

KATHMANDU UNIVERSITY  
End Semester Examination  
July/August, 2024

Marks Scored:

Level : B.E.

Year : III

Exam Roll No. :

Registration No.:

Time: 30 mins.

Course : EPEG 315

Semester : II

F. M. : 10

Date :

12 AUG 2024

SECTION "A"

[20 Q. × 0.5 = 10 marks]

**Choose and encircle in the most appropriate option from each set of choices**

- The current largest substation of Nepal is
  - Suichatar Substation
  - Hetauda Substation
  - Dhalkebar Substation
  - Kaligandaki Substation
- A 100MVA generator of 4kV has a reactance of 5%. The reactance value after converting to a new base of 320 MVA and a new voltage base of 16kV will be
  - 0.01pu
  - 0.1pu
  - 0.15pu
  - 0.20pu
- What is the primary reason for using a stranded ACSR conductor?
  - Stranded conductor reduces the overall conductor resistance
  - Ease of transportation to sites
  - Capacitance is less with the stranded conductor.
  - Low chance of corona.
- Four conductors (A,B,C, and D) have diameter from ascending order with A having the lowest overall conductor diameter and D having the highest overall conductor diameter. Which conductor will experience the highest probability of electric field breakdown around it?
  - A
  - B
  - C
  - D
- A transmission line connecting two substations of 50kms has an ampacity of 250A and three phase line voltage of 220kV (Take power factor as unity). The maximum thermal power this line can transfer is
  - 188MW
  - 95.26MW
  - 122.87MW
  - 32.001MW
- The impact of high charging current due to capacitance in a long transmission line is to
  - Make the receiving end voltage higher than the sending end voltage
  - Make the receiving end voltage lower than the sending end voltage
  - Loss of conductor property
  - Decrease the earth capacitance effect on conductors
- An insulator string is connected to a charged electrical line and has six disc insulators. The string efficiency is 70%. Which insulator will experience the highest voltage?
  - Insulator at the middle of the conductor.
  - Insulator farthest from the conductor.
  - Insulator nearest to the conductor.
  - All insulators will experience the same voltage.

8. Which tower type requires the strongest foundation and the largest tower width?  
a. Type A tower    b. Type B tower    c. Type C tower    d. Type D tower
9. The most important criterion while designing the electric distribution systems is  
a. Line loss    b. Corona    c. Efficiency    d. Voltage drop
10. The current power system loss of Nepal is around  
a. 10%    b. 5%    c. 15%    d. 6.25%
11. Which modeling approach will you choose for a short transmission line?  
a. Nominal-T model    b. Nominal-pi model  
c. Distributed model    d. Resistance and Inductance model
12. Calculate the most economical voltage for transmission of 300MW over a distance of 150kms at a power factor of 0.8.  
a. 138kV    b. 280kV    c. 420kV    d. 705kV
13. The tower width of a single circuit, 400kV tower of Type A should be around  
a. 6m    b. 3m    c. 10m    d. 15m
14. A symmetrical three phase transmission line are placed equidistantly at 1.5m with each diameter of conductors being 1.2cm. Calculate the inductance of the conductor.  
a. 1.89mH/km    b. 0.889mH/km    c. 2.288mH/km    d. 1.154mH/km
15. An ACSR conductor has an ampacity of 100A. What is the tentative conductor temperature when the conductor carries 100A?  
a. 75° Celsius    b. 100° Celsius    c. 20° Celsius    d. None of the above
16. What kind of capacitor compensation will you recommend to improve the power-factor for an industry whose electrical load demand is constant throughout its working hour?  
a. Fixed capacitor bank compensation  
b. Variable capacitor bank compensation  
c. Both (a) and (b)  
d. Tap changing transformer-based compensation
17. Stockbridge damper is used for \_\_\_\_\_  
a. Improvement of string efficiency  
b. Damping of vibration due to wind in overhead lines  
c. Reducing corona loss  
d. Strengthen the transmission tower
18. What is the desirable feature for selection of underground cables?  
a. High specific weight/km, High dielectric strength, High capacitance  
b. Low specific weight/km, High dielectric strength, High capacitance  
c. Low specific weight/km, High dielectric strength, Low resistance  
d. Low specific weight/km, Low dielectric strength, Low resistance

19. Which of the statement is **FALSE**?
- a. Voltage drop will be maximum at the end of the radial feeder
  - b. The conductor at the start of the radial feeder should have the largest diameter
  - c. Loop system is more reliable than the radial feeder system
  - d. The conductor at the middle of the radial feeder will carry the maximum current
20. The current peak demand of Nepal is around
- a. 2316MW
  - b. 1200MW
  - c. 1400MW
  - d. 4400MW



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

SECTION "B"

[5 Q. × 8 = 40 marks]

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

1. Elaborate the following statements : [8×1=8]
  - a. The price of selling electricity by Nepal to India (Indian Power exchange) varies every day.
  - b. Higher voltage should be opted for transmitting larger power over longer distance.
  - c. There is a need for both variable and fixed capacitor banks for proper power factor correction.
  - d. Explain the cause of Ferranti effect.
  - e. Three-phase four wire systems are chosen over three-phase three wire systems in the secondary distribution system.
  - f. Factors affecting the weight of a transmission tower.
  - g. Kelvin's law for electrical conductor selection,
  - h. The needs for real-time electrical monitoring of electrical lines.
  
2.
  - a. Derive the expression for inductance for a symmetrical and equidistant three-phase line. [4]
  - b. Explain the following terms: Electrical corona and its effect, Advantage of per unit systems, choice of XLPE cables for underground distribution systems, and Kelvin law for the most economical conductor selection. [4]
  
3.
  - a. Suppose you are hired by a distribution company for designing and installation of electrical distribution line at a new area, explain with a flowchart how you will execute this process. [6]
  - b. List the impact of poor power factor in electrical power systems. [2]
  
4. A 3-phase 50Hz, 100kms long overhead line has the following line constants: resistance per phase per km= 0.153-ohm, inductance per phase per km= 1.21mH, capacitance per phase per km = 0.00958μF. The line supplies a load of 20MW at 0.9 power factor lagging at a line voltage of 110kV at the receiving end. Use nominal-pi method, calculate the sending end voltage, sending end current, efficiency, and voltage regulation. [8]

P.T.O.

5. Find the most economical conductor from the two conductors given in Table 1. Both the conductors carry 100 MW at 230kV 0.8 power factor over 100kms and a single circuit configuration. Further details are given below: [8]

Cost of Aluminum per ton = NRs. 50,000

Cost of Steel per ton = NRs. 200,000

Tower Span = 350m

Loss of Load factor (LLF) = 0.3

Temperature coefficient of ACSR = 0.004/°c

**Table 1.** ACSR conductor details.

Code name	Aluminum (Kg/Km)	Steel (Kg/Km)	Resistance at 20°c (Ω/km)	Ampacity (A)	Weight of each Tower (Tons)
Panther	589	388	0.1390	487	4
Moose	1463	535	0.005595	836	6

- 6.
- A new hydropower wants to evacuate 150MW at 0.95 power factor lag with a transmission length of 120kms. Calculate the most economical voltage and the circuit for transmission of this power. [4]
  - Calculate the tower dimension for the final circuit (Single or Double) which you obtain from Question 6(a). [4]

## APPENDIX

**Table 1.** ACSR conductor details.

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