KATHMANDU UNIVERSITY
End Semester Examination
May/June, 2022

Marks Scored:

Level : B.E.
Year : III

Course : EPEG 315
Semester : II

Exam Roll No. :

Time: 30 mins.

F. M. : 10

Registration No.:

Date :

SECTION "A"
[20Q. × 0.5 = 10 marks]

Encircle the most appropriate option.

1. The current electrical peak demand of Nepal is around
   a. 1500 MW b. 3000 MW c. 800 MW d. 100 MW

2. The largest transmission line voltage in Nepal is
   a. 132 kV b. 400 kV c. 220 kV d. 765 kV

3. The transmission line reactance greatly depends on
   a. Capacitance
   b. Properties of ACSR conductor
   c. Height of tower
   d. Spacing between conductors

4. The effect of earth is to
   a. Decrease the capacitance of lines
   b. Increase the capacitance of lines
   c. No impact on lines
   d. Slowly decrease the capacitance of lines

5. Per unit system helps in:
   a. Design of distribution lines
   b. Modeling
   c. Calculation
   d. Protection of lines

6. Ferranti effect is observed in
   a. Distribution system
   b. HVDC
   c. Lightly loaded, long transmission lines
   d. Heavily loaded, long transmission lines

7. The selection of number of disc insulators in a transmission line is based on
   a. Lightning overvoltage
   b. Continuous operating voltage criterion
   c. Continuous operating voltage and impulse voltage criterion
   d. Continuous operating voltage, temporary overvoltage and impulse voltage criterion

8. An insulator string with low string efficiency signifies
   a. More electric stress on the insulator near the crossarm
   b. More electrical stress on the insulator near the power conductor
   c. Uniform electrical stress on all insulators
   d. No electrical stress on all insulators

9. Corona effect can be reduced by using
   a. Small diameter conductor and bundled conductors
   b. Large diameter conductor and bundled conductors
   c. Small diameter conductor
   d. AAC conductor

10. Stockbridge damper is used to
    a. Damp vibration due to high voltage in conductors
    b. Damp vibration due to ice loading in conductors
    c. Damp vibration due to weight of conductors
    d. Damp vibration due to wind in conductors

11. Underground cables generate _____ at long distances
    a. High reactive power
    b. Low reactive power
    c. No reactive power
    d. Active power

12. Tower design and its dimension greatly depends on
    a. Weight of conductor
    b. Frequency level
    c. Current level
    d. Voltage level

13. Sag in transmission lines increases with
    a. Weight of conductor
    b. Height of tower
    c. Cross arm length
    d. Tower foundation

14. Which kind of distribution system is widely used in Nepal?
    a. Interconnected b. Network c. Loop d. Radial

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

16. Kelvin law helps to determine
    a. Conductor size b. Voltage c. Power d. Tower cost

17. Poor power factor 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

18. The power factor correction can be done by installing
    a. Large industries b. Series inductor c. Shunt inductor d. Shunt capacitors

19. Commonly used cable for transmission and distribution is
    a. XLPE cable b. ABC cable c. PVC cable d. AAC cable

20. Which insulator has the highest dielectric strength?
    a. Porcelain b. Toughened glass c. Polymer d. Clay

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Time : 2 hrs. 30 mins.

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

SECTION "B"
[5Q. × 8 = 40 marks]

Attempt *ANY FIVE* questions. Symbols have their usual meanings. Urgent appropriate assumptions are permissible.

1. a. Starting from Gauss law, derive the expression for capacitance between phases and capacitance between phase and neutral in a single phase system. [6]
   b. Explain the phenomenon of capacitive charging current in single phase line and its significance. [2]

2. A transmission line of 120km carries 80MW of power from a hydropower to the electrical substation. Check whether this conductor used fulfills the Voltage regulation criterion. Assume the transmission voltage as 132kV, power factor as 0.95 and Wolf conductor is used. Conductor configuration and details is given in Figure 1 and Table 1 respectively. [8]

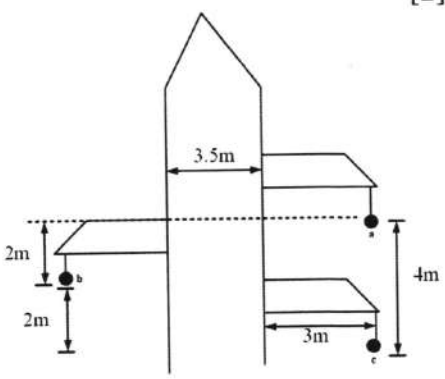

Figure 1. Conductor configuration

3. a. Calculate the number of disc insulators required for a 220 kV system. Use Tables A-2 and A-3 for the calculation. [6]
   b. Briefly describe the types of insulator based on the material type. [2]

4. Calculate the value of maximum sag for the Goat conductor in a span of 350m. Some necessary design details are as follows: wind pressure, ice density, thickness of ice, linear expansion coefficient, modulus of elasticity as 100kg/m^2, 950kg/m^3, 10mm, 17.73*10^{-6}/° C, 0.787×10^{10} kg/m^2 respectively. More required details are given in Table 1. [8]

5. a. Explain the type of distribution system based on scheme of connection. [5]
   b. Calculate the total voltage drop, total real power per phase for each load and total reactive power per phase for each load for a three phase four wire 400V system shown in Figure 2. [3]

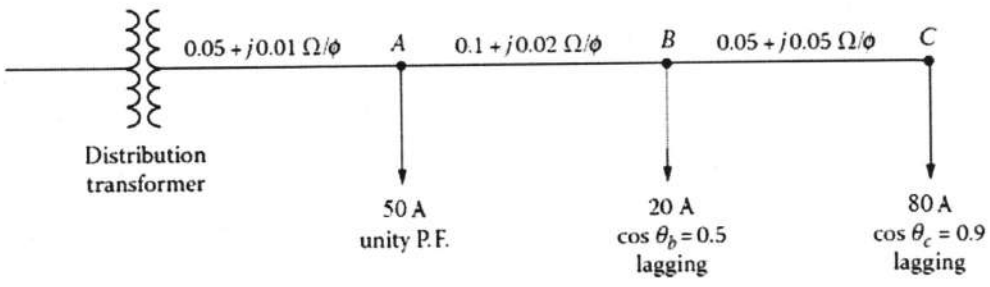

Figure 2. One line diagram of a three phase four wire system

6. a. A new hydropower plans to evacuate 120 MW to a nearest substation which is at a distance of 90 kms. Find the most economical voltage for its transmission and number of circuits required. The transmission line loading capability is given in Table 4. [4]

   b. Calculate all the required transmission tower dimension for a single circuit 220 kV system. Also draw and label the designed tower. [4]

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)
Wolf	37	18.13	194.94	730	7591	0.1828	470
Lynx	37	19.53	226.20	846	8699	0.1576	520
Panther	37	21.00	261.54	970	9960	0.1363	560

Temperature coefficient of ACSR = 0.004/°c

$$K_1 = -T_1 + \alpha(\theta_2-\theta_1)AE + \frac{W_1^2L^2}{24T_1^2}AE$$

$$K_2 = \frac{W_2^2L^2}{24T_1^2}AE$$

iv. **Table A-2: Withstand voltage capability for different system voltage.**

Maximum System Voltage	1 Minute Dry withstand (kV)	1 Minute Wet Withstand (kV)	Impulse Withstand (kV)
123	215	185	450
145	265	230	550
255	435	395	900
420	760	680	1550

v. Table A-3: Flashover voltages for 254 x 154 mm disc insulators

Number of Discs	1 Minute Dry FOV (kV)	1 Minute Wet FOV (kV)	Impulse FOV (kV)
1	80	50	150
2	155	90	255
3	215	130	355
4	270	170	440
5	325	210	525
6	380	250	610
7	435	290	695
8	485	330	780
9	535	370	860
10	585	410	945
11	635	450	1025
12	685	485	1105
13	730	520	1185
14	775	555	1265
15	820	590	1345
16	865	620	1425
17	910	650	1505
18	955	680	1585
19	100	710	1665
20	1045	740	1745

Table 4. Transmission line loading capability

Length (km)	80	160
mf limit	2.75	2.25