Strathmore
UNIVERSITY

SCHOOL OF ENGINEERING AND COMPUTING SCIENCES
BACHELOR OF ELECTRICAL & ELECTRONICS ENGINEERING
END OF SEMESTER EXAMINATION
BEE 1201: CIRCUIT THEORY I

DATE: 2nd August 2024 **TIME: 15:30-17:30 Hours**

INSTRUCTIONS:

i. This paper contains **FIVE** questions.
ii. You are required to answer **THREE** questions, that is, **QUESTION ONE** which is **COMPULSORY** and any other **TWO** questions.
iii. All questions carry equal marks i.e. **20 MARKS** each.

QUESTION ONE.

Adoption of digital technology to transform India's healthcare post-Covid-19: Jyoti Arora, Special Secretary, MeitY

NASSCOM CoE for IoT & AI organizes Healthcare Innovation Challenge (HIC) for the digital transformation of healthcare providers in India
22 March, 2021 by BW Online Bureau

With an aim to drive the digital transformation of the healthcare providers in the country, NASSCOM CoE for IoT & AI successfully organized Healthcare Innovation Challenge (HIC). The one-of-a-kind initiative was meant to find out possible solutions to digital technology challenges shared by participating hospitals, the challenges focused on out-patients convenience including lesser dependence upon administrative staff, cost reduction, Inpatient care improvement, Pathology digitalization, and use of AI, among others by utilizing best health-tech solutions, better branding and promotions, finding cost-effective options and through innovation.

Jyoti Arora, IAS, Special Secretary, MeitY, said, "Realising the importance of emerging technologies long back, the key aspect of our programs was a collaboration between industry and different state governments in the PPP model to promote the development and adoption of emerging technologies in different sectors including health. The challenges before India's healthcare system are immense and with digital technology, we can improve the efficiency of service delivery within the Indian context. The role of digital platforms like the Arogya Setu app, telemedicine portals, online bookings, mapping of patients, teleconsultation, intelligent diagnosis, online clinical support, smart devices, among others during the Covid-19 pandemic has brought the importance of digital healthcare to the forefront. Understanding the need, the Government of India has also launched the National Digital Health mission to digitize the healthcare records across the country and during this transformation phase, the solutions coming out of HIC will help hospitals in improving

their efficiency, reduce costs and ensure quality healthcare and making healthcare more inclusive."

"The seismic shifts caused by the COVID-19 pandemic have put the spotlight on India's healthcare sector. The sector is at a strategic inflection point of digital disruption, and thus it is pivotal to streamline our0 efforts to leverage the best of the digital technologies to strengthen medical infrastructure for an effective response to emergency care. The integration of healthcare with technology is blurring the divide and improving patient care services, increasing access, affordability, and lowering costs. It is heartening to see not just corporates and governments but even start-ups coming ahead to develop innovative solutions to support the sector. An important initiative like HIC is vital as it will pave the way to bridge the gap between existing challenges and innovative solutions." said Debjani Ghosh, President, NASSCOM.

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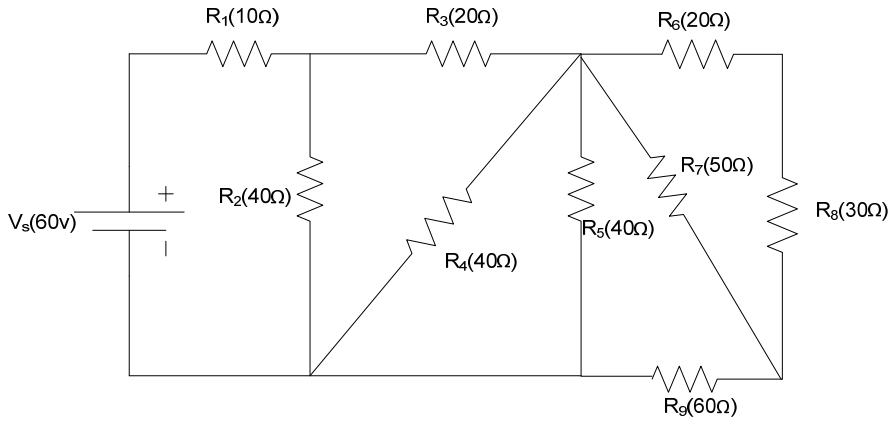
'"Today, people are heavily dependent on hospitals to find solutions to problems created by the coronavirus pandemic. In such a situation, use of technology will play a pivotal role in all areas like supply chain, patient registration, physician assistance etc. Furthermore, through the latest innovations, healthcare facilities can be made available for the remotest locations very easily," said Ishaq Quadri, Secretary, HIMSS India Chapter.

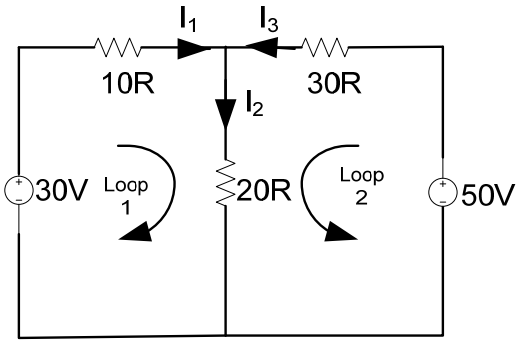
a) With reference to the above case, briefly discuss whether the author is right in his statement. (4 marks)
b) List and describe four types of sensors that can be used in the healthcare sector according to the above case indicating their relation to circuit theory. (4 marks)
c) Based on the above case and taking the two types of sensors and actuators, develop a proposal on an IoT based idea which the healthcare sector can use to increase efficiency and implement the system based on Arduino. (4 marks)
d) Assuming, according to your proposal, the four sensors make a combined circuit, draw the circuit and determine the current through the third sensor using Thevenin's theorem. (4 marks)
e) With graphical representations, explain the factors affecting the resistance of these sensors. (4 marks)

QUESTION TWO.

a) Seven sensors and one actuator are connected as below to form a greenhouse system.
   Based on Norton's analysis, determine the; (10 marks)
   i. Total Resistance
   ii. Total current
   iii. Current through each device
   iv. Voltage through each device
   v. Power in each device



b) Calculate the values for I_1, I_2 and I_3 in the circuit shown below. (4 marks)



c) Describe the device that is associated with the following diagram indicating what it represents and its applications in relation to a digital system. Sketch the relation between its operational parameters. (6 marks)

QUESTION THREE.

a) Convert the Δ (delta) network in Fig Q3 a) to an equivalent Y (star) network. (4 marks)

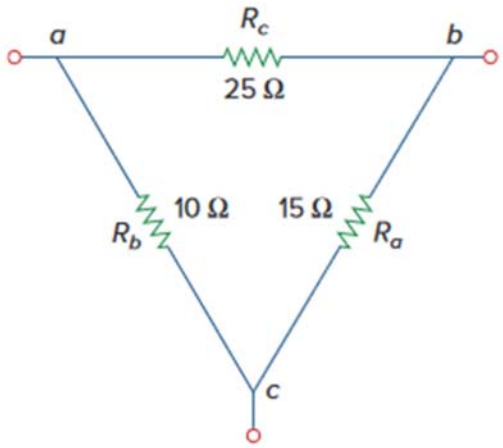


Fig Q3 a)

b) Two amplifiers, one of 0M0024 resistance and a second one, are connected in series in a public address system. A microphone of 4500K and an audio mixer of twice the resistance value of the second amplifier together in series are connected in parallel with this circuit. The equivalent resistance of all the four systems is given by 3K5. (8 marks)

   i. Calculate the value of the second and fourth resistors.
   ii. If a battery with e.m.f. of 0.020kV is connected to this final circuit, calculate the current through the fourth resistor using Thevenin's theorem.

c) Differentiate between any two devices associated with light sensing indicating how they are used in digital system development. Your explanation should include graphical relations of the corresponding operational parameters. (8 marks)

QUESTION FOUR.

a) A series RLC circuit consists of a resistor R=10 Ω, an inductor L=0.1 H, and a capacitor C=100 μF. The circuit is driven by an alternating current (AC) source with a peak voltage of Vm=50 V at a frequency f=50 Hz.

   i. Calculate the inductive reactance XL and capacitive reactance XC.
   ii. Determine the impedance Z of the circuit.
   iii. Calculate the peak current Im in the circuit.
   iv. Find the phase angle ϕ between the voltage and the current.
   v. Compute the resonant frequency f0 of the circuit. (10 marks)

b) Find the Thevenin and Norton equivalent circuits across the resistor R. (6 marks)

c) Describe any eight applications of this system. (4 marks)

QUESTION FIVE.

a) If a current of 2A flows for 1 hour in an electric kettle, find the quantity of electricity transferred. Taking the Kenyan mains supply determine the amount of power, energy in kWh consumed and the total cost if 1 kWh is kSh 200. (6 marks)

b) An electric heater consumes 2.4 MJ when connected to a 240V supply for 30 minutes. Find the power rating of the heater and the current taken from the supply. (4 marks)

c) With graphical representations, describe how each parameter that affects electric energy storage can be used in Arduino based sensors. (4 marks)

d) Design a three-phase system based on the device in b) above and its passive counterparts. (6 marks)