The Open University of Sri Lanka
Faculty of Engineering Technology

Study Programme	:	Bachelor of Technology Honours in Engineering
Name of the Examination	:	Final Examination
Course Code and Title	:	**MEX3274 – Electronics, sensors and actuators**
Academic Year	:	2016/17
Date	:	25th November 2016
Time	:	0930hr-1230hr
Duration	:	3 hours

General instructions

1. Read all instructions carefully before answering the questions.
2. This question paper has **eight** questions. All questions carry equal marks.
3. Answer **five questions** only, selecting **at least two questions** each from **part A and part B.**

PART A

Question 01

a) What are the common rectification methods available to convert AC to DC? Briefly explain.

b) A circuit is to give an output voltage of 5 V from an input voltage of 15 V as shown in the figure Q1-b. If $R_2 = 200\Omega$, calculate the resistance of R_1.

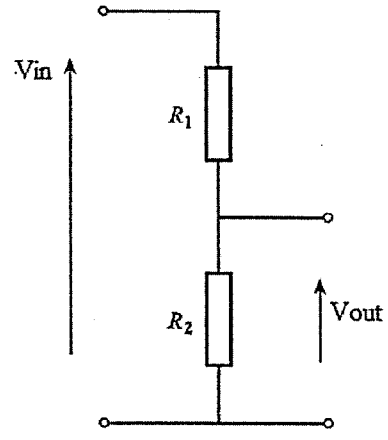

Figure Q1-b

c) Determine V_X by finding V_{TH} and R_{TH} to the left of A-B using Thevenin's theorem.

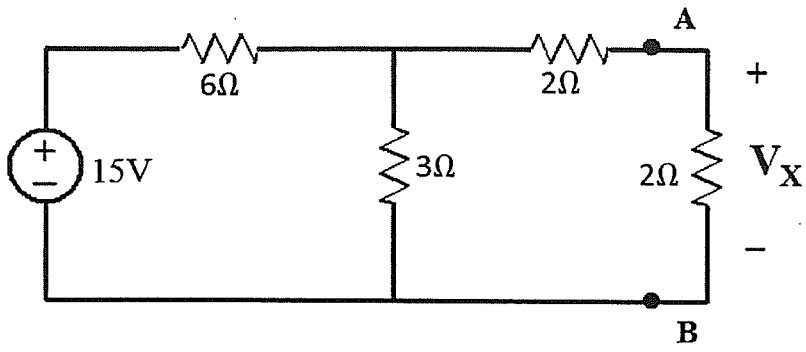

Figure Q1-c

d) Derive the Norton equivalent circuit using the Thevenin's circuit drawn for the part (c)

Question 02

a) An alternating voltage signal displayed on oscilloscope screen is shown in figure Q2-a. The signal amplitude control is set to 2 V/ division and time base setting is 5ms/division. Determine;

i. Frequency of the signal
ii. Peak to peak voltage

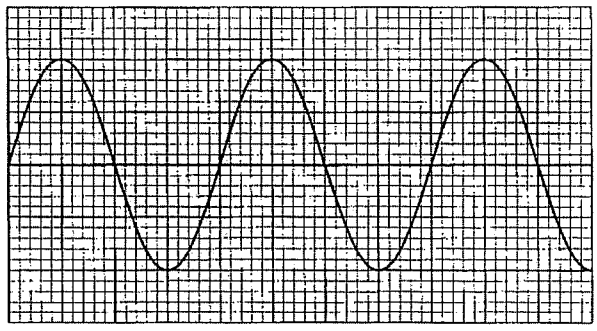

Figure Q2-a

b) A step-down transformer is required to transform 240 V a.c. to 12 V a.c. If the primary coil has 1000 turns, how many turns should the secondary have? How you can identify the secondary coil using a multi-meter?

c) An average of 120 kW is delivered to a city which is located 100 km away from the power station. The transmission lines have a total resistance of 4 Ω. Calculate the power loss if the transmission voltage is;

i) 230 V
ii) 33kV

d) Determine I_1 and I_2 of the circuit shown in figure Q2-d

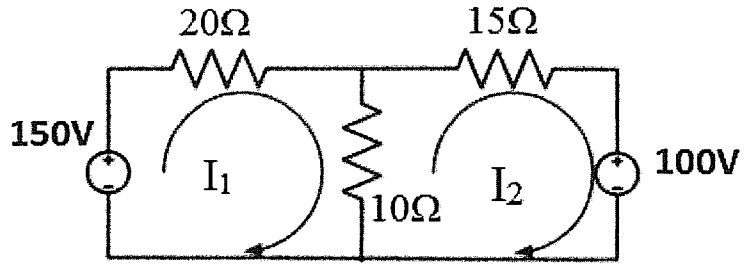

Figure Q2-d

Question 03

a) Convert (note: clearly show the necessary steps);
   i. 100111_2 to hexa-decimal and decimal
   ii. 355_{10} to hexa-decimal and octal
   iii. $3E_{16}$ to binary and octal
   iv. 67_{10} to binary coded decimal(BCD)

b) What is the main significance of two's complement representation of binary numbers?

c) Determine sign-and-magnitude (8 bit) binary representation of the -43_{10}

d) Explain how R-2R ladder network is used to convert digital signal to analog.

Question 04

a) Determine V_B, V_E, I_C and V_C of the BJT circuit shown in figure Q4-a

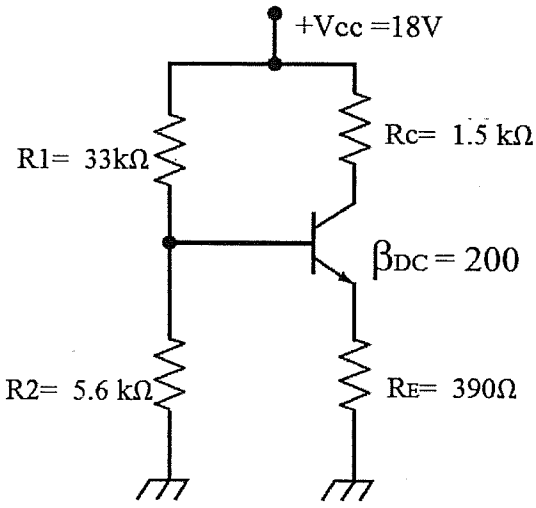

Figure Q4-a

b) Determine the gain and output voltage of the operational amplifier shown in figure Q4-b, when R1 = 10kΩ , R2=100kΩ , Vin= 0.2V.

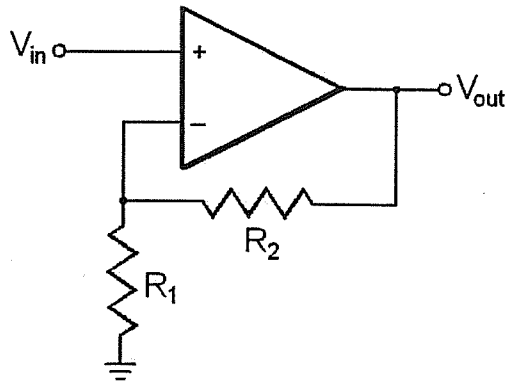

Figure Q4-b

c) Determine the output voltage of the operational amplifier shown in figure Q4-c, when R1=R2=R3= 10kΩ , RF=20kΩ , V1= 1V, V2=1.5V and V3=2V.

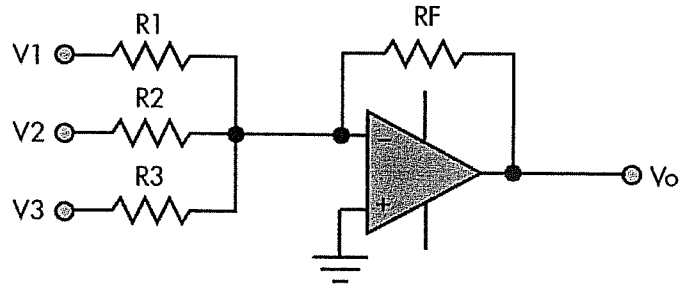

Figure Q4-c

PART B

Question 05

a) Distinguish between active sensors and passive sensors. Elaborate with suitable examples.

b) Explain the difference between accuracy and precision with respect to sensors with using suitable examples.

c) What is a stain gauge? Briefly explain the applicability of such sensor in a practical situation.

d) What are the parameters need to determine the resistance change of a strain gauge. Explain with a suitable example.

Question 06

a) Discuss the advantages and disadvantages of a potentiometer and a linear variable differential transformer (LVDT) with respects to a displacement measurement application.

b) Figure Q6-b illustrates a cutaway view of an encoder.

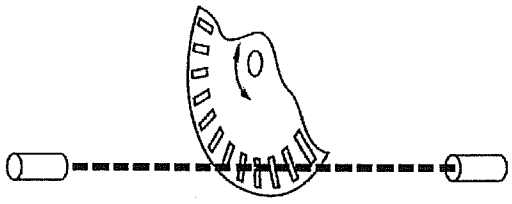

Figure Q6-b

i. Identify the type of the encoder.

ii. State another type of optical encoder and mention the major differences compared to this encoder.

c) Discuss the differences between inductive, capacitive and optical proximity sensors.

Question 07

a) Discuss the differences between 'Permanent Magnet' and 'Variable Reluctance' stepper motors.

b) What are the three step modes which use to operate the stepper motor?

c) Briefly explain following dc motor types which are categorized according to the field windings.

i. Shunt connected
ii. Series connected
iii. Compound connected

d) A three-phase, four poles induction motor is connected to AC source. The frequency of the power source is 40 Hz.

Determine;

i. the synchronous speed, and

ii. the speed of the rotor when the slip is 5%

Question 08

a) Discuss the advantages and disadvantages of pneumatic systems.

b) Draw symbols of following pneumatic components.

i. 3/2 way directional control valve
ii. 5/2 way directional control valve
iii. Air service unit

c) Design a simple pneumatic circuit to operate a single acting cylinder.

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