**17EE3203 – SWITCHGEAR AND PROTECTION**

**(EEE)**

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| **Course Category:** | Professional core | **Credits:** | 4 |
| **Course Type:** | Theory | **Lecture-Tutorial-Practical:** | 3-2-0 |
| **Pre-requisite:** | Power system equipment, power system Analysis, circuit analysis and field theory. | **Sessional Evaluation:****External Exam Evaluation:****Total Marks:** | 4060100 |

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| **Course Objectives:** | Students undergoing this course are expected : |
| 1.To learn protection against overvoltage and to insulation co-ordination2. To learn in detail about switchgear protective equipments.3. To learn about construction and operation of types of circuit breakers.4. To learn about types of relay operation.5. To learn about different relay applications.6.To learn about zones of protection and equipment protection in the  power system. |
| **Course Outcomes:** | After completing the course the student will be able to: |
| **CO1** | Gain knowledge in the field of over voltage protection. |
| **CO2** | Understand the application and operation of the fuses as well as on Arcing Phenomenon. |
| **CO3** | Gain knowledge in the operation and application of various types of circuit breakers in the real time applications of power system. |
| **CO4** | Understand the operation of different relays. |
| **CO5** | Understand the application of relays in the power system. |
| **CO6** | Understand about zones of protection and equipment of protection in the power system. |
| **Course Content:** | **UNIT-I****Over voltage protection:** Causes of over voltages in the power system, Phenomena of lightning, protection against direct strokes & indirect strokes, lightning arresters, zinc oxide lightning arrester, surge absorbers, surge diverters. **Insulation coordination:** Volt-time curve, basic impulse insulation levels of different equipments, insulation coordination of transformers, lightning arresters, bus bars and transmission lines. **UNIT-II****Fuses:** Definitions, characteristics, selection of fuses, types of fuses and applications.**Circuit breakers:** Arc phenomena, initiation & maintenance of arc, methods of arc interruption, restriking voltage and recovery voltages, restriking phenomenon, average and max. RRRV, expression for RRRV, resistance switching, single frequency transients, double frequency transients, current chopping, interruption of capacitive currents.**UNIT-III****Classification of circuit breakers:** Principle of operation & constructional features of oil, air blast, SF6 & vacuum CBs, ratings of CBs, testing of CBs, auto reclosures. **UNIT-IV****Protective relays:** Fundamental requirement of protective relays, primary and backup protection, principle of operation of protective schemes. **Classification of relays:** Types of Electromagnetic relays, over current relays, directional relays and non-directional relays, earth fault relays.**UNIT-V**Distance relays, negative sequence- differential and under frequency relays-applications.**Static relays:** Basic static relays used in protective scheme, classification of static relays, over current, directional, distance, differential relays. comparators, amplitude & phase comparators, duality.**UNIT-VI****Equipment protection:** Main considerations in equipment protection CTs and PTs and their applications in protection in protection schemes.**Feeder protection:** Transmission line, protection-bus bar protection.**Generator protection:** Protection for stator faults, rotor faults and protection for abnormal conditions.**Transformer protection:** Differential protection schemes-Buchholz relay.  |
| **Text books****&****Reference books:** | **Text books:**1.“Power system protection and switchgear”, by Badri Ram *&* D. N.  Vishwakarma*,* Tata-McGraw-Hill, 2nd Edition2.“Electrical power systems”, by C.L. Wadhwa, 7th Edition NAI  publishers.3.“A Course in power systems”, by J.B Gupta, Publisher: S.K. Kataria&  Sons*;* 11th Edition.**Reference books:**1. “Switchgear & protection”, by Sunil S Rao, Khanna Publishers.
2. “Power system protection & switchgear” by B*.* Ravindranath, and N*.* Chander*,* Wiley Eastern Limited.
3. “Electrical power”, by DrS L Uppal*,* Khanna Publishers.
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