THE OPEN UNIVERSITY OF SRI LANKA
FACULTY OF ENGINEERING TECHNOLOGY
LEVEL 4
FINAL EXAMINATION – 2011/2012
MEX4242 – AUTOMOTIVE ELECTRONICS

DATE : 18th MARTH 2012
TIME : 1400 HRS. TO 1700 HRS.
DURATION : THREE HOUR [3 Hours]

READ THE FOLLOWING INSTRUCTIONS CAREFULLY BEFORE ANSWERING THE QUESTION PAPER

Instructions

1. This question paper consists of six (06) questions.
2. Answer **Question 01**, which is **compulsory** and **three others**. Question 01 carries 40 marks, whereas the others each 20 marks.

Question 01

a) The ECU is an extremely reliable piece of hardware which has the capability to receive and process information hundreds of times per second in a vehicle. At the heart of the ECU is the microprocessor. It is the processing center of the ECU where input information is interpreted and output commands are issued. The process and output functions of the ECU in a vehicle can be generally classified as follows:

- Fuel Injection Control
- Spark Advance Control
- Idle Speed Control
- Self Diagnosis
- Related Engine and Emission Control
- Failure Management (Fail-safe and backup)

Explain the Fuel, Spark and Failure Management functions in a typical ECU. (You main emphasizes should be on electronic control system)

b) Draw a suitable schematic diagram for a control system of an active suspension system which is proposed for an automobile in order to achieve improved ride quality.

(40 marks)

Question 02

Relays are used throughout the automobile. Relays which come in assorted sizes, ratings, and applications, are used as remote control switches. A typical vehicle can have 20 relays or more.

a) Why are voltage-spikes a problem with relay? Explain how the spikes are created.
b) Explain how voltage suppression is controlled in a relay. Provide a drawing of each type.
c) Describe in details the procedure to identify the relay type when it is not labeled.
d) Explain how you properly test a suppression diode inside the relay.

(20 Marks)

Question 03

Consider the transistor switch circuit shown in the Figure Q3. The transistor has following characteristics: $h_{FE} = 100$, $I_{CO} = 50\mu A$, $V_{CE(sat)} = 0.2$ V.

a) If R = 1 kΩ, determine I_B, I_C, V_C, and power dissipation in the transistor when the switch S is open state and closed state separately.
b) What is the used of 10 kΩ resistor and the capacitor C?
c) Calculate the maximum theoretical value possible for R.
d) If the light bulb in the circuit is replaced by a relay switch having same specifications. State the additional precautions that must be taken for safe operation of the circuit.

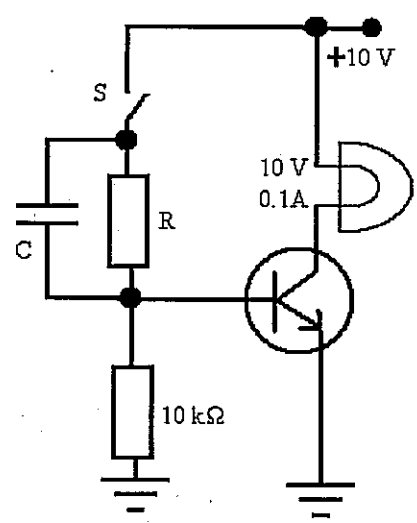


Figure Q3

(20 Marks)

Question 04

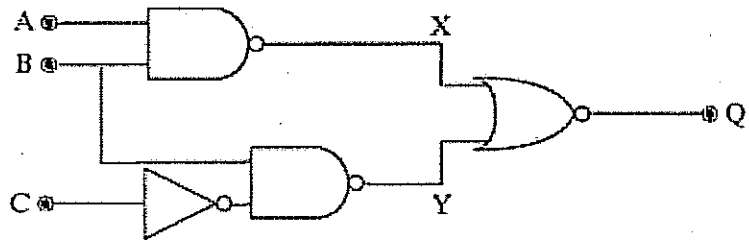


Figure Q4

a) Write down Boolean expressions for the signals at points X, Y, and Q in terms of the inputs A, B, and C in logic circuit shown in Figure Q4.

b) Complete the truth table below for the signals at X, Y, and Q in the logic circuit shown above.

A	B	C	X	Y	Q
0	0	0			
0	0	1			
0	1	0			
0	1	1			
1	0	0			
1	0	1			
1	1	0			
1	1	1			

Table Q4

c) Draw the simplified logic circuit would have the same function as the above circuit shown in Figure Q4 using K map.

d) Design an Ex-NOR (Exclusive NOR) Gate using;
   (i) Only NAND gates
   (ii) Only NOR Gates.

(20 marks)

Question 05

Consider the common emitter amplifier circuit shown in the Figure Q5. The amplifier is to be used to amplify audio signal in the range 20 Hz to 20 kHz. If the quiescent collector current is set at 1 mA and the gain at 50,

a) Determine suitable values for R_C, R_E, R_1 and R_2. Assuming $V_{BE} = 0.6V$ and $h_{FE} = 100$

b) What is the input impedance of the amplifier?

c) Determine the suitable value for C_2.

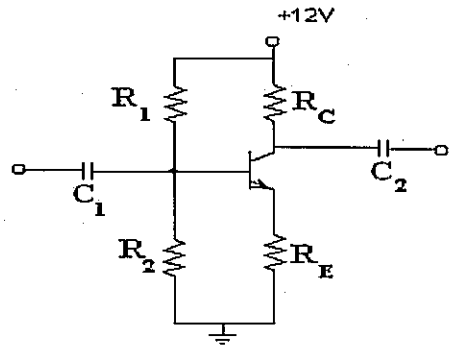


Figure Q5

(20 marks)

Question 06

A battery tester which uses comparators to test the battery output against a series of set voltages shown in Figure Q6.

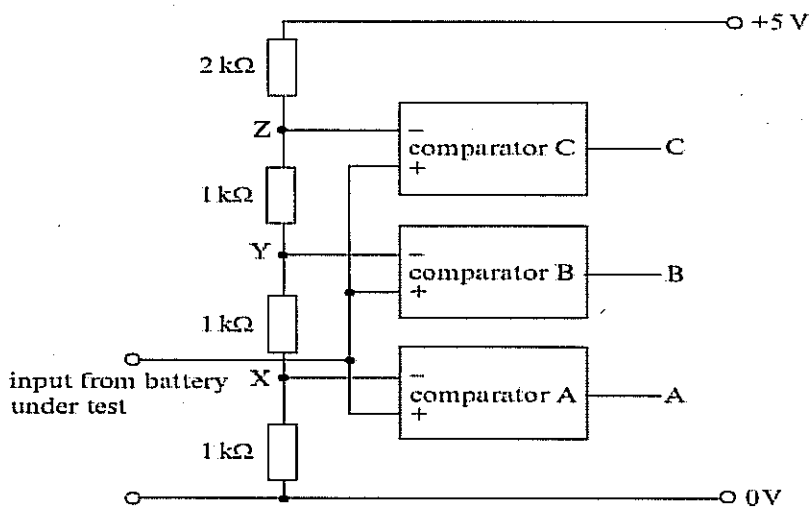


Figure Q6

a) Calculate the total resistance of the voltage divider formed by the four resistors.
b) Calculate the current through the voltage divider.
c) Calculate the voltages at X, Y, and Z.
d) Complete the table below to give the output states, **high** or **low** at A, B, and C for the input voltages given.

Input Voltage (V)	A	B	C
0.5			
1.5			
2.5			
3.5			

(20 Marks)

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