RASHTRASANT TUKADOJI MAHARAJ NAGPUR UNIVERSITY, NAGPUR
B.TECH. (Electrical Engineering) (CBCS)
8th Semester Electrical Engineering (CBCS)
Syllabus of **Electrical Safety & Standards.**
Subject Code : BTCHEE801T

Teaching Scheme **Examination Scheme**

Theory-03Hours/Week **Th (U)=70 M (I)=30 M**

Duration of University Exam:- 3 Hours

COURSE OUTCOMES	
Upon successful completion of the course, the student must be able to	
CO1	Understand the Indian power sector organization and Electricity rules, electrical safety in residential, commercial, agriculture, hazardous areas .
CO2	Outline the electrical safety during installation, testing and commissioning procedure.
CO3	Make use of specification of electrical plants and classification of safety equipment for various hazardous locations.
CO4	Understand Safety Management & Standards in Electrical Systems.

SYLLABUS		
Unit No.	**Contents**	**Hours**
1	**Introduction To Electrical Safety, Shocks And Their Prevention:** Terms and definitions, objectives of safety and security measures, Hazards associated with electriccurrent and voltage, who is exposed, principles of electrical safety, Approaches to prevent Accidents, scope of subject electrical safety. Primary and secondary electrical shocks, possibilities of getting electrical shock and its severity, medical analysis of electric shocks and its effects, shocks due to flash/ Spark over's, prevention of shocks, safety precautions against contact shocks, flash shocks, burns, residential buildings andshop.	8
2	**Electrical Safety in Residential, Commercial and Agricultural Installations**: Wiring and fitting –Domestic appliances –water tap giving shock –shock from wet wall –fan firing shock –multi-storied building –Temporary installations – Agricultural pump installation –Do's and Don'ts for safety in the use of domestic appliances.	7
3	**Electrical Safety during Installation, Testing and Commissioning, Operation and Maintenance**: Preliminary preparations –safe sequence –risk ofplant and equipment –safety documentation –field quality and safety -personal protective equipment –safety clearance notice –safety precautions –safeguards for operators –safety.	7
4	**Electrical Safety in Hazardous Areas**: Hazardous zones –class 0,1 and 2 – spark, flashovers and corona discharge and functional requirements – Specifications of electrical plants, equipment's for hazardous locations – Classification of equipment enclosure for various hazardous gases and vapours – classification of equipment/enclosure for hazardous locations.	6
5	**Safety Management of Electrical Systems**: Principles of Safety Management, Management Safety Policy, Safety organization, safety auditing, Motivation to managers, supervisors, employees. **Review of IE Rules and Acts ,their Significance**: Objective and scope – ground clearances and section clearances – standards on electrical safety - safe limits of current, voltage –Rules regarding first aid and fire fighting facility. The Electricity Act, 2003,	8

Learning Resources
Text Books:
1. Rao, S. and Saluja, H.L., "Electrical Safety, Fire Safety Engineering and Safety Management", Khanna Publishers, 1988. 2. Pradeep Chaturvedi, "Energy management policy, planning and utilization", Concept Publishing company, New Delhi, 1997
Reference Books:
1. Cooper.W.F, "Electrical safety Engineering", Newnes-Butterworth Company, 1978. 2. John Codick, "Electrical safety hand book", McGraw Hill Inc., New Delhi, 2000. 3. Nagrath, I.J. and Kothari, D.P., "Power System Engineering", Tata McGraw Hill, 1998. 4. Wadhwa, C.L., "Electric Power Systems", New Age International, 2004.

RASHTRASANT TUKADOJI MAHARAJ NAGPUR UNIVERSITY, NAGPUR
B.TECH. (Electrical Engineering) (CBCS)
8th Semester Electrical Engineering (CBCS)
Syllabus Advance Professional Elective VI
POWER SEMICONDUCTOR DRIVES
Subject Code : BTCHEE802T

Teaching Scheme **Examination Scheme**

Theory-03Hours/Week **Th (U)=70 M (I)=30 M**

Duration of University Exam:- 3 Hours

COURSE OBJECTIVE	
1	To study the dynamics of Electric drives along with stability.
2	To learn the various converters control methods used for DC drives.
3	To study advanced control topologies applicable for induction motor.
4	To learn the basics of Industrial drives used for special applications.
5	To study the traction drives using ac and dc motors with advanced control.

COURSE OUTCOMES	
Upon successful completion of the course, the student must be able to	
CO1	Understand dynamics of electric drives used in industry with steady state stability.
CO2	Apply the knowledge of various converters control methods used for DC drives.
CO3	Analyze control topologies used for induction motor applicable to various industrial Applications.
CO4	Execute the basics of Industrial drives used for special applications.
CO5	Attribute the traction drives using ac and dc motors with advanced control.

Unit1: Dynamics of electric drives:

Power Modulators, Block Diagram of electrical Drives, Four Quadrant Speed torque diagram, Hoist Drive, Components of Load torque, Fundamental torque equation, Loads with Rotational and Translational Motion, Numerical, Time and Energy loss in Transient operation, Control of Electric Drives, Modes of operation, Speed transition. Steady state stability.

(08Hrs)

Unit2: D.C. Motor drives

Controlled rectifier fed D.C. drives, Single Phase and Three phase Fully Controlled rectifier control of D.C. separately excited motor Derivation and Numerical for only Continuous Conduction, . Dual converter control of D.C. separately excited motor, fractional hp motors, Chopper controlled dc drives of separately excited dc motor.

(07Hrs)

Unit3:Induction motor drives

Stator voltage control, Voltage source and current source inverter control, Variable frequency control from voltage source and current source ,Cycloconvertor control, Static Rotor resistance Control of Induction Motor, Scherbius Drive, Krammers drive. **(07Hrs)**

Unit4: Special Industrial drives

Brushless dc motor(BLDC) drives, Stepper Motors, Switched Reluctance Motor, Solar and battery powered drives, Energy Conservation in Electrical Drives. **(07Hrs)**

Unit5:Traction drives

Conventional dc and ac traction, dc traction with resistance control, Semiconductors converter controlled Drives, 25KV AC traction using on-load transformer tap changer, 25KV AC traction using semiconductor converter controlled dc motors, DC traction using semiconductor chopper controlled dc motors.

(07Hrs)

List of Books:

Text Book:

1. G. K. Dubey “Fundamentals of Electric drives” CRC Press.
2. B. K. Bose “Power Electronics and drives” Pearson.

Reference Books:

1. Vedam Subrahmanyam “Electric drives concepts and applications” McGraw-Hill, 1996.
2. R. Krishnan, Electrical motor Drives : Modeling, analysis and Control, 2001, Pearson.

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B.TECH. (Electrical Engineering) (CBCS)

8th Semester Electrical Engineering (CBCS)

Syllabus Advance Professional Elective VI

ELECTRICAL DISTRIBUTION SYSTEM

Subject Code : BTCHEE802T

Teaching Scheme
Theory-03Hours/Week

Examination Scheme
Th (U)=70 M (I)=30 M
Duration of University Exam:- 3 Hours

Sr No	Course Objective
1	To know about practical electrical distribution system and its necessity in the real world
2	The conceptual knowledge on how to determine the performance of a distribution system through its important parameters i.e voltage drops and power losses.
3	How to improve the voltage profiles and power factor of the system to better value using various voltage control and compensation techniques.

Course Outcomes

After successful completion of this course the student will be able to:

CO1	Understand the general aspects of electrical distribution system
CO2	Design and analysis of distribution feeders and substations
CO3	Understand the need for protection and distribution automation.
CO4	Recognize the significance of voltage drop and power loss in the distribution system
CO5	Understand the need for controlling the PF, Voltage and Power and the equipment used for mitigating them

Syllabus (Electrical Distribution System)

Content	No. of Hours
UNIT – I: INTRODUCTION & GENERAL CONCEPTS: Introduction to distribution systems, Load modeling and characteristics. Coincidence factor, contribution factor loss factor - Relationship between the load factor and loss factor. **Classification of loads:** Residential, commercial, Agricultural and Industrial loads and their characteristics.	06
UNIT II: DISTRIBUTION FEEDERS & SUBSTATIONS: Design Considerations of Distribution Feeders: Radial and loop types of primary feeders, voltage levels, feeder loading; basic design practice of the secondary distribution system. **SUBSTATIONS:** Rating of distribution substation, service area within primary feeders. Benefits derived through optimal location of substations. Layout of the Substation	07
UNIT – III: DISTRIBUTION SYSTEM ANALYSIS: Voltage drop and power-loss calculations: Derivation for voltage drop and power loss in lines, manual methods of solution for radial networks, three phase balanced primary lines.	08
UNIT –IV: PROTECTIVE DEVICES&AUTOMATION : Objectives of distribution system protection, types of common faults and procedure for fault calculations. **Protective Devices:** Principle of operation of Fuses, Circuit Reclosures and line sectionalizes, and circuit breakers. **Automation**:-Introduction to Distribution Automation, Data acquisition system and decentralized control, data acquisition and protection considerations of control panel.	07
UNIT – V: VOLTAGE CONTROL & POWER FACTOR IMPROVEMENT: Equipment for voltage control, effect of series capacitors, line drop Compensation, effect of AVB/AVR, Power factor control using different types of power capacitors, shunt and series Capacitors, effect of shunt capacitors (Fixed and Switched), capacitor allocation- Economic Justification- Procedure to determine the best capacitor location.	08

TEXT BOOK:

1. Electrical Power Distribution Systems, V.Kamaraju, TMH
2. Electrical Distribution Systems, Dr.S.Sivanagaraju, Dr.K.Shankar. Danapathi Rai Publications.
3. Electric Power Distribution A. S. Pabla Tata Mc Graw-Hill Publishing Company

REFERENCES:

1. Electrical Power Distribution System Engineering, TuranGonen, CRC Press.
2. Electrical Power Generation, Transmission and Distribution, SN Singh, PHI Publications.Electric
3. Electric Power Distribution Automation M. K. Khedkar& G. M. Dhole University Science Press

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B.TECH. (Electrical Engineering) (CBCS)

8th Semester Electrical Engineering (CBCS)

Syllabus of Professional Elective: VII

EHVAC-HVDC Transmission System

SubjectCode:BTCHEE803T

Teaching Scheme
Theory-03Hours/Week

Examination Scheme
Th (U)=70M(I)=30M
Duration of University Exam:-3Hours

Course Objective:	
1	To Understand various aspects of Transmission systems
2	To study Electrostatic and Electromagnetic fields of EHV lines and corona in EHVAC lines
3	To study and understand different types HVDC systems
4	To study power flow controls for HVDC lines and design parameters of Harmonic filters
5	To study and understand HVDC circuit breakers and HVDC fault clearing, protective schemes

CourseOutcome:AfterSuccessfulCompletionofthiscoursestudentswillbeableto	
CO1	Analyze power handling capacity of different EHVAC transmission lines
CO2	Knowledge of Electrostatic and electromagnetic fields and corona in EHVAC lines
CO3	Knowledge of different types HVDC systems
CO4	Analyze power flow control in HVDC lines & design parameters of harmonic filters
CO5	Design appropriate circuit breakers and protective schemes for different HVDC systems

Contents	**Hours**
Unit1: Power Handling capacities of EHV AC transmission lines, Voltage, gradients; Electric field of point charge line-charge, Maxwell's potential coefficients, Mangoldt formula.	**08**
Unit2: Electrostatic of electrostatic field ,Corona types, critical disruptive voltages ;factor affecting corona ,methods for reducing corona power loss, corona current wave form charge voltage diagram audible noise and radio interference.	**06**
Unit3: Comparison of EHVAC and HVDC systems ,Kinds of DC link, Earth Electrode and earth-returns : Introduction &objectives ,location and configuration, Multi-terminal HVDC system: Introduction, 2pole transmission, MTDC system with series and paral1el connected converters.	**06**
Unit 4:- **Power flow control in HVDC system:** Constant current. Constant voltage, constant ignition and excitation angle control, control characteristics. Parallel operation of AC and DC links (Synchronous and Asynchronous links). **Harmonic Filters**: Types of Filter, Configuration of AC filters, design of AC filters, single & double frequency tuned filters, Configuration of D.C. Harmonic filters, Grouping of AC & DC filters, Reactive power compensation: Reactive power requirements of HVDC convertors, effect of Delay angle and extinction angle on reactive power.	**08**
Unit 5: HVDC circuit breakers Introduction, construction, principle, switching energy interruption of DC current application of MRTB, types of HVDC C.B., HVDC substation protection against short-circuit: fault Clearing, protective zones, protection symbols, HVDC line pole protections(fault clearing and re-energizing), HVDC sub-station protection against over voltage, difference	**08**

between Insulation coordination of AC and DC systems, surge-Arrestors protection scheme .Insulation coordination and protection margin.	

Text Books		
Title of ook	**Name ofAuthor/s**	**Edition& Publisher**
EHVAC and HVDC Transmission Engineering and practice.	Sunil S. Rao	Khanna publications
Electrical Power Systems	C.L.Wadhwa	2nd Edition New Age International
Reference Books		
HVAC Transmission	Rakosh Das Begamudre	New Age International

RASHTRASANT TUKADOJI MAHARAJ NAGPUR UNIVERSITY, NAGPUR
B.TECH. (Electrical Engineering) (CBCS)

Syllabus of Professional Elective-VII: Power Quality

8th Semester Electrical Engineering (CBCS)
Subject Code : BTCHEE803T

Course Outcomes:

After the study of this course, the students will be able to:

CO1: Explain importance of Power Quality and good grounding practices.

CO2: Describe the causes of flickers and transient over voltages and suggest corrective measures.

CO3: Discuss the causes and consequences of voltage sags and suggest mitigation techniques

CO4: Discuss the causes and effects of harmonics and suggest harmonic reduction techniques.

CO5: Explain the need, objectives and approaches of power quality monitoring and assessment.

Unit 1: Introduction **8 Hours**

Importance of power quality, terms, and definitions of power quality as per IEEE std. 1159. such as transients, short and long duration voltage variations, interruptions, short and long voltage fluctuations, imbalance, flickers and transients. Symptoms of poor power quality. Definitions and terminology of grounding. Purpose of groundings. Problems due to poor grounding and good grounding practices.

Unit 2: Flickers and Transient Voltages **6 Hours**

RMS voltage variations in power system and voltage regulation per unit system, complex power. Principles of voltage regulation. Various devices used for voltage regulation and impact of reactive power management. Various causes of voltage flicker and their effects. Various means to reduce flickers. Transient over voltages & their sources, impulsive transients, switching transients, Effects & Control of transient voltages.

Unit 3: Voltage Sag, Swells and Interruptions **6 Hours**

Definitions of voltage sag and interruptions. Economic impact of voltage sag. Major causes and consequences of voltage sags. Voltage sag characteristics. Voltage sag assessment. Influence of fault location and fault level on voltage sag. Areas of vulnerability. Assessment of equipment sensitivity to voltage sags. Mitigation measures for voltage sags, such as UPS, DVR, SMEs, CVT etc.

Unit 4: Waveform Distortion **8 Hours**

Definition of harmonics, inter-harmonics, sub-harmonics. Causes and effect of harmonics. Voltage versus current distortion. Harmonic indices. A.C. quantities under non-sinusoidal conditions. Harmonics series and parallel resonances. Consequences of harmonic resonance. Principles for controlling harmonics. Reducing harmonic currents in loads. K-rated transformer. Computer tools for harmonic analysis. Locating sources of harmonics. Harmonic filtering, passive and active filters. IEEE Harmonic standard519-1992.

Unit 5: Power Quality Monitoring **8 Hours**

Need of power quality monitoring and assessment, Power quality monitoring objectives and requirements. Initial site survey. Power quality Instrumentation. Selection of power quality monitors, selection of monitoring location and period. System wide and discrete power quality monitoring. Setting thresholds on monitors, data collection and analysis. Selection of transducers. Harmonic monitoring, Transient monitoring, event recording and flicker monitoring, Power quality indices and standards.

Text Books		
Title of Book	**Name of Author/s**	**Edition & Publisher**
Understanding power quality problems, voltage sag and interruptions	M. H. J. Bollen	IEEE press, 2000, series on power engineering
Electrical power system quality	R.C. Dugan, M.F. McGranghan, S. Santoso, H. Wayne Beaty	2nd, McGraw Hill Pub.
Reference Books		
Power system quality assessment	J. Arrillaga, M.R. Watson, S. Chan	John Wiley and sons
Electric power quality	G. J. Heydt	
Power system harmonics: Computer modeling and analysis	EnriquesAcha, Manuel Madrigal	John wiley and sons ltd
Power System Harmonics	J. Arrillaga& N. Watson	
IEEE std 519-1992/ IEEE std 1159 IEEE recommended practices and requirements for harmonics control in electrical power system		