DR. BABASAHEB AMBEDKAR TECHNOLOGICAL UNIVERSITY, LONERE – RAIGAD -402 103

Mid Semester Examination – October - 2017

Branch: (Elect./Extc./Comp/IT/Instru/Biomedical)
Sem.:- I

Model Answer for the paper

Marks: 20

Subject with Subject Code:- Basic Electrical Engineering [EE104]

==

*** M in bracket for marks.**

Q.No.1. Attempt any three of the following (3 x 2marks) (06)

1. Define power and energy write their SI units.
Ans:
Electrical power is the rate of work doneIt is the rate of doing work. Its units is watt (W) which represents 1 joule per second.1 W = 1 J/s
or which gives rate of change of energy with time and is equal to power. The SI derived unit for power (P) is watt expressed as Joule per sec. P=dw/dt=V x I ---- (**1 M**)
Energy
It is the the capacity of doing the work and its SI unit is watts-sec or joules. - ------- **(1 M)**
E=P x t Jouel.

2. State Maximum Power Transfer Theorem.
Ans.: This theorem may be stated as follows :
A resistive load will abstract maximum power from a network when the load resistance is equal to the resistance of the network as viewed from the output terminals, with all energy sources removed leaving behind their internal resistances. **----------- (2 M)**
$R_L = R_{th}$

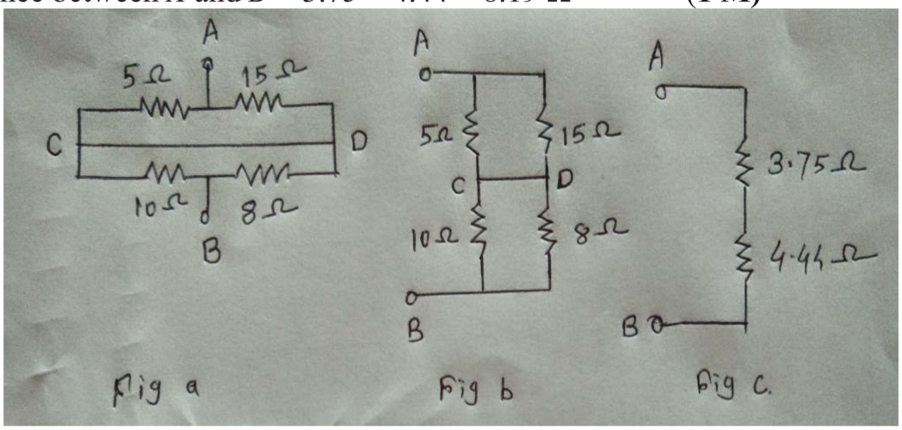
3. State the effect of temperature on resistance of 1. Aluminium 2. Eureka.
Ans:1. Aluminium: Aluminium is pure metal so, the resistance increases with increase in temperature. **----------- (1 M)**
2. Eureka**:** Eureka is alloy so, with as increase in temperature resistance increases slightly. **(1 M)**

4. Find the equivalent resistance across terminal A and B.

Solution:

Resistance of branch *ACD* = 5 || 15 = (5 x15)/(5+15)=3.75 Ω **(Figure b.) ------- (1/2 M)**

Resistance of branch *BCD* = = 10 || 8 = (10 x 8)/(10 + 8)= 4.44 Ω **(figure c) ------ (1/2 M)**
Resistance between *A* and *B* = 3.75 + 4.44 = 8.19 Ω **------- (1 M)**



Q.No. 2 Attempt any one of the following: (1x 6) (06)

a.) A water immersion heater develops 1800000 K Joules heat energy to boil the water 20 °C to 70 °C when connected across 240volt supply. The heater has resistance of 50 **Ω** and heat efficiency is 85 %. Determine 1. volume of water .
2. Input energy.
3. Time required to boil the water.
Assume specific heat of water 4200 J/kg C.
solution: Given
Heat produced electrically *H* = 1800,000 Joules, t_1=20 °C and t_2=70 °C ,efficiency =85% ,V= 240 V ,Specific heat capacity S=4200 J / Kg °C Resistance of heater =50 **Ω**.

volume or mass of water :(m)

H=m x s x ΔT = m x 4200 x (70-20)=2,10,000m

m= H / 210000 =1800000 /210000 =**8.57 kg. ------------------- (2 M)**

In put Energy: Ei to heater : Ei= H / efficiency =1800000 /0.85 =**2117647.058 J**. **----- (2 M)**

Time required to boil the water :(t)

Ei= (V^2 / R) x t =(240^2/ 50) t

t=Ei x(50/240^2) =2117647.058 x (50/240^2) =1838.235 sec.

t=1838.235 / 60 = 30.63 min. ------ (2 M)

b.) Determine current flowing through 5 Ω register using superposition theorem.

solution: Assume terminals of 5Ω as A & B.

Step 1

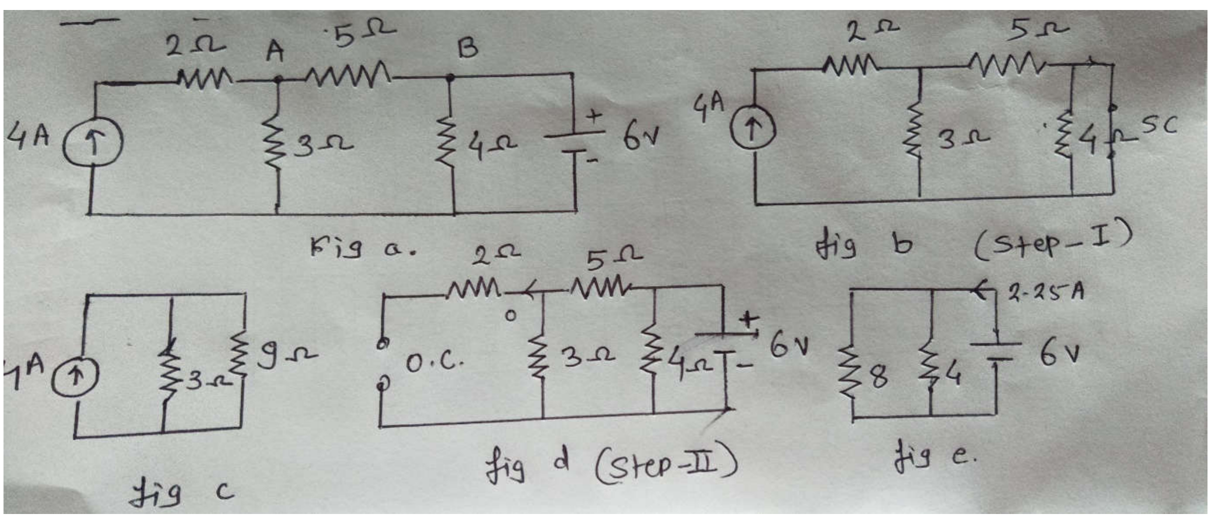
6-volt battery has been removed. Fig(b)
Calculate the current I_{AB} due to 4 Amp current source
Resistance 5 and 4 are in series = (4 +5) = 9Ω (Fig c)
Using current division rule , $I_{AB\,1}$= 4 x [3/(3+9)]=**1 A ------ (2 M)**

Step 2

4 A current source has been removed. (Fig. d)
Calculate the current I_{BA} due to 6 -volt battery.
Total resistance =(3 + 5) ‖ 4 = (8 x 4) /(8+4) =32 /12=2.66 Ω
I= 6/2.66 = **2.25 A.**
Using current division rule , I_{BA}= 2.25 x [4/(4+8)]=**0.75 A** (Fig. e)
$I_{AB\,2}$**= -0.75 A --------------(2 M)**

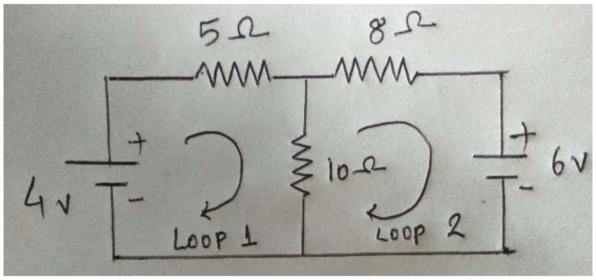
Step 3 find I_{AB}

I_{AB}= I_{AB1} + $I_{AB\,2}$ = 1 A - 0.75 A = 0.25 A ---------- (2 M)



Q. No 3. Attempt any two of the following (2 X 4 = 8) (08)

1. Find the current through 10-ohm resistance using loop analysis.



Solution:

For loop 1 Applying KVL,we get

$-5I1$ $-3\ (I1 - I2) + 5 = 0$ or $15I1 - 10\ I2 = 4$ ...**(i)** **------(1M)**

For loop 2 Applying KVL ,we have

$-8\ I2 - 10(I2 – I_1) - 6 = 0$ or $10I1 - 18\ I2 = 6$ or 5I1-9I2=3 ...(ii) **------(1M)**

Solve simultaneous equation find I1 & I2 **--------------(1M)**

Multiply equation (2) by 3 and add to equation (1)

$17I2 = - 9 + 4 = -5$

$I2 = - 0.294$ A

Substituting the value of $I2 = - 0.294$ A in **(i)** we get

15 I1 + 2.94 = 4 or 15 I1 = 4 -2.94

15 I1 =1.06 A

or I1 =0.070 A

Find current through $I_{10\Omega}$

$I_{10\ \Omega}$ = 0.07-(-2.94) =**0.36 A** **------(1M)**

2 .**Define RTC and proof** **Where = tempt. coeff. at 0°C ; = tempt. coeff. at t °C.**

Solution :

The temperature-coefficient of a material may be defined as :*The increase in resistance per ohm original resistance per °C rise in temperature.* **------(1M)**

value of α itself is not constant but depends on the initial temperature on which the increment in resistance is based. When the increment is based on the resistance measured at 0°C,

then α has the value of α0. At any other initial temperature *t*°C, value of is α*t* and so on.

Suppose a conductor of resistance *R*0 at 0°C is heated to *t*°C Its resistance *Rt* after heating is given by

---------------i **------(1M)**

Where α0 is the temperature coefficient at 0°C.

The resistance given in terms of

From eq 2 we have,

------(1M)

Substitute value of in Eq. i we get,

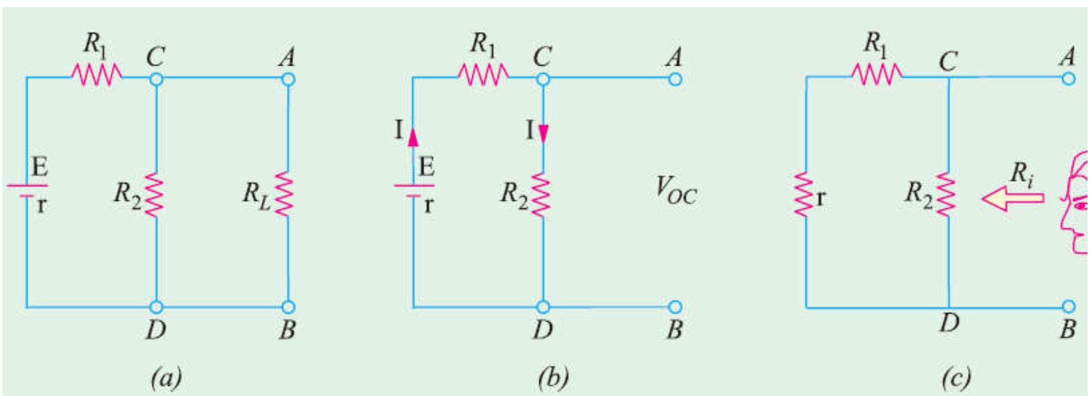
Hence,   ------(1M)

3.State Thevenin's theorem and explain how it is applied for network problem.

Solution :

Thevenin's Theorem stated as

The current flowing through a load resistance RL connected across any two terminals A and B of a linear, active bilateral network is given by Voc || (Ri + RL) where Voc is the open-circuit
voltage (i.e. voltage across the two terminals when RL is removed) and Ri is the internal resistance of the network as viewed back into the open-circuited network from terminals A and B with all voltage sources replaced by their internal resistance (if any) and current sources by infinite resistance.   ------(1M)



Suppose, it is required to find current flowing through load resistance *RL*, as shown in Fig. (*a*).

Steps   **------(2 M)**

1. Remove *RL* from the circuit terminals *A* and *B* and redraw the circuit as shown in Fig. (*b*). The terminals have become open-circuited.

2. Calculate the open-circuit voltage *Voc* which appears across terminals *A* and *B* when they are open *i.e.* when *RL* is removed.

As seen, *Voc* = drop across *R*2 = *IR*2 where *I* is the circuit current when *A* and *B* are open.

$I = E/(R_1 + R_2 + r)$

$Voc = IR2 = E R_2/(R_1 + R_2 + r)$ (r is the internal resistance of battery)

It is also called 'Thevenin voltage' *Vth*.

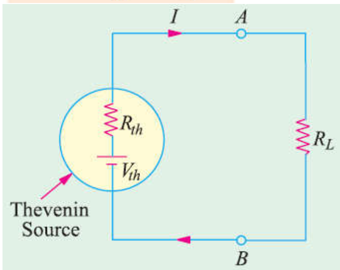
3. Now, imagine the battery to be removed from the circuit, leaving its internal resistance *r* behind and redraw the circuit, as shown in Fig. (*c*). When viewed inwards from terminals *A* and *B*, the circuit consists of two parallel paths : one containing *R*2 and the other containing (*R*1 + *r*). The equivalent resistance of the network, as viewed from these terminals is given as

$R_{th} = R2 \parallel (R1 + r) = R2(R1 + r) / (R2 + (R1 + r))$

This resistance is also called, Thevenin resistance *Rth*

4. *RL* is now connected back across terminals *A* and *B* from where it was temporarily removed earlier.Draw the Thevenin's equivalent circuit and find Current flowing through *RL* .

$$I = \frac{V_{th}}{R_{th} + R_L}$$



-------(1M)