B.E. (EE) Part-III 5th Semester Examination, 2007

Planning and Design

(EE-505)

Time : 3 hours **Full Marks : 100**

Use separate answerscript for each half.

Two marks are reserved for neatness in each half.

FIRST HALF

(Answer any THREE questions.)

1. a) Show that the volume of distributor conductor is inversely proportional to the square of the voltage and power factor of the load.

   b) Show that for overhead system the ratio of volume of conductor in D.C. two wire and A.C. single phase is $V_1 : V_2 = 1 : \frac{2}{\cos^2 \varphi}$.

   c) "ABT is a three part tariff" – justify the statement. How it improves the system frequency? **[4+6+6]**

2. a) Prove that the voltage drop diagram for a uniformly loaded distributor fed at one end is a parabola.

   b) A two-wire ring main system is fed at P and at Q, R, S is tapped off as shown in Fig.-1. Calculate the potentials at Q, R and S. **[7+9]**

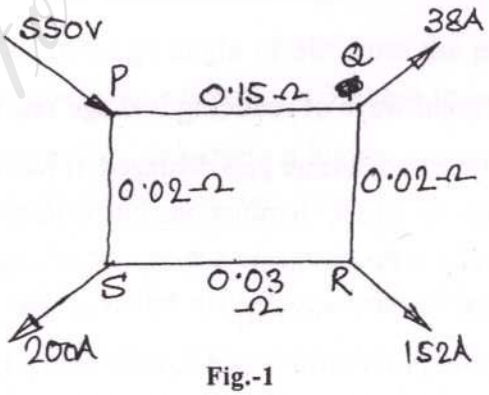

Fig.-1

3. a) State the economical and technical effect of installation of capacitor bank.

   b) What are the sources and sinks of reactive power? State and discuss the different reactive power compensating devices used in electrical power systems. **[9+7]**

4. a) What is load forecasting? Why it is necessary in electrical power system planning? What are the factors on which it depend?

   b) What are the typical regression curves used in power system load forecasting? Which curve best suits the forecast of electrical energy consumption?

   c) Explain the following terms in relation to thermal power generating station : (i) Auxiliary energy consumption, (ii) installed capacity, (iii) plant load factor. Why auxiliary power is needed in a thermal generating station?

   d) The input to a subtransmission system is 876×10^5 kWh annually. On the peak load day of the year, the peak is 25×10^3 kW. The energy input on that day is 3×10^5 kWh. Find the annual load factor and for the peak load day.

   e) Explain the significance of spinning reserve in power system operation.

   [3+3+4+3+3]

5. a) Discuss the different parameters on which the transmission and distribution losses depend.

   b) What are the factors that affect substation expansion and its site selection?

   c) What are the various tariff structures used for supplying electricity to consumers? What is the difference between block rate tariff and two part tariff?

   d) "The electricity consumers are categorised on the basis of the value derived on consumption of electricity". Explain. **[3+3+4+6]**

SECOND HALF

(Answer Q.No.6 and any ONE from Q.No.7 & 8 and any ONE from Q.No.9 & 10.)

6. Answer any four : **[4×3]**

   a) Discuss the different ways of reducing leakage reactance in a transformer.

   b) A 3-phase core type transformer gets damaged. It was decided to replace the hot rolled laminations by CRGO laminations but with core dimensions remaining unchanged. Investigate the change in output, cost of copper and voltage regulation of the transformer. Assume appropriate values of data if required.

   c) Why pole arc /pole pitch ratio of a d.c. machine is kept between 0.6 – 0.7?

   d) A motor using class A insulation is continuously operated for 6 hours at rated load at an elevated ambient temperature such that its embedded detectors record a maximum hot spot temperature of 75°C. Calculate the life extension factor and increased life expectancy of the motor. Assume a standard life of 10 years.

e) Calculate the diameter of copper wire of length 100 meters used as winding material in a transformer such that the resistance of the whole winding is 2 ohm. Calculate the diameter of the wire if aluminium is to be used for the above winding, resistance remaining the same. Assume the data not given.

f) Explain magnetic anisotropy. What type of magnetic materials are produced using this principle? Discuss.

7. a) What is a conservator? Where is it placed? State the advantages of using a conservator.

b) State three important design considerations for (i) distribution transformer. (ii) power transformer.

c) How do you compute the magnetising branch parameters of a transformer from design data?

d) Estimate the main core dimensions for a 50Hz, 3 phase 200 kVA, 6600/400 V star/delta core transformer.

9. a) Show that for the same I^2R losses, a general purpose standard electrical machine wound with aluminium has a power rating of approximately 78% of that would with copper.

   b) Why composite insulating materials are used in design of electrical machines? Name the materials or combination of materials for class F, class H and class C type insulation with due mention to their safe permissible temperatures. State the factors that decide the life of the insulation.

   c) Explain the term dielectric strength of an insulating material. State the factors which affect the dielectric strength of an insulating material. **[3+(3+6+2)+4]**

10. a) Define thermal resistance and show that a material having a large value of thermal resistivity will dissipate less amount of heat.

    b) Explain convection and radiation modes of heat transfer and hence deduce the equation representing Newton's law of cooling.

    c) Discuss various types of ventilation systems used in rotating electric machines.

    d) A turbo-alternator runs on test at a continuous rated load of 30 MVA with a power factor of 0.8. The following cooling air measurements are taken.

       Volume of cooling air measured at intake = 30 m^3/s
       Intake air temperature = 15°C
       Outlet air temperature = 45°C
       Barometric reading = 750 mm of mercury

    Find the efficiency of the machine, taking the specific heat of air at constant pressure as 1000 J/kg°C and the volume of 1 kg of air at 0°C and a pressure of 760 mm mercury as 0.78 m^3. **[4+6+4+4]**

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