Program: Diploma
Semester: Fifth
Course: Switch Gear and Protection
Course Code: 6D.301

L	T	P	C
3	0	0	3

Course Objective:

- Explain the working of different types of switchgear equipments like circuit breakers and relays.
- Design the ratings for fuses according to the requirement
- Elucidate various protection schemes of various power system components like alternators, transformers and bus-bars.
- Explain various methods of over voltage protection in power systems.

UNIT I:

Fundamental: Necessity & functions of protective system. Normal & abnormal conditions. Types offaults & their causes. Short circuit calculations (Symmetrical faults only). Use of current limiting reactors & their arrangements. **Circuit interrupting devices:** Fuses-Construction, Working of Semien closed & HRC fuse, characteristics, selection and applications. Isolators-Vertical break, Horizontal break & Pento graph type. Arc formation process, methods of arc extinction – High resistance method, Low resistance or current zero method, related terms–Arc voltage, Recovery voltage & Re striking voltage.

Circuit breakers -Concept, Classification, Working principle, Construction, Specification & Applications ofH.T–Bulkoil circuit breaker, Minimum oil circuit breaker (M.O.C.B.), SulpherHexa Fluoride circuit breaker (SF6), Vacuum circuit breaker. L.T.-Air circuit breakers (ACB), Miniature circuit. Breakers (MCB), Moulded case circuit breaker (MCCB), Earth leakage circuit breaker (ELCB), Comparison off use & MCCB. Selection of MCCB for motor. Selection and rating of circuit breakers.

UNIT II:

Protective Relaying: Fundamental Requirements (Qualities)-Selectivity, Speed, Sensitivity, Reliability,Simplicity, Economy. Basic relay terminology-Protective relay, relay time, Pick up current, Reset current, Current setting, Plug setting multiplier, Time setting multiplier. Classification Electromagnetic attraction– Operation of Attracted armature type, Solenoid type and Balanced beam type relays. Electromagnetic induction type–Operation of Shaded pole type and Watt hour meter type relays. Block diagram, Operation, Advantages & disadvantages of Static and µP based relays. CT and PT as Protective transformers. (Definition of Ratio error, Phase angle error, CT burden). Over current relay-Time current characteristics. Operation of Static over current relay with block diagram. Operation of µP based over current relay with

block diagram. Distance relaying-Principle, Operation of– Definite distance relay, Time distance relay and MHO relay. Direction relay –The need of direction relay, construction, operation of Induction type directional over current relay.

UNIT III:

Differential Relay- Operation of Current differential relay & Voltage differential relay. Protection of Alternator: Abnormalities & Faults, Differential protection, Differential protection, over current, earth fault, inter turn fault, negative phase sequence, over heating protection. Reverse power protections.

Protection ofTransformer: Abnormalities & faults.Differential, Biased differential, Over current, Earth fault, Inter turn,Restricted earth fault, Over heating protection. Buchholz relay.

Protection of Motor: Abnormalities & faults.Short circuit protection, Overload protection, Single phase preventer.

UNIT IV:

Protection of Bus bar & transmission line: Abnormalities & faults. Bus bar protection– Operation ofDifferential Protection and Fault bus protection schemes. Transmission line, over current, distance protection. Pilot wire protection. **Neutral Earthing:** Introduction & importance. Types of earthing. Substation earthing. Difference between Equipment earthing and Neutral earthing. **Over voltage Protection:** Causes of over voltages. Lighting phenomena & over voltage due to lightning .Protection of transmission line & substation from direct stroke. Types of lightning arresters – Rod gap, Horn gap, Expulsion and Thyrister type, their construction & principle of operation. Surge absorber – Definition & working with neat diagram. Protection against traveling waves. Necessity of Insulation co-ordination.

Suggested Reading:

1. *Power System Protection & Switch Gear:Badriram and Vishwa Karma, TMH Publications.*
2. *Switch Gear and Protection Sunil S. Rao, Khanna Publications*

Program: Diploma
Semester: fifth
Course: AC Machine
Course Code: 6D.302

L	T	P	C
3	0	0	3

Course Objective:

- To understand what the meant by the term “ac circuit.”
- To understand how to analyze ac circuits.
- To understand the basic construction and operation of an ac machine.
- To understand how to analyze an ac machine.

UNIT I:
Three phase induction motor: Construction of three phase induction motor. Production of rotatingmagnetic field. Principle of working/operation. Concept of slip. Equation of rotor induced emf, current, frequency, reactance, and impedance under steady and running condition. Torque equation of three phase induction motor. Starting and running torque of squirrel cage and slip ring induction motor. Condition for maximum and starting torque. Torque slip characteristics of three phase induction motor. Effect of change in rotor circuit resistance on torque-slip characteristics. Effect of change in supply voltage on torque-slip characteristics. Measurement of slip by a) Tacho-meter method b) Comparing rotor frequency and stator frequency. Speed control of three phase induction motor by) Pole changing method. Frequency control methods) by stator voltage control) Rotor resistance control. Comparison between squirrel-cage and slip-ring induction motor. Applications of three phase induction motor. Power stages of three phase induction motor. Double cage IM a) Construction b) Characteristic of outer, inner cage & combined characteristic) Industrial Applications. I.M. as a generalized transformer. Vector diagram of IM. Equivalent circuit of 3-phase IM. Starting of 3-phase IM .a) Stator resistance starter b) Star-Delta starter. Auto transformer starter. Rotor resistance starter.

UNIT II:
Three Phase Alternator:
Definition and construction of three phase Alternator a) Armature. Rotor– smooth cylindrical & projecting type. Derivation of e.m.f. equation of Alternator which includes a) Chording factor. Distribution factor. Factors affecting the terminal voltage of Alternator. Armature resistive drop b) Leakage reactance drop. Armature reaction at various power factors & concept of Synchronous impedance .Regulation of three phase Alternator by a) Synchronous impedance method. Mmf method.

UNIT III:
Synchronous Motor:
Principle of working/operation. Synchronous Motor on load with constant excitation. Effect of excitation at constant load V curve & Inverted V curve. Hunting & phases winging. Applications. Starting of Synchronous Motor. Comparison between IM & Synchronous Motor.

UNIT IV:

Single phase Motors:

Double field revolving theory, Types of Single phase IM, Split phasing principle of starting Resistance start induction run. Capacitor start induction run. Capacitor start Capacitor run .Double value Capacitor applications motor. Shaded pole IM. Applications.

Special machines: Induction Generator: Principle of operation, Construction and Applications. LinearInduction Motor Principle of operation, Construction and Applications. AC series motor Principle of operation, Construction and Applications.

Suggested Reading:

1. P. S. Bimbhra, Electrical Machines, Khanna Publishers

2. I. J. Nagrath, D.P. Kothari, Electric Machines, TMH, New Delhi, 2002.

JHARKHAND Rai University

Program: Diploma
Semester: Fifth
Course: AC Machine Lab
Course Code: 6DP.302

L	T	P	C
0	0	2	1

List of Experiments:

1. To perform no load and blocked rotor test on a three phase induction motor to find out its performance parameters with the help of (a) Equivalent circuit (b) Circle diagram.

2. To perform direct load test on a three phase induction motor to find out its performance Parameters at different load conditions.

3. To study the construction of a three phase induction motor with the help of a model.

4. To study about the starters of three phase induction motors.

5. To study about the speed control methods for three phase induction motors.

6. To perform no load and blocked rotor test on single phase induction motor to obtain its equivalent circuit.

7. To study about the induction generator.

JHARKHAND Rai University

Program: Diploma
Semester: Fifth
Course: Power Electronics
Course Code: 6AD.307

L	T	P	C
3	0	0	3

Course Objective:

- To understand and acquire knowledge about various power semiconductor devices.
- To prepare the students to analyze and design different power converter circuits.
- Acquire knowledge about fundamental concepts and techniques used in power electronics.
- Ability to analyze various single phase and three phase power converter circuits and understand their applications.
- To develop skills to build, and troubleshoot power electronics circuits.

Unit I :

Introduction to thyristors and other power Electronics devices Construction, working principles of SCR two transistor analogy of SCR, V-I characteristics of SCR; SCR specifications and ratings; Different methods of SCR Triggering; Different commutation circuits for SCRs; Series and parallel operations of SCRs; Basic idea about the selection of heat sinks for thyristors; Construction and working principle of Diacs andTriacs and their V-I characteristics; Construction, workings and ratings of Gate Turn off (GTO) thyristors; Characteristics of SCR diac. Triac, programmable uni-junction transistor (PUT), ASCR, RCT, LASCR, SCS ; Contribution and working of UJT and its application as relaxation oscillators; Comparison between BJT and SCR;Construction,

Unit II :

Application of SCR and Triacs: Illumination control; Temperature control; Battery charger; Fan regulators; Emerging light using SCR; Speed control of DC and universal motor; LDR operated SCR circuit; Switched mode power supply; Uninterrupted power supply; Solid state relays . Controlled Converters: Half wave controlled rectifier with resistive load; Half wave ; controlled rectifier with inductive load; Full wave half controlled rectifier with resistive load; Full wave half controlled rectifier with inductive load; Full wave fully controlled rectifier with resistors as well as inductive load; Three-phase half wave fully controlled rectifier with resistors as well as inductive load; Three phase fully wave fully controlled and half controlled with resistive as well inductive loads; Duel converters and their applications.

Unit III :

Inverters: Voltage and current source inverters; Working principle of single phase series and parallel inverter; Working principle of single phase bridge inverter; Working principle of three

phase bridge inverter. Choppers: Working of voltage, current and load, commutated choppers; Classification of choppers. Cyclo Converter: Working principle of single phase and three phase cyclo converter.

Unit IV:

Electric Device Control: D. C. drive control - Speed control of dc series motor using bridge rectifier; Speed control of dc shunt motor using bridge rectifier; Speed control of dc motor using choppers; Study ofcontrol scheme for speed control of a separately excited dc motor above and below the base speed; AC drive control - Speed control of induction motor using phase control; Speed control of induction motor using variable frequency; Speed control of induction motor using slip power recovery schemes

Suggested Reading:

1. *Dr. P. S. Bimbhra, Power Electronics, Khanna Publishers*
2. *Dr. B.R. Gupta, V. Singhal,Power Electronics, Katson Books*

Program: Diploma
Semester: Fifth
Course: Power Electronics Lab
Course Code: 6ADP.307

L	T	P	C
0	0	2	1

List of Experiments:

1. To study VI characteristics of a diode
2. To determine characteristics of Zener diode
3. To determine characteristics of SCR
4. To determine input & transfer characteristics of IGBT
5. To determine input & transfer characteristics of MOSFET
6. To study the characteristics of step up chopper
7. To study the characteristics of step up chopper

Program: Diploma
Semester: Fifth
Course: Extra High Voltage Transmission
Course Code: 6D.304

L	T	P	C
3	0	0	3

Course Objective:

- Describe the principles behind generating high DC – AC and impulse voltages
- Develop equivalent circuit models of the different high voltage generators
- Perform a dynamic response analysis of high voltage measurement systems
- Compute the breakdown strength of gas, liquids and solids insulation systems
- Transient voltages and their propagation characteristics 6. Insulation life and accelerated tests

UNIT I:

EHV AC transmission lines- Need for EHV transmission lines. Transmission line trends andPreliminaries. Standard transmission voltages. Average values of line parameters. Power handling capacity and line loss. Examples on Giant power pools and number of lines. Cost of transmission lines and equipments. Mechanical consideration in line performance. Traveling wave equations, Transmission, Reflection, Attenuation and Distortion of traveling waves.

Calculation of **line and ground parameters**: Resistance of conductors. Temperature rise of conductorsand current carrying capacity. Properties of bundled conductors. Inductance of EHV line configurations. Line capacitance calculations. Sequence inductances and capacitances. Line parameters for modes of propagation. Resistance and inductance of ground return.

UNIT II:

Voltage gradient of **conductors**: Electrostatics. Field of a point charge and its properties, Field of asphere gap, Field of line charges and their properties, Corona inception gradient, charge potential relations for multi-conductor lines, Maximum charge condition on three phase line. Surface voltage gradient on conductors –single conductor, 2 conductors and multi conductor bundle, maximum surface voltage gradient, Mangolt formula, design of cylindrical cage for corona gradients.

UNIT III:

Electrostatic and Magnetic fields of **EHV lines**: Electric shock and threshold currents. Capacitance oflong object. Effect of high electrostatic fields on Humans, Animals and Plants. Electrostatic induction in un-energized circuit of a double circuit line. Induced voltage in insulated ground wires. Magnetic field effects. **Analysis** of **HVDC converters**: Three phase and six phase converter circuits, voltage and currentwaveforms and ratios, apparent power factor and utilization factor, delay angle, transformer rating, pulse number, commutation group,

Graetz circuit, overlap, advance angle and extinction angle, analysis of two and three valve conduction mode, equivalent commutation resistance, reactive power requirements of HVDC converters.

UNIT IV:

Control of **HVD Converters:** Principle of dc link control, Converter control characteristics, Reactivepower requirement of HVDC converters Influence of AC systems strength on AC/DC system interaction. Short circuit ratio, reactive power and AC system strength Problem with low effective short circuit ratio, Solution to problem with weak systems, Effective inertia constant, forced commutation.

Suggested Reading:

1. *High Voltage Engineering, MS Naidu and V. Kamaraju, TMH New Delhi*
2. *Extra High Voltage AC Transmission by R. D. Begamudre, Wiley Eastern ltd.*
3. *HVDC Power Transmission System by K. Padiyar*

Program: Diploma
Semester: Fifth
Course: Embedded System
Course Code: 6AD.308

L	T	P	C
2	0	0	2

Course Objective:

- To bring both Circuits and System views on design together.
- It offers a profound understanding of the design of complex circuits, simulation and synthesis tool for hardware design.
- To be aware about the trends in semiconductor technology, and how it impacts scaling and performance.
- Able to learn Layout, Stick diagrams, Fabrication steps, Static and Switching characteristics of circuits.

UNIT I :
INTRODUCTION TO EMBEDDED SYSTEMS

Introduction to Embedded Systems – The build process for embedded systems- Structural units in Embedded processor,selection of processor & memory devices- DMA – Memory management methods- Timer and Counting devices, Watchdog Timer, Real Time Clock, In circuit emulator, Target Hardware Debugging.

UNIT II:
EMBEDDED NETWORKING

Embedded Networking: Introduction, I/O Device Ports & Buses– Serial Bus communication protocols – RS232 standard – RS422 – RS485 – CAN Bus - Serial Peripheral Interface (SPI) – Inter Integrated Circuits (I2C) –need for device drivers.

UNIT III:
EMBEDDED FIRMWARE DEVELOPMENT ENVIRONMENT

Embedded Product Development Life Cycle- objectives, different phases of EDLC, Modelling of EDLC; issues in Hardware-software Co-design, Data Flow Graph, state machine model, Sequential Program Model, concurrent Model, object oriented Model.

UNIT IV:
RTOS Based Embedded System Design

Introduction to basic concept of RTOS- Task, Process & threads, interrupt routines in RTOS, Multiprocessing and Multitasking, preemptive and non-preemptive scheduling, Task communication shared memory, message passing-, Inter process communication synchronization between processes- between processes-semaphores, Mailbox, pipes, priority inversion, priority inheritance, comparison of Real time Operating systems: Vx Works, C/OS-II, RT Linux.

Suggested Reading:

1. *Rajkamal, „Embedded System-Architecture, Programming, Design", Mc Graw Hill, 2013.*
2. *Peckol, "Embedded system Design", John Wiley & Sons,2010*
3. *Lyla B Das," Embedded Systems-An Integrated Approach", Pearson, 2013*

Program: Diploma
Semester: Fifth
Course: Seminar in Executive Communication
Course Code: 40D.401

L	T	P	C
0	2	0	0

Course Objective:

To impart more advanced basic skills through intensive practice, in this unit again the students get opportunities to apply their general awareness and classroom learning to practical situation to achieve the targeted career goal in this increasingly competitive world Some of the career oriented units are Discussion Skills, Interview Skills, Job Search Strategies , Job Correspondence etc. , they need to undergo ,

- *An average student acquires basic skills required for a cherished job.*
- *Their appreciative personality development becomes a value added attribute in their professional sphere.*
- The course enhances *communication*, leadership and teamwork *skills*; and personal development *skills* using practical approach and exposure of students to the realities of the world
- To put greater emphasis on development of non-technical skills, such as flexibility, leadership and good *communication*.

(Activity Based)

WORKSHOPS

- Debate
- Extempore
- Group Discussion
- Panel Discussion
- Presentation-Paper & Oral
- Reports: Survey Report, Project Report, Case Study

Suggested Books & Readings:

Monippally, Matthukutty. M. 2001. *Business Communication Strategies*. 11th Reprint. Tata McGraw-Hill. New Delhi

Swets, Paul. W. 1983. *The Art of Talking So That People Will Listen: Getting Through to Family,Friends and Business Associates*. Prentice Hall Press. New York

Lewis, Norman. 1991. *Word Power Made Easy.* Pocket Books

Sen , Leena .Communication Skills ; Eastern Economy Edition

Ghanekar , Dr. Anjali . Essentials of Business Communication Skills ; Everest Publishing House

David Green .*Contemporary English Grammar, Structure &Composition*; MacMillan Dictionary; Oxford, Dictionary; Longman

Websites

- www.tatamcgrawhill.com/digital_solutions/monippally
- www.dictionary.cambridge.org
- www.wordsmith.org
- www.edufind.com
- www.english_the_easy_eay.com
- www.englishclub.com
- www.english_grammar_lessons.com
- www.wikipedia.org/wiki/english_grammar