

KATHMANDU UNIVERSITY
End Semester Examination
February, 2025

Level : B.E.
Year : III
Time : 2 hrs. 30mins.

27 FEB 2025

Course : EPEG 315
Semester : II
F. M. : 40

SECTION "B"

Attempt ANY FOUR questions. (Q.N. 1 is compulsory.) Symbols have their usual meanings. Urgent appropriate assumptions are permissible. Marks are indicated inside brackets.

1. a. Considering the system shown in Figure 1, Draw the impedance diagram.
 represents electrical substation or load and represents generating station. [3]

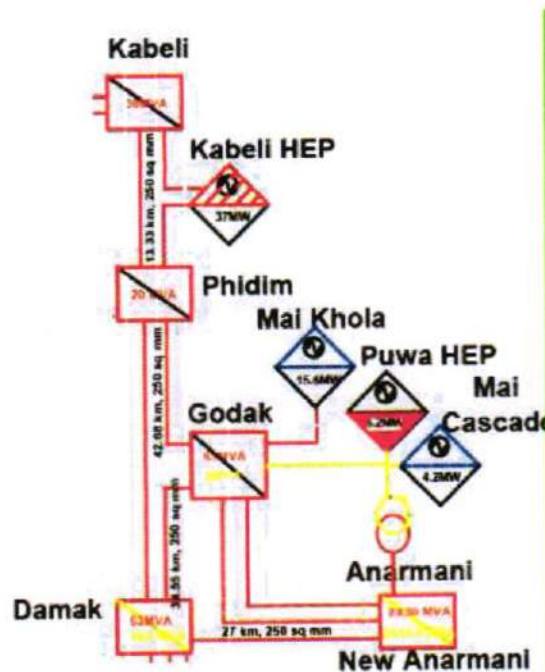


Figure 1. System for Question 1(a)

- b. Considering the system given in Figure 2 [7]
- i. Create a survey diagram.
 - ii. Calculate the voltage drop (%) for the two last nodes. Assume 1 household consumes 16A (Single phase), 0.95pf. The distribution line employed for this system has both resistance and reactance as $0.5\Omega/\text{km}$. Assume a rule of $1\text{cm}=30\text{m}$ rule in any direction.
2. a. Starting from gauss law, calculate the capacitance of a single-phase electrical line. [4]
- b. Show that the electrical line generates reactive power even when no active power is transmitted through it. [3]
- c. Explain the causes of over-voltage in electrical power systems. [3]

P.T.O.

- 3.
- A new hydropower wants to evacuate 450MW at 0.95 power factor lag with a transmission length of 90kms. Calculate the most economical voltage and the circuit for transmission of this power. [3]
 - Calculate the tower dimension for the final circuit which you obtain from Question 6(a). [3]
 - List the steps in a design of electrical distribution systems for an unelectrified area. [4]
- 4.
- A 3-phase 50Hz, 80kms long overhead line has the following line constants: resistance per phase per km= 0.153-ohm, inductance per phase per km= 1.5mH, capacitance per phase per km = 0.01μF. The line supplies a load of 50 MW at 0.95 power factor lagging at a line voltage of 210kV at the receiving end. Use nominal-pi method, calculate the sending end voltage, sending end current, efficiency, and voltage regulation. [7]
 - Compare the performance of overhead and underground insulated cables. [3]
- 5.
- Calculate the sag for the conductor details given in Table 2 under the easiest condition. Consider the wind pressure as 100kg/m², density of air as 950kg/m³, and thickness of ice as 0.01m, linear expansion coefficient (α)= 17.73*10⁻⁶/°c, Modulus of elasticity (E)=0.787*10¹⁰ kg/m². [7]
 - List the issues caused due to poor power factor in electrical systems. [3]

APPENDIX

Table 1. Length vs mf limit .

Length(kms)	80	160	240
mf limit	2.75	2.25	1.75

Minimum air clearance (a)= 1cms for 1kV and factor of safety =30cms

$$y = \frac{l + a}{\sqrt{1 - \left(\frac{x}{y}\right)^2 \left(\frac{l+a}{cl}\right)^2}}$$

where $\frac{1}{4} \leq \frac{x}{y} \leq \frac{1}{3}$

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Table 2. ACSR conductor details.

Code name	Total strands	Overall diameter (mm)	Total area (mm ²)	Total Mass (Kg/km)	Ultimate tensile strength (Kg)	Resistance at 20°C (Ω/km)	Ampacity (A)
Panther	37	21.00	261.54	970	9960	0.1363	560

$$T_2^3 + K_1 T_2^2 - K_2 = 0$$

$$K_1 = -T_1 + \alpha(\theta_2 - \theta_1)AE + \frac{w_1^2 L^2}{24} AE$$

$$K_2 = \frac{W_2^2 L^2}{24} AE$$



Figure 2. Map for Question 1 (b)