Khulna University of Engineering & Technology

B. Sc. Engineering 3rd year 2nd Term (Regular) Examination, 2016

Department of Electrical and Electronic Engineering

EE 3203

Power System Analysis-I

Time: 3 hours Full Marks: 210

N.B.: (i) Answer **ANY THREE** questions from each section in separate scripts.
(ii) Figures in the right margin indicate full marks.

Section A

Q1. (a) What are the different types of Aluminum conductors? What do you mean by stranded conductors? Discus them briefly. (08)

(b) Define transposition. Derive and expression for the inductance per phase of a 3-Φ line when the conductors are asymmetrically placed and completely transposed. (12)

(c) The distance between conductors of a single phase line is 10 feet. Each conductor is composed of seven equal strands. The diameter of each strand is 0.1 inch. Show that D_s for the conductor is 2.177 times the radius of each strand. Find the inductance of the line in milihenrys per mile. (15)

Q2. (a) Define inductance. Derive expressions for calculating internal and external flux linkage of a conductor for carrying current. (13)

(b) Deduce the expression for inductance of a single phase line consisting of two composite conductors and then explain mutual GMD and self GMD. (14)

(c) What are bundle conductors? Show the possible bundle arrangements. Write the advantages of using bundle conductors in EHV line. (08)

Q3. (a) What is charging current? Find the capacitance of a three phase line with equilateral spacing and also find equations of charging current. (12)

(b) Deduce an expression with mathematical derivations for the capacitance of a three phase line considering the effect of earth into account. How can the effect of earth be minimized? (15)

(c) Calculate the capacitance to neutral in farads per meter of a single phase line taking into account the effect of ground. The line composed of two single strand conductors each having a diameter of 0.229 inch. The conductors are 10 ft apart and 25 ft above ground. (08)

Q4. (a) What is line compensation? Describe series and shunt compensations with practical implications. (10)

(b) Evaluate the A, B, C, D constants of an unsymmetrical Π-network and then show that $AD = 1 + BC$. (10)

(c) The constants of a 3-Φ lines are $A = 0.9\angle 2°$, and $B = 140\angle 70°$ ohm per phase. The line delivers 60MVA at 132kV and 0.8 p.f. lagging. Draw circle diagram and find, (15)

(i) Sending end voltage and power angle, (ii) The sending end power and p.f. and (iii) Line losses.

Section B

Q5. (a) What do you mean by span length and safety factor? Mention the formulae to determine the spacing between conductors. (09)

(b) Explain the effect of wind and ice loading on conductors sag for overhead transmission line and also calculate the vertical sag. Illustrate the measure to reduce sag. (15)

(c) An overhead line having a span of 250m is to be erected at 40°C in still air conditions. It is desired that a factor of safety of 2 should be maintained under bad weather conditions when the temperature is 10° C and wind load is $378 N/m^2$ of projected area. The data for ACSR conductor used for the line is: diameter = 1.95cm, area = 2.25 q-cm, weight = 8.31N/m, breaking load = 77900N, co-efficient of linear expansion = $18.44\times10^{-6}/°C$ and Young's modulas = $91.4\times10^3 N/mm^2$. Calculate the sag and tension under erection conditions. (11)

Q6. (a) What are the desirable properties for conductors and insulators of overhead transmission lines? (10)

(b) Write down the advantages of suspension type insulator of overhead lines. Define and explain string efficiency. (10)

(c) A 3-Φ overhead line is being supported by three disc suspension insulators. The potential across the first and second insulators are 8kV and 11kV, respectively. Calculate (i) the ratio of capacitance between pin and earth to self-capacitance of each unit, (ii) the line voltage and (iii) the string efficiency. (15)

Q7. (a) What are the requirements of underground cable? Explain the constructional details of underground cable. (12)

(b) What do you mean by grading of cables? Explain how a cable can be graded using intersheath. Also mention the limitation of intersheath grading. (13)

(c) A 66 kV, 1-core metal sheathed cable is to be graded by intersheath. Calculate the diameter of the intersheath and voltage at which it must be maintained to obtain the minimum overall diameter of cable. The maximum voltage at which the insulating material can be worked is 60kV/cm. Had the cable been ungraded, what will be the overall diameter of the cable? (10)

Q8. (a) Mention the advantages of corona. How can the corona effects be reduced? (10)

(b) Derive the expression to calculate the current rating of a cable. (16)

(c) A 3-Φ line consisting of three conductors placed at the corner of an equilateral triangle has a total corona loss of 0.3835kW at 132kV and 6.52kW at 150kV. Compute the critical disruptive voltage using peek's formula for corona loss under fair weather. (09)

Khulna University of Engineering & Technology
B. Sc. Engineering 3rd year 2nd Term (Regular) Examination, 2016
Department of Electrical and Electronic Engineering
EE 3219
Electrical Engineering Materials

Time: 3 hours | Full Marks: 210

N.B.: (i) Answer **ANY THREE** questions from each section in separate scripts.
(ii) Figures in the right margin indicate full marks.

Section A

Q1. (a) Define bravais lattice. "All crystal can be explained in terms of lattice and basis"- Justify the statement. (08)

(b) What do you understand by secondary bonding? Explain the hydrogen bonding. (08)

(c) Why we need to identify the crystallographic directions and planes? Explain point defects with their significance for determining the device performance. (10)

(d) The interaction energy between Na^+ and Cl^- ions in the NaCl crystal can be written as $E(r) = -\frac{4.03\times10^{-28}}{r} + \frac{6.97\times10^{-96}}{r^8}$, where the energy is given in joules per ion pair and inter ionic separation is in meters. Calculate the binding energy and the equilibrium ionic separation in the crystal; include the energy involved in electron transfer from Cl^- to Na^+. (09)

Q2. (a) Write down the assumptions of classical Drude model. (05)

(b) Why resistance appears in pure metal? Show that resistance of a pure metal is proportional to temperature. (11)

(c) Start from classical mechanics derive the relationship of conductivity and hence elucidate Ohm's law. (11)

(d) Briefly describe the Matthiessen's rule and Fourier's law of heat conduction. (08)

Q3. (a) Define drift mobility and relaxation time. Discuss the influence of carrier concentration and temperature on mobility. (10)

(b) "Large particles only manifest their particle nature, they never manifest their wave nature"-Justify the statement. (09)

(c) Solve the Schrödinger equation for a confined electron in a one dimensional infinite potential well. Show the possible energy wave functions, and the probability distribution for the electron. (16)

Q4. (a) Explain the physical meaning of E-K diagram. Describe the Fermi-Dirac statistics and explain the significance of Fermi energy. (11)

(b) What do you mean by effective mass and effective mass tensor? (06)

(c) Derive the relationship of electron energy density of states for a three dimensional solid. (09)

(d) Which properties of nonomaterials make them unique? State some peculiar applications of nanotechnology. (09)

Section B

Q5. (a) What do you mean by electric dipole moment and electronic polarization? Why electronic polarization within an atom is quite small compared with the polarization due to the valence electrons in the covalent bonds within the solid? (08)

(b) What is dielectric constant? Derive the Clausius-Mossotti equation and show that it allows the calculation of macroscopic property from microscopic polarization phenomena. Also write the significance of the equation. (14)

(c) Briefly explain ionic and orientational polarization mechanism. (08)

(d) Draw the frequency dependence of the real and imaginary parts of the dielectric constant in the presence of interferial, orientational, ionic and electronic polarization mechanisms. (05)

Q6. (a) Derive the Debye equations. Also, draw the cole-cole plot and equivalent circuit of Debye dielectric. (10)

(b) Obtain the dielectric loss per unit capacitance in a capacitor in terms of the loss tangent. Obtain the phase difference between the current through the capacitor and that through R_p. What is the significant of δ? (09)

(c) Briefly discuss the major mechanisms that can lead to dielectric breakdown in solids. (08)

(d) Draw the bar-chart diagrams of some typical examples of dielectrics for a range of capacitance values and for a range of usable frequencies. (08)

Q7. (a) Briefly explain piezoelectricity, Ferro electricity and pyroelectricity. What do you mean by piezoelectric coefficient? (10)

(b) Briefly describe the construction of multilayer ceramic capacitor with diagram. (08)

(c) Explain the magnetization process using elementary current loops. (10)

(d) A toroidal coil with a ferrite core of 300 turns is used in HF work with small signals. The mean diameter of the toroid is 2.5 cm and the core is 0.5 cm. If the core is Mn-Zn ferrite. What is the approximate inductance of the coil? (07)

Q8. (a) Define magnetic domain, magnetocrystalline anisotropy and domain walls with necessary diagrams. (09)

(b) What do you mean by superconductor? Discuss the salient features of superconductivity. (14)

(c) A super conducting solenoid of 10 cm in diameter, 1 m in length and has 500 turns of Nb_3Sn wire, whose critical field B_c at 4.2 k is about 20 T and critical current density J_c is 3×10^6 Acm^{-2}. What is the current necessary to set up a field of 5 T at the center of a solenoid? What is approximate energy stored in the solenoid? Assume that the critical current density decreases linearly with the applied field and the field across the diameter of the solenoid is approximately uniform. (12)