

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

CLASS: BE  
BRANCH: EEE

SEMESTER : VII  
SESSION : MO/13

SUBJECT: EE7107 HIGH VOLTAGE ENGINEERING

TIME: 3.00 HOURS

FULL MARKS: 60

INSTRUCTIONS:

1. The question paper contains 7 questions each of 12 marks and total 84 marks.
2. Candidates may attempt any 5 questions maximum of 60 marks.
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.

- Q1. (a) Explain the two important conditions to be satisfied for a collision of an electron with an atom to be ionizing one. [2]  
(b) What is meant by the withstand strength of an insulation? Are the withstand strength and breakdown strength constant for an insulating material? [4]  
(c) Why is grounding very important in an HV laboratory? Describe a typical grounding system used. [6]

- Q2. (a) What is time lag? Discuss its components and factor which affect these factors. [2]  
(b) Explain the processes of breakdown in electronegative gases. [4]  
(c) The following table gives experimental results for studying Townsend's mechanism. The field is kept constant. [6]

Gap Distance (mm)	Observed Current
0.5	$1.5 \times 10^{-13}$
1.0	$5.0 \times 10^{-13}$
1.5	$8.5 \times 10^{-13}$
2.0	$1.5 \times 10^{-12}$
2.5	$5.6 \times 10^{-12}$
3.0	$1.4 \times 10^{-10}$
3.5	$1.4 \times 10^{-10}$
4.0	$1.5 \times 10^{-9}$
5.0	$7.0 \times 10^{-7}$

The minimum current observed is  $6 \times 10^{-14}$  A. Determine the values of Townsend's first and second ionization coefficients.

- Q3. (a) Give difference between pure and commercial liquids used for insulation purpose. [2]  
(b) What is the effect of solid impurities in the oil on the breakdown strength of liquids? [4]  
(c) Explain the various theories that explain breakdown in commercial liquid dielectrics. [6]

- Q4. (a) What is composite dielectric and what are its properties? [2]  
(b) What is thermal breakdown in solid dielectric? [4]  
(c) Explain the phenomenon 'treeing and tracking' in solid insulating materials under electrical stress. How does it lead to breakdown? [6]

- Q5. (a) What do you mean by a 2000kV, 1.2/50 impulse voltage? [2]  
(b) A voltage multiplier has ten stages with capacitances, all equal to 0.05 microfarad. The supply transformer secondary voltage is 100kV at a frequency of 100Hz. If the load current to be supplied is 5mA, find the regulation and percentage ripple. [4]  
(c) A four stage Cockroft - Walton cascade circuit with capacitances all equal to 0.05 microfarad, is fed from 150kV. If 1.7mA of current is to be supplied to the load by this circuit, determine [6]  
(i) The ripple,  
(ii) The voltage drop and regulation if the supply frequency is 50Hz and 150Hz. Calculate the same parameters for an eight - stage generator for a load current of 3.5mA, the supply frequency being 150Hz.

- Q6. (a) What is a mixed potential divider? [2]  
(b) Explain with diagram, different types of rectifier circuits for producing high DC voltages. [4]  
(c) An electrostatic voltmeter has two parallel plates. The movable plate is 10 cm in diameter. With 10kV between the plates the pull is  $5 \times 10^{-3}$  N. Determine the change in capacitance for a movement of 1 mm of moveable plate. [6]

- Q7. Write short note on [4]  
(i) Transmission losses [4]  
(ii) Bundled conductors [4]  
(iii) Equivalent circuit of HVDC system [4]