Register No.: ………………………………. Name: ……………………………………………………………..

SAINTGITS COLLEGE OF ENGINEERING (AUTONOMOUS)

(AFFILIATED TO APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY, THIRUVANANTHAPURAM)

SECOND SEMESTER M.TECH DEGREE EXAMINATION (Regular), JULY 2022

POWER SYSTEMS

(2021 Scheme)

Course Code: **21PS204-B**

Course Name: **EHV AC and DC Transmission**

Max. Marks: **60** **Duration: 3 Hours**

PART A

(Answer all questions. Each question carries 3 marks)

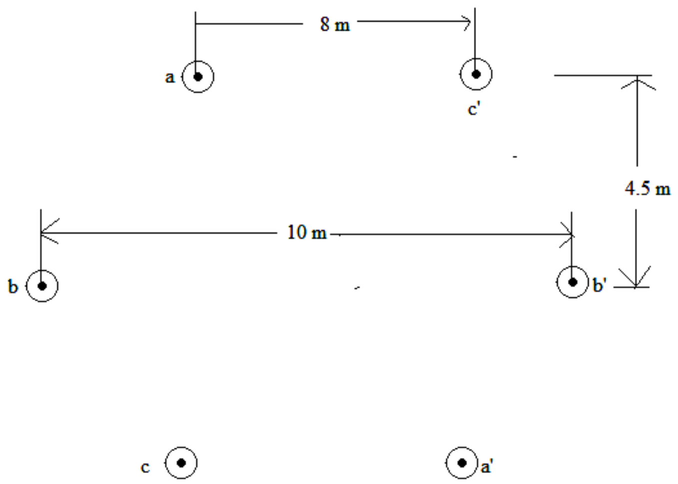
1. Describe different modes of propagation in three phase systems.
2. Explain the effects of high electrostatic field on human, animals and plants.
3. Illustrate the source of occurrence of ferro-resonance overvoltage in a power system with the help of necessary circuit diagrams.
4. Clarify the need of DC smoothing reactors in HVDC system.
5. Discuss the application of firing angle control at DC links.
6. Explain the factors to be considered for choice of converter configuration in multi-terminal DC links.
7 Differentiate between the methods adopted for load flow analysis in AC and DC systems.
8. Describe the major sources of harmonics in HVDC systems.

PART B

(Answer one full question from each module, each question carries 6 marks)

MODULE I

9. Determine the capacitance per km of a transposed 3–phase transmission line as shown in figure. The conductor has a diameter of 3.2 cm. Also evaluate the charging current per km of the line when it is operating at a voltage of 220 kV. (6)



OR

10. The capacitance matrix in F/m of a 750 kV horizontal configuration line is as follows.

$$C=\begin{bmatrix}10.80 & -1.35 & -0.45\\ -1.35 & 12.10 & -1.35\\ -0.45 & -1.35 & 10.80\end{bmatrix}$$

Prove that $[T]^{-1}\,[C]\,[T] = \begin{bmatrix}\lambda_1 & 0 & 0\\ 0 & \lambda_2 & 0\\ 0 & 0 & \lambda_3\end{bmatrix}$ (6)

Where λ_1, λ_2 *and* λ_3 are the eigenvalues of the capacitance matrix.
Also obtain the value of ground return current for all the three modes of propagation in the system.

MODULE II

11. Describe the charge-potential relations for multi-conductor lines and derive the condition for maximum charge in a 3-phase line. (6)

OR

12. Describe the procedure for evaluation of estimation of charges and voltage gradients in the presence of ground wires on towers. (6)

MODULE III

13. A 400 kV, 400 km transmission line has the distributed parameters:
Resistance r= 0.034 ohm/km, Inductance l =1.8 mH/km and capacitance c = 12 nF/km.
Ground return Resistance, r_g=0.329 ohm/km
Ground return Inductance, l_g=0.4 mH/km
Shunt Capacitance, c_{sh}=10.2 nF/km (6)
Calculate the following parameters considering the ground-return parameters
(a) Velocity of wave propagation along line
(b) Surge impedance
(c) Attenuation Factor
(d) Maximum open-end voltage

OR

14. In a short circuit test with earthed neutral on a 400 kV, 3-phase circuit breaker, the power factor of the fault was 0.3, the recovery voltage was 0.92 times the full line value, the breaking current was symmetrical and restriking transient had a natural frequency of 18000 Hz. Estimate the maximum value of the restriking voltage, time of maximum re-strike value and RRRV. (6)

MODULE IV

15. Discuss the issues associated with HVDC-AC system interactions and possible solutions associated with weak systems. (6)

OR

16. Illustrate various types of HVDC system configurations and compare its features with AC transmission systems. (6)

MODULE V

17. Derive an expression for average output voltage without overlap in a Graetz circuit and illustrate the voltage and current waveforms. (6)

OR

18. Differentiate between various types of control methods for HVDC links. (6)

MODULE VI

19. Construct a flowchart to describe the solution methodology for AC-DC load flow solution. (6)

OR

20. Derive expressions for DC and AC components of characteristics harmonics in an HVDC system with 12-pulse converter. (6)

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