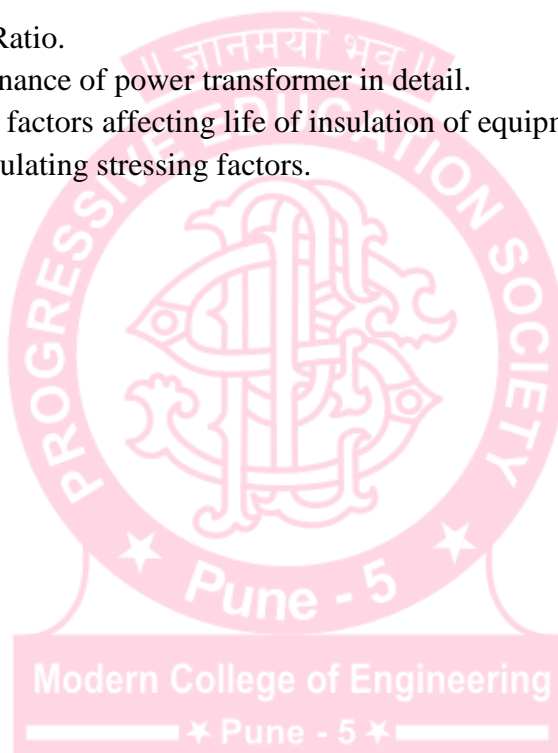


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Question Bank

Unit: III

- Q.1 State different types of maintenance strategies. Explain Breakdown and preventive maintenance.
- Q.2.Explain planned and preventive maintenance of transformer.
- Q.3.What is breakdown maintenance and condition based maintenance? Give one example of each.
- Q.4.State the basic causes of insulation degradation and explain how they affect the quality of insulation.
- Q.5 Explain the preventive maintenance activities of induction motor which can be performed without actually dismantling the motor completely.
- Q.6 Explain the different strategies of maintenance.
- Q.7Define and Explain w. r. t. condition monitoring
- i) Polarization Index.
 - ii) Dielectric Absorption Ratio.
- Q.8 Explain preventive maintenance of power transformer in detail.
- Q.9 State and explain different factors affecting life of insulation of equipment.
- Q.10. Write a short note on insulating stressing factors.





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Unit No.-IV: Condition Monitoring and Testing of Electrical Equipment

Pre-requisites:-

Basic concepts of Condition Monitoring of Major Electrical Equipments.

Objectives:-

- To learn different Failure modes and the testing of transformer.
- To study IS/Specifications for testing of transformer bushing and oil.

Outcomes:- After successfully completing this unit students will be able:

To understand practical aspects of condition monitoring and maintenance of Transformer

Lecture No.	Details of the Topic to be covered	References	Mode of Delivery
1	Failure modes of transformer, Condition monitoring of oil as per the IS/IEC standards,	T1,T4,R1 IS : 1180 – Distribution Transformer	Chalk and Talk
2	Filtration/reconditioning of insulating oil, Condition monitoring of transformer bushings,	T1,T4,R1	Chalk and Talk
3	On load tap changer, dissolved gas analysis, degree of polymerization.	T1,T4,R1	Chalk and Talk
4	Induction motor fault diagnostic methods – Vibration Signature Analysis, Motor Current Signature Analysis.	T1,T4,R1	Chalk and Talk
5	Testing of Power cables – Causes of cable failure, fault location methods and Remedial actions.	T1,T4,R1	Chalk and Talk
6	Testing of Transformer - Type tests and Routine tests.	IS : 1180 – Distribution Transformer	Chalk and Talk

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Question Bank

Unit IV:

- Q.1 Discuss in detail various failure modes of transformer.
- Q.2 Write a troubleshooting chart of transformer.
- Q.3 How transformer oil gets contaminated? With suitable block diagram explain the reconditioning process of transformer oil.
- Q.4 Explain the Transformer contamination process. Explain the filtration of t/f oil with block diagram.
- Q.5 Explain the process of condition monitoring of transformer bushings.
- Q.6 Write short note on degree of polymerization.
- Q.7 Explain tan delta measurement for condition monitoring of insulation.
- Q.8 Explain in detail condition monitoring of On Load Tap Changer.
- Q.9 Explain how dissolved gas analysis is useful for condition monitoring of transformer.
- Q.10 How degree of polymerization and partial discharge measurement is used for condition monitoring of transformer?
- Q.11 State and explain different faults and their causes occurring in the induction motor.
- Q.12 which are the faults occurred in induction motor? What are the causes and remedies?
- Q.13 What is signature analysis? How it is used for condition monitoring of induction motor ?
- Q.14 Write a detail on thermography and its use in condition monitoring of induction motor.
- Q.15 Explain the various abnormal condition and causes of failure of induction motor.
- Q.16 What is $\tan \delta$? Explain its importance in Condition Monitoring of electrical machines.
- Q.17 State the induction motor fault parameters.
- Q.18 Write short note on infrared thermography in relation with condition monitoring of induction motor.
- Q.19 Explain the various abnormal condition in induction motor.
- Q.20 Explain diagnostic methods for induction motor.

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Unit No. - V: Estimation and Costing

Pre-requisites:-

Basic concepts of HT, LT overhead and Underground Cable.

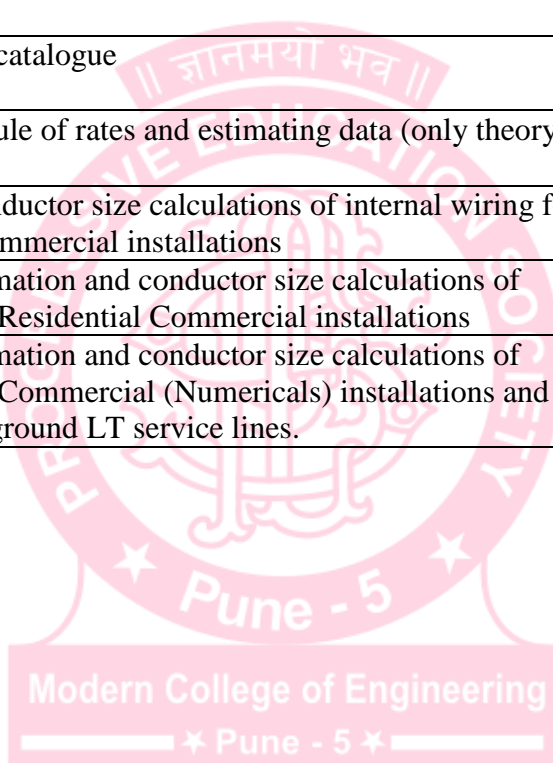
Objectives:-

To give overview of aspects of Estimation and Costing of internal wiring for Residential and Commercial Installation

Outcomes:-After successfully completing this unit students will be able to:

Understand, Estimation and Costing of internal wiring for Residential and Commercial Installation.

Lecture No.	Details of the Topic to be covered	References	Mode of Delivery
1	Introduction, HT, LT overhead lines and underground cables	R3, R4, R5	Chalk and Talk
2	cable sizing, price catalogue	R3, R4, R5	Chalk and Talk
3	labour rates, schedule of rates and estimating data (only theory),	R3, R4, R5	Chalk and Talk
4	Estimation and conductor size calculations of internal wiring for Residential and Commercial installations	R3, R4, R5	Chalk and Talk
5	Numerical on Estimation and conductor size calculations of internal wiring for Residential Commercial installations	R3, R4, R5	Chalk and Talk
6	Numerical on Estimation and conductor size calculations of internal wiring for Commercial (Numericals) installations and estimate for underground LT service lines.	R3, R4, R5	Chalk and Talk





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Question Bank
Unit No.-V

- Q.1 Draw the single line diagram of 11kV outdoor substation.
- Q.2 How the quantity of material required for internal wiring is determined?
- Q.3 What are the essentials of estimating and costing?
- Q.4 Differentiate between: Overhead Line & Underground line.
- Q.5 Write the general rules for the residential and commercial wiring work.
- Q.6 State the general factors that should be considered in estimation of HT or LT lines.
- Q.7 Describe how the labor rates and schedule of rates are considered for estimating the data for laying of overhead lines.
- Q.8 Explain the procedure of installation of Underground LT service lines.
- Q.9 How cable sizing is decided for particular application? Explain how prize catalogue is referred for the same.
- Q.10 Explain the estimation of LT underground cable line for substation. Justify your answer by considering cable size, prize, labor rates, rate of escalation.
- Q.11 Give the various steps in estimation.
- Q.12 Write a short note on:
- a. Schedule of labor rates.
 - b. Points of consideration to determine size of conductor of line.
 - c. Current carrying capacity
 - d. Voltage drop.
- Q.13 What do you mean by a service line? What are the types of service line? Drawing a suitable diagram, explain briefly only one.
- Q.14 What are the essentials of estimating and costing?



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Unit No.-VI: Electrical Safety

Pre-requisites:-

Basic knowledge of Electrical Equipment's, Different fault condition.

Objectives:-

To learn the Electrical Safety (Accident and Precaution) guidelines while handling electricity.

Outcomes:-After successfully completing this unit students will be able to:

Understand to prevent the accidents and precautions to be taken.

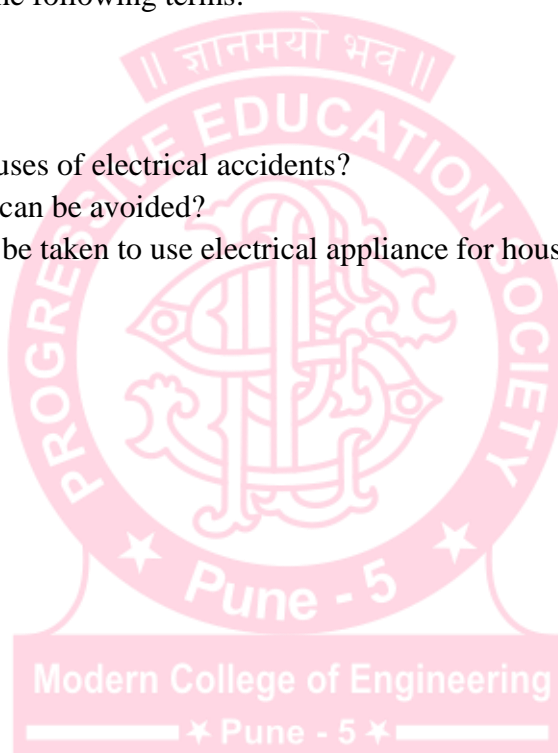
Lecture No.	Details of the Topic to be covered	References	Mode of Delivery
1	Causes of Accidents, Prevention of Accidents & precautions to be taken.	T1,T4,R1	Chalk and Talk
2	Dangers arising as a result of faulty equipments and tools, chemicals, water, poor joints and insulation strains and moving machines.	T1,T4,R1	Chalk and Talk
3	Contents of first aid box, treatment for cuts, burns and electrical shock. Procedures for first aid (e.g. removing casualty from contact with live wire and administering artificial respiration).	T1,T4,R1	Chalk and Talk
4	Various statutory regulations (Electricity supply regulations, factory acts and Indian electricity rules of Central Electricity Authority (CEA),	T1,T4,R1	Chalk and Talk
5	Classification of hazardous area.	T1,T4,R1	Chalk and Talk
6	Review of Unit		Chalk and Talk



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Question Bank
Unit No.-VI

- Q.1 Explain the causes of accidents. How they can be prevented?
- Q.2 Write down IE Act and Statutory Regulations for Electrical Safety.
- Q.3 Write short notes on following:
- a. Contents of First Aid Box
 - b. Treatment for Electrical Shock
 - c. Danger Arising due to Failure of Insulation.
 - d. Objectives of Electrical Safety.
- Q.4 State any 10 objectives of safety.
- Q.5 State the meaning of the following terms:
- a. Safety
 - b. Hazard
 - c. Accident
- Q.6 What are the reasons/causes of electrical accidents?
- Q.7 How electrical accident can be avoided?
- Q.8 What precautions are to be taken to use electrical appliance for house hold purpose?





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List of Experiments

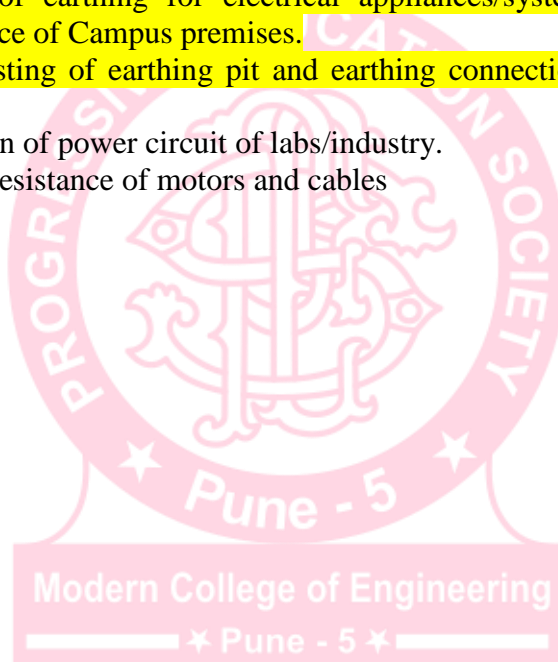
Compulsory experiments:

(Drawing sheets for 1 and 2 using AutoCAD or other CAD software)

1. Single Line diagram of 132 or 220 or 400 kV substation (based on actual field visit) Symbols, Plate or Pipe earthing.
2. Estimation for 11 kV feeders and substation.
3. Assignment on design of earthing grid for 132/220 kV substation.

Any **five experiments** are to be performed out of following:

1. Measurement of Dielectric Absorption Ratio and Polarization Index of insulation.
2. Study of troubleshooting of electrical equipment based on actual visit to repair workshop (Any One).i) Three phase induction motor ii) Transformer iii) Power Cable
3. Study of thermograph images and analysis based on these images.
4. Assignment – Construction, working and troubleshooting of any two household Electrical equipment's (Fan, Mixer, Electric Iron, Washing Machines, Electric Oven, Microwave - Limited to electrical faults)
5. Study the various types of earthing for electrical appliances/systems, Practice of earthing and Measurement of Earth resistance of Campus premises.
6. Design, Estimation and costing of earthing pit and earthing connection for computer lab, Electrical Machines Lab, HT Substation.
7. Project design and estimation of power circuit of labs/industry.
8. Measurement of insulation resistance of motors and cables





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Unit No.____

Theory Paper

[Total No. of Questions = 3]

[Total No. of Pages = 1]

T.E. (Electrical) 2015-Course

Subject Code:_____ Subject Name: _____

Semester: I (2019-20) Exam: _____

[Time: 1 Hours] [Max Marks = 10]

Instructions to Candidates:

1. Answer any 2 Questions out of 3 questions
2. Use single answer book for all questions.
3. Figures to the right of each question indicate full marks.
4. Use of Scientific calculator is allowed.

Q. 1	a)		[]
	b)		[]
Q. 2	a)		[]
	b)		[]
Q. 3	a)		[]
	b)		[]

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Tutorial

[Total No. of Questions = 5]

[Total No. of Pages = 1]

T.E. (Electrical) 2015-Course

Subject Code: _____ Subject Name: _____

Semester: I (2019-20) Exam: _____

[Time: 1 Hours] [Max Marks = 20]

Instructions to Candidates:

1. Answer any 4 Questions out of 5 questions
2. Use single answer book for all questions.
3. Figures to the right of each question indicate full marks.
4. Use of Scientific calculator is allowed.

Q. 1		[]
Q. 2		[]
Q. 3		[]
Q. 4		[]
Q. 5		[]

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Assignment

[Total No. of Questions = 5]

[Total No. of Pages = 1]

T.E. (Electrical) 2015-Course (Credit pattern)

Subject Code: _____ Subject Name: _____

Semester: I (2019-20) Exam: _____

[Time: 1 Hours] [Max Marks = 20] [-Credits]

Instructions to Candidates:

- 1. All Questions are compulsory.**
- 2. Use of Scientific calculator is allowed.**

Q. 1		[]
		[]
Q.2		
Q.3		
Q.4		
Q.5		

