Code No: **RT41029** **R13** **Set No. 1**

IV B.Tech I Semester Regular/Supplementary Examinations, October/November - 2017

ELECTRICAL DISTRIBUTION SYSTEMS

(Electrical and Electronics Engineering)

Time: 3 hours **Max. Marks: 70**

Question paper consists of Part-A and Part-B
Answer ALL sub questions from Part-A
Answer any THREE questions from Part-B
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PART–A *(22 Marks)*

1. a) The load curves of two different categories of loads and system peak load are as follows: Peak load for industrial load: 2000 kW; Peak load for residential load: 2000 kW; System peak load: 3000 kW. What is diversity factor and coincidence factor of the system? [4]
   b) Write the benefits that are derived through optimal location of substations. [4]
   c) Why voltage drop considerations are important in a distribution system. [3]
   d) What is the principle of sectionalizer? [3]
   e) What are the differences between fixed and switched capacitors? [4]
   f) What are the effects of AVR on voltage control? [4]

PART–B *(3x16 = 48 Marks)*

2. a) Explain briefly classification of loads? How is load modeling done in distribution networks? [8]
   b) A power supply is having the following loads:

Type of load	Maximum Demand	Diversity of group	Demand Factor
Domestic	1500 kW	1.2	0.80
Commercial	200 kW	1.1	0.80
Industrial	10000 kW	1.25	1.0

If the overall system diversity factor is 1.35, determine (i) maximum demand (ii) connected load of each type. [8]

3. a) What are the various factors that influence the voltage levels in the design and operation of the distribution system? [8]
   b) Compare the four and six feeder patterns in substation location? [8]

4. a) In terms of resistance and reactance of the circuit, derive the equation for load power factor for which voltage drop is minimum? [8]
   b) Consider the single phase radial distributor shown in the following Fig. (4b). The magnitude of load currents, p.fs and distances are indicated in the figure. The resistance and reactance of each wire are 0.1 Ω per km and 0.2 Ω per km respectively. It is required to maintain voltage at point B as $230\angle 0^0$ Volts. Find voltage drop in the three sections and total voltage drop in the feeder. The p.f. angles of individual loads are w.r.t. voltage at point B.

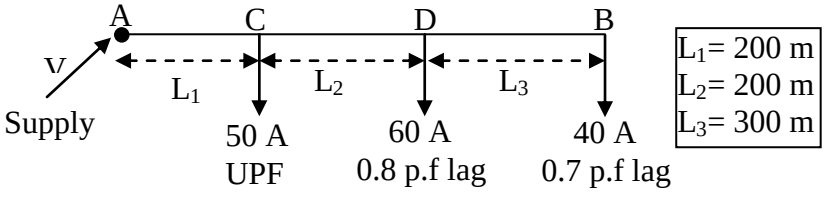

Fig. (4b) [8]

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5. a) Describe the recloser to circuit breaker coordination with current time characteristics. [8]
   b) List out the frequently occurring faults on a distribution system and derive the formulae for fault currents. [8]

6. a) Briefly explain the economic justification for capacitors installation. [7]
   b) A 3-phase substation transformer has a name plate rating of 7500 kVA and a thermal capability of 125% of the name plate rating. If the connected load is 8816 kVA with a 0.85 pf lagging, determine (i) The kVAR rating of the shunt capacitor bank required to decrease the kVA load of the transformer to its capability level (ii) The power factor of the corrected level. [9]

7. a) Explain about the line drop compensation with neat diagram. [8]
   b) Why voltage control is required in a distribution system. [8]

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(Electrical and Electronics Engineering)

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Question paper consists of Part-A and Part-B
Answer ALL sub questions from Part-A
Answer any THREE questions from Part-B
*****

PART–A *(22 Marks)*

1. a) Find the annual load factor and average demand, given that peak load is 3.5 MW and energy supplied is 10 million units (10^7 kWh). Peak demand was recorded during April-June. [4]
   b) What are the advantages and disadvantages of square-shaped type distribution feeder? [4]
   c) What are the differences between three phase balanced and unbalanced primary lines? [3]
   d) What are the objectives of distribution system protection? [4]
   e) What is the need of power factor improvement in distribution systems? [4]
   f) List out various types of equipment used for voltage control in distribution system? [3]

PART–B *(3x16 = 48 Marks)*

2. a) Explain the following: (i) coincidence factor (ii) contribution factor (iii) loss factor [8]
   b) The annual peak load input to a primary feeder is 1300 kW. The voltage drop and losses shows that the total loss at the time of peak load is 120 kW. The total annual energy supplied to the sending end of the feeder is 5.8×10^6 kWh. (i) Determine the annual loss factor (ii) Calculate the total annual energy loss and the annual cost if the unit charge is Rs. 5/- [8]

3. a) Compare the radial, loop and ring main primary distribution systems on the basis of load, reliability of supply and economy. [8]
   b) An industrial area near a city was found to have a load density 0.5 MVA/km^2. The total area was to be located between the rectangular strip 8 km × 4 km. Determine suitable number of 33/11 kV substations, their capacity and feeder length. The loads are served by 11 kV feeders. [8]

4. a) Derive the voltage drop equation for a non-uniform distributed load. [7]
   b) Consider a single-phase, 2-wire secondary distributor of length 'l' meters from the distribution transformer. At a length of 'l_1' meters from source, a load of 'I_1' amps with a p.f. of cos φ_1 (lag) is tapped. At a length of 'l_2' meters from first load, a second load of 'I_2' amps with a power factor cos φ_2 (lead) is taped. At a length of 'l_3' meters from second load, a third load of 'I_3' amps with a UPF is tapped. If resistance and reactance of each wire are r and x ohms/meter respectively, derive approximate voltage drop equation in the distributor. [9]

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5. a) Explain the coordination between auto recloser to fuse with time-current characteristics. [8]
   b) Explain the principle of operation of Residual Current Circuit Breaker (RCCB) with a neat sketch. [8]

6. a) Explain the effect of shunt capacitor for power factor improvement in distribution system with diagram. [8]
   b) An industrial plant has 300 HP induction motor load that runs at 0.8 p.f lagging and efficiency 0.85. A synchronous motor of 150 HP and an average efficiency 85% is available. If the motor is run on no load with same losses, determine the p.f of the motor, to make the overall p.f of the plant to 0.9. Can the p.f of the plant be raised to u.p.f.? If so what will the KVA intake of synchronous motors. [8]

7. a) Explain effect of the series capacitors in the distribution system with phasor diagrams. What are the limitations in this method? [8]
   b) Explain about the AVB in the distribution feeder with neat diagram. [8]

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(Electrical and Electronics Engineering)

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Answer ALL sub questions from Part-A
Answer any THREE questions from Part-B

*****

PART–A *(22 Marks)*

1. a) A feeder supplies 2 MW to an area. The total losses at peak load are 100 kW and units supplied to that area during a year are 5.61 millions. What is the loss factor and average power loss? [4]
   b) How do you fix the rating of a distribution substation? [3]
   c) How is power loss in a distribution system estimated approximately? [4]
   d) Write the working principle of residual current circuit breaker. [4]
   e) What are the benefits with capacitor installation in distribution systems? [4]
   f) How an AVB will control the voltage in distribution system. [3]

PART–B *(3x16 = 48 Marks)*

2. a) Explain in detail about residential and industrial loads and their respective characteristics. [10]
   b) A distribution substation experiences an annual peak load of 3,500 kW. The total annual energy supplied to the primary feeder circuits is 107 kWh. Find (i) the annual average power (ii) the annual load factor. [6]

3. a) Explain the basic design practice of the secondary distribution system. [8]
   b) Give a detailed analysis of square shaped and hexagonal shaped distribution substation areas. [8]

4. a) Prove the power loss due to load currents in the conductors of the 2-phase, 3 wire lateral with multi-grounded neutral is approximately 1.64 times larger than the one in the equivalent 3-phase lateral. [8]
   b) A single phase feeder circuit has total impedance of (0.5+j0.2) Ω and $V_R = 11\,\text{kV}$ and $I_R = 5\angle -30^0\,\text{A}$, respectively. Find (i) Power factor of the load (ii) Load p.f. for which the impedance angle is maximum (iii) load p.f. for which impedance angle is maximum and derive the formula used. [8]

5. a) Explain the general coordination procedure of protective devices. [8]
   b) What is an automatic line sectionalizer? Explain its operation, purpose and advantages. [8]

6. a) Discuss the general procedure to determine the best location of capacitors in distribution system. [8]
   b) A synchronous motor improves the p.f of a load of 300 kW from 0.8 lagging to 0.95 lagging. Simultaneously the motor carries a load of 150 kW. Find the leading kVAR taken by the motor, kVA rating of the motor and the p.f at which the motor operates. [8]

7. a) How an AVR can control voltage. With the aid of suitable diagram explain its function. [8]
   b) Explain the on load tap changing transformer with neat sketch. [8]

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Time: 3 hours **Max. Marks: 70**

Question paper consists of Part-A and Part-B
Answer ALL sub questions from Part-A
Answer any THREE questions from Part-B
*****

PART–A *(22 Marks)*

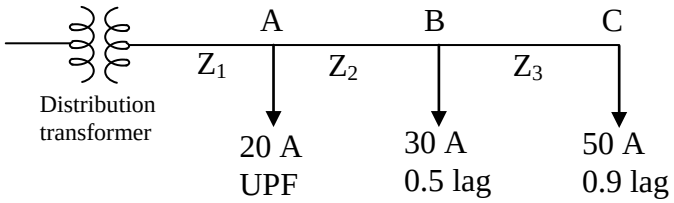
1. a) A substation has a connected load of 45 MW and a maximum demand of 22 MW, the units supplied being $60x10^6$ per annum. Determine the load factor and demand factor. [4]
   b) Write the factors that are affecting the primary feeder loading. [4]
   c) What is the difference between uniformly and non-uniformly distributed loads in a distribution system? [3]
   d) Write principle of automatic circuit reclosers. [4]
   e) How do you determine the best location of capacitors in distribution system? [4]
   f) What is meant by line drop compensation? [3]

PART–B *(3x16 = 48 Marks)*

2. a) Prove that approximate formula for loss factor $(F_{LS}) = 0.3F_{LD} + 0.7F_{LD}^2$, where F_{LD} = load factor. [8]
   b) A generating station supplies four feeders with the maximum demands of 16 MW; 10 MW; 12 MW and 7 MW. The overall maximum demand on the station is 20 MW and the annual load factor is 45%. Find the diversity factor and the number of units generated annually. [8]

3. a) What are the various factors that influence the primary feeder loading? [8]
   b) How do you analyze a substation service area with 'n' primary feeders? [8]

4. a) Prove the power loss due to the load currents in the conductors of single-phase lateral ungrounded neutral case is 2 times larger than one in the equivalent three phase lateral. [8]
   b) Consider a three phase, 3 wire 240V secondary system with balanced loads at A, B and C as shown in Figure (4b) Determine: (i) The voltage drop in one phase of lateral (ii) The real power per phase for each load (iii) The reactive power per phase for each load.



Z_1=(0.03+j0.01) Ω/phase
Z_2=(0.1+j0.03) Ω/phase
Z_3=(0.05+j0.05) Ω/phase

Figure (4b) [8]

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5. a) What are the different types of coordination of protective devices? Describe the fuse to circuit breaker coordination. [8]
   b) A 3-phase, 11 kV, 25 MVA generator with X_0 = 0.05 p.u, X_1 = 0.2 p.u and X_2 = 0.2 p.u is grounded through a reactance of 0.3Ω. Calculate the fault current for a single line to ground fault. [8]

6. a) Describe the need of compensation in the distribution system and how it will be obtained. [5]
   b) What is meant by power capacitor? Mention the types of power capacitors. [5]
   c) Explain the power factor correction by installing the series capacitor bank. [6]

7. a) Why we need to control the voltage of power system. Explain the methods in detail. [8]
   b) What are the various ways to improve the overall voltage regulation? [8]