Total No. of printed pages = 8

CAI-603/SS&P/6th Sem/2018/M

SUBSTATION, SWITCHGEAR AND PROTECTION

Full Marks – 70

Time – Three hours

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

PART – A

Question Nos. 1-14, fill up the blank with the proper word given in the bracket.

(One mark each) 1×4=4

1. A fuse element should have ——— melting point. (low / high)

2. A fuse have ——— time-current characteristics. (linear / inverse)

3. Induction relays are used with ——— quantities. (AC / DC / both AC and DC)

4. Back-up protection is generally employed for protection against ——— faults. (short circuit/ other than short circuit)

[Turn over

5. Buchholz relay is a ——— actuated relay. (voltage / gas / current)

6. A potential transformer is a step ——— transformer. (up / down)

7. In voltage balance differential protection systems, the secondaries of two identical current transformers are connected in ———. (series / series opposition)

8. The chief cause of over speed in an alternator is the ———. (sudden loss of load / sudden increase of load)

9. In equipment grounding, the encloser is connected to ——— wire. (neutral / ground)

10. The colour of the ground wire should be ———. (black / green)

11. Most of the faults on an overhead system are ——— faults. (phase to earth / phase to phase)

12. In AC system, addition and subtraction of currents and voltages are done ———. (arithmetical / vector)

13. The basic unit of energy is ———. (Joule / Watt)

14. Power factor correction substations are generally located at the ——— end of a transmission line. (sending / receiving)

Question Nos. 15-17, fill up the blank. (One mark each) 1×3=3

15. In sulphur hexafluoride circuit breakers, the arc quenching medium is ———.

16. In a single phase two winding transformer, energy transferred from primary to secondary through the ———.

17. Current transformers are used in the substations for the measurement of ———.

Question Nos. 18-25, choose the most appropriate option. (One mark each) 1×8=8

18. In star-delta starting method of 3-phase induction motors

(a) The stator is connected in star during the starting period.

(b) The stator is connected in delta during the starting period.

(c) All the three windings of stator are connected in series during the starting period.

(d) All the three windings of stator are connected in parallel during the starting period.

19. In a R-L AC series circuit

(a) Current leads the applied voltage by an angle of 30°.

(b) Current lags the applied voltage by an angle of 30°.

(c) Current lags the applied voltage by an angle of 90°.

(d) Current lags the applied voltage.

20. The concept of symmetrical component method is widely used for fault calculation in electrical engineering. It was first given by

(a) Michael Faraday

(b) Nikola Tesla

(c) Isaac Newton

(d) Dr. C. L. Fortescue

21. An impedance of $(2 - j.3)\Omega$ is connected across an AC source of output $(230 + j.0)V$. The magnitude of current will be

(a) $35.34 + j.53.01$

(b) $35.34 - j.53.01$

(c) $r = 63.71, \theta = -56.31$

(d) $r = 93.71, \theta = -56.31$

22. Protective relays are devices that detect abnormal conditions in electrical circuits by measuring

(a) current during abnormal condition

(b) voltage during abnormal condition

(c) constantly the electrical quantities which differs during normal and abnormal conditions

(d) None of the above

23. The arcing contacts in a circuit breaker are made of

(a) Copper tungsten alloy

(b) Aluminium

(c) Porcelain

(d) Electrolytic copper

24. The nature of the fault L-L-G is

(a) symmetrical

(b) unsymmetrical

(c) can't be determined

(d) depends on the conductor size

25. The laws of electromagnetic induction was given by

(a) W. C. Rontgen

(b) N. Bohr

(c) Michael Faraday

(d) None of the above.

PART – B

Answer any *three* questions.

1. (a) How circuit breakers are classified ? Write about the classifications. 1+2=3

(b) Write about any one method of arc extinction in circuit breaker. 7

(c) Write five advantages of SF_6 circuit breaker. 5

2. (a) In electric power generating stations why generated voltage is stepped up ? With a neat diagram, show how electric power is transmitted from the generating station through various substations in its way to the retail consumers. 9

(b) Draw the symbols of the following equipments : 0.5×4=2

(i) Earth fault relay

(ii) Vacuum circuit breaker

(iii) Lightning arrester (active gap)

(iv) Over current relay

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

3. (a) With a neat diagram, explain the construction and operation of induction type directional power relay. 8

(b) "A protective relay is a device which detects the fault and initiate 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. 7

4. (a) "Selectivity, sensitivity and reliability are the three important fundamental requirements of protective relaying." Explain briefly. 9

(b) What are the different types of electro-magnetic attraction relays ? Briefly write about them. 6

5. (a) "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. 10

(i) Failure of the prime mover

(ii) Failure of the field

(iii) Over speed

(iv) Unbalance loading

(b) Briefly write about the application of current and potential transformers in power system. Draw necessary diagrams.

2.5+2.5=5