Ref No.: Ex/PG/EE/T/127D/2024

M.E. ELECTRICAL ENGINEERING FIRST YEAR SECOND SEMESTER - 2024

SUBJECT: HIGH VOLTAGE FIELDS (HV)

Time: Three Hours | Full Marks: 100

Question No.			Marks

Answer any five questions

1.	(a)	Explain why unequal nodal distances are necessary for electric field computation in real life cases. With the help of proper diagram discuss where and why the nodal distances should be smaller or larger. (CO1)	3+3
	(b)	Explain the significance of identification of region of interest in numerical electric field computation. Why the region of interest needs to be discretized in numerical electric field computation? (CO1)	4+4
	(c)	Explain why electric field computation in and around a porcelain disc insulator is advantageous using Cylindrical Coordinate System than Cartesian Coordinate System. (CO1)	6
2.		For the axi-symmetric multi-dielectric configuration with parallel dielectric arrangement as shown in the Figure below, write the FDM equations for the nodes having unknown potentials. Derive the equations used. (CO2)	6+14

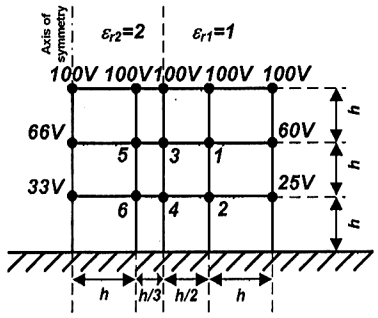

Fig.1 Pertaining to Question#2

3.	(a)	Which one is better for simulating complex boundaries – FDM or FEM? Explain with relevant diagrams. (CO2)	3+3
	(b)	Mention about the four types of fictitious charges, which are most commonly used in CSM. Give one example for the usage of each of these four charges. (CO3)	4+4
	(c)	How is refinement of mesh is done in FEM and why is it necessary? (CO2)	3+3
4.	(a)	Explain in details the FEM Formulation in Axi-Symmetric System with single dielectric medium using variational approach. (CO2)	12

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(b) Explain how the FEM formulation for single dielectric system can be extended to multi-dielectric system. Draw the relevant diagrams. (CO2) 5+3

5. (a) In the case of Charge Simulation Method (CSM), explain how the floating potential electrodes are simulated. (CO3) 8

(b) Discuss in details with the help of necessary diagrams the CSM formulation for multi-dielectric media leading to creation of the coefficient matrix. Consider series dielectric arrangement. (CO3) 12

6. (a) Explain how Capacitive-Resistive field distribution due to surface resistance of dielectric can be computed by CSM using complex fictitious charges. (CO3) 12

(b) Explain in details how the conformal transformation of two non-co-axial cylinders to two co-axial cylinders, as shown in the figure below, can be performed. (CO4) 8

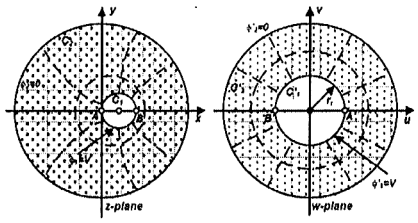

Fig. Pertaining to Question#6(b)

7. (a) A long dielectric cylinder of radius 10cm is placed in a uniform field of field intensity 25kV/cm as shown in the figure below. Relative permittivity of the dielectric cylinder is 2.3, while that of the surrounding medium is 5. The coordinate of the center of the cross-section of the dielectric cylinder is (50,50) cm. Determine the electric potential and r- and θ-components of the electric field intensity at the following two points on the cross-sectional plane: i) Point 1 - Coordinates (62, 62) cm and ii) Point 2 - Coordinates (52, 52) cm. (CO4) 5+5

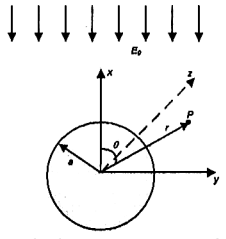

Fig. Pertaining to Question#7(a)

(b) Explain how the mechanical force acting on the dielectric-dielectric boundary can be demonstrated practically with the help of electrostatic pump. Draw the necessary diagrams. (CO5) 7+3

8. Correct or justify the following statement: "A spherical conducting particle present in a uniform field causes lower local electric field intensity compared to a cylindrical conducting particle". Derive the necessary equations. (CO4) 4+8+8