Ref No.: Ex/EE/PE/B/T/414B/2024

B.E. ELECTRICAL ENGINEERING FOURTH YEAR FIRST SEMESTER - 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

Question No.		Part I	Marks

Answer Question No. 1 and any two from the rest

1.	(a)	Discuss about a two-dimensional field distribution considering Cartesian coordinate system with a real life example.	5
	(b)	Explain whether obtaining different solutions for a given problem by the use of different methods is violation of uniqueness theorem or not.	4
	(c)	Why the region of interest needs to be discretized in numerical electric field computation?	5
	(d)	Discuss in details the procedural steps in numerical electric field computation highlighting the importance of each step. Draw the procedural step chart.	4+2
2.	(a)	Explain why Taylor Series is better suited than Mean Value Theorem for the derivation of Finite Difference Equations for electric field calculation.	5
	(b)	Explain why the FDM equation for a node lying away from the axis of symmetry is not valid for a node lying on the axis. Hence, elaborate how this problem is overcome.	2+3
	(c)	Explain how the electric field in infinity extended unbounded field region can be computed using FDM. Draw the relevant diagram.	3+2
3.	(a)	Discuss about the type of coefficient matrix created in Finite Element Method. Hence, elaborate which type of solver is best suited for this method.	4+1
	(b)	Explain how conveniently the FEM formulation for 2D system can be extended for axi-symmetric system. Draw the relevant diagrams.	3+2
	(c)	How can the assumption of linear variation of electric potential over a finite element in FEM give accurate results for the non-linear field distribution in real life?	5
4.	(a)	With proper diagram, explain the effect of the location of fictitious charge vis-à-vis the contour points on the simulation accuracy in CSM.	2+3
	(b)	Explain with proper diagram the boundary conditions used for simulating a two-dielectric arrangement in CSM.	3+2
	(c)	Discuss about a criterion which is a more sensitive indicator of the	5

[Turn over

simulation accuracy for electrode boundary in CSM.

5. (a) Correct or justify the following statement with reasons – "If a spherical conducting particle is present in a uniform external field of magnitude 3kVpeak/mm, then the maximum electric field intensity on the surface of the conducting particle will be 6kVpeak/mm". 5

(b) Explain why partial discharges occur in cylindrical air cavities present in moulded epoxy resin insulation. 5

(c) A 25 kVrms single-phase railway line conductor has 107 sq. mm cross-sectional area and the height from the track is 5.5 m. Find the electric potential on the head of a person of height 1.8 m standing directly below the railway line. 5

EX/EE//PE/B/T/414B/2024

B.E. ELECTRICAL ENGINEERING FOURTH YEAR FIRST SEMESTER EXAMINATION, 2024

HIGH VOLATGE TECHNIQUE - I

Time: Three hours | Full Marks: 100

(50 marks for each part)
Use separate answer script for each part.

Part – II

Answer any three questions.
Two marks are reserved for neat and well organized answers.

1.a)	Explain the significance of studying breakdown mechanism of gaseous dielectrics in the cases of high voltage applications.	4
1.b)	What is self-sustained discharge? Deduce the condition for self-sustained discharge.	3+5
1.c)	State what do you mean by "Yield". Explain why yield is higher in the case of insulators than in metals.	1+3
2.a)	State what is meant by partial discharge - give one practical example of occurrence of partial discharge. Discuss how partial discharge develops in a solid dielectric when subjected to ac and dc voltage applications respectively.	2+2+8
2.b)	State whether the breakdown of a gap occurs instantly after the application of voltage – if not, state why the gap does not break instantly.	4
3.a)	State what type of solid dielectrics may undergo electro-mechanical breakdown. Discuss the process of electro-mechanical breakdown in solid dielectrics.	2+6
3.b)	Explain the development of surface discharge in a post insulator.	8
4.	Explain the breakdown in pure liquids. Also comment on electro convention and hydrodynamic models.	10+6
5.a)	Explain the breakdown in vacuum.	8
5.b)	Explain why the corona inception voltage and breakdown voltage are different in the case of non-uniform field.	8