Motilal Nehru National [illegible] of Technology-Allahabad
End Semester Examination, Even Semester- 2016-17

Class: B.Tech (Electrical Engineering), 2nd Year,
Sub.: Power System-I (EE1403)

Marks: 60
Time allt.: 3 Hrs.

Question 1: 10 x 1 = 10

a) The overall diameter of stranded ACSR conductor is $D =$ _____ if $n$ is number of layers, and $d$ is diameter of each strand.
b) In a two system, if the current flowing in each conductor is opposite to each other, then in respect of proximity effect, the inductance will be _____ in adjacent elements than elements in farther apart.
c) The method of determining the capacitance of line with effect of earth is known as _____.
d) For a loss less line, $Z_C = \sqrt{L/C}$ is known as _____ of a line.
e) With Ferranti effect observed in a line, the charging current produces a voltage drop in the reactance of line which is _____ to the receiving end voltage.
f) In respect of swing equation for group of machines that swing together, the accelerating power of the group is the _____ of the accelerating powers of individual machines.
g) The GMR of quadruple bundled conductor is terms of GMR of individual conductors is given as _____.
h) The surge impedance loading of a line is given by _____.
i) Express the 2nd order swing equation as a set of two 1st order differential equations.
j) Draw the cost vs cross sectional area of conductor according to Kelvin's law.

Question 2: 5 x 3 = 15

a) A three-phase, 50 Hz, transmission line has flat horizontal spacing with 3.5 m between adjacent conductors. The conductors are No.2/0 hard-drawn seven strand copper (outside conductor diameter = 1.05 cm). The voltage of the line is 110 kV. Find the capacitance to neutral and the charging current per km of line.
b) A 50 Hz, 4 pole turbo-generator rated 100 MVA, 11 kV has an inertia constant of 8 MJ/MVA. If the mechanical input is suddenly increased to 80 MW for an electrical load of 50 MW, find the rotor acceleration, neglecting mechanical and electrical losses.
c) A 400 V, 3 –phase, 4-wire service mains supplies a star connected load. The resistance of each line is 0.1 ohm and that of neutral is 0.2 ohm. The load impedances are $Z_R(6+j9)\ ohm, Z_Y = 8\ ohm, Z_B = (6-j8) ohm$. Calculate the voltage across each load impedance and current in neutral. Consider the phase sequence RYB and phase R as reference phasor.
d) Find the critical disruptive voltage (LL) and corona loss for a 3-phase line operating at 110 kV which has conductor of 1.25 cm diameter arranged in a 3.05 m delta (triangular configuration) arrangement. Assume air density factor of 1.07 and dielectric strength of air to be 21 kV/cm.
e) Calculate the maximum sag of a conductor having following data: Span = 200m, weight = 0.8 kg/m and maximum allowable tension = 1600 kg.

Question 3: 5 x 5= 25

a) A single-phase, 50 Hz generator supplies an inductive load of 5 MW at a power factor of 0.707 lagging by means of an overhead transmission line 20 km long. The line resistance and inductance are 0.0195 ohm and 0.63 mH per km. The voltage at the receiving end is required to be kept constant at 10 kV. Find the (i) sending end voltage and voltage regulation of the line, (ii) the value of capacitances to be placed in parallel with the load such that the voltage regulation is reduced to 50% of that in part (i).
b) A string of 8 insulators is to be graded to obtain uniform distribution of voltage across the string. If the capacitance of the top unit is 10 times capacitance to ground of each unit, determine the capacitance of the remaining 7 units.
c) Determine the KE stored by a 50 MVA, 50 Hz 2 pole alternator with an inertia constant (H) of 5 kW sec per kVA. If the machine is running steadily at synchronous speed with a shaft input (minus rotational losses) of 65000 HP when the electrical power developed suddenly changes from its normal value to a value of 40 MW, determine the acceleration or deceleration of the rotor. If the acceleration computed for the generator is constant for a period of 10 cycles, determine the change in torque angle in that period and the rpm at the end of 10 cycles.
d) A DC 2 wire system is to be converted into AC 3 phase system by the addition of third conductor of the same cross-section as the existing conductors. If the RMS voltage between wires and the percentage loss in the line remains unchanged, determine the additional load which can now be supplied. Assume balanced load of unity pf.
e) A 3-core, 3-phase belted cable tested for capacity between a pair of cores on single phase, with the third core earthed, gave a capacity of 0.4 μF per km. Calculate the charging current for 15 km length of this cable when connected to 22 kV, 3 – phase, 50 Hz supply.

Question 4: 5 x 2 = 10

a) Define steady state stability, steady state stability, transient state stability of a power system.
b) Discuss the corona loss occurrence on a factor related conductor size. [Wadhwa_P-143]
c) Explain dielectric loss of a UG cable with phasor diagram.
d) Explain load buses, voltage controlled buses and slack bus in the power network in terms of known/unknown parameters.
e) Explain equal area criterion with the help of power-angle curve in terms of acceleration and deceleration of torque.