

Reg. No.

Question Paper Code

13063

B.E. / B.Tech. - DEGREE EXAMINATIONS, NOV / DEC 2024

Sixth Semester

Electrical and Electronics Engineering

20EEEL602 – HIGH VOLTAGE ENGINEERING

Regulation - 2020

Duration: 3 Hours

Max. Marks: 100

PART - A (MCQ) (20 × 1 = 20 Marks)

Answer ALL Questions

- | | <i>Marks</i> | <i>K – Level</i> | <i>CO</i> |
|---|--------------|------------------|-----------|
| 1. The primary cause of lightning over voltages in power systems is _____
(a) Switching of transformers (b) Sudden change in power demand
(c) Atmospheric discharges (d) Equipment failures | 1 | K1 | CO1 |
| 2. Corona loss in transmission lines increases with _____
(a) Higher atmospheric pressure (b) Smaller conductor diameter
(c) Lower operating voltage (d) Decreased humidity | 1 | K1 | CO1 |
| 3. A transmission line terminated with an open circuit causes a reflected wave to have _____
(a) The same voltage and polarity (b) Opposite polarity
(c) Zero voltage (d) Reduced amplitude | 1 | K1 | CO1 |
| 4. The principle is employed in a lightning arrester is _____
(a) Absorption of energy (b) Impedance matching
(c) Ionization of air gap (d) Reflection of traveling waves | 1 | K1 | CO2 |
| 5. In a uniform electric field, the breakdown voltage of a gas is primarily influenced by _____
(a) Electrode material and gas pressure
(b) Gas type and electrode gap distance
(c) Electrode gap distance and field uniformity
(d) Type of applied voltage and gas ionization energy | 1 | K1 | CO2 |
| 6. Vacuum breakdown primarily depends on _____
(a) Gas ionization
(b) Electron field emission from electrode surfaces
(c) Corona formation around electrodes
(d) Conduction path through residual gases | 1 | K1 | CO2 |
| 7. The breakdown voltage of a commercial insulating oil is significantly lower than pure oil due to _____
(a) Higher viscosity of commercial oil
(b) Contaminants and moisture in the oil
(c) Enhanced molecular stability of commercial oil
(d) Additives increasing field strength in commercial oil | 1 | K1 | CO2 |
| 8. To improve the long-term reliability of solid insulation in a power system, it is critical to _____
(a) Use thinner insulation layers for better flexibility
(b) Apply coatings to prevent surface tracking and treeing
(c) Operate at voltages close to the breakdown strength
(d) Use insulating materials with low thermal conductivity | 1 | K1 | CO2 |

9. In a high-voltage DC testing setup, a rectifier circuit is used with a voltage multiplier. The primary purpose of the multiplier is to _____ 1 K1 CO3
 - (a) Stabilize the output voltage
 - (b) Increase the DC voltage beyond the transformer's peak output
 - (c) Reduce ripple in the DC output
 - (d) Regulate input frequency variations
10. Impulse voltages are typically generated using a _____ 1 K1 CO3
 - (a) Multi-stage Marx generator
 - (b) Voltage doubler circuit
 - (c) Cockcroft-Walton multiplier
 - (d) Rotary spark gap generator
11. In an impulse current generator, if the peak current does not reach the desired value, the likely solution is to _____ 1 K1 CO3
 - (a) Reduce the inductance in the circuit
 - (b) Increase the damping resistor value
 - (c) Increase the voltage rating of the capacitor bank
 - (d) Shorten the discharge path
12. In high-voltage impulse testing of transformers, the wave shape is defined by _____ 1 K1 CO3
 - (a) Charging voltage and discharge resistor values
 - (b) Inductance of the test object and damping capacitance
 - (c) Series resistance, capacitance, and load inductance
 - (d) Triggering voltage and input frequency
13. A high resistance with a series ammeter is primarily used for measuring _____ 1 K1 CO4
 - (a) High currents in low-resistance circuits
 - (b) Leakage currents in high-voltage circuits
 - (c) Voltage across capacitive loads
 - (d) Ground fault currents in power systems
14. A capacitive divider is commonly used in high-voltage measurement because _____ 1 K1 CO4
 - (a) It eliminates power losses completely
 - (b) It allows proportional voltage scaling without significant heating
 - (c) It provides excellent accuracy for DC measurements
 - (d) It reduces high-frequency distortions
15. A capacitance voltage transformer (CVT) is primarily used for _____ 1 K1 CO4
 - (a) Step-up voltage applications
 - (b) High-frequency signal measurement
 - (c) Voltage measurement in power transmission systems
 - (d) Power factor correction in transmission lines
16. During a sphere gap test for high-voltage measurement, the breakdown occurs at a lower voltage than calculated. The probable cause is _____ 1 K1 CO4
 - (a) Excess humidity in the surrounding air
 - (b) Larger electrode spacing
 - (c) Low surface roughness of the spheres
 - (d) Insufficient calibration of the test equipment
17. High voltage testing of electrical apparatus is primarily performed to _____ 1 K1 CO5
 - (a) Determine the mechanical strength of components
 - (b) Ensure the safety and reliability of insulation under extreme conditions
 - (c) Test the energy efficiency of electrical equipment
 - (d) Verify the harmonic content in power system
18. According to international standards (IEC), the test voltage for high-voltage testing of insulators should _____ 1 K1 CO5
 - (a) Be 10% higher than the rated system voltage
 - (b) Be 20-50% higher than the maximum operating voltage
 - (c) Match the rated voltage of the equipment
 - (d) Be lower than the operating voltage for safety

19. During an impulse voltage test on a transformer, the observed wave front is slower than specified. This could be caused by_____ 1 K1 CO5
 (a) Insufficient charging of the impulse generator
 (b) High resistance in the test circuit
 (c) Poor grounding of the equipment under test
 (d) Excessive inductance in the impulse generator circuit
20. The primary objective of insulation coordination in high voltage systems is to: 1 K1 CO5
 (a) Minimize the cost of insulation
 (b) Ensure all equipment can withstand the same test voltage
 (c) Protect equipment from over voltages by selecting proper insulation levels
 (d) Test for mechanical stability of insulators

PART - B (10 × 2 = 20 Marks)

Answer ALL Questions

21. Define switching surges and mention two scenarios in which they occur in a power system. 2 K2 CO1
22. Explain the role of a surge diverter in overvoltage protection. 2 K2 CO1
23. Identify the two essential properties of dielectric materials used in electrical insulation. 2 K2 CO2
24. Identify two common mechanisms of breakdown in solid dielectrics. 2 K2 CO2
25. State the significance of the Marx circuit in generating high impulse voltage. 2 K1 CO3
26. List two practical applications of switching surge generators. 2 K2 CO3
27. Explain why the capacitance voltage dividers preferred for high ac voltage measurements. 2 K1 CO4
28. Define a mixed potential divider. How is it used for impulse voltage measurements? 2 K1 CO4
29. Define basic impulse insulation level. 2 K2 CO5
30. Explain how the salt-fog test is conducted on insulators. 2 K1 CO5

PART - C (6 × 10 = 60 Marks)

Answer ALL Questions

31. a) Discuss with diagrams how lightning protection systems like ground wires and lightning arresters are used to protect power systems. 10 K2 CO1
OR
 b) Explain the mathematical expressions for reflection and refraction coefficients in traveling waves and discuss their implications on overvoltage propagation. 10 K2 CO1
32. a) Compare vacuum breakdown with gaseous breakdown, emphasizing their respective mechanisms and implications. 10 K2 CO2
OR
 b) Discuss the applications of insulating materials in electrical equipment. Provide examples of materials used for different voltage ranges and their specific properties. 10 K2 CO2
33. a) A ten stage cockcroft-Walton voltage multiplier circuit has all capacitors of 0.05 μF. The secondary voltage of the supply transformer is 120 k at a frequency of 150 Hz. If the load current is 1.2 m, determine the following (i) voltage regulation, (ii) percentage of ripple voltage, (iii) the optimum number of stages for maximum output voltage, (iv) the maximum output voltage. 10 K2 CO3

OR

- b) Illustrate the principle of impulse current generation. Describe the construction of a typical impulse current generator with diagrams. 10 K2 CO3
34. a) Describe with neat diagram, the working principle and operation of an electrostatic voltmeter for measuring high voltages. 10 K2 CO4
- OR**
- b) i) Discuss the detailed procedure for measuring peak value of very high DC and impulse voltages using standard sphere gaps. 5 K2 CO4
- ii) Identify the different type of resistive shunt used for impulse current measurements. 5 K2 CO4
35. a) Explain in details about the procedure for conducting power frequency, impulse voltage and thermal tests on high voltage bushings. 10 K2 CO5
- OR**
- b) Demonstrate the various tests to be carried out on a Circuit Breaker. 10 K2 CO5
36. a) i) Examine the construction and working of a Van de Graaff generator. 5 K2 CO4
- ii) Mention the tests to be conducted on circuit breakers. Explain in detail. 5 K2 CO5
- OR**
- b) i) Explain Rogowski coil methods for measurement of high impulse current. 5 K2 CO4
- ii) Mention the tests to be conducted on isolators. Explain in detail. 5 K2 CO5