B.E.(EE) Part–III 5th Semester Examination, 2012

ELECTRICAL POWER SYSTEM – I
(EE–502)

Time: 3 hours   Full Marks: 70

Use separate answer script for each half.
Answer SIX questions, taking THREE from each half.
Two marks are reserved for neatness in each half.

FIRST HALF

1.(a) (i) Why and (ii) how is transposition done on EHV transmission line? (iii) Derive an expression for inductance of such a line.

(b) A 100 km long, $3-\phi$ transposed line operated at 50 Hz is arranged as RY = 4.5 m, YB = 4.5 m and BR = 9 m. The conductor diameter is 1.2 cm. Draw the cross-sectional view and determine total inductance and inductive reactance per phase of the line.   [6+5]

2.(a) Derive an expression for capacitance to neutral of a $3-\phi$ transmission line of equilateral spacing. Neglect the effect of earth.

(b) (i) State the advantages of using bundle conductor in a power system. (ii) Derive the GMR of 2-bundle, 3-bundle and 4-bundle conductor for capacitance calculation.   (5+6)

3.(a) (i) What is pu method? (ii) Derive an expression for pu impedance of a $3-\phi$ element.

(b) Three $1-\phi$ transformers each rated 25 MVA, 38.1/3.81 KV connected in $\triangleright$ - Y for $3-\phi$ system to supply a Y connected resistive load of 1.5 Ω per phase. Show that the pu load resistance is same whether referred to HT or LT.   (6+5)

4.(a) What happens when one phase of an ungrounded $3-\phi$ long overhead transmission line is faulted through ground? Draw circuit diagram, phasor diagram and compute the magnitude of fault current.

(b) Explain the application of Zig-Zag grounding transformer in a $3-\phi$ delta connected supply system.   (5+6)

SECOND HALF

6. Justify the function of the following equipments:

i) Coal pulverizing unit in thermal power station

ii) Multiple boiler feed pumps in steam generating unit of a thermal station

iii) Surge tank in a hydel unit

iv) Trash rack in a hydel station

v) Moderator in a nuclear reactor.   [3 + 2 X 4]

7. a) How do you analytically establish that the bottom most unit of a suspension insulator assembly gets maximum voltage stress?

   b) An EHV overload transmission line conductor is subjected to a horizontal wind load of 1.78 kg/m and vertical ice loading of 1.08 kg/m. If the maximum permissible sag is 6 meters from the horizontal, calculate the permissible span between two supports allowing a factor of safety of 2. Assume weight of conductor to be 0.844kg/m.   [6+5]

8. a) Find an expression of power factor of power cables.

   b) A cable has inter-sheath grading that satisfies the relation $(R_1/R_2) = (R_2/R_3) = \alpha$. The cable radii are $R_3 = 1.00$cm; $R_1= 2.50$cm. Determine the location of the inter-sheath and calculate the ratio of maximum electric field strengths with and without inter-sheath. No derivation of any formulae is required.   [4+7]

9. a) Show that for a short transmission line,

$|A| = 1; |B| = |Z|; |C| = 0$ and $|D| = 1$

b) A three phase 66KV (L-L) 50 Hz transmission line is 120 km long. The primary parameters are:

Resistance /km = 0.1Ω/ph ,Inductive reactance /km = 0.3Ω/ph,

Capacitive suseptance /km = 0.04×10^{-4} s/ph

The load at the receiving end is 10MW at 66KV, 0.8 p.f. (lag). Find sending end voltage, current and transmission efficiency. Use nominal T-method.   [4+7]

10. a) Obtain the expression of real and reactive power at the receiving end of a two bus power line in terms of generalized ABCD parameters and modify these expressions for short line with resistance assumed in the line in addition to line reactance as well as for a medium long line with shunt suseptance assumed to be present.

b) What is surge impedance of a power line? Find an expression for it. What is the surge impedance line loading for a 400KV, 50 Hz 3-phase line having surge impedance of 400 ohms per phase?