B.E. ELECTRICAL ENGINEERING FOURTH YEAR FIRST SEMESTER SUPPLEMENTARY EXAM - 2024

SUBJECT: HIGH VOLTAGE TECHNIQUE - I

Time: Three Hours | Full Marks 100 (50 Marks for each part)

Use a separate Answer-Script for each part
(Two marks for well-organized answers)
Answer Any Three Questions

Question No.		Part I	Marks
1.	(a)	Explain how singularity problem is eliminated in Charge Simulation Method for single-dielectric as well as multi-dielectric systems.	6
	(b)	Discuss about the criteria, which are commonly used to estimate the simulation accuracy of numerical electric field computation.	4
	(c)	The field utilization factor for two long parallel cylinders is given by the following expression: $$\therefore f = \frac{E_{max}}{E_{av}} = \frac{\sqrt{\left(d/2\right)^2 - r^2}}{r \ln\left[\frac{d}{2r} + \frac{1}{r}\sqrt{\frac{d^2}{4} - r^2}\right]}$$ where, the symbols have their usual meaning. Hence, determine the break down voltage in air for a long horizontal cylinder of diameter 15cm, when the axis of the cylinder is at a height of 25cm from the earth surface. Assume standard temperature and pressure.	6
2.	(a)	Explain how Finite Element formulation for electric field calculation in single homogeneous medium can be extended for use in multi-dielectric media.	6
	(b)	Derive Finite Difference equation for unknown node potentials in three-dimensional system with unequal nodal distances.	5
	(c)	Explain how Finite Difference Method can be used for infinity extended unbounded region, e.g. an isolated spherical electrode located above the earth surface at a certain height, where no defined boundary exists apart from the electrode and earth surfaces.	5
3.	(a)	For the two-dimensional multi-dielectric system shown in Fig.1, write the FDM equations for the unknown node potentials. Derive the formulae used.	6+6

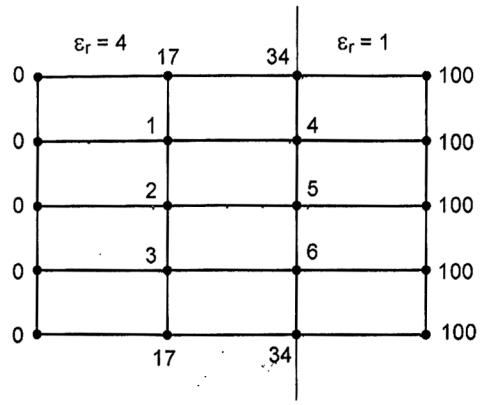

Fig.1 Pertaining to Question No. 3(a)

(b) For FDM formulation in multi-dielectric media, what will be the problem, if two different dielectric media lie between two successive nodes? 4

4. (a) Discuss about the effect of the ratio of inner cylinder radius to outer cylinder radius on the uniformity of field distribution in the case of co-axial cylindrical system, where the inner cylinder is live and the outer cylinder is earthed. 6

(b) A cylindrical gas bubble is placed in uniform field as shown in Fig.2. Determine the magnitudes of electric potential and electric field intensity at the point A. Assume that the electric potential on the axis of the cylinder is 20kV. Derive the formulae used. 10

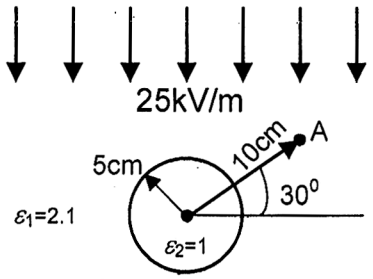

Fig.2 Pertaining to Question No. 4(b)

5. (a) A small spherical metallic particle is present in a gas insulated system having a uniform field of intensity 60kVp/cm. The breakdown strength of the gas in the GIS is 150kVp/cm. Explain whether partial discharge will take place due to the presence of the metallic particle or not. 8

(b) Explain how the method of successive imaging can be applied to find the field utilization factor for sphere-gap arrangement, where one sphere is live and the other sphere is earthed. 8

EX/EE/PE/B/T/414B/2024(S)

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High Voltage Technique – I

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Full Marks 100
(50 marks for each part)

Part - II

Use a separate Answer-Script for each part

Answer any three questions.

Two marks are reserved for well organized answers.

1.a)	Explain in brief collision ionization process of gaseous dielectric.	10
1.b)	State limitations of Townsend's theory.	6
2.a)	State how placement of a solid barrier between the electrodes in a non – uniform field improves the break down voltage of a gaseous dielectric.	6
2.b)	Deduce the expression for Paschen's minimum voltage. Explain the nature of Paschen's curve.	5+5
3.a)	What is surface discharge? Explain the process of development of surface discharge in a post insulator.	2+8
3.b)	State reasons behind popular use of SF_6 as gaseous dielectric.	6
4.	Write short notes on i) Electro-mechanical breakdown ii) Thermal breakdown of solid dielectric.	8+8
5.a)	State and explain the method of breakdown in vacuum.	6
5.b)	State what you mean by partial discharge. Describe the phenomenon of partial discharge in the following cases: i) Solid insulating material is subjected to ac application. ii) Solid insulating material is subjected to dc application.	6+4