SREENIVASA INSTITUTE of TECHNOLOGY and MANAGEMENT STUDIES (autonomous)

Electrical Power Distribution

Question bank

III - B.TECH / V - SEMESTER regulation: R20

Compiled by

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III B.Tech V Semester	L	T	P	C
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20EEE352 ELECTRICAL POWER DISTRIBUTION

Pre-requisites: A Course on Electrical Power Transmission

Course Educational Objectives:

1.Acquire knowledge of Distribution system, types of loads and their characteristics.
2.Impart knowledge on methods of classification of different distribution systems and determine voltage drops in DC distribution systems.
3 Impart knowledge on methods of classification of different distribution systems and determine voltage drops in AC distribution systems.
4 Capitalize knowledge of various types of substations and their optimal locations. To gain knowledge of different bus bars and their operation.
5 Know the importance and improvement of power factor and voltage control in distribution systems.

UNIT -1: GENERAL CONCEPTS

Introduction to distribution systems, Load factor, Diversity factor, Capacity factor, Utilization factor, Coincidence factor, Contribution factor, loss factor – Relationship between the load factor and loss factor. Load curve and load duration curves – Classification of loads (residential, commercial, agricultural and industrial) and their characteristics.

UNIT – 2: DC DISTRIBUTION SYSTEMS

Classification of Distribution systems – Comparison of DC vs AC and Underground vs Overhead distribution systems – Requirements and design features of Distribution systems- Voltage drop Calculations (Numerical Problems) in DC Distributors for the following cases: Radial DC Distributor fed from one end and fed from the both the ends (equal/unequal Voltages) – Ring main distributor. Distributors with concentrated and uniform loading – numerical problems.

UNIT – 3: AC DISTRIBUTION SYSTEMS

Requirements and design features of AC Distribution feeders: Radial and loop types of primary feeders, feeder voltage levels, feeder loading – Basic design practice of the secondary distribution system. Voltage drop calculations (Numerical Problems) in AC Distributors for the following cases: Power factors referred to receiving end voltage and with respect to respective load voltages.

UNIT – 4: SUBSTATIONS

Classification of substations – Indoor, Outdoor, transformer substations, layout of 33kV/11kV, 11kV/400V substations showing the location of all the equipments, symbols for equipments in the substations, Applications of Isolators, Earthing switches and load break switches, Optimal substation location – Bus bar arrangements: single, double, main and transfer, ring, one and half bus bar schemes and their operation.

UNIT – 5: PROTECTION AND COORDINATION OF DISTRIBUTION SYSTEMS

Causes and effects of low power factor – Methods of improving PF- Most economical PF for constant kW load – numerical problems. Importance of voltage control, methods of voltage control: shunt, series capacitors, synchronous condensers, tap changing and booster transformers. Objectives of distribution system protection, Protective Devices: Principle of operation of fuses, circuit reclosures, line sectionalizes, and circuit breakers- Coordination of protective devices: General coordination procedure.

Course Outcomes:

	On successful completion of the course, students will be able to	POs related to Cos
CO1	Demonstrate knowledge on distribution system, types of loads and their characteristics.	PO1,PO2& PS01,PSO2
CO2	Acquire knowledge on methods of classification of different distribution systems and determine voltage drops in DC distribution systems.	PO1,PO2,&PS01, PSO2
CO3	Acquire knowledge on methods of classification of different distribution systems and determine voltage drops in AC distribution systems.	PO1,PO3,PO3& PS01,PSO2
CO4	Incurs knowledge of various types of substations and their optimal locations, different bus bars and their operation.	PO1,PO2,PO3& PS01,PSO2
CO5	Knows the importance and improvement of power factor and voltage control in distribution systems. Can understand coordination of protective devices.	PO1,PO2,PO3,PO4, PO5,PO6,PO12& PS01,PSO2

Text Books:

1. Dr. H.P. Inamdar of Electric Power – by, Electrotech Publication, 1st Edition, 2011.
2. Electrical Power Distribution systems – by V.Kamaraju, McGraw Hill Publishers, 2017.

REFERENCE BOOKS:

1. Electrical Power Distribution system Engineering, Turan Gonen, McGraw Hill Publishers, 1986.
2. Electrical Power Distribution, A.S. Pabla, McGraw Hill Publishers, 2004.
3. Principles of Power Systems, 4 th Edition, V.K.Mehta, S.Chand Publishers.

REFERENCE WEBSITE LINK:

https://nptel.ac.in/courses/108/107/108107112/

Question No.	Questions	PO Attainment
	UNIT – 1: GENERAL CONCEPTS	
	PART-A (Two Marks Questions)	
1	Define Load factor.	PO1
2	What is plant capacity factor?	PO1
3	Define Average load and Connected load.	PO1
4	Define (i) loss factor (ii) Utilization factor	PO1
5	Define(i)Demand factor (ii)maximum demand	PO1
6	Define coincidence factor	PO1
7	Define contribution factor	PO1
8	Define plant use factor	PO1
9	Define load curve and load duration curve	PO1
10	draw the load characteristics of daily load curve	PO1
11	Define demand, demand interval	PO1
12	List the types of loads.	PO1
13	For pumping of water what type of loads used?	PO1
14	Draw the characteristics of Industrial, commercial loads.	PO1
15	The maximum demand on a power station is 100 MW. If the annual load factor is 40% , calculate the total energy generated in a year	PO1
16	Compare the load curve and load duration curve	PO1
17	draw the load characteristics of Agricultural loads.	PO1
18	Define diversity factor. write its formulae.	PO1
19	Write Necessity of load curve	PO1
20	What is distribution systems.	PO1
	PART-B (Ten Marks Questions)	
1	Discuss the relationship between load factor and loss factor for different load cases?	PO1, PO2
2	The annual peak load input to a primary feeder is 2000kW. The total copper loss at the time of peak load is 100kW. The total annual energy supplied to the sending end of the feeder is 6.7*106 kWh. Then: i. Determine the annual loss factor ii. Calculate the total annual copper loss energy and its value at Rs. 2.5/kWh.	PO1, PO2
3	(a)A 50 MW hydro generator delivers 320 million KWH during the year. Calculate the plant load factor? (b). Explain the load characteristics of distribution system?	PO1, PO2
4	Discuss different types of loads present in distribution system and explain their characteristics?	PO1, PO2
5	(a) A 120 MW substation delivers 120 MW for 4 Hrs, 60 MW for 10 Hrs and shut down for rest of each day. It is also shut down for the maintenance for 30 days each year. Calculate its annual load factor? (b) A generation station has a connected load of 43 MW and a maximum demand 20MW, the units generated being 61.5*106 kw per annum. Calculate (i) demand factor and (ii) load factor?	PO1, PO2
6	Derive an expression for inductance of composite conductors of a 1-phase line consisting of m strands in one conductor and n strands in the other conductor.	PO1, PO2
7	(a) A feeder supplies 2 MW to an area the total losses at peak load are 100KW and units supplied to that area during an year are 5.61 million units calculate	PO1, PO2

	loss factor? (b) Discuss about Diversity factor and Coincidence factor?	
8	Discuss the characteristics of the following categories of loads (i) Residential (ii) Agriculture (iii) Commercial (iv) Industrial.	**PO1, PO2**
9	A generating station has a maximum demand of 25MW a load factor of 60%, a plant capacity factor of 50% and a plant use factor of 72% find (i) Reserve capacity of the load (ii) The daily energy produced and (iii) Maximum energy that could be produced daily if the plant while running as per schedule were fully loaded?.	**PO1, PO2**
10	Classify the types of loads and draw their characteristics and Explain in detail.	**PO1, PO2**
11	Explain about load curve and load duration curve.	**PO1, PO2**
12	A generating station has a connected load of 43MW and a maximum demand of 20 MW; the units generated being 61·5 × 106 per annum. Calculate (i) the demand factor and (ii) load factor	**PO1, PO2**
13	A generating station has the following daily load cycle : Time (Hours) 0 —6 6 —10 10 —12 12 —16 16 —20 20 —24 Load (M W) 40 50 60 50 70 40 Draw the load curve and find (i) maximum demand (ii) units generated per day (iii) average load and (iv) load factor	**PO1, PO2**
14	A power station has a maximum demand of 15000 kW. The annual load factor is 50% and plant capacity factor is 40%. Determine the reserve capacity of the plant.	**PO1, PO2**
15	Define(a) load factor (b)diversity factor (c)plant capacity factor (d)utilization factor(e)loss factor	**PO1, PO2**

Question No.	**Questions**	**PO Attainment**
	UNIT – 2: DC DISTRIBUTION SYSTEMS	
	PART-A (Two Marks Questions)	
1	What is a service main in distributed systems	**PO1**
2	Define the terms Distributor and feeder	**PO1**
3	Classify the distribution systems	**PO1**
4	What are the requirements of distribution systems?	**PO1**
5	What are the types of DC distributors?	**PO1**
6	What is Ring Distributor	**PO1**
7	What is Inter connected system?	**PO1**
8	How the current can distributed in 3wire system?	**PO1**
9	Define Ground Detector.	**PO1**
10	Compare the 3-Wire and 2-Wire D.C. Distribution.	**PO1**
11	List any two comparisons between DC vs AC Distribution systems	**PO1**
12	List any two comparisons between Underground vs Overhead distribution system	**PO1**
13	Classify the distribution system according to scheme of connection	**PO1**
14	What are the advantages of Disadvantages of DC distribution system	**PO1, PO2**
15	Compare concentrated loading and uniform loading	**PO1**
16	Define loading	**PO1, PO2**

17	What are elements in distribution system	**PO1**
18	Draw the neat sketch of ring main distributed system?	**PO1**
19	What are the advantages of ring main distributed system?	**PO1**
20	Draw the neat sketch of interconnected distributed system?	**PO1**
PART-B (Ten Marks Questions)		
1	(a) Compare overhead and underground distribution systems? (b) Explain requirements and design features of distribution systems?	**PO1, PO2**
2	Explain Radial and Ring main and interconnected systems?	**PO1, PO2**
3	A 2 wires dc distributor cable AB is 2km long and supplies loads of 100A,150A,200A and 50A situated 500m,1000m,1600m and 2000m from the feeding point A. Each conductor has a resistance of 0.01ohm per 1000m.calculate potential difference at each load point if a potential difference of 300V is maintained at point A.	**PO1, PO2**
4	A 2 wire dc ring distributor is 300m long and is fed at 240V at point A. At point B 150m from A, a load of 120A is taken and at C, 100m in the opposite direction, a load of 80A is taken. If the resistance per 100m of single conductor is 0.03Ω. Find (i) Current in each section of distributor (ii)Voltage at points B and C.	**PO1, PO2**
5	A two-wire dc distributor AB, 600 meters long is loaded as under: Distance from A (meters): 150 300 350 450 Loads in Amperes : 100 200 250 300 The feeding point A is maintained at 440V and that of B at 430V. If each conductor has a resistance of 0.01Ω per 100 meter, calculate (i) The current supplied from A to B (ii) The power dissipated in the distributor.	**PO1, PO2**
6	Derive the voltage drop when (a)Distributor fed at one end (b)distributor fed at both ends with concentrated loading	**PO1, PO2**
7	A 2-wire d.c. distributor 200 metres long is uniformly loaded with 2A/metre. Resistance of single wire is 0·3 Ω/km. If the distributor is fed at one end, calculate : (i) the voltage drop upto a distance of 150 m from the feeding point (ii) the maximum voltage drop	**PO1, PO2**
8	A 2-wire d.c. street mains AB, 600 m long is fed from both ends at 220 V. Loads of 20 A, 40 A, 50 A and 30 A are tapped at distances of 100m, 250m, 400m and 500 m from the end A respectively. If the area of X-section of distributor conductor is 1cm^2 , find the minimum consumer voltage. Take $\rho = 1{\cdot}7 \times 10^{-6}$ Ω cm	**PO1, PO2**
9	A d.c. distributor A B is fed at both ends. At feeding point A, the voltage is maintained at 235 V and at B at 236 V. The total length of the distributor is 200 metres and loads are tapped off as under : 20 A at 50 m from A 40 A at 75 m from A 25 A at 100 m from A 30 A at 150 m from A T he resistance per kilometre of one conductor is 0·4 Ω. Calculate the minimum voltage and the point at which it occurs	**PO1, PO2**
10	Determine the voltage drop in a uniformly loaded distributor fed at both ends with equal and unequal loads.	**PO1, PO2**
11	Two conductors of a d.c. distributor cable AB 1000 m long have a total resistance of 0·1 Ω. The ends A and B are fed at 240 V. The cable is uniformly	**PO1, PO2**

	loaded at 0·5 A per metre length and has concentrated loads of 120 A, 60 A, 100 A and 40 A at points distant 200 m, 400 m, 700 m and 900 m respectively from the end A. Calculate (i) the point of minimum potential (ii) currents supplied from ends A and B (iii) the value of minimum potential.	
12	A 2-wire d.c. distributor ABCDEA in the form of a ring main is fed at point A at 220 V and is loaded as under : 10A at B ; 20A at C ; 30A at D and 10 A at E. The resistances of various sections (go and return) are : AB = 0·1 Ω ; BC = 0·05 Ω ; CD = 0·01 Ω ; DE = 0·025 Ω and EA = 0·075 Ω. Determine : (i) the point of minimum potential (ii) current in each section of distributor	**PO1, PO2**
13	A d.c. ring main ABCDA is fed from point A from a 250 V supply and the resistances (including both lead and return) of various sections are as follows : AB = 0·02 Ω ; BC = 0·018 Ω ; CD = 0·025 Ω and DA = 0·02 Ω. The main supplies loads of 150 A at B ; 300 A at C and 250 A at D. Determine the voltage at each load point. If the points A and C are linked through an interconnector of resistance 0·02 Ω, determine the new voltage at each load point	**PO1, PO2**
14	A two conductor main A B, 500 m in length is fed from both ends at 250 volts. Loads of 50 A, 60 A, 40 A and 30 A are tapped at distance of 100 m, 250 m, 350 m and 400 m from end A respectively. If the Xsection of conductor be 1 cm2 and specific resistance of the material of the conductor is 1·7 μ Ω cm, determine the minimum consumer voltage.	**PO1, PO2**
15	Discuss the design features of distribution system.	**PO1, PO2**

Question No.	Questions	PO Attainment
UNIT – 3: AC DISTRIBUTION SYSTEMS		
PART-A (Two Marks Questions)		
1	List any two comparisons between DC vs AC Distribution systems	**PO1**
2	What are the applications of feeder	**PO1**
3	Define AC Distribution system.	**PO1**
4	List the factors affecting the selection of feeder voltage level.	**PO1**
5	Write the factors affecting the selection of primary feeder loading.	**PO1**
6	Define primary transmission, distribution.	**PO1**
7	What is interconnected network	**PO1**
8	Define voltage square factor rule.	**PO1**
9	Formula for feeder service area coverage principle	**PO1**
10	Write factors affecting design of feeder	**PO1**
11	Define transformer application factor	**PO1, PO3**
12	What are the advantages of interconnected distribution system?	**PO1**
13	What are the advantages of Disadvantages of AC distribution system	**PO1, PO3**
14	Define secondary network	**PO1, PO3**
15	Draw the neat sketch of loop type primary feeder?	**PO1**
16	Draw the neat sketch of radial type primary feeder with express feeder	**PO1**
17	Define tie line.	**PO1**
18	What are the requirements of primary feeder.	**PO1**

19	Write the Need of distributor.	**PO1**
20	Define power factor	**PO, PO3**
PART-B (Ten Marks Questions)		
1	(a) Compare the radial and loop type primary feeders? (b) Explain the basic design practice of secondary distribution system?.	**PO1, PO2, PO3**
2	Derive the equations for voltage drop and power loss in a radial feeder with uniformly distributed load fed at one end?	**PO1, PO2, PO3**
3	A single phase ac distributor AB 300m long is fed from end A and is loaded as under (i) 100A at 0.707 p.f lagging 200m from point A (ii) 200A at 0.8 p.f lagging 300m from point A. The load resistance of distributor is 0.2Ω and 0.1Ω/km. Calculate the total voltage drop in the distributor. The load p.f Refer to the voltage at the far end?	**PO1, PO2, PO3**
4	Explain the loop type and different types of radial type of primary feeders with neat diagrams and mention its advantages and disadvantages.	**PO1, PO2, PO3**
5	Explain methods of solving AC Distribution calculations (a)when PF referred to receiving end voltages (b)when PF referred to its load voltages	**PO1, PO2, PO3**
6	A single phase distributor 2 kilometres long supplies a load of 120 A at 0·8 p.f. lagging at its far end and a load of 80 A at 0·9 p.f. lagging at its mid-point. Both power factors are referred to the voltage at the far end. The resistance and reactance per km (go and return) are 0·05 Ω and 0·1 Ω respectively. If the voltage at the far end is maintained at 230 V, calculate : (i)voltage at the sending end (ii) phase angle between voltages at the two ends	**PO1, PO2, PO3**
7	A single phase distributor one km long has resistance and reactance/conductor of 0·1 Ω and 0·15 Ω respectively. At the far end, the voltage V_B = 200 V and the current is 100 A at a p.f. of 0·8 lagging. At the mid-point M of the distributor, a current of 100 A is tapped at a p.f of 0·6 lagging with reference to the voltage V_M at the mid-point. Calculate : (i)voltage at mid-point (ii) sending end voltage V_A (iii) phase angle between V_A and V_B	**PO1, PO2, PO3**
8	Explain factors affecting Primary feeder loading	**PO1, PO2, PO3**
9	(a)Requirements and design features of primary feeder (b)Discuss about tie lines	**PO1, PO2, PO3**
10	(a)Requirements and design features of secondary distribution systems (b)Discuss about secondary banking	**PO1, PO2, PO3**

Question No.	Questions	PO Attainment
UNIT – 4: SUBSTATIONS		
PART-A (Two Marks Questions)		
1	Define the term Bus-bar.	**PO1**
2	Explain switching substation	**PO1**
3	Define the term circuit breaker	**PO1**

4	Draw the neat sketch of single bus bar arrangement?	PO1, PO2
5	Define Substation. What is the need of a sub-station in the power system?	PO1, PO2
6	List the different types of bus bar arrangements used in substations	PO1, PO2
7	What is transformer substation?	PO1, PO2
8	Classify substations according to type of insulation	PO1, PO2
9	Draw he symbols for earth fault relay, over current relay	PO1
10	Write equipment used in substations	PO1
11	Compare the indoor and outdoor substations	PO1
12	What is converting substation. write its significance	PO1
13	Comparison between pole mounted and foundation mounted substations	PO1
14	Define potential transformer	PO1
15	Discuss the different ways of classifying the sub-stations	PO1
16	Write ant two application of isolators, load break switches ,earth switches.	PO1
17	Draw the sketch for main and transfer bus bar arrangement	PO1
18	Write disadvantages for ring bus arrangement.	PO1
19	Classify substation based on service requirement.	PO1
20	What is the use of earthing in substations	PO1, PO2
	PART-B (Ten Marks Questions)	
1	(a) Explain the various factors to be considered to decide the ideal location of substation? (b) Explain how to decide the rating of a distribution a substation?	PO1, PO2, PO3
2	Explain different busbar arrangements with neat sketch?	PO1, PO2, PO3
3	Explain the classification of Substations?	PO1, PO2, PO3
4	Draw the Single line diagram showing the location of all substation equipments?	PO1, PO2, PO3
5	Explain (a) Air insulated substation (b) Indoor and outdoor substation	PO1, PO2, PO3
6	Explain the single bus bar arrangement in substation?	PO1, PO2, PO3
7	Explain how do you analyze a substation service area with‘n’ primary feeders?	PO1, PO2, PO3
8	Draw the layout of 11KV/400V sub-station showing the location of all the equipments.	PO1, PO2, PO3
9	Draw the key diagram of a typical 66/11 kV sub-station.	PO1, PO2, PO3
10	Explain classification of substations and compare the indoor and outdoor substations in detail.	PO1, PO2, PO3

Question No.	Questions	PO Attainment
	UNIT – 5: PROTECTION AND COORDINATION OF DISTRIBUTION SYSTEMS	
	PART-A (Two Marks Questions)	
1	List the causes of low power factor.	PO1, PO7
2	Define power factor	PO1, PO7
3	List the methods of voltage control	PO1, PO7
4	Define synchronous condenser	PO1, PO7

5	Write the importance of voltage control	**PO1**
6	Write a short note on booster transformer	**PO1, PO6**
7	Write advantages of static capacitors.	**PO1**
8	Write effects of low power factor	**PO1**
9	Write the advantages of power factor improvement.	**PO1**
10	What are the equipment used in improving power factor.	**PO1**
11	Name the protective devices used in distribution system.	**PO1**
12	Advantages of Static Var Systems	**PO1**
13	Applications of Static Var Systems	**PO1**
14	What are the materials used to make fuse element.	**PO1**
15	Define coordination and its significance	**PO1**
16	List the types of fuses.	**PO1**
17	List the applications of circuit breakers	**PO1**
18	Write the objectives of distribution system protection	**PO1, PO6**
19	Write the types of faults on distribution system	**PO1**
20	Define static compensation.	**PO1**
	PART-B (Ten Marks Questions)	
1	(a)Write the causes for low power factor in power system? (b) Explain (i)Phase advancers (ii)Static capacitors	**PO1, PO6**
2	Explain Most economical power factor for constant KW load.	**PO1, PO6**
3	Explain the power factor improving methods?	**PO1, PO6**
4	Explain voltage control using tap changing transformer.	**PO1, PO6**
5	Explain voltage control methods.	**PO1, PO6**
6	Explain operation and working principle of fuse.	**PO1, PO6**
7	Explain operation and working principle of circuit breaker.	**PO1, PO6**
8	Explain fuse to fuse coordination	**PO1, PO6**
9	(a)Explain general coordination procedure to provide protection (b)Explain about HRC fuse	**PO1, PO6**
10	Explain about fuse to recloser coordination	**PO1, PO6**
11	Explain about fuse to circuit breaker coordination	**PO1, PO6**
12	Explain about recloser to circuit breaker coordination	**PO1, PO6**
13	Explain operation and working principle of autorecloser.	**PO1, PO6**

*****ALL THE BEST*****