Total No. of printed pages = 7

**END SEMESTER EXAMINATION – 2019**

Semester : 6th

Subject Code : CAI-603

**SUBSTATION, SWITCHGEAR AND PROTECTION**

Full Marks –70

Time – Three hours



The figures in the margin indicate full marks for the questions.

**Instructions :**

1. Questions on PART–A are compulsory.
2. Answer any *five* questions from PART–B.

PART – A

Marks – 25

1. Fill in the blanks : 1×10=10

   (a) Under normal operating condition, the contacts of the circuit breaker remain _____.

   (b) For greater flexibility, _____ bus-bar system is used in substations.

[Turn over

(c) Under fault conditions, _____ supplies information to the circuit breaker to open.

(d) A fuse has _____ time-current characteristics. (linear/inverse)

(e) The minimum relay coil current at which the relay operates is called _____.

(f) Induction relays are used with _____ quantities. (AC/DC both AC and DC)

(g) The chief cause of over speed in the alternator is _____. (sudden increase of load / sudden loss of load)

(h) In India, the frequency of AC voltages is _____.

(i) _____ system is used for transmission of power to long distances. (3-phase, 3-wire/3-phase, 4-wire)

(j) The operator 'a' rotates a vector by _____ in the anti-clockwise direction. (120°/90°/180°)





2. Write true or false : 1×10=10

(a) The most common type of 3-phase unsymmetrical fault is single line to ground fault.

(b) The operator 'j' rotates a vector by 90° anti-clockwise direction.

(c) A circuit breaker opens automatically when a fault occurs on the system.

(d) HRC fuses are used widely in industries. The full form of HRC fuse is High Resonance Capacity fuse.

(e) The outdoor type switchgear is generally used for voltage beyond 1000 volt.

(f) Buchholz relay can detect faults above oil level in the transformer.

(g) In solid grounding method, the neutral point of three phase system is directly connected to earth through a conductor of negligible resistance.

(h) The unit of capacitive reactance is farad.

(i) In pure resistive circuit, voltage and current are not in the same phase.

(j) The melting point of a fuse element should be very low.

3. Choose the correct option : 1×5=5

(a) The arcing contacts in a circuit breaker are made of

(i) copper tungsten alloy

(ii) aluminium

(iii) porcelain

(iv) electrolytic copper

(b) An ideal electric transformer is a device which can change

(i) electric power

(ii) only voltage level

(iii) voltage and frequency both

(iv) only current and power

(c) Current transformer is basically a

(i) step down transformer

(ii) variable differential transformer

(iii) current maximizer

(iv) step up transformer





(d) The nature of the fault L-L-G is

(i) symmetrical

(ii) unsymmetrical

(iii) can't be determined

(iv) depends on the conductor size

(e) The laws of electromagnetic induction was given by

(i) W. C. Rontgen

(ii) N. Bohr

(iii) Michael Faraday

(iv) None of the above.

## PART – B

Marks – 45

4. (a) What are the fundamental requirements of protective relaying ? 3

(b) "A protective relay is a device which detects the fault and initiates the operation of circuit breaker to isolate the defective element from the rest of the system." Explain with a neat diagram, how a relay detects an abnormal condition in the system and send a signal to the circuit breaker to initiate its operation. 6

5. "Alternators are the heart of the power system. They generate electrical energy and supply to the power grid. Failure of an alternator in the generating station causes reduction of energy generation which may affect the supply of power to large numbers of consumers." Explain about the following faults that may occur on an alternator : 9

(i) Failure of the prime mover

(ii) Failure of the field

(iii) Over speed

(iv) Unbalance loading

6. (a) Draw a neat diagram of 11 KV/ 400V indoor substation with essential parts. 4

(b) Briefly write about the classification of substations. 5

7. With neat diagram, briefly discussed about the primary and back-up protection scheme of power system. 9

8. (a) What do you mean by equipment grounding and system grounding ? 2+2=4





(b) Write five advantages of neutral grounding. 5

9. (a) What are electromagnetic attraction relays and how they are classified ? 4

(b) Derive an expression for net force developed in an induction type relay. 5

10. Briefly write about the working of $SF_6$ circuit breaker. Also mention some important advantages of this circuit breaker. 9