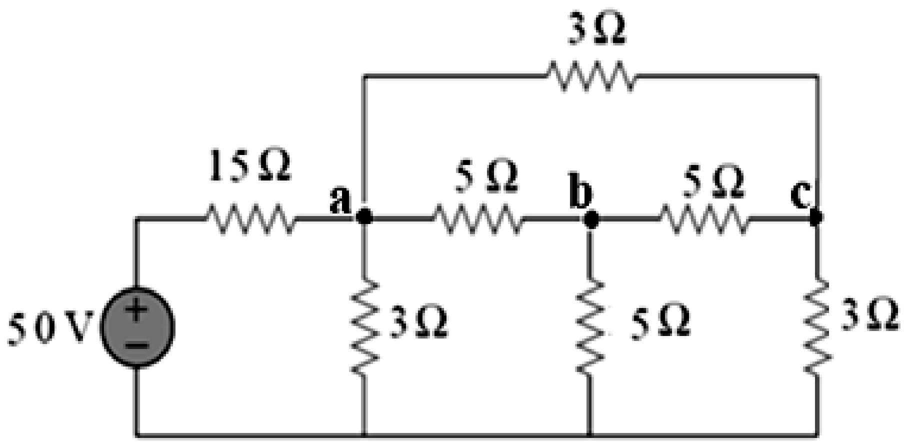
BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, PILANI
II Semester 2022-2023
EEE F111 Electrical Science
Comprehensive Examination (Closed Book)

MM: 135 | **15th July'23** | **Time: 180 minutes**

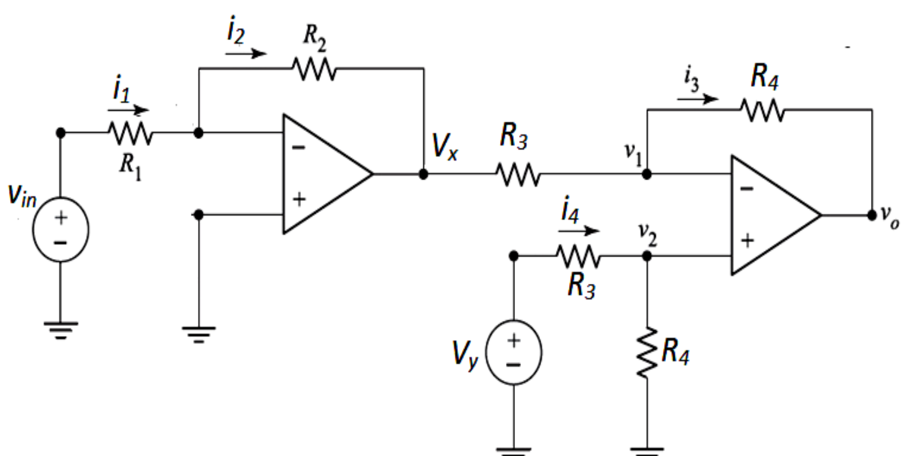
(i) Attempt all parts of a question consecutively.

(ii) Full credit will only be given for neat solution and showing all the required steps.

Q1. For the circuit given below, using any method, determine:
(i) Current supplied by the voltage source
(ii) Power dissipated in 5 Ω resistor (between b & c)
(iii) Thevenin Resistance seen across 3Ω resistor (between a & c). **[25]**



Q2.(a) For the given ideal op-amp circuit, if $\mathbf{R_3 = R_2}$ and $\mathbf{V_y = 1V}$, the output expression of v_o is expressed as $v_o = \mathbf{R_4(\alpha V_{in} + \beta)}$, then find the values of $\boldsymbol{\alpha}$ and $\boldsymbol{\beta}$. **[15]**



(b) A consumer requires 88 kW power at a power factor of 0.707 lagging by using 480 V rms, 50Hz. The transmission line resistance from the power company's transformer to the consumer house is 0.12Ω. Determine the power that must be supplied by the power company:

(i) Under present conditions and

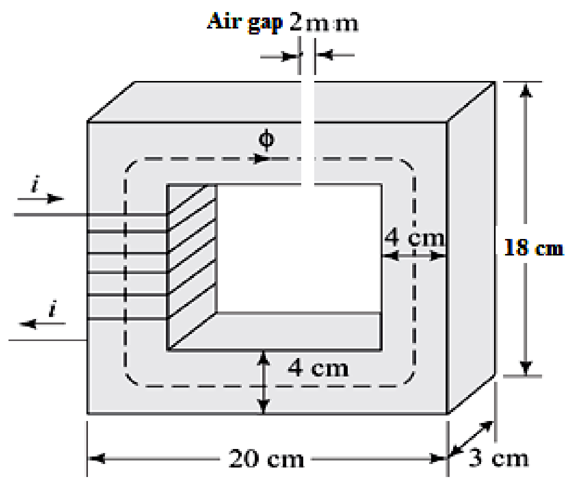
(ii) If the consumer correct power factor from 0.707 to 0.90 lagging. **[15]**

Q3.(a) A rectangular magnetic iron core having a relative permeability of 1500 is wrapped over by a coil which is having 2000 turns and carries a current of 200 mA as shown in figure below. An air gap of 2 mm is created into it to make it work in linear region. Find the

(i) total reluctance of the magnetic circuit.

(ii) magnetic flux in the air gap

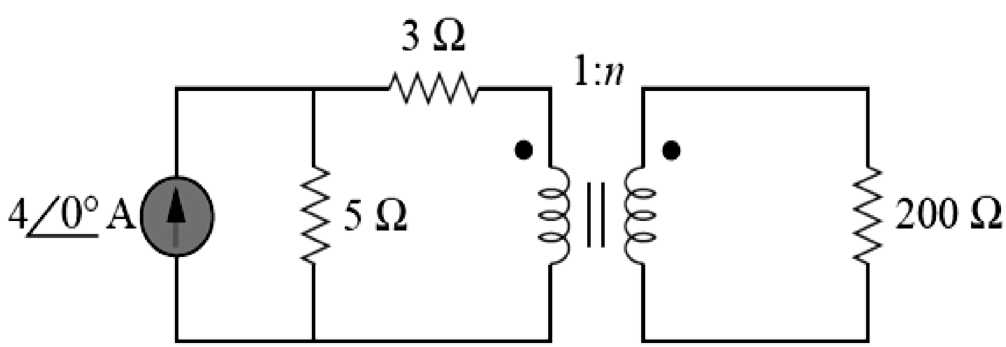
(iii) self-inductance "L" of the coil. Assume no fringing effect. **[15]**



(b) For the given transformer circuit in figure below, find

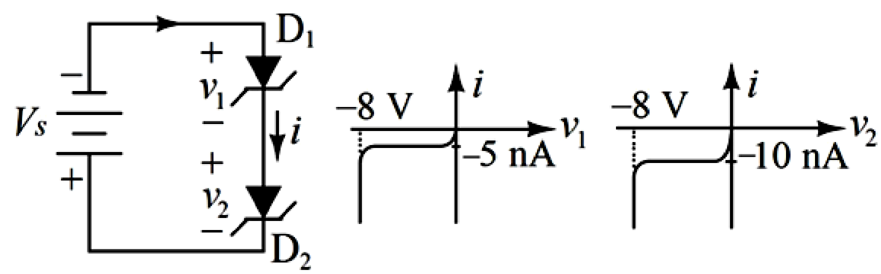
(i) Value of n (transformer ratio) for maximum power supplied to the load of 200Ω.

(ii) Current in the primary coil corresponding to the maximum power transfer condition.



[10]

Q4.(a) The zener diode circuit shown below, contains two silicon Zener diodes D_1 and D_2 with saturation currents of 5 nA and 10 nA, respectively, at 300 K, and both diodes have breakdown voltages of 8 V. The i-v characteristics for the diodes are also shown below. Find the current i and voltages v_1 and v_2 for v_S = 10 V by checking the following conditions:
Condition 1: Both D_1 and D_2 are in breakdown region,
Condition 2: D_1 is in reverse bias
Condition 3: D_2 is in reverse bias. **[15]**

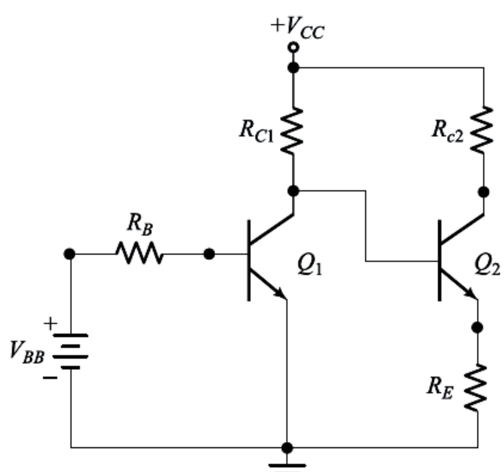


(b) A piece of germanium has **4.4 X 10^{28}** atoms/m^3 and has an intrinsic concentration of **2.5 X 10^{19}** m^{-3} at **300 K**. If one side is doped with one part per 10^8 of an acceptor impurity, how many parts per million of a donor impurity should the other side be doped such that the barrier potential across the resulting *pn* junction 0.3 V? Assume V_T = 26mV at 300K. **[15]**

Q5. For the circuit shown below, suppose that R_B **= 230 kΩ**, R_{C1} **= 1 k Ω**, R_{C2} **= 0 Ω**, R_E **= 2 kΩ**, and V_{BB} **= 3V** and V_{CC} **= 6 V**.

(i) Given that the Si BJTs have β **= 100**, verify that the transistors are in the active region by finding i_{C1}, v_{CE1}, i_{C2}, & v_{E2} .

(ii) Now if **Q_2** is disconnected from V_{CC} & **Q_1** and for **V_{BB}** = 13 V, **Q_1** start operating in saturation region, calculate the value of dc current gain (h_{FE}) for **Q_1**. **[25]**



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