BITS, Pilani –Dubai Campus,

Knowledge Village, Dubai
Year 2003-2004, Semester II

Comprehensive Exams

IVth Year- EEE, EEE UC462 – Advanced Power Systems

Max Marks 40 **Time: Three Hours**

Answer any Five Questions. Each question carries equal marks

Q1 a) Explain briefly the construction and operation of a nuclear reactor. How nuclear plants are classified (4)

b) The load duration curve of a system for the whole year of 8760 hours is as shown in Figure 1. The system is supplied by two stations A and B having the following annual costs

Station A = Rs (75000+80 x kw+0.02 x kwh)
Station B = Rs (50,000+50 x kw+0.03 x kwh)

Determine the installed capacity required for each station and for how many hours per year peak load station should be operated to give the minimum cost per unit generated. (4)

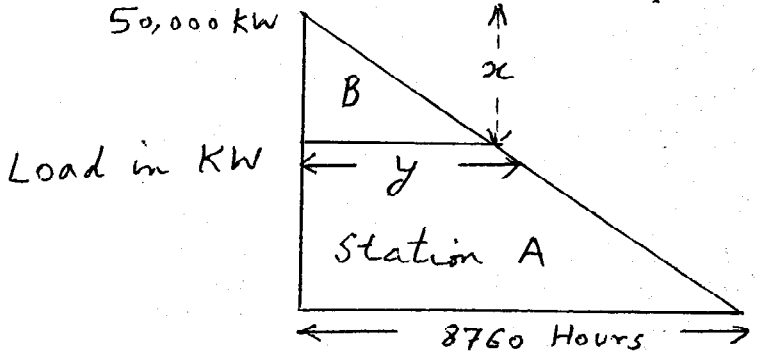

Figure 1

Q 2 a) What is corona effect. Discuss the advantages and disadvantages of corona. (3)

b) A 100 MVA 33 kV 3 phase generator has a sub transient reactance of 15%. The generator is connected to the motors through a transmission line and transformer as shown in Figure 2. The motors have rated inputs of 30 MVA, 20 MVA and 50 MVA at 30kV with 20% sub transient reactance. The three phase transformers are rated at 110MVA, 32kV Delta/ 110 kV Star with leakage reactance 8%. The line has a reactance of 50 ohms.

Selecting the generator rating as the base quantities in the generator circuit, determine the base quantities in other parts of the system and evaluate the corresponding p.u values. (5)

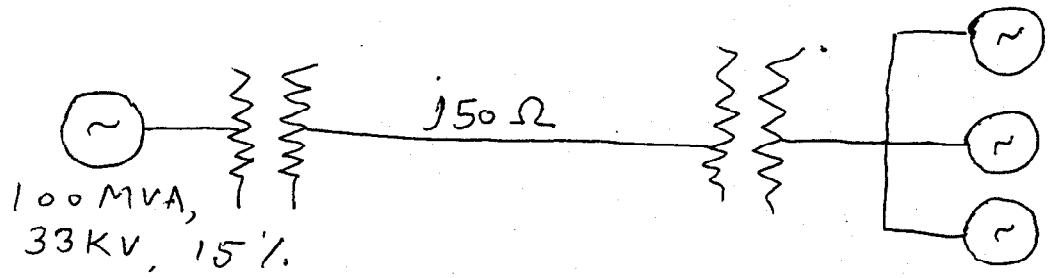

Figure 2

Q3 a) Using the nominal pie method, find the sending end voltage and voltage regulation of a 250 km three phase 50 Hz transmission line delivering 25 MVA at 0.8 lagging power factor to a balanced load at 132 kV. The conductor resistance is 0.11 ohm/km, inductance 1.24mh/km and capacitance 0.0094 mH/km. (4)

b) What are the various methods of neutral grounding? Compare their performance with respect to i) protective relaying ii) fault levels iii) stability and iv) voltage levels of power systems. (4)

Q4 a) Define plug setting multiplier for a relay. Write universal torque equation and explain how the characteristics of different type of relays may be obtained from universal torque equation. (4)

b)A star connected 3 phase 10 MVA, 6.6 kV alternator has a per phase reactance of 10% . It is protected by differential protective scheme which is set to operate for fault current not less than 175 A. Calculate the value of earthling resistance to be provided in order to ensure that only 10% of the alternator winding remains unprotected. (4)

Q5 a) What is power system stability? Clearly distinguish between three types of stability. Discuss equal area criteria of stability. (4)

b) Explain the significance of load flow in power system analysis. Classify the various types of busses in power system for load flow studies. Write a nodal admittance matrix for three bus system (4)

Q6 Discuss any two of the followings.

i) SCADA
ii) Static and micro processor based relays.
iii) HVDC and EHVC System (4x4)

Marking Scheme Advanced Power Systems
Comprehensive Examinations
IVth Year 2003-2004 IInd Semester

Q1 a) Construction of nuclear power reactor — 1 mark
Operation of the reactor — 1 mark
Classification — 1 mark

b) Capacity of station A =32,758kW
Capacity of station B =17,241kW — 4 marks

Q2

a) Corona effect — 1 mark
Advantages — 1 mark
Disadvantages — 1 mark

b) On assuming base values as 100 MVA and 33kV in the generator circuit , the p.u reactance of the generator will be 15%. The base value of the voltage in the line will be

$$33 \times (110/32) = 113.43 \text{ kV}$$

in the motor circuit,

$$113.43 \times (32/110) = 33 \text{ kV}$$ — 1 mark

the reactance of the transformer given as 8% corresponding to 110 MVA, 32kV. Therefore, corresponding to 100MVA and 33kV the p.u reactance will be

$$.08 \times (100/110) \times (32/33)^2 = 0.06838 \text{ p.u}$$

the p.u impedance of the line = $50 \times 100/(113.43)^2$ =0.388 — 1 mark
the p.u reactance of the motor 1 = 0.5509 pu — 1 mark
motor 2 = 0.826 — 1 mark
motor 3 = 0.3305 — 1 mark

Q 3

a) Total R = 27.5 Ohm
Total X = 97.4 Ohm
Total Y = 7.38×10^{-4} Ohm

Ir = 109.3< -36.9

Vr = 76.2<0

Vs = 143 kV — 2 marks

Voltage regulation = 12.3% — 2 marks

b)

Methods of neutral grounding	1 mark
Performance w r t protective relaying	1 mark
Performance w r t fault level and voltage level	1 mark
Performance w r t stability	1 mark

Q4

a)

PSM	1 mark
Universal torque equation	1 mark
Characteristics of different kind of relays	2 marks

b)

Reactance of 10% winding = 0.0436 ohms
e.m.f induced in 10% winding = 381 V

Earthing Resistance = 2.171 ohm

Q 5

a)

Power system stability	1 mark
Distinction in three type of stability	1 mark
Equal area criterion of stability	2 marks

b)

Load flow's significance	1 mark
Type of buses	1 mark
Nodal admittance matrix	2 marks

Q6 4 marks each

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Test 2 (Open book)

IVth Year- EEE, EEE UC462 – Advanced Power Systems

Max Marks 20 **Time: 50 Minutes**

Answer all questions.

Q1 A three phase power system represented as single phase equivalent circuit in Figure 1 supplies a load of 88 MW and 30 MVAR at 11 kV. The ratings of the components are given in table 1. The load may be assumed as the equivalent impedance load. Draw the single line impedance diagram representing the impedance in per unit of each component to common base values of 130 MVA and 11 kV, which are the rating of the generators. (12)

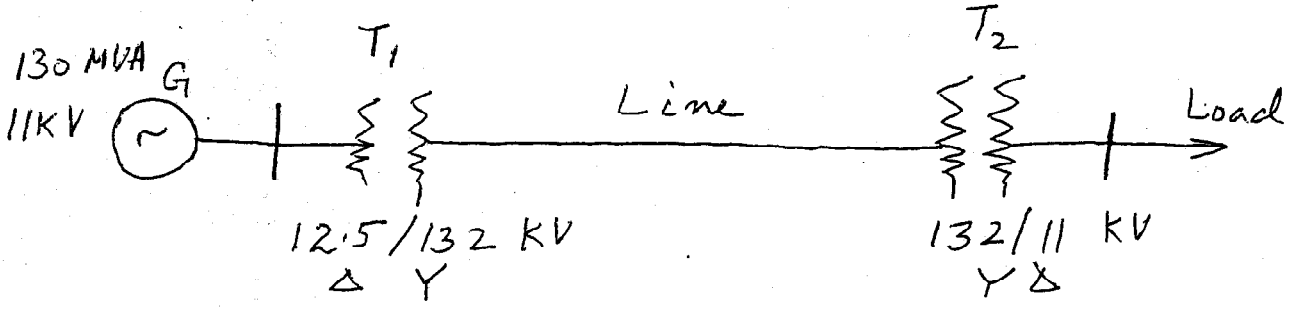

Figure - 1

Table 1

Component	MVA	KV	Impedance
Generators	130	11	(0+j0.17) p.u
Step up transformer	3 x 55	12.5 Delta/ 132Star	(0+j 0.15) p.u referred to 12.5 KV
Line	150	132	(4+J12) Ohm
Step down transformer	150	132 Star / 11 Delta	J0.115 Ohm (Total Impedance referred to 11 Kv side)

Q2 A short circuit to earth occurs near the terminals of phase A of a three phase alternator, star connected with neutral point earthed, the current to earth being 1000 Amps. If the alternator is not supplying any normal current calculate the positive, negative and zero sequence components of currents of all phases. (8)

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Test 1

IVth Year- EEE

EEE UC462 – Advanced Power Systems

Max Marks 20 **Time: 50 Minutes**

Answer all questions. Each question carries equal marks

Q1 A generating station has a maximum demand of 75MW and a yearly load factor of 40%. Generating costs inclusive of station capital costs are Rs 60 per annum per kw demand plus 4 paise per kwh transmitted. The annual capital charges for transmission system are Rs 20,00,000 and for distribution system Rs 15,00,000, The respective diversity factors being 1.2 and 1.25. The efficiency of transmission system is 90% and that of distribution system is 85%. Find the yearly cost per kw demand and cost per kwh supplied at the substation and at the consumers premises. (8)

Q2 What is the importance of diversity factor of power station? (1)

Q3 What do you understand by run off river plant? How introducing a pondage increases its performance? Draw a layout of hydroelectric station and discuss its various components (6)

Q4. Write short notes on non conventional energy sources (5)

OR

Q4 Name different types of Nuclear Reactors. Write the name of fuel, moderator, and coolant used for different type of Nuclear reactors. Discuss any one of them in details. (5)