|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Roll No |  |  |  |  |  |  |  |  |  |  |  |

PRESIDENCY UNIVERSITY BENGALURU

SCHOOL OF ENGINEERING

MAKEUP EXAMINATION - JULY 2024

|  |  |
| --- | --- |
| **Semester : 1st** | **Date :11/07/2024** |
| **Course Code :EEE3003** | **Time :9:30 am to 12:30 am** |
| **Course Name : Switchgear & Protection** | **Max Marks :100** |
| **Program : B.Tech & 6th Sem** | **Weightage :50%** |

**Instructions:**

1. *Read all questions carefully and answer accordingly.*
2. *Question paper consists of 3 parts.*
3. *Scientific and non-programmable calculator are permitted.*
4. *Do not write any information on the question paper other than Roll Number.*

|  |  |  |  |
| --- | --- | --- | --- |
| **PART A** | | | |
| **ANSWER ANY 5 QUESTIONS 5Q X 2M=10M** | | | |
| 1 | Recall the role of auxillary switchgear and principal switchgear in power system protection | (CO1) | [Knowledge] |
|  | | | |
| 2 | Summarize the significance of arc interruption theories for circuit breakers' construction and functionality. | (CO1) | [Knowledge] |
|  | | | |
| 3 | Examine and contrast the ways in which SF6 circuit breakers, vacuum circuit breakers, air circuit breakers, and oil circuit breakers operate. Talk about their design, functionality, benefits, and drawbacks. Give instances of where each kind of circuit breaker is used in the actual world. | (CO1) | [Knowledge] |
|  | | | |
| 4 | Using examples such as open-type, semi-enclosed re-wirable, D-type cartridge, and HRC fuses, please explain how each type of fuse works. You should talk about how they are made, how they work, and where they are used in electrical setups. Outline the benefits and drawbacks of each type of fuse and provide a comparative analysis. | (CO1) | [Knowledge] |
|  | | | |
| 5 | Provide an example of a real-world use of re-wirable type fuses and discuss their role in protective systems. | (CO2) | [Knowledge] |
|  | | | |
| 6 | Summarize an overview of how SF6 circuit breakers work and what makes them better than others. | (CO2) | [Knowledge] |
|  |  |  |  |
| 7 | State the differences and similarities between D-type cartridge fuses and HRC fuses, focusing on the functions and characteristics that set them apart. | (CO2) | [Knowledge] |
|  | | | |

|  |  |  |  |
| --- | --- | --- | --- |
| **PART B** | | | |
| **ANSWER ANY 5 QUESTIONS 5Q X 10M=50M** | | | |
| 8 | The notion of Current Setting in protective relaying refers to the predetermined amount of current at which the relay is designed to operate. It plays a crucial role in setting the operational characteristics of the relay. The Current Setting is modified depending on several system parameters, including fault current levels, load conditions, and coordination requirements. By considering these factors, the Current Setting may be optimized to ensure that the relay operates reliably and effectively in detecting and responding to faults. Summarize some examples to demonstrate how to determine the Current Setting in various types of protective relaying schemes. | (CO2) | [Understand] |
|  | | | |
| 9 | Analyze and differentiate various categories of circuit breakers, including air circuit breakers, vacuum circuit breakers, and SF6 circuit breakers, with respect to their structure, functioning, and practical uses. | (CO2) | [Understand] |
|  | | | |
| 10 | The Plug Setting Multiplier (PSM) is a concept used in protective relaying to determine the sensitivity of a relay to detect faults. It is a numerical value that is multiplied by the relay's current setting to establish the threshold at which the relay will trip and initiate protective actions. Examine the calculation process of PSM (Pickup Setting Multiplier) and its importance in determining the operational parameters of a relay. Offer instances to demonstrate the utilization of PSM in protective relaying methods. | (CO3) | [Understand] |
|  | | | |
| 11 | The figure below illustrates a protective mechanism. The graphic displays the overcurrent relays, denoted as R\_{1}, R\_{2}, R\_{3}, and R\_{4}, with respective time settings of 1 second, 500 milliseconds, 350 milliseconds, and 300 milliseconds. A, B, C, and D serve as the circuit breakers. Suppose a defect arises at point 'F' as depicted in the diagram. Which relay will exhibit a quicker response to the fault and why? Furthermore, elucidate the sequential process of the relay's operation in the event of primary protection failure. IMG_256 | (CO2) | [Understand] |
|  | | | |
| 12 | A Power system supplied by two Synchronous generators at the two buses X and Y respectively has been shown below. The Transmission line XY has positive sequence impedance of Z1 Ohms and zero sequence impedance of Z0 Ohms. An Single Line to Ground fault with zero fault impedance occurs at the centre of the transmission line in Phase R. Bus voltage at X and line current from X to F for the phase ‘R’, are given by Va Volts and Ia amperes, respectively. Impedance relay has been installed for the protection of transmission line at bus X. Explain how relay operate Single Line to Ground fault for this system. IMG_256 | (CO3) | [Understand] |
|  | | | |
| 13 | Consider the protection system shown in the figure below. The circuit breakers numbered from 1 to 7 are of identical type. A single line to ground fault with zero fault impedance occurs at the midpoint of the line (at point F), but circuit breaker 4 fails to operate (‘‘Stuck breaker’’). If the relays are coordinated correctly, Interpret a valid sequence of operation of circuit breakers out of the following operations (A) 1, 2, 6, 7, 3, 5 (B) 1, 2, 5, 5, 7, 3 (C) 5, 6, 7, 3, 1, 2 (D) 5, 1, 2, 3, 6, 7 by providing a proper explanation. IMG_256 | (CO2) | [Understand] |
|  |  |  |  |
| 14 | Examine the significance of accurate fuse selection in electrical installations. When choosing a fuse, it is important to take into account several criteria, including the current rating, voltage rating, and application requirements. Offer instances to demonstrate the repercussions of incorrect fuse selection and its potential effects on the safety and dependability of an electrical system. | (CO3) | [Understand] |
|  | | | |

|  |  |  |  |
| --- | --- | --- | --- |
| **PART C** | | | |
| **ANSWER ANY 2 QUESTIONS 2Q X 20M=40M** | | | |
| 14 | Consider a power system consisting of a transmission line protected by three distance relays located at different locations along the line. The line impedance is Z=0.4+j0.8 ohms per kilometer. The relays are set to operate for a reach of 80% of the line impedance. The line is 100 km long, and the fault occurs at a distance of 60 km from the source end. (Assume a fault clearing time of 0.1 seconds and a relay time delay of 0.05 seconds). a) Identify the unknown quantities that could be computed from the given data b) Compute the unknown parameters | (CO4) | [Understand] |
|  | | | |
| 15 | The output of an LVDT is connected to a 5 V voltmeter through an amplifier of amplication factor 250. An output of 2 mV appears across the terminals of LVDT when the core moves through a distance of 0.5 mm. the voltmeter has 100 divisions. The scale can be read to 1/5th of a division.  i) Identify the unknown parameters that could be computed from the given data ii) Compute the unknown parameters | (CO3) | [Understand] |
|  | | | |
| 16 | The Table provides the time-current (PSM) characteristic of an overcurrent relay for a TMS of 1. Given that the current plug setting is set at 50% and the time multiplier is set at 0.75. The fault current is 3000 A and the relay is connected to a current transformer (CT) ratio of 400/5. a) Identify the unknown quantities that could be computed from the given data b) Compute the unknown quantities  IMG_256 | (CO2) | [Understand] |