KATHMANDU UNIVERSITY
End Semester Examination
June/July, 2023

Marks Scored:

Level : B.E.
Year : III
Course : EPEG 315
Semester : II

Exam Roll No. :
Time: 30 mins.
F. M. : 10

Registration No.:
Date : 11 JUL 2023

SECTION "A"
[20 Q. × 0.5 = 10 marks]

Encircle the most appropriate answer.

1. The current largest hydropower station of Nepal is
   a. Kulekhani Hydropower Station
   b. Kaligandaki Hydropower Station
   c. Upper Tamakoshi Hydropower Station
   d. Arun-III Hydropower Station

2. A 50MVA generator of 6.6kV has a reactance of 10%. The reactance value after converting to a new base of 100 MVA and a new voltage base of 11kV will be
   a. 0.072pu b. 0.15pu c. 0.055pu d. 0.20pu

3. Which statement is **TRUE** about the ACSR conductor?
   a. Stranded conductor reduces the overall conductor resistance
   b. The ampacity of ACSR conductor is dependent on maximum allowed temperature (75 degrees)
   c. ACSR conductor has higher ampacity than HTLS conductor
   d. The inductance of ACSR conductor is higher than copper conductor

4. Three conductors of three phase line have a symmetric spacing of 1.5m and conductor radius of 1cm. The inductance of a conductor per phase is:
   a. 1mH/km b. 1.5mH/km c. 1.19mH/km d. 2.25mH/km

5. A transmission line connecting two substations of 50kms has an ampacity of 100A and three phase line voltage of 132kV (Take power factor as unity). The maximum thermal power this line can transfer is
   a. 100MW b. 45.72MW c. 15.24MW d. 22.86MW

6. The impact of high charging current due to capacitance in a long transmission line is to
   a. Make the receiving end voltage higher than the sending end voltage
   b. Make the receiving end voltage lower than the sending end voltage
   c. Loss of conductor property
   d. Decrease the earth capacitance effect on conductors

7. Which of the following material has the highest dielectric strength?
   a. Air b. Paper c. Porcelain d. Glass

8. An insulator string with low string efficiency signifies:
   a. Non uniform electric stress on all insulators
   b. More leakage loss
   c. Uniform electrical stress on all insulators
   d. No electrical stress on all insulators

9. Which tower type will you choose for at very sharp bending?
   a. Type A tower b. Type B tower c. Type D tower d. Type C tower

10. The minimum ground clearance for a 220kV transmission tower is
   a. 12m b. 5m c. 7m d. 10m

11. Which of the following factor does not greatly affect the transmission tower strength?
   a. Conductor weight b. Wind force
   c. Lightning d. Line deviation

12. The GMD for a three phase three wire transmission line is 5m and GMR is 10mm. The transmission voltage is 132kV. What is the corona inception voltage?
   a. 175kV b. 185kV c. 195kV d. 200kV

13. Power transmission through underground cables over a long distance require
   a. Capacitor compensation b. Inductor compensation
   c. Resistance compensation d. Fuse protection

14. The most important criterion while designing the electric distribution systems is
   a. Line loss b. Corona c. Efficiency d. Voltage drop

15. Horizontal configuration of transmission lines is commonly employed at
   a. 132kV b. Sub-transmission voltage
   c. High voltage d. Ultra-High voltage

16. Overcompensation of power factor by installing larger size capacitors then required in industries results in
   a. Low line loss and high receiving end voltage
   b. High line loss and low receiving end voltage
   c. High line loss and high receiving end voltage
   d. Low line loss and low receiving end voltage

17. The current distribution system loss of Nepal is around
   a. 10% b. 5% c. 15% d. 6.25%

18. It is desired to transmit 70MW power at 50kms distance (power factory = unity). The economic voltage selected should be
   a. 220kV b. 132kV c. 66kV d. 400kV

19. Which modeling approach will you choose for a long transmission line?
   a. Nominal-T model b. Nominal-pi model
   c. Distributed model d. Resistance and Inductance model

20. For the same diameter, which conductor type has the highest ampacity?
   a. HTLS b. ACSR c. AAC d. ABC

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SECTION "B"
[5 Q. × 8 = 40 marks]

Attempt *ANY FIVE* questions. Assume suitable data if necessary.

1. a. Derive the expression for inductance of a single phase line. [4]

b. Consider the system given in Figure 1. Select a common base of 100MVA. Perform the per-unit calculation and draw a impedance diagram with the final per unit values. The manufacturers data are given below: [4]

G: 50MVA, 11kV, 10%
T1: 80MVA, 11/132kV, 5%
T2: 80MVA, 132/11kV, 5%
Line 1: reactance: 50Ω
Load: 3-phase, 25MVA, 0.8pf lagging

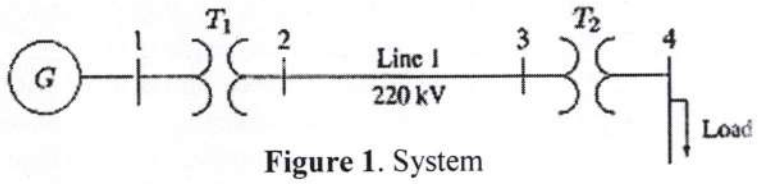

Figure 1. System

2. A transmission line of 120km uses Panther conductor and carries 80MW of power from the hydropower to the electrical substation. Check whether this conductor fulfills the Efficiency and Voltage regulation criterion. Assume the transmission voltage as 220kV and power factor as 0.8. Conductor configuration and details is given in Figure 2 and Table 1 (attached in Appendix) respectively. [8]

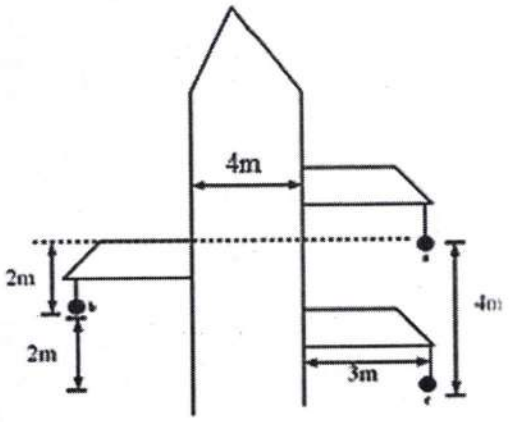

Figure 2. Conductor configuration

3. Find the most economical span for a conductor given the following data: [8]
Conductor diameter = 28mm
Cross-sectional area = 463 mm^2
Wind pressure = 100 kg/m^3
Factor of safety = 2
Assume all towers are straight line towers. The tower configuration is given in Figure 2. Minimum ground clearance is 6m. Neglect the effect of ground wire. Assume the cost of steel per ton as Rs. 3,00,000.

Span (m)	Maximum sag (m)
250	3.24
275	3.88
300	4.57
325	5.32
350	6.12

4. a. Assume that you are hired by a distribution company to survey and design the distribution line for a new community. Explain with flowcharts how you will fulfill this process. [6]

b. Compare the radial, loop and interconnected structure of distribution systems. [2]

5. Justify the following statements. [8×1=8]
   a. Discuss the Impact of lesser inductance and higher capacitance of underground cables.
   b. The price of selling electricity by Nepal to India (Indian Power exchange) varies everyday.
   c. Higher voltage should be opted for transmitting larger power over longer distance.
   d. Both variable and fixed capacitor banks need to be employed for proper power factor correction.
   e. Explain the flashover voltage in insulators.
   f. ACSR conductor should not be operated at more than 75 degrees Celsius.
   g. The overhead line capacitance and inductance mainly depends on the geometry of lines.
   h. For same conductor size, loop distribution has lower power loss than the radial distribution system.

6. Justify the following statements. [8×1=8]
   a. Long transmission lines may possess reactive power even though there is no active power flowing through it.
   b. The last homes in a radial system always have a lower voltage than the homes near to the distribution transformer.
   c. The use of three phase three wire for distributing power to homes work perfectly at balanced condition but may not work satisfactorily under unbalanced condition.
   d. Discuss the importance of voltage regulation term through expression.
   e. A conductor with a smaller diameter which satisfies all technical electrical criterion may not be the most economical conductor.
   f. Explain the importance of tension at easiest condition (T_3).
   g. Factors affecting the weight of a transmission tower.
   h. Modeling difference between short, medium and long transmission line.

APPENDIX

Table 1. ACSR conductor details.

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

Temperature coefficient of ACSR = 0.004/°c

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

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

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

$$H_g = \left(\frac{V-33}{33} + 17\right) feet$$, V: Line Voltage (kV)

1m =3.28ft