ELEKTRIJADA 2009 – Analiza EES-a

**ANNOTATION:** You must choose only one of given answers for problems. Right answers worth 1 point. Wrong answers worth −0.25 point. For answers “I don’t know” there is no negative points.

1. Line with parameters $X_g = 10 \, \Omega$ and $R_g = 0 \, \Omega$ is given. Voltage at beginning of line is $U_1 = 110 \, kV$, and power at the end of line is $P_2 = (50+j30) \, MVA$. Find voltage at the end of line $U_2$. The answer is:
   a) $U_2 = 107.1 e^{-j2.43^\circ} \, kV$
   b) $U_2 = 107.1 e^{-j4.35^\circ} \, kV$
   c) $U_2 = 107.1 e^{-j4.35^\circ} \, kV$
   d) No one of given answers
   e) I don’t now

2. Transmission line (Un=220 kV, $f_n=50 \, Hz$) with parameters $r_v=0.08 \, \Omega/km$, $l_v=1.2 \, mH/km$, $c_v=9.55 \, nF/km$, $L_v=100 \, km$, is given. Voltage and power at the beginning of line are $U_1 = 220 \, kV$ and $P_1 = (100+j50) \, MVA$. Using “π” model of line find power losses. The answer is:
   a) $S_{gub} = (2.195-j3.35) \, MVA$
   b) $S_{gub} = (2.195+j10.343) \, MVA$
   c) $S_{gub} = (2.195+j3.35) \, MVA$
   d) No one of given answers
   e) I don’t now

3. Bus A supplied consumption area with constant power $P = (6+j4) \, MVA$. Shunt capacitor bank with constant capacitance $C=60 \, \mu F/phase$ is connected at bus A. In that case voltage at bus A is $U_A = 10.3 \, kV$. Find power factor at bus A. The answer is:
   a) $\cos \phi_A = 0.9487$
   b) $\cos \phi_A = 0.9487$
   c) $\cos \phi_A = 0.9487$
   d) No one of given answers
   e) I don’t now

4. Transmission line, shown on the figure, supply consumption area with $\tan \phi_p = 0.5$. Near bus 2 serial capacitor bank is connected. Find value of serial capacitor bank ($X_c$) which fully compensated voltage drop from bus 1 to bus 2.
   The answer is:
   a) $X_c = 14 \, \Omega$
   b) $X_c = 14 \, \Omega$
   c) $X_c = 14 \, \Omega$
   d) No one of given answers
   e) I don’t now

5. For transformer, given at Figure, find phase group.
   The answer is:
   a) 1
   b) 3
   c) 5
   d) No one of given answers
   e) I don’t now

6. Equivalent impedances for all three symmetrical systems at one bus are $Z_d = jX$, $Z_f = Z_d$, $Z_{ij} = jkX$. Find three phase fault and single phase to ground fault current ratio at he bus in function of parameter k. The answer is:
   a) $|I_{3k}|/|I_{1k}| = 1$
   b) $|I_{3k}|/|I_{1k}| = (2+k)/3$
   c) $|I_{3k}|/|I_{1k}| = (2+k)/3$
   d) No one of given answers
   e) I don’t now
7. Two networks M1 and M2 are connected via two three wind transformer (see figure). Equivalent zero-sequence reactances for networks are \( X_{0M1} = X_{0M2} = 0.1 \) r.j.. Transformers have same reactances for corresponding windings \( X_1 = 0.3 \) r.j., \( X_2 = 0.38 \) r.j. and \( X_3 = 0.2 \) r.j.. Find equivalent zero-sequence from busses 1 and 2.

![Diagram of two networks connected via transformers](image)

The answer is:
- a) \( Z_{o1}^{ekv} = j0.1 \) r.j., \( Z_{o2}^{ekv} = j0.0833 \) r.j.
- b) \( Z_{o1}^{ekv} = j0.0833 \) r.j., \( Z_{o2}^{ekv} = j0.0833 \) r.j.
- c) \( Z_{o1}^{ekv} = j0.0833 \) r.j., \( Z_{o2}^{ekv} = j0.1 \) r.j.
- d) No one of given answers
- e) I don’t now

8. Simply power system with data is shown on the figure.

![Diagram of power system](image)

G: \( S_{nG} = 200 \) MVA, \( U_{nG} = 10.5 \) kV, \( x_g = 20 \% \)
T: \( S_{nT} = S_{nG}, m_T = 110/10.5 \) kV/kV, \( x_T = 10 \% \)
V: \( x_d = 0.4 \) Ω/km, \( x_{ov} = 3 \cdot x_d, L_v = 50 \) km
M: Mreža “\( \infty \)” snage

Find value of reactor (\( X_p \)) which limits single phase to ground current at bus 1 at value 5.5 kA. The answer is:
- a) \( X_p = 5.016 \) Ω
- b) \( X_p = 5.016 \) Ω
- c) \( X_p = 5.016 \) Ω
- d) No one of given answers
- e) I don’t now

9. Active network via three phase transmission line supply consumption \( Z \) (see figure). Current at phase B is \( I_B = 3e^{-j120°} \) r.j. Find symmetrical component for transmission line current

![Diagram of active system](image)

The answer is:
- a) \( I_d = \sqrt{3}e^{-j30°} \) r.j., \( I_I = \sqrt{3}e^{-j150°} \) r.j., \( I_I = 0 \) r.j.
- b) \( I_d = \sqrt{3}e^{-j30°} \) r.j., \( I_I = \sqrt{3}e^{-j150°} \) r.j., \( I_I = 0 \) r.j.
- c) No one of given answers
- d) I don’t now

10. In table data for busses in one transmission network (voltage, voltage angle, active and reactive generation and load power) are given. Data are given in p.u.

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Based on given data find dimension of Jacobian matrix in Newton-Raphson method for power flow calculation. The answer is:
- a) \( \text{dim}(J) = 7 \times 7 \)
- b) \( \text{dim}(J) = 5 \times 5 \)
- c) \( \text{dim}(J) = 6 \times 6 \)
- d) No one of given answers
- e) I don’t now