B.E. (EE) Part-III 6th Semester Examination, 2012

Power System-II

(EE-602)

(Attempt any six questions taking three from each half)
(Use separate answer sheet for each half)
Two marks are reserved for neatness for each half.

Time: 3 hrs. **Full Marks: 70**

First half

1.

a) State at least three important advantages of HVDC systems over equivalent AC systems. **(3)**

b) What are different types of HVDC links? Compare their relative advantages and disadvantages.**(4)**

c) Why do we need VAR compensating device at the converter stations of HVDC systems? **(2)**

d) Why a series inductive reactor is installed in series with a HVDC line? **(2)**

2.

a) Briefly state the mechanism of arc interruption in AC circuit breakers. **(3)**

b) b) Define RRRV and state its unit. **(2)**

c) Explain what do you mean by breaking capacity of a circuit breaker. **(3)**

d) A 220 KV 3phase 50 Hz circuit breaker protects a star-delta 220/33 KV transformer. When the transformer is at no-load the magnetizing current is 7A (instantaneous value) and the circuit breaker is tripped at this instant due to manual operation. The inductance and capacitances of the transformer are 35.2 Henry and 0.0023microFarad. Find the value of restriking voltage appearing at the breaker contacts assuming that the inductive energy is transferred to capacitive energy due to switching. **(3)**

3.

a) What are the advantages of SF6 breakers? **(4)**

b) Why vacuum circuit breakers are normally not used beyond 33KV voltage range? **(3)**

c) How do you establish that the magnitude of load voltage at a bus without voltage control is very much susceptible to reactive power status of the bus? **(4)**

4.

a) Derive an expression of reflection coefficient at load bus in a transmission line subjected to an flat tapped voltage wave when line has surge impedance of $R_o$ohm and load has resistance of R_L ohm per phase. What is its value if $R_L=R_o$ and when the termination is open as well as shorted instead of terminated by R_o? **(4)**

b) Develop expressions for transmission coefficient of voltage and current when an overhead line is terminated by a cable. Assume the line has surge impedance of R_L ohm per phase while the cable has surge impedance of R_c ohm per phase. **(4)**

c) Two substations (A and B) are connected together by an underground cable having a surge impedance of 60 ohms. Substation B feeds an overhead transmission line having a surge impedance of 400 ohms. If a step fronted surge of peak value 100KV travels along the cable towards the junction of cable and line, determine the value of the reflected and transmitted wave of voltage and current at the junction. **(3)**

5.

a) Write the governing equation of the speed governing system of a generator turbine system in Laplace domain and in terms of regulation of the speed governor. From this equation, using the concept of transfer functions for the amplifier and turbine develop the primary ALFC loop. **(6)**

b) How do you complete the structure of primary ALFC loop? Explain this concept in Laplace domain.**(5)**

Second Half

6.

a) Derive the short circuit current in an alternator under no load condition when there is a dead short circuit fault among the three phases.

b) What is meant by doubling effect?

c) Generator emf is 1 p.u. and the transient reactance is 25%. Find the transient current.

[6+2+3]

7.

a) Prove that the reactance inside the alternator is time varying in nature.

b) A synchronous generator and a synchronous motor each rated 25 MVA, 11 kV having 15% sub transient reactance are connected through transformers and a line. The transformers are rated 25 MVA, 11/66 kV and 66/11 kV with leakage reactance of 10% each. The line has a reactance of 10% on base of 25 MVA, 66 kV. The motor is drawing 15 MW at 0.8 power factor leading and a terminal voltage of 10.6 kV when a symmetrical three-phase fault occurs at the motor terminals. Find the sub transient current in the generator, motor and fault. **[5+6]**

8.

a) Explain the function of reactors in power system. What are the different types of reactors commonly used?

b) The 33 kV bus-bars of a station are in two sections P and Q separated by a reactor. The section P is fed from four 10 MVA generators each having a reactance of 20%. The section Q is fed from the grid through a 50 MVA transformer of 10% reactance. The circuit breakers have a rupturing capacity of 500 MVA. Find the reactance of a reactor to prevent the circuit breakers from being overloaded if a symmetrical short-circuits occurs on an outgoing feeder connected to A. take base MVA as 50 MVA. **[5+6]**

9.

a) Write down the merits and demerits of Corona.

b) Derive the mathematical expression for visual critical disruptive voltage for a 3-phase transmission line.

c) A three phase, 50 Hz, 138kV transmission line has conductors in equilateral formation spaced 2.5 meters apart. The conductor diameter is 1.04 cm and the surface factor is 0.85. The air pressure and temperature are 74 cm of Hg and 21 degree Celsius respectively. Determine the critical visual voltage for corona and the corona loss per km per phase of the line, $m_v = 0.72$

[3+5+3]

10. Write short notes on (any two):

a) Sub transient and Transient Reactance. **[5.5 x 2]**

b) Phenomenon of Corona.

c) Factors Affecting Corona Loss.