

Ex/BESUS/EE-602/07

B.E. (EE) Part-III 6th Semester Examination, 2007

Power System-II
(EE-602)

Time : 3 hours

Full Marks : 100

Use separate answerscript for each half.

Answer SIX questions, taking THREE from each half.

Two marks are reserved for neatness
and intelligent answer in each half.

FIRST HALF

1. (a) What are the possible reasons of transient overvoltages in a power transmission system?
(b) "A power transformer at the receiving end of a EHV line behaves more like a terminal condenser than as a lumped inductance at time $t = (0+)$ when encountering a travelling voltage surge in the line". Justify the statement with analytical reasonings.
(c) A 132 kV (L-L), 3 phase 50 Hz power line AB is connected with a 3 phase-50 Hz power cable BC at junction B at the same voltage level. The surge impedances of the overhead line and the cable are 400 ohms and 80 ohms respectively. If a 250 kV switching surge travels from A to B, calculate (i) the value of this voltage surge when it first reaches C, (ii) value of the neglected component of this surge when the first neglection reaches A, and (iii) the surge current in the cable BC. [2+8+6]
2. (a) What is insulation co-ordination? Define the following terms :
 - i) Impulse Flashover Voltage (Impulse FoV)
 - ii) Basic Insulation Level (BIL)(b) Assume a lighting discharge current value of 50 kA (rms) for a EHV tower when the tower footing resistance is 10 ohms. If the tower holds a 132 kV (L-L), 3 phase 50 Hz line then find the value of impulse voltage strength for the insulators in the tower on per phase basis. If the overvoltage factor (OVF) is assumed to be 8.0, how many insulators of 100 kV grade need to be connected in each phase? [8+8]

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3. (a) Analytically justify the need of a switching resistor in high voltage AC circuit breakers.
- (b) Define the following with respect to a circuit breaker :
- Symmetrical and Asymmetrical breaking capacity
 - Symmetrical and Asymmetrical making capacity
 - Short time rating.
- (c) An OCB is rated 1200 A, 1500 MVA, 33 kV, 3 ph, 50 Hz, 3-sec. What are its rated continuous current, symmetrical breaking and making capacities in kA? [6+6+4]
4. (a) What are the advantages of a SF₆ (Sulphur Hexa-fluoride) breaker?
- (b) In a 220 kV (L-L) system, the phase to ground capacitance is 0.01 μ F, the inductance is 6H. Justify why current chopping will take place for a breaker interrupting a terminal inductor current of 5A (instantaneous) in this system. Calculate the resistance to be used across the contacts of the breaker to eliminate high restriking voltage.
- (c) What are the advantages of HVDC transmission? [4+6+6]
5. (a) Why do we prefer HRC fuse over ordinary rewirable fuse?
- (b) What is series reactive loss in EHV AC lines and what are its implications?
- (c) What are the methods of "compensation" normally used in AC power systems? Briefly discuss about any one method.
- (d) What are different types of HVDC links? Briefly discuss. [3+4+4+5]

SECOND HALF

6. (a) A three phase alternator running unloaded with resistance and transient inductance per phase R and L respectively is suddenly short circuited across all its terminals at $t=0$. If the applied emf is $\sqrt{2} V \sin(\omega t + \alpha)$ per phase, derive an expression for the short circuit per phase. Hence explain the following terms – symmetric short circuit current, dc off-set current and doubling effect.
- (b) A-3-phase, 10000 kVA, 11 kV alternator has a subtransient reactance of 8%. A-3-phase short circuit occurs at its terminals. Calculate the fault current and fault MVA. [10+6]

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7. Two generating stations having short circuit capacities of 1,500 MVA and 1000 MVA respectively and operating at 11 kV are linked by an interconnecting cable having a reactance of $0.6 \Omega/\text{phase}$. Determine short circuit capacity of each station. [16]
8. (a) What are current limiting reactors? In what positions are they employed in large stations?
- (b) Find the value of ohms of the reactance per phase external to a 20 MVA, 10 KV, 50 c/s, 3-ph generator such that the steady state current on short circuit shall not exceed 8 times the full load current. The internal resistance of the generator is 5%.
- (c) Why is it preferable to express the reactance of various elements in percentage values for short circuit calculations? [4+8+4]
9. (a) Derive the critical disruptive voltage in a single-phase transmission line after taking into account the atmospheric conditions and surface of the conductor.
- (b) A single phase overhead line has two conductors of diameter 1 cm with a spacing of 1 meter between centres. If the dielectric strength of air is 21 kV/cm, determine the line voltage for which corona will commence on the line. [8+8]
10. Write short notes on : (any two) [8×2]
- (i) Network Reduction Technique
- (ii) Methods of Reducing Corona loss
- (iii) Advantages & disadvantages of Corona.
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