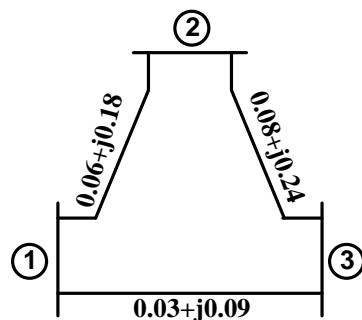# 5 Mark Question

Module 1: Basic Concepts

1. Compare Micro grid with conventional utility grid
2. Draw and explain the structure of power system indicating the voltage level in each transmission line.
3. Explain the concept of Distributed Energy Resources (DERs).
4. Explain conventional and non-conventional energy sources.
5. Explain the working principle of a thermal power plant.
6. Explain the evolution of power systems from early DC networks to modern interconnected AC grids. **[CO1]**
7. Write short notes on any two renewable energy sources such as solar and wind energy, mentioning their working principles and advantages. **[CO1]**
8. Draw and describe the layout of a thermal power plant. Explain the main components and their functions. **[CO2]**
9. Compare the features and operation of Hydro-electric and Diesel power plants. Discuss their advantages, disadvantages and applications. **[CO2]**
10. What are Distributed Energy Resources (DERs)? Explain their role and significance in microgrids and modern power systems. **[CO3]**
11. Discuss the importance of energy storage in renewable-integrated power systems. Explain different energy storage technologies and how they support grid stability and reliability. **[CO4]**
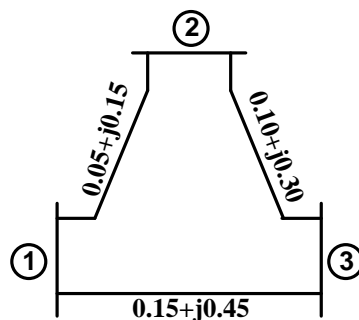
Module 2: Distribution Systems

1. Explain the difference between single-phase and three-phase distribution systems with neat diagrams. **[CO1]**
2. What are the factors to be considered for selecting the site of a substation? Explain briefly. **[CO1]**
3. Describe the 3-phase 4-wire distribution system. What are its advantages and typical applications? **[CO2]**
4. Explain different bus-bar arrangements used in substations. Compare single bus, double bus and ring main arrangements with suitable diagrams. **[CO2]**
5. Derive the expression for voltage drop in an A.C. distributor when power factor is referred to receiving end voltage. **[CO3]**
6. Compare the main and transfer busbar arrangement with the double bus, double breaker arrangement.
7. How does the main and transfer busbar arrangement improve upon the single busbar scheme, and what is the role of the bus coupler?
8. What factors should be considered when selecting a site for a substation? Discuss at least three critical considerations.
9. Compare radial and ring main distribution systems for AC power supply.

Module 3: Power Flow Analysis

1. What is load flow analysis? Classify various types of buses in a power system for load flow studies.
2. Write down the advantages and limitations of Gauss-Seidel method.
3. Explain the Jacobian matrix for the Newton-Raphson method. What is acceleration factor in Gauss-Siedel method?
4. Write down the advantages and limitations of Newton-Raphson method.
5. How can power flow analysis help in designing new power systems?
6. Determine YBus for the 3-bus system shown in figure. The line series impedance are in pu.

7. Write down the advantages of bus admittance matrix. Determine YBus for the 3-bus system shown in figure. The line series impedance are in pu.

8. Explain the objectives of power flow (load flow) analysis in a power system. What information can be obtained from a load flow study? **[CO1]**
9. Derive the real and reactive power balance equations at a node in a power system. **[CO1]**
10. Describe the different types of buses used in power flow analysis — Slack, PV and PQ buses — with their specified and unknown quantities. **[CO2]**
11. Explain the steps involved in forming the Bus Admittance Matrix (Y_{bus}) for a power system network using the inspection method. **[CO3]**
12. Discuss the Gauss–Seidel method for solving load flow equations. Mention its advantages and limitations compared to other numerical methods. **[CO2]**

13. With the help of a flowchart, explain the Newton–Raphson method for load flow analysis. How does it differ from the Gauss–Seidel method in terms of convergence and accuracy? **[CO4]**
14. What are the computational issues encountered in large-scale power systems during load flow studies? Discuss the methods used to handle sparse matrix storage and computation. **[CO4]**

Module 4: Power System Components

1. Derive the expression for the inductance of a 3-phase line without considering the effect of a transposition.

2. Draw the cross section of an insulated cable and explain the significance of the various layers.

3. (i) What is sag in overhead lines?

(ii) Explain the terms 'puncture' and 'flashover' with respect to an electrical insulator.

4. (i) What is the per-unit system?

(ii) What are the advantages of using the per unit system for power system?

5. (i) Define string efficiency in connection with suspension insulators.

(ii) State how with the help of guard rings string efficiency can be improved.

6. Explain various methods of improving string efficiency.

7. What is meant by "transposition of conductors"? Explain the necessity of transposition.

8. Derive the expression for the voltage regulation of a short transmission line for lagging power factor load.

9.Explain Surge Impedance Loading.

Discuss about Ferranti Effect.

10.What is corona? How can the corona loss be minimized in a transmission line?

11. Prove that g max / g min in a single core cable is equal to D/d.

12. What is meant by the term "bundled conductors"? Explain the advantages of bundled conductor.Define surge impedance loading (SIL) of a transmission line. **[CO1]**

13. Explain the types of insulators used in overhead transmission lines. **[CO1]**

14. What is the per-unit system? Write its basic formula for voltage, current and impedance. **[CO2]**
15. A 3-phase overhead transmission line is not transposed. Explain the difference between GMR and GMD and how they affect line inductance and capacitance. **[CO3]**
16. Explain the voltage distribution across a suspension insulator string and define string efficiency. **[CO3]**
17. Derive the ABCD constants for a short transmission line and explain their significance in voltage and current calculations. **[CO4]**
18. A single-phase overhead transmission line delivers 1100 kW at 33 kV at 0·8 p.f. lagging. The total resistance and inductive reactance of the line are 10 Ω and 15 Ω respectively.Determine : sending end voltage **[CO3]**

10 Mark Question

Module 1 Basic Concepts

1. (i) With neat sketch, explain typical micro grid configuration.

   (ii) What is the role of distributed energy resources?

2. (i) Draw and explain the structure of power system indicating the voltage level in each transmission line.

   (ii) Why is electric power preferably to be transmitted at a high voltage?

3. Explain the working principles, main components and layout of a hydroelectric power plant. Compare its efficiency and environmental impact with that of a **thermal power plant**.

4. Describe the structure of a modern electric power system. Explain the functions of the generation, transmission and distribution subsystems with suitable diagrams.

5. Discuss the advantages and limitations of different types of conventional and non-conventional power plants (Thermal, Hydro, Nuclear, Solar and Wind). Explain how the choice of generation source affects overall system stability and cost.

6. Explain how different types of power plants (thermal, hydro, nuclear and renewable) are combined in a modern power system to meet varying load demands throughout the day. Illustrate with a simple load curve showing base-load and peak-load plants.

7. Analyze the role of Distributed Energy Resources (DERs) and Energy Storage Systems (ESS) in microgrid operation. Explain how these technologies enhance power quality, reliability and resilience during grid disturbances or islanded operation.
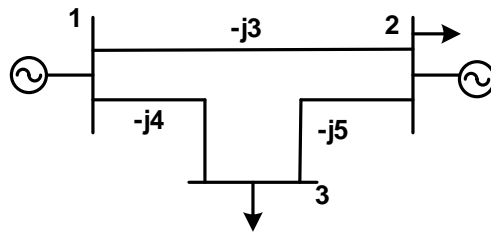
Module 2 Distribution Systems

1. **Describe the process and significance of voltage drop calculations in AC distributors. How does the power factor influence these calculations for different load conditions?**

2. Explain the classification and main components of distribution substations. Discuss the factors influencing their design, such as voltage level, load density and reliability requirements.

3. A single phase A.C. distributor AB 300 metres long is fed from end A and is loaded as under:
   - (i)   100 A at 0·707 p.f. lagging 200 m from point A
   - (ii)   200 A at 0·8 p.f. lagging 300 m from point A

   The load resistance and reactance of the distributor is 0·2 Ω and 0·1 Ω per kilometre. Calculate the total voltage drop in the distributor. The load power factors refer to the voltage at the far end.

4. Explain the voltage drop in a 3-phase, 4-wire AC distribution system supplying both balanced and unbalanced loads. Discuss how unbalanced loads affect system performance and suggest simple ways to reduce voltage drop and losses.
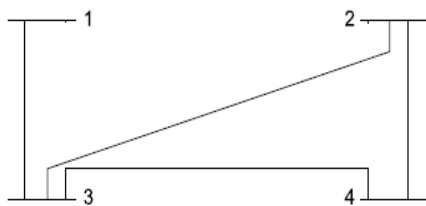
Module 3 Power Flow Analysis

1. Explain the procedure for load flow solution using Gauss-Seidel method. write down the importance of acceleration factors.

2. Describe the real and reactive power balance equations at a node in a power system. How are these equations used in power flow analysis?

3. Explain the necessity of load flow studies in power system. Derive static load flow equations for two bus system.

4. List and briefly describe the types of numerical methods used for solving power flow equations in a power system.

5. Explain the computational procedure for load flow solution using Newton-Raphson method.

6. A three-bus power system is shown in figure. The relevant per unit line admittances on 100 MVA base are indicated on the diagram and bus data are given in table. Form the Y_{bus} and determine the voltages at bus 2 after the 1st iteration. Take the acceleration factor 1.

Bus number	Type	Generation		Load	
		P_G(MW)	Q_G(MVAr)	P_L (MW)	Q_L(MVAr)
1	Slack	?	?	0	0
2	PQ	25	15	50	25
3	PQ	0	0	603	30

7. With the help of a neat diagram, explain the formation of the Bus Admittance Matrix (Y_{bus}) using the singular transformation method. Discuss its importance in power flow analysis.

8. Develop the Y_{Bus} Matrix.

Line, Bus to Bus	R pu	X pu
1-3	0.10	0.30
2-3	0.25	0.45
2-4	0.10	0.30
3-4	0.05	0.15

9. List and briefly describe the types of numerical methods used for solving power flow equations in a power system.

<mark>Module 4   Power System Components</mark>

1. (i) How is transmission lines classified?

(ii) Define regulation of a transmission line.

(iii) Derive the A, B, C, D parameters for long transmission line.

2. (i) Explain various methods of improving string efficiency.

(ii) In a 33 kV overhead line, there are three units in the string of insulators. If the capacitance between each insulator pin and earth is 11% of the self-capacitance of each insulator. Find String Efficiency.

3. (i) Draw and explain underground cable cross section diagram.

(ii) Prove that g max / g min in a single core cable is equal to D/d.

4. (i) Why transposition is required in a transmission line?

(ii) A single-phase transmission line consists of two parallel conductors one meter apart and 1.25 cm in diameter. Calculate the loop inductance per km of the line.

5. (i) What is surge impedance loading? What is Reactive Power?

(ii) Show that the inductance per loop meter of a two-wire transmission line using solid round conductor is given by

is given by

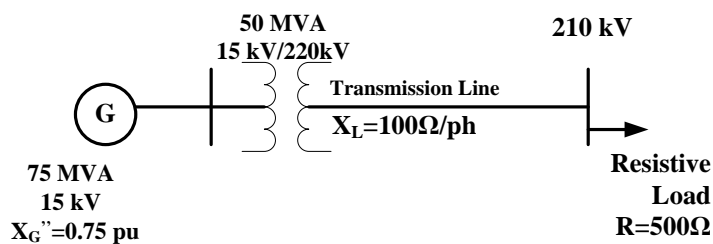$$L = 4 \times 10^{-7} \ln \frac{d}{r'} \text{ H,}$$

Where, d is the distance between the conductors and r' is the GMR of the conductors.

6. What do you mean by tariff? Describe the desirable characteristics of a tariff.

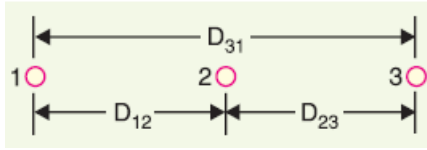What is sag in overhead lines? What factors affects sag?

7. A single phase load of 200 kVA is delivered at 2500 V over a transmission line having R=1.4 Ω, X=0.8 Ω. Calculate the current, voltage and power factor at the sending end when the power factor of the load is a) unity b) 0.8 lagging c) 0.8 leadig.

8. Determine the generator, transformer and transmission line reactance in per unit for the given figure. Consider base MVA is 100.

9. Explain the concept of GMD (Geometric Mean Distance) and GMR (Geometric Mean Radius). Derive the expression for inductance of a 3-phase transposed transmission line.

10. Describe the ABCD parameters of transmission lines. Derive the relationship between sending end and receiving end voltage and current for a medium transmission line using the nominal π method.

11. Calculate the inductance of each conductor in a 3-phase, 3-wire system when the conductors are arranged in a horizontal plane with spacing such that $D_{31} = 4$ m; $D_{12} = D_{23} = 2$m. The conductors are transposed and have a diameter of $2 \cdot 5$ cm.

12. Analyze the factors affecting voltage distribution across suspension insulator strings. Derive the expression for string efficiency, discuss the methods of improving it and explain its practical significance in high-voltage transmission systems.