DEPARTMENT OF ELECTRICAL ENGINEERING

Major **Date: 20/11/2019** **Maximum Marks – 70** **Time allowed: 2 hours**

Note: Write complete and relevant solutions only at a SINGLE PLACE in the answer script for each question, else NO MARKS will be given and clearly write each step of your calculation.

Write your **name in block letters, entry number, and group number** clearly on your answer script.

Ensure that this question paper contains **SEVEN** questions.

Question -1: [4+1+5]

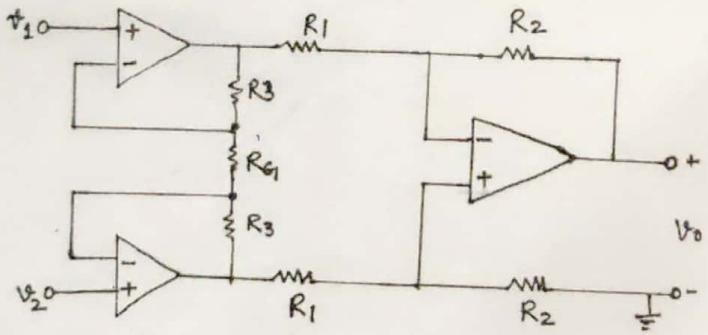
(A): In case of a transformer, in which of the following cases, the difference between no load voltage and full load voltage is higher?
a) Full load at lagging power factor (power factor angle - Ø lagging)
b) Full load at leading power factor (power factor angle - Ø leading)
Justify your answer with the help of proper phasor diagrams.

(B): The maximum efficiency of a transformer occurs at 80% of full load. Find the ratio of copper loss to iron loss at full load. (*Hint: At maximum efficiency, core loss is equal to copper loss*)

(C): A 20kVA, 2500/250 V, 50Hz, single phase transformer gives the following test results:
a) Open circuit test (LV side): 250V, 1.4A, 105W
b) Short circuit test (HV side): 104V, 8A, 320W
Compute the parameters of the approximate equivalent circuit referred to the low voltage side. Assuming the resistances and the reactances of the low voltage side and the high voltage side referred to the low voltage side are same, draw the exact equivalent circuit referred to low voltage side.

Question -2: [10]

Find the output v_o of the following circuit in terms of v_1, v_2 and the other circuit parameters assuming all OP-AMPS to be ideal.



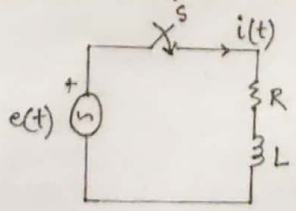
Question -3: [3+4+3]

For the circuit shown in figure below, switch S is closed at $t = 0$ and $e(t) = \sin(wt + \theta)$. Initial energy stored in inductance is assumed to be zero.

(A): Find the natural response of $i(t)$.

(B): Find the complete response of $i(t)$.

(C): Express θ in terms of R, L and w so that the natural response term of $i(t)$ is zero.



Question -4: [4+2+4]

A three input logic circuit gives output as 1 when two or more inputs are 1. The output is 0 otherwise.

(A): Obtain truth table for such a circuit.

(B): Write the Boolean function for the circuit.

(C): Realize the circuit using three AND and one OR gate.

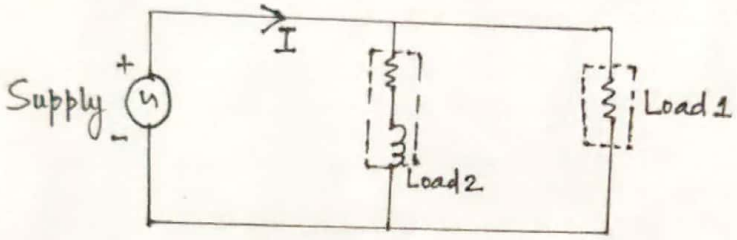
Question -5: [5+2+3]

A single phase plant delivers power to two loads as shown in the figure below. Load-1 draws 30kW at unity power factor and load-2 draws 90 kW at 0.6 lagging power factor. Power is supplied at 4000V, 50Hz.

(A): Determine the total apparent power and current I.

(B): Determine the power factor of the plant.

(C): The power factor of the plant is to be corrected to 0.9 lagging without affecting the total active power. Determine the desired ideal capacitor to be connected in parallel with the load.



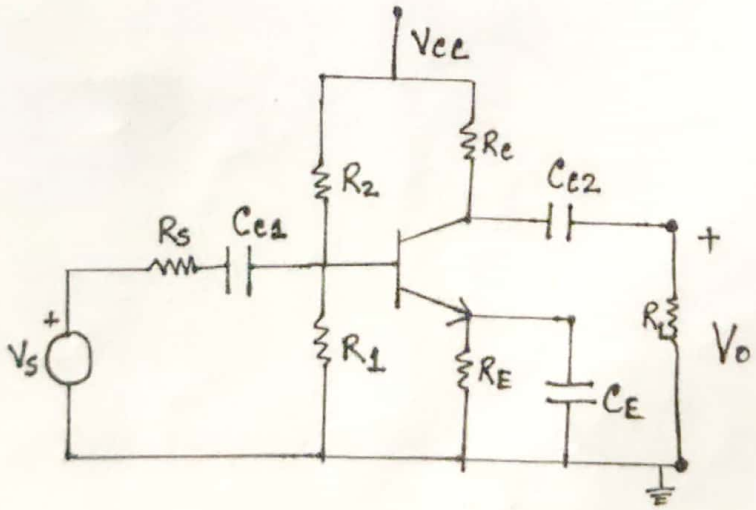
Question -6: [2+5+3]

We would like to analyse low frequency behaviour of RC-coupled amplifier as shown in figure below. Ignoring the effect of the coupling capacitors C_{C1} and C_{C2} , i.e. assuming them short circuited for frequency being considered but considering the effect of only the capacitor C_E.

(A): Draw the small signal model for the circuit.

(B): Find the frequency dependent gain V_o/V_s.

(C): Find the lower cut-off frequency.



Question -7: [5+5]

For the RC-coupled amplifier circuit of question 6, with $R_S = 5k\Omega$; $R_1 = 58k\Omega$; $R_2 = 142k\Omega$; $R_C = 8k\Omega$; $R_E = 3.9k\Omega$; $V_{cc} = 10V$; $\beta_1 = 100$; $\beta_2 = 50$.

(A): Determine the operating point (or Q-point), that is (I_C , V_{CE}) and V_{CB} , for $\beta = 50$ and also $\beta = 100$.

(B): Determine the operating point (or Q-point), that is (I_C , V_{CE}) and V_{CB} , with R_E replaced by short-circuit (that is emitter is directly connected to ground) for $\beta = 50$ and $\beta = 100$.