

KATHMANDU UNIVERSITY
End Semester Examination
July, 2018

Level : B.E.
Year : IV

Course : EPEG 409
Semester : II

Exam Roll No. :

Time: 30 mins.

F. M. : 10

Registration No.:

Date

JUL 16 2018

SECTION "A"

[20 Q × 0.5 = 10 marks]

Encircle the most appropriate answer for the following questions:

1. Average electrical field is the magnitude of electrical field
 - a. at midpoint between conductors
 - b. ratio of potential difference to the distance between the conductors
 - c. at surface of the lower potential electrode
 - d. ratio of potential difference to half the distance between the conductors
2. Ionization coefficients α and γ are functions of
 - a. applied voltage
 - b. pressure and temperature
 - c. electric field
 - d. ratio of electric field to pressure
3. Pachen's law states that
 - a. breakdown voltage is a function of electric field
 - b. breakdown voltage is a function of pd
 - c. α and γ depends on E/p
 - d. Electronegative gases have high breakdown voltage
4. The requirement of gases for insulation purpose is
 - a. high dielectric strength and thermal stability
 - b. high dielectric strength
 - c. high thermal stability
 - d. high thermal stability and low temperature condensation
5. Streamer mechanism of breakdown explains the phenomena of electrical breakdown of ...
 - a. very short spark gaps
 - b. when pd is less than 1000 torr-cm
 - c. very long gaps where field is non-uniform
 - d. spark gaps subjected to impulse voltage
6. Stressed oil volume theory is applicable when
 - a. small volume of liquid is involved
 - b. large volume of liquid is involved
 - c. large gap distance is involved
 - d. pure liquids are involved
7. The relation between breakdown strength and gap distance in liquid dielectrics is V_b ...
 - a. K/d
 - b. Kd^n
 - c. Kd^{-n}
 - d. (K_1d+K_2)
8. Long-term deterioration and breakdown occurs in solid dielectrics due to
 - a. thermal breakdown
 - b. surface discharges
 - c. internal discharges
 - d. treeing phenomenon

9. The material used for insulation that is exposed to atmosphere is
 a. ceramic b. polyesters c. plastics d. rubber
10. Thermal classification of insulating materials is done for
 a. gases b. liquids c. solids d. composite insulation
11. Tesla coil is used for
 a. generation of sinusoidal output voltages
 b. generation of very high voltages
 c. generation of rectangular voltages
 d. generation of high frequency a.c. voltages
12. Time to front of an impulse voltage waveform is defined as
 a. 1.25 times the interval between 0.1 to 0.9 of peak value
 b. time interval between 0.1 to 0.9 of peak value
 c. 1.67 times the interval between 0.1 to 0.9 of peak value
 d. 1.5 times the interval between 0.1 to 0.9 of peak value
13. In an impulse current generator the capacitors are connected in
 a. series
 b. parallel
 c. parallel while charging and in series while discharging
 d. connected in series-parallel while discharging
14. A trigetron gap is used with
 a. cascade transformers units b. impulse current generator
 c. impulse voltage generator d. dc voltage double units
15. A generating voltmeter is used to measure
 a. impulse voltage b. ac voltage
 c. dc voltage d. high frequency ac voltage
16. Electrostatic voltmeters can measure
 a. only dc voltage b. both dc and ac voltages up to high frequency
 c. impulse voltage d. ac, dc and impulse voltage
17. Sphere gap measurement is linear and valid for gap spacing less than or equal to
 a. radius of the sphere b. diameter of the sphere
 c. half the radius of sphere d. two times diameter of the sphere
18. Hall generators are normally used to measure
 a. impulse voltages b. unidirectional impulse currents
 c. any type of impulse currents d. large ac currents
19. Standard atmospheric condition as per Indian Standard Specifications are ...
 a. Temp = 27°, pressure = 1013 millibans and humidity = 17gms/m³
 b. Temp = 20°, pressure = 1013 millibans and humidity = 11gms/m³
 c. Temp = 27°, pressure = 1013 millibans and humidity = 11gms/m³
 d. Temp = 27°, pressure = 1000 millibans and humidity = 17gms/m³
20. Most important tests conducted on isolators and circuit breakers are
 a. Voltage withstand tests b. short circuit tests
 c. high current tests d. temperature rise tests

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SECTION "B"
[5Q × 8 = 40 marks]

Attempt *ANY FIVE* questions. Assume necessary data if required.

1. a. Comment on the estimation of electrical field in a single dielectric medium. [2]
b. Define Townsend's first and second ionization coefficients. Explain how these coefficients could be determined experimentally. [3]
c. Explain the streamer theory of breakdown in gases. Also explain Paschen's Law for gases dielectrics with its breakdown voltage versus pd curve. [3]
2. a. In an experiment for determining the breakdown strength of transformer oil, the following observations were made. Determine the power law dependence between the gap spacing and the applied voltage of the oil. [2]

Gap spacing (mm):	4	6	10	12
Voltage at breakdown (kV) :	90	140	210	255

b. Describe the factors that affect conduction in pure liquids and commercial liquids. [3]
c. Explain the breakdown of solid dielectrics by treeing, tracking and internal discharges. [3]
3. a. Figure-1 shows a solid dielectric sample having dielectric constant of 4 and thickness of 10 mm. The sample has an internal cavity of thickness 1 mm and is subjected to a voltage of 80 kV (rms). If the cavity is air-filled and if the breakdown strength of air can be taken as 30 kV (peak)/cm, find the voltage at which an internal discharge can occur. [3]

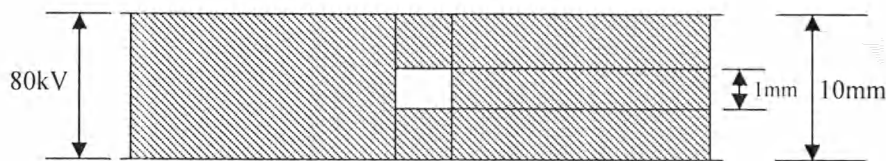


Figure-1

- b. Why is a Cockcroft-Walton circuit preferred for voltage multiplier circuits? Describe the working of Cockcroft-Walton voltage multiplier with its circuit diagram. [3]
- c. Explain any one method of controlled tripping of impulse generators. Why is controlled tripping necessary? [2]
4. a. Explain the different schemes for cascade connection of transformers for producing very high a.c. voltages. [3]
b. Draw the circuit diagram for the Marx circuit of multistage impulse generator and describe the components of the impulse generator. [3]
c. What is capacitance voltage transformer? Explain it can be used for voltage measurements in powersystems. [2]

5. a. Explain the resistance voltage divider circuit for the measurement of high dc voltage. [3]
- b. Explain how a sphere gap can be used to measure the peak value of voltages. What are the parameters and factors that influence such voltage measurement? [3]
- c. List the different test carried out on high voltage cables and insulators. [2]
6. a. A 8-stage Cockcroft-Walton circuit has all capacitors of 0.05 μ F. The secondary voltage of the supply transformer is 125 kV at a frequency of 150 Hz. If the load current is 5 mA, determine the followings: (i) percentage ripple, (ii) the voltage regulation, and the optimum number of stages for maximum output voltages. [4]
- b. What is a time lag for breakdown? Explain. [2]
- c. Describe the working of an electrostatic voltmeter used for high ac voltage measurement. [2]

Useful Formulae:

$$V_b = K.d^n, \rho = \frac{R\pi r^2}{t}, R_p = \frac{V}{(D \times G)}, G = \frac{V}{R_s} \times \frac{1}{n} \times \frac{1}{D_s}, r = r_1 + \frac{g}{2} \delta, R = \frac{C_1}{\tau}, R = \frac{t}{C_1 \ln \frac{V_0}{V}},$$

$$\tan \delta = \frac{1}{\omega CR}, V_l = \frac{V d_1}{d_1 + \left(\frac{\epsilon_0}{\epsilon_1}\right) d_2}, W_{d.c.} = E^2 \sigma, W_{a.c.} = \frac{E^2 f \epsilon_r \tan \delta}{1.8 \times 10^{12}}, t_1 = 3.0 R_l \frac{C_1 C_2}{C_1 + C_2}, t_2 = 0.7 (R_l + R_2)$$

$$(C_1 + C_2), F = \frac{1}{2} \epsilon_0 \left(\frac{V}{s}\right)^2 A, n_{\text{optimum}} = \sqrt{\frac{V_{\text{max}} f C}{I}}, \delta V = \frac{I}{f C} \frac{n(n+1)}{2}, \Delta V = \frac{I}{f C} \left(\frac{2}{3} n^3 + \frac{n^2}{2} - \frac{n}{6}\right),$$

$$I_{\text{rms}} = \frac{V C_m}{\sqrt{2}} \omega$$
