

**BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI  
(END SEMESTER EXAMINATION)**

**CLASS: M.TECH.  
BRANCH: EEE**

**SEMESTER : II  
SESSION : SP/22**

**SUBJECT: EE563 ADVANCED POWER SYSTEM PROTECTION**

**TIME: 2HOURS**

**FULL MARKS: 50**

**INSTRUCTIONS:**

1. The question paper contains 5 questions each of 10 marks and total 50 marks.
  2. Attempt all questions.
  3. The missing data, if any, may be assumed suitably.
  4. Before attempting the question paper, be sure that you have got the correct question paper.
  5. Tables/Data hand book/Graph paper etc. to be supplied to the candidates in the examination hall.
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Q.1(a) Analyze the performance of computer relays over electromagnetic and static relays, particularly with respect to multi-functionality, programmability, and communication. [5]

Q.1(b) Develop a digital relay algorithm for monitoring of voltage phasors of power system using 3 sample algorithms. Assume the voltage waveforms are pure sinusoidal waveforms. [5]

Q.2(a) Analyze whether a numerical impedance relay set at 3 Ohms will operate or not .The voltage and current samples are given below, assume sampling frequency 12.5 KHz. Using 3 sample technique determine Z seen by the relay for evaluating the operation of the relay. [5]

Samples	1	2	3	4
v(t)	-150.000	-143.4269	-136.7634	-130.0136
i(t)	-10	-9.9968	-9.9873	-9.9716

Q.2(b) Evaluate the performance of numerical transformer protection is based on IEEE Std IEEE C37.91-200 using discrete Fourier transform algorithm to extract the fundamental phasor component and 2nd harmonic component from the given samples. The sampling frequency is 200 Hz and operating frequency is 50Hz. [5]

v(t)	0	224.9999	0.3902	-224.999
i(t)	-2.55	4.2416	2.5573	-4.2379

Q.3(a) Design of protection system for large synchronous generators based on the IEEE C37.102 standards includes the protection against inter-turn fault. Analyse its effectiveness using a block diagram representation of the relay. [5]

Q.3(b) A 400 kV transmission line from Kolaghat to Jeerat is 130 km long and the adjoining 400 kV line from Jeerat to Subhasgram is 80 km long. Design the 3 zone protection scheme for the entire length of transmission. The transmission line has resistance of 0.0297  $\Omega$ /km and reactance of 0.332  $\Omega$ /km. [5]

Q.4(a) Based on block diagram for architecture for WAMS, evaluate the performance of phasor measurement unit assisted WAMS based protection with respect to hidden failures, security and dependability. [5]

Q.4(b) Design a PMU Data archival system (DAS) for PDC with minimum possible size storage is 10 bytes per time-value pair (4 bytes for time, 4 for data, and 2 for flags) within a historian for a month. Assume that a PDC that collects data from 20 PMUs. Each PMU sends 4 time-value pair measurements (voltage, current, frequency, ROCOF) each at 30 samples per second within a historian system. [5]

Q.5(a) Design philosophy of system integrity protection (SIPS) is based on architecture, geographical area, events and applications. Accordingly give a classification of the SIPS. [5]

Q.5(b) Evaluate System Integrity Protection Scheme (SIPS) as mandated by IEEE, USA and NERC (North American Electric Reliability Corporation (NERC), incorporating Special Protection Schemes (SPS) and Remedial Action Schemes (RAS) and other additional protections. [5]

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