46 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2074 Bhadra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEX	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Power System *(EE553)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

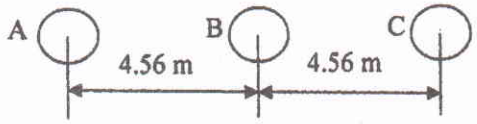
1. a) Draw a single line diagram of general power system. Mention the function of each of the components. [3+5]

   b) A transmission line at a river crossing is supported by two towers 50m and 55m above water level. The horizontal distance between towers is 300m. The tension in the conductor is 2000kg and weight of conductor is 0.85 kg/m. [8]

   (i) Find minimum clearance between conductor and water.
   (ii) Determine the position of minimum clearance.

2. a) Justify that the inductance of a conductor due to its internal flux linkage do not depend on conductor geometry and current carried by the conductor. [8]

   b) A 50 Hz, 132 kV overhead transmission line has conductors placed in a horizontal plane as shown below. Radius of the conductor is 1.12 cm. If the line length is 100 km, calculate the charging current per phase assuming complete transposition. [8]

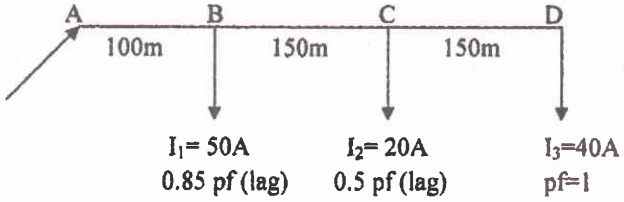


3. a) A 132kV, 3-phase transmission line of 200 km long has, resistance, reactance and susceptance per km of 0.15Ω and 0.5Ω and 2x10-6 Siemen respectively. If the transmission line is delivering 50 MVA at 0.85 pf (lagging) at the receiving end. Calculate sending end voltage and current, voltage regulation and efficiency of line. [8]

   b) Explain clearly the Ferrantic effect with a phasor diagram. Also discuss the significance of surge impedance loading in case of ferranti effect. [8]

4. a) How the Y-matrix can be formulated in load flow analysis. Derive with suitable example. [8]

   b) The loading on a distributor having resistance and reactance of 0.25 Ω and 0.125 Ω per 1000 meters is given below. If the voltage at point D is to be kept 400V, what should be the voltage at point A. [8]



5. a) State the difference between a fuse and circuit breaker. Explain the time current characteristics of a fuse with necessary mathematical aid. [8]

   b) Write short notes on: [4×2]

   (i) Under ground cables
   (ii) Transposition of Transmission line

46 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2075 Baisakh

Exam.	Back		
Level	BE	Full Marks	80
Programme	BEX	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Power System *(EE553)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

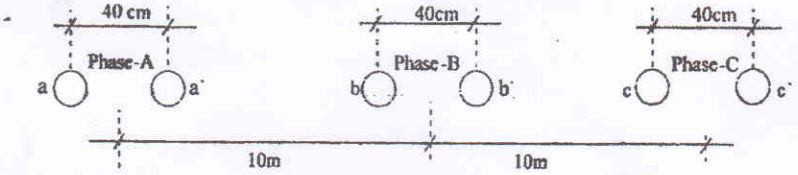
1. a) Draw a neat diagram of a typical power system with typical voltage levels and explain generation, transmission and distribution components. Why are different voltage levels required in an interconnected power system? [8]

   b) What are the factors affecting sag of a conductor? How do you calculate sag of a conductor supported at different levels? [5]

   c) Show that insulation resistance of a single-core cable is inversely proportional to its length. [6]

2. a) A three phase transmission line has an equilateral spacing of 6m. Keeping the GMD same, a horizontal configuration is built so that the central conductor is midway between the two conductors. Find the spacing between the conductors in horizontal configuration. [5]

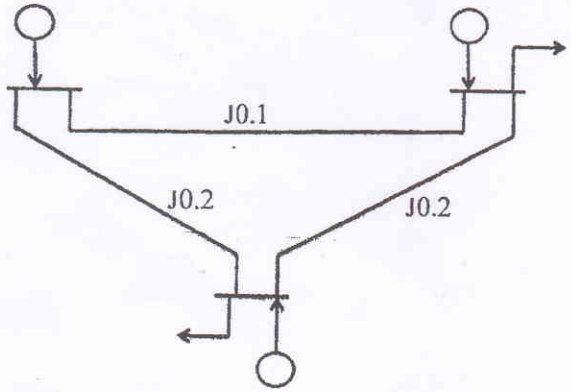
   b) Calculate the inductance and capacitance per phase per km of a three-phase transmission line with bundle conductor as shown in figure below. Given that radius of each conductor is 9 mm and the line is transposed. [8]



3. a) Mention the advantages of per unit representation. "Selecting proper base values, pu impedance is same on both primary and secondary sides of a transformer", Justify. [8]

   b) A 3-ϕ, 132 KV Transmission line is connected to a 80 MW load at a power factor of 0.8 lagging. The line constants of the 80 KM long line are Z = (30+j74) ohm and Y = (j0.001) mho. Using pi-model representation, calculate (i) sending end voltage (ii) sending end current (iii) sending end power factor (iv) line losses. [8]

4. a) Classify buses in power system for load flow analysis purpose. Compute the Y_{bus} for the interconnected system shown in figure below. [8]



b) A 2-wire feeder ABC supplied at A has a load of 120 A at C and 60 A at B both at pf 0.8 lagging. The impedance AB is (0.04 + j0.08) ohm and that of BC is (0.08 + j 0.12) ohm. If the voltage at the far end C is to be maintained at 400 V, determine the voltage (i) at A and (ii) at B. [8]

5. a) Draw a neat schematic of differential protection scheme of transformer and describe its operation under faulty condition. [8]

b) Write short notes on: [4×2]

(i) Surge impedance loading
(ii) Earth effect in capacitance of a line

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46 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2073 Bhadra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEX	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Power System *(EE553)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. a) What is a single line diagram? Draw a single line diagram of a typical power system network? And list out the advantages of adopting high voltage level for transmission of power. [6]

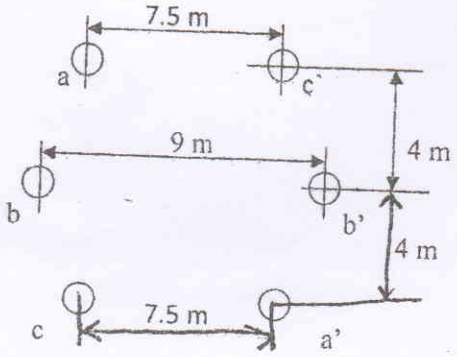
   b) A transmission line at a river crossing is supported by two towers 50 m and 55 m above water level. The horizontal distance between towers is 300 m. The tension in the conductor is 2000 kg and weight of conductor is 0.85 kg/m [8]

      i) Find the minimum clearance between conductor and water

      ii) Determine the position of minimum air clearance

2. a) What are cable faults? Explain how you can locate a ground fault. [6]

   b) Determine the inductance per km of a transposed double circuit 3-ϕ line shown in figure below. The diameter of the conductors is 2.5 cm. [6]



3. a) Calculate the capacitance /phase/km of the transposed line with following configuration. [Take: $r_a = r_b = r_c = 12.5\text{mm}, d_1 = 8\text{m}, d_2 = 10\text{m}$ and $d_3 = 6\text{m}$] [6]

   b) How does the earth affect the capacitance of a transmission line? Explain briefly. [4]

4. a) A 200 km 3-ph, 50 Hz transmission line has following data: [6]

$A = D = 0.938 < 1.2°$ $B = 131.2 < 72.3° \Omega$ $C = 0.001 < 90°S$

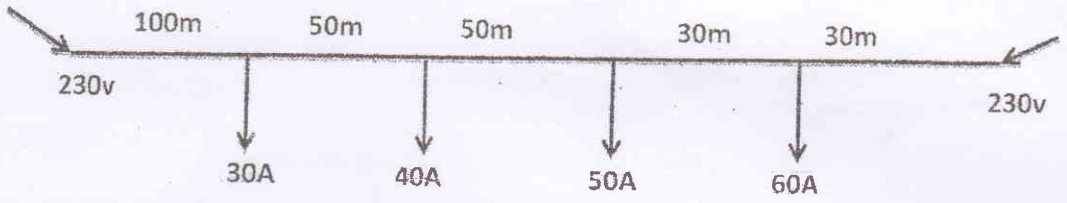
The sending end voltage is 230 kV. Find

i) V_R on no load
ii) Efficiency of transmission line

b) What is line compensation? Compare shunt capacitor compensation and shunt reactor compensation. [4]

c) Why is it necessary to balance both active and reactive power in an interconnected power system? [4]

5. a) A dc distributor fed at both ends at 230 V with conductor resistance of 0.1 ohm/km is loaded as shown in figure below. Determine the minimum voltage along the distributor and the point of minimum voltage. [8]



b) Draw a neat schematic diagram of differential protection scheme of generator and describe briefly how it operates under faulty condition. [4]

c) Explain the use of PLCC in modern electrical power system. [4]

6. a) Why power flow analysis is made? Describe the various types of buses in load flow analysis of an interconnected power system. [6]

b) What are the differences between a fuse, relay and circuit breaker? [4]

c) List out the major differences in urban and rural power distribution system. [4]

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46 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2072 Ashwin

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEX	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Power System *(EE553)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. a) Give the reasons for the following in brief: [8]
   i) Necessity of higher voltage for transmission of electric power.
   ii) Advantage of 3-phase transmission and distribution
   iii) Popularity of A.C. application in power system.
   iv) Interconnecting of several generators in parallel

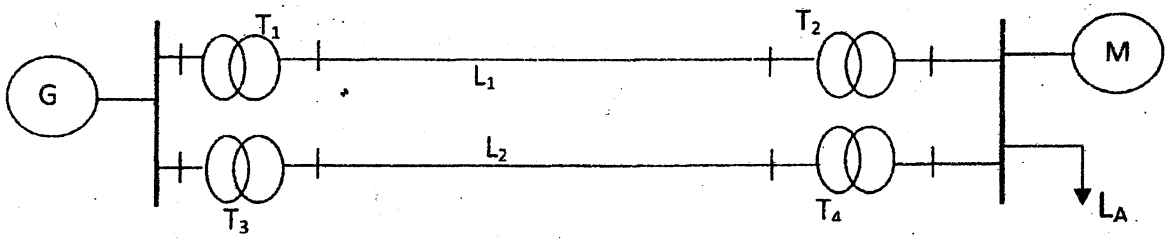
   b) A transmission line conductor having a distance of 19 mm weighs 0.82 kg/m. The span is 250 m. The wind pressure is 39 kg/m^2 of projected area and with ice coating of 12 mm. The ultimate strength of conductor is 8000 kg. Calculate the maximum sag if the factor of safety is 2.5 and ice weighs 900 kg/m^3. [8]

2. a) How are the faults in underground cables located? Describe one of the methods with necessary figures. [6]

   b) Why transposition is required in three-phase line with un-symmetrical spacing? [4]

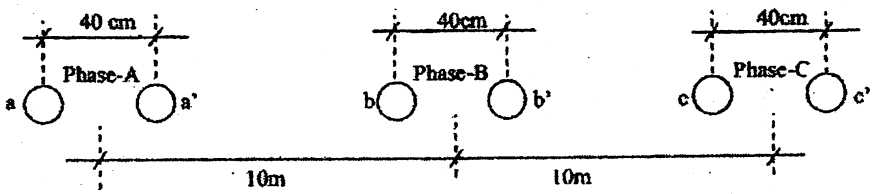
   c) Explain impedance protection scheme applied for the protection of transmission line. [6]

3. a) The single line diagram of a 3-ϕ system is shown in figure below and corresponding ratings are described. Select the common base of 100MVA and 22 kV on the generator side. Draw an impedance diagram with all the impedances marked in p.u. The 3-ϕ load (L_A) is 57 MVA, 0.6(lag) power factor at 10.45 kV. Lines L_1 and L_2 have reactance of 48.4 Ω , 65.43 Ω respectively. [8]

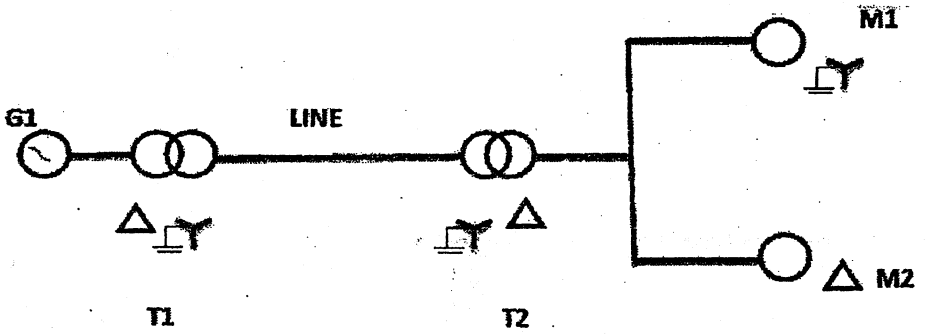


G:	90 MVA	22 kV	reactance 18%
T_1:	50 MVA	22/220 kV	reactance 10%
T_2:	40 MVA	220/11 kV	reactance 6%
T_3:	40 MVA	22/110 kV	reactance 6.4%
T_4:	40 MVA	110/11 kV	reactance 8%
M:	66.5 MVA	10.45 kV	reactance 8.5%

b) Calculate the inductance and capacitance per phase per km of a three-phase transmission line with bundle conductor as shown in figure below: Given that radius of each conductor is 9 mm and the line is transposed. [8]



4. a) A 90 MVA 11 kv 3-phase generator has a reactance of 25%. The Generator supplies 2 motors through transformers and transmission line as shown in figure below. The transformer T1 is a 3-phase, 100 MVA, 10/132 kV, 6% reactance. The transformer T2 is composed of 3 single phase units each rated at 30 MVA, 66/10 kV with 5% reactance. The connection of T1 and T2 are as shown in figure below. The motors are rated at 50 MVA and 40 MVA both 10 kV and 20% reactance. Taking the generator rating as base, draw reactance diagram and indicate the reactance in pu. The reactance of the line is 100 ohms. Generator neutral is also grounded. [8]



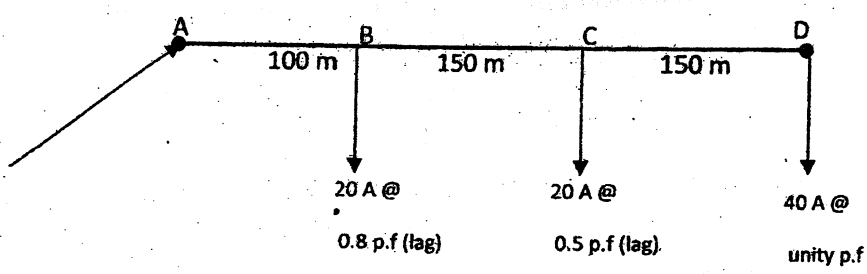
b) A 3-phase 220 kV, 50 Hz transmission line supply the power of 100 MW at power factors of 0.8 lagging. If the line has following ABCD parameters. [8]

$$\begin{bmatrix} A & B \\ C & D \end{bmatrix} = \begin{bmatrix} 0.9 < 0.01 & B \\ 0.00114 < 90 & 0.9 < 0.001 \end{bmatrix}$$

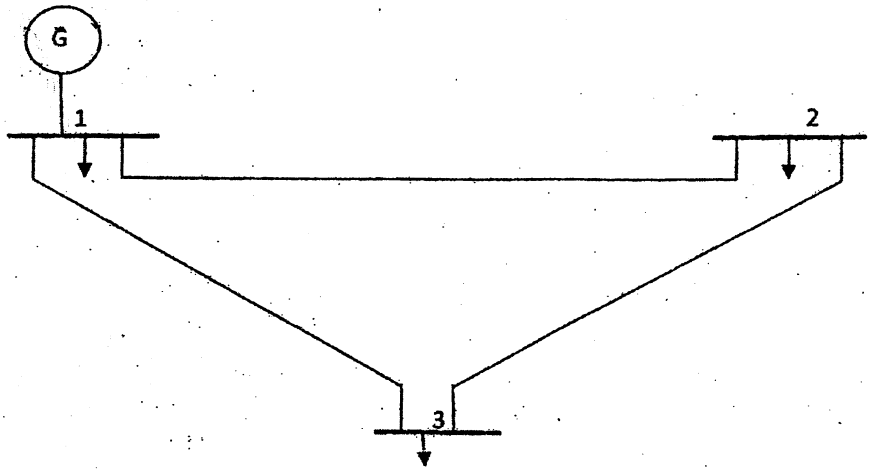
Determine the following:

i) Sending end voltage
ii) No-load receiving end voltage
iii) Real and reactive power at sending at full load
iv) Real and reactive power loss in the line at full load
v) Voltage regulation and line efficiency at full load

5. a) The loading on a distributor is shown in figure below. The distributor is a two-core cable for which the resistance and reactance are 0.25Ω and 0.125Ω per km of cable run respectively. What should be the voltage at the point A to maintain 400V at point D? [6]



b) Use Guss Seidal Method to obtain unknowns for the following data set (all values are in p.u) referring to the 3-bus, 3-line system as shown in figure below. Iterate only two steps. The range of Q_2 is in between 0.01 p.u to 1 p.u. Assume each line to have series impedance of 0.8+j0.2 p.u and a shunt admittance of 0.04 p.u. [10]



Bus No.	P_D	Q_D	P_G	Q_G	V	Bus type
1	1.0	0.75	?	?	1.05+j0	Slack
2	0.5	1.0	0	0	?	PQ bus
3	1.2	0.5	0	?	|1.02|	PV bus

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46 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2072 Magh

Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BEX	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Power System *(EE553)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. a) What are the advantages of HVDC over HVAC transmission line? Draw neat single line diagram for representation of power system. [4+4]

   b) A transmission line has a span of 180 m between level supports. Line conductor has a cross-sectional area of 1.2 cm^2 and it weighs 1kg/m. Calculate the maximum sag in a wind pressure of 33.5 kg/m^2 of the projected area of the ice covered line. The radial thickness of the ice is 1.3 cm. Assume that the maximum stress in the line is not to increase one fifth of the ultimate strength of 4200 kg/cm^2. [6]

   c) What are the different types of cable faults? Explain to find the location of earth fault in cable. [2+4]

2. a) What is skin effect and proximity effect in transmission line? [2+2]

   b) Derive an expression for inductance of transmission line with unsymmetrical spacing. [4]

   c) A 220 KV, 50 Hz, 200 km long 3 phase line has its conductors at the corners of a triangle with sides 6m, 6 m and 12 m. The conductor radius 1.75 cm. Find the capacitance per phase per km, charging current and total charging MVAR. [8]

3. a) What do you understand by Surge Impedance Loading (SIL)? [2]

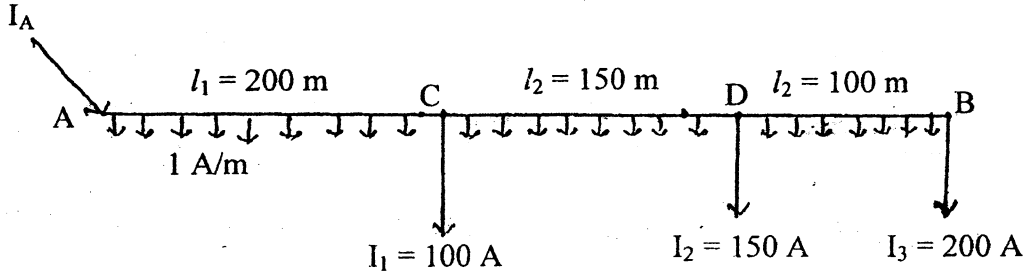
   b) Show base impedance in case of 3-phase with 3-phase MVA and line to line voltage as base quantities is same as that of phase voltage and per phase MVA base. [4]

   c) A 12 km long 3-phase overhead line delivers 6 MW at 11 KV at power factor of 0.8 lagging. Line loss is 10% of the power delivered. Line inductance is 1.2 mH per km per phase. Calculate sending end voltage and regulation. [6]

4. a) Classify different types of bus in used in load flow. Explain real power/frequency balance with neat diagram. [2+6]

   b) What is primary and secondary distribution system? [4]

   c) The dc distributor is loaded as under: $I_1 = 100$ A, $I_2 = 150$ A, $I_3 = 200$ A. The lengths $l_1 = 200$ m, $l_2 = 150$ m and $l_3 = 100$ m. The resistance of both conductors is 0.1Ω /km. The distributor supplies a distributed load of 1 A/m in addition to concentrated loads. Find the voltage at points C, D and B if $V_A = 200$ V. [8]



5. a) Write down the differences of fuse and circuit breaker? [6]

   b) Explain basic protection scheme for transformer. [6]

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46 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2071 Bhadra

Exam.	Regular / Back		
Level	BE	Full Marks	80
Programme	BEX	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Power System *(EE553)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
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- ✓ *Assume suitable data if necessary.*

1. a) Explain the generation, transmission and distribution components of a power system with the help of single line diagram. [6]

   b) An overhead transmission line at a river crossing is supported from two towers at height of 25m and 75m above the water level. The horizontal distance between the towers is 250m. If the required clearance between the conductor and the water, midway between the tower is 45m and if both the towers are on the same side of the point of maximum sag, find the stringing tension in the conductor, the weight of the conductor is 0.8 kg/m. [10]

2. a) What is insulation resistance of a cable also show that it varies inversely to the length of cable. [1+3]

   b) List out the advantages and application of per unit system in the power system analysis. [4]

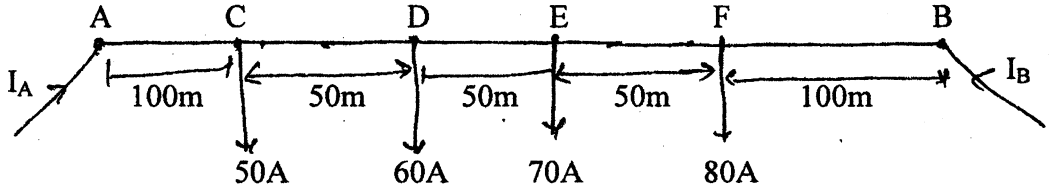
   c) A 300 km, 132 kV 3-ϕ overhead line has a total series impedance of $(52 + j200)\Omega$ per phase and a total shunt admittance of $j1.5 \times 10^{-3}$ Siemen per phase. The line is supplying 40 MVA at 0.8 pf lagging at 132 kV. Find sending end voltage, current, power factor and power using nominal π-model. [4×2]

3. a) Derive the expression for inductance of a line due to internal flux linkage. [6]

   b) A 220 kV, 50 Hz 200 km long 3-ϕ transmission line has its conductor place in horizontal configuration with spacing between adjacent conductor as: 6m, 6m and 12m. The conductor radius is 1.81 cm. Find the capacitance per phase per kilometer, capacitive reactance per phase, charging current and total charging MVAR of the line. [10]

4. a) Derive the basic load flow equation for a general "N" Bus interconnected power system. [6]

   b) A DC distributor AB is fed from both ends. At feeding point A, the voltage is maintained at 235 V and at B it is 240 V. The total length of the feeder is 200 meter and loads are tapped as under in the figure. The resistance of one conductor is 0.4 Ω/km. Calculate the currents in various section of the feeder, the minimum voltage and the point at which it occurs in the system. [10]



5. a) Explain the different types of power system faults. [6]

   b) What is the function of circuit breaker and explain its operation. [6]

   c) Explain differential protection for a transformer. [4]

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2071 Bhadra

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1. a) Explain the generation, transmission and distribution components of a power system with the help of single line diagram. [6]

   b) An overhead transmission line at a river crossing is supported from two towers at height of 25m and 75m above the water level. The horizontal distance between the towers is 250m. If the required clearance between the conductor and the water, midway between the tower is 45m and if both the towers are on the same side of the point of maximum sag, find the stringing tension in the conductor, the weight of the conductor is 0.8 kg/m. [10]

2. a) What is insulation resistance of a cable also show that it varies inversely to the length of cable. [1+3]

   b) List out the advantages and application of per unit system in the power system analysis. [4]

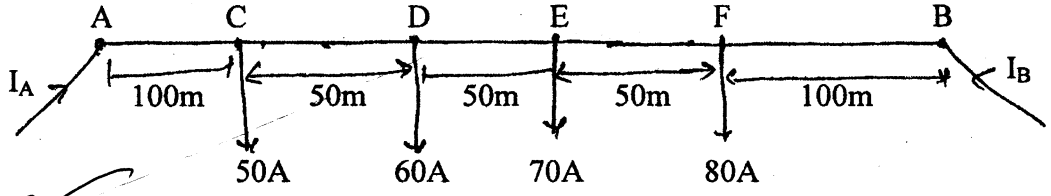
   c) A 300 km, 132 kV 3-ϕ overhead line has a total series impedance of $(52 + j200)\Omega$ per phase and a total shunt admittance of $j1.5 \times 10^{-3}$ Siemen per phase. The line is supplying 40 MVA at 0.8 pf lagging at 132 kV. Find sending end voltage, current, power factor and power using nominal π-model. [4×2]

3. a) Derive the expression for inductance of a line due to internal flux linkage. [6]

   b) A 220 kV, 50 Hz 200 km long 3-ϕ transmission line has its conductor place in horizontal configuration with spacing between adjacent conductor as: 6m, 6m and 12m. The conductor radius is 1.81 cm. Find the capacitance per phase per kilometer, capacitive reactance per phase, charging current and total charging MVAR of the line. [10]

4. a) Derive the basic load flow equation for a general "N" Bus interconnected power system. [6]

   b) A DC distributor AB is fed from both ends. At feeding point A, the voltage is maintained at 235 V and at B it is 240 V. The total length of the feeder is 200 meter and loads are tapped as under in the figure. The resistance of one conductor is 0.4 Ω/km. Calculate the currents in various section of the feeder, the minimum voltage and the point at which it occurs in the system. [10]



5. a) Explain the different types of power system faults. [6]

   b) What is the function of circuit breaker and explain its operation. [6]

   c) Explain differential protection for a transformer. [4]

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44 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2071 Magh

Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BEX	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Power System *(EE553)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
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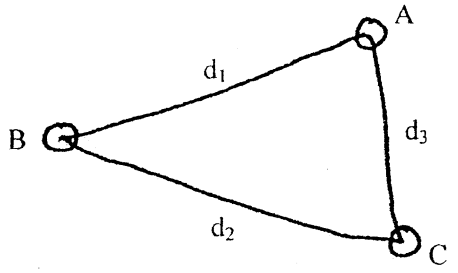
- ✓ *Assume suitable data if necessary.*

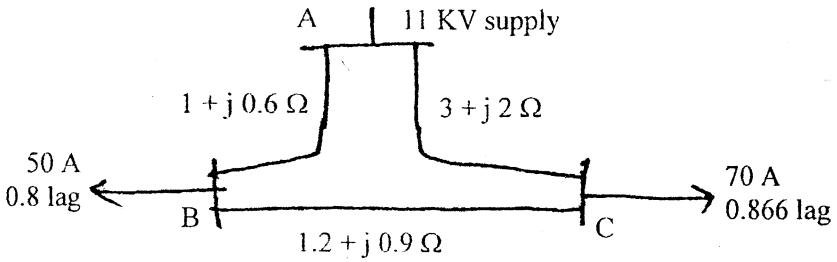
1. Why ac system is more popular than dc system. Explain with mathematical expression. [8]
2. A transmission line conductor having a diameter of 19.5 mm weighs 0.85 kg/m. The span is 275 m, and wind pressure of 39 kg/m^2 is applied to the projected area with ice coating of 13 mm. The ultimate strength of the conductor is 8000 kg. Calculate the maximum sag if the factor of safety is 2 and ice weighs 910 kg/m^2. [6]
3. Discuss the application of G.P.S. system in power system. [6]
4. Derive an expression for the calculation of inductance/phase/km of the transposed line with following configuration. [8]



$r_a = r_b = r_c = r$

5. What do you mean by GMD and GMR? Explain how the value of GMR differs in calculating the inductance and capacitance. [8]
6. What are the methods of compensating the reactive power in transmission lines? [4]
7. A single phase 50 Hz generator supplies an inductive load of 5 MW at a power factor of 0.707 lagging by mean of an overhead transmission line 20 km long. The resistance and the inductance of the line are respectively 0.0195 ohm and 0.63 mH per km. The voltage at the receiving end is required to be kept constant at 10 kV. Find [8]
   i) The sending end voltage and the voltage regulation of the line;
   ii) The value of capacitance to be placed in parallel with the load such that the regulation is reduced to 50% of (i)
   iii) Compare the efficiencies of the line in parts (i) and (ii)
8. How real power/frequency and reactive power/voltage balanced is maintained in power system. Explain with suitable mathematical expression. [8]

9. For a distribution network shown below, calculate the current flow through the various line sections (AB, BC, CA) and the voltage at buses B and C. [8]



10. Compare rural and urban distribution network. [4]

11. Write short notes on: [4×3]

a) HRC fuse
b) Types of circuit breaker
c) Basic protection scheme for transformer

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INSTITUTE OF ENGINEERING
Examination Control Division
2069 Bhadra

Exam.	Regular (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BEX	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Power System *(EE553)*

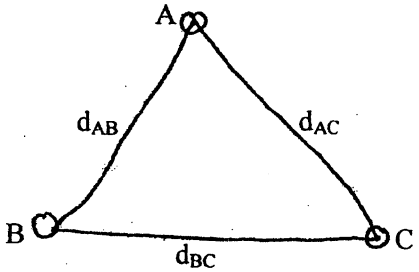
- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1 a) The volume of a conductor material required in the power line decreases with the increase in voltage so also with the increase in power factor. Explain. [4]

b) Write the reasons for adopting high transmission voltage in electrical power transmission. [4]

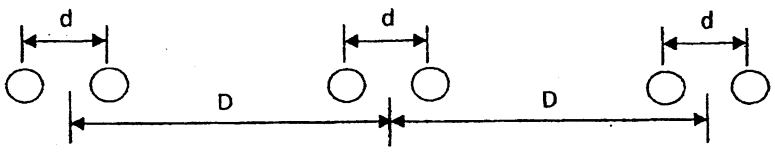
c) An overhead line is erected across a span of 250m on the same level supports. The conductor has a diameter of 1.42cm and weighs 1.09Kg/m. The line is subjected to a wind pressure of 37.8 Kg/m^2 of the projected area. The radial thickness of ice is 1.25cm. The line is carried by insulator string 1.43m long. Calculate: (i) Maximum sag in the deflected direction (ii) Sag in the vertical direction and (iii) The height of the lowest cross-arm to give minimum ground clearance of 7.62m. Assume that ice weighs 915 Kg/m^3 and permissible tension in the conductor is 1663 Kg. [8]

2. a) Starting from a suitable point, derive an expression for the calculation of capacitance/phase/km of the transposed line with following configuration. [8]



$r_a = r_b = r_c = r$

b) A 3-phase, 460 kV, 50 Hz transposed transmission line with flat-horizontal configuration is shown in figure below. The diameter of each sub-conductor is 5 cm. Calculate capacitive reactance per phase per km of the line. Also calculate the charging current and charging VAR per km of the line. (Assume: D = 8m and d = 40cm) [8]

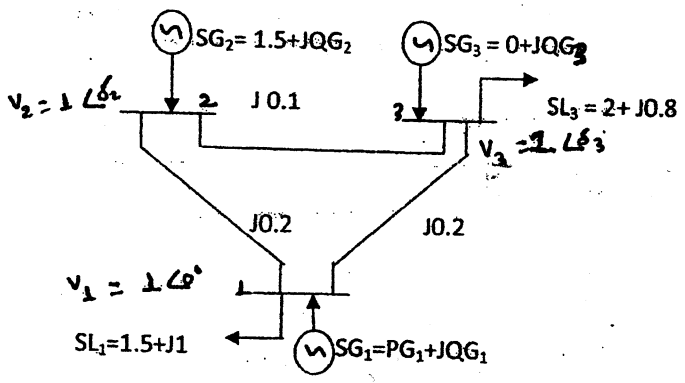


3. a. A 100 km long 3-phase transmission line has following line constants:

- resistance/km/phase=0.1 ohm
- reactance/km/phase =j0.5 ohm
- susceptance /km/phase=j10^{-5} S

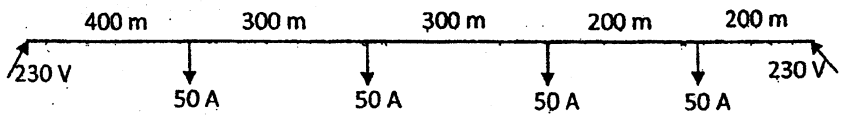
If the line supplies a load of 20 MW, 0.9 pf lagging at 66 kV to the receiving end, calculate, by using nominal pi-method; (i) sending end power factor, (ii) voltage regulation, and (iii) transmission efficiency. [8]

b. For the interconnected system as shown, line resistance may be neglected and pu line reactances are as shown and the voltage at all buses should be 1 pu. The pu values of loads and active power generated at the different buses are also shown. Calculate reactive power generated at all buses. [8]



4. a) What do you mean by power system protection? Describe different type of circuit breakers with their relative merits, demerits and applications. [2+6]

b) A DC distributor fed at both ends at 230V with conductor loop resistance of 0.2 Ohm/km is loaded as shown in figure below. Determine the minimum voltage and along the distributer and the point of minimum voltage. [8]



[4×4]

5. Write short notes on:
   a) Fault detection of underground cable
   b) Types of relays
   c) Rural vs. urban distribution
   d) Scourge impedance loading of a transmission line

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INSTITUTE OF ENGINEERING
Examination Control Division
2068 Magh

Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BEX	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Power System

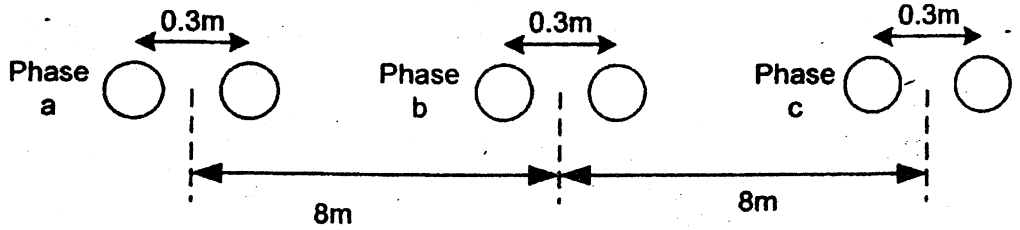
- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt any **Five** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. a) What are the reasons for adopting high transmission voltage in electrical power transmission? Also explain the issues that limit selection of high working voltage. [8]

   b) Nepal Electricity Authority is planning to construct a 66kV transmission line, in which the tower span is 150m. The requirements are: ground clearance = 15m and maximum stress = 1250kg/m^2. A consultant proposes a line conductor with cross-sectional area 1.25cm^2 and weight of 0.8kg/m, in which the designed sag was 3.45m. Comment on the design whether the resultant stress will be within the requirement, and also determine the height at which the conductors to be supported. [8]

2. a) Explain the effect of earthing in the capacitance of a transmission line. In which cases, between the overhead and underground cable, the earthing effect is more prominent. [8]

   b) A 400kV bundled conductor has the lines spacing as shown below. Assuming that each conductor in a phase carries 50% of total current and radius of each conductor being 2cm, calculate GMD and GMR of the configuration. If applicable, use these values to calculate the inductance and capacitance per phase of the configuration. What will be the net capacitive charging var per km for this configuration? The line is operated at 50hz. [8]

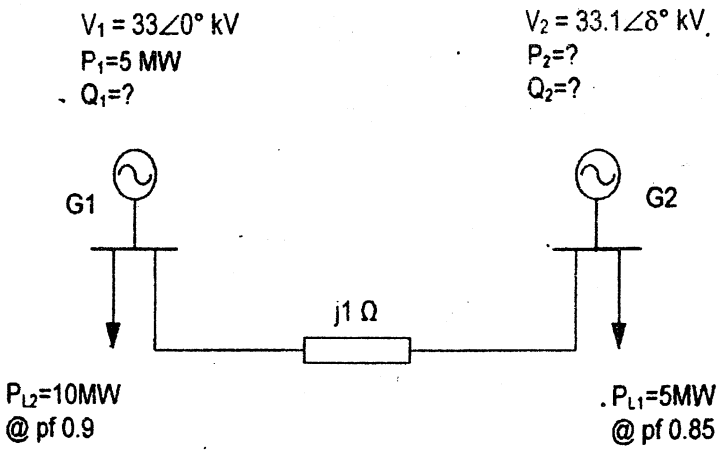


3. a) With the aid of power flow equations for a short transmission line with R<<X, explain how the decoupled control of active power and reactive power can be achieved by regulating the power angle and voltage drop, respectively. [8]

   b) A 3-phase, 50Hz, 150km line has a resistance, inductive reactance and capacitive shunt admittance of 0.1 ohm, 0.5ohm and 3.1 × 10^{-6} S per km per phase. Construct the nominal π model for this line. If the line delivers 50MW at 110 kV and 0.8 p.f. lagging, determine the sending end voltage, sending end current and efficiency of the line. [8]

4. a) Mention the type of feeders in distribution system and explain, in detail, one of them. [8]

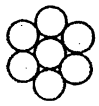
   b) For an interconnected system as shown, calculate reactive power injected by G1; and active power, reactive power and power angle of G2. Assume the pf given in the loads are lagging one. [8]



5. a) What is the implication of active and reactive power supply and demand mismatch in an electric power system? [8]

   b) Briefly describe the significance of line supports in power transmission system. [4]

   c) Compute the self GMD of the following conductor. Each strand has a radius of 4mm. [4]



6. Write short note on following (Attempt any four: (a) & (b) are compulsory.) [4×4]

   a) Generator protection scheme
   b) Circuit breaker
   c) Underground cable
   d) Computer application of power system
   e) Surge impedance loading
   f) Skin effect and proximity effect

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INSTITUTE OF ENGINEERING
Examination Control Division
2068 Bhadra

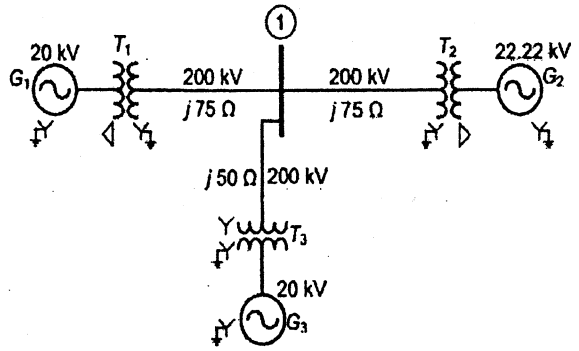
Exam.	Regular / Back		
Level	BE	Full Marks	80
Programme	BEX	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Power System

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt any **Five** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. a) Single line diagram of an interconnected power system shown in figure below with data given in the following table. Assuming that the shunt parameters of the transformers are negligible, develop the reactance diagram. [8]

Generator G_1	200MVA, 20kV, $X_{G1} = j0.225\Omega$
Generator G_2	300MVA, 18kV, $X_{G2} = j0.225\Omega$
Generator G_3	300MVA, 20kV, $X_{G3} = j0.225\Omega$
Transformer T_1	200MVA, 220/20kV, $X_{T1} = j0.225\Omega$
Transformer T_2	300MVA, 220/20kV, $X_{T1} = j0.225\Omega$
Transformer T_3	300MVA, 220/22kV, $X_{T3} = j0.225\Omega$

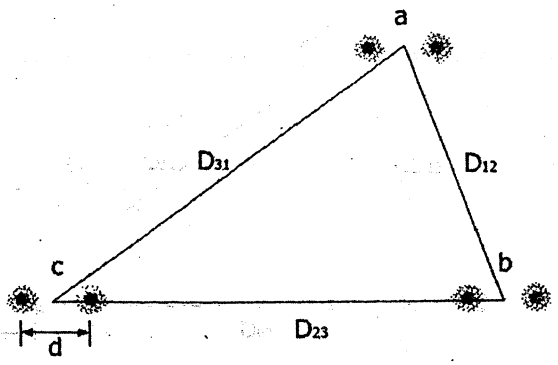


b) Compare the characteristics and applications of overhead conductor and underground cables. [8]

2. a) What are the parameters of transmission line? Explain how these parameters are affected by the size of the conductor and the configuration of the transmission line. [8]

b) A 460kV bundled conductor has the lines spacing as shown below. Assuming that each conductor in a phase carries 50% of total phase current and the effective radius of each conductor being 2 cm, calculate GMD and GMR of the configuration. If applicable, use these values to calculate the inductance and capacitance per phase of the configuration. What will be the net capacitive charging var per km length for this configuration? A 3-phase, 50Hz, 345KV overhead transmission line has two sub-conductors per phase and line spacings as shown below. [8]

$D_{12} = 7m$
$D_{23} = 8m$
$D_{31} = 10m$
$d = 0.3m$



3. a) Derive an expression for the voltage regulation of short transmission line. With the help of derived results, point out the factors that affect the voltage regulation. Also suggest the measures for better voltage regulation. [8]

b) A 3-phase, 50Hz overhead transmission line has the following constants: [8]

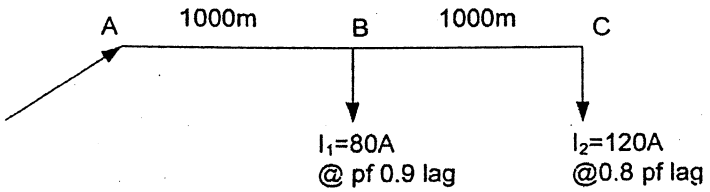
Resistance/phase = 9.6Ω
Inductance/phase = 0.097mH
Capacitance/phase = 0.765μF

If the line is supplying a balanced load of 24000kVA 0.8 p.f. lagging at 66kV, calculate: (i) sending end current (ii) Line value of sending end voltage (iii) Sending end power factor (iv) Percentage regulation, and (v) Transmission efficiency.

4. a) What do you mean by an interconnected power system? Explain the merits of interconnected power system over isolated one. What are the steps to be undertaken before a generator is connected with a power grid? [8]

b) For the single line diagram of the distributor with impedance of distributor/km = (0.05 + j0.1) Ω below. If the voltage at the far end C is maintained at 230V, calculate: [8]

i) Voltage at the sending end
ii) Power angle between voltages at the two ends A and C.



5. a) Draw a neat sketch of a cable used in underground application and describe the functions of each components. [5]

b) Classify power cables based on insulation used. [3]

c) A 1-phase overhead line has radius of phase conductor equal to 8mm and radius of neutral conductor equal to 6 mm. Compute the inductance of the line if its length is 1.2 km. [5]

d) What is the effect of earth on capacitance of an overhead line? Explain briefly. [3]

6. Write short notes on: (any four) [4×4]

a) Fuse as a protective device
b) Generator protection schemes
c) Series and shunt compensation
d) Per unit system
e) Skin effect and proximity effect

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