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THE OPEN UNIVERSITY OF SRI LANKA

FACULTY OF ENGINEERING TECHNOLOGY

LEVEL 4

FINAL EXAMINATION-ACADEMIC YEAR 2009/2010

MEX4242/ECX4240 AUTOMOTIVE ELECTRONICS

DATE : 28TH MARCH 2010

TIME : 1400 HRS.-1700HRS.

DURATION : THREE HOURS [3 HRS.]

READ THE FOLLOWING INSTRUCTIONS BEFORE ANSWERING THE PAPER

Instructions:

1. *This question paper consist six questions.*
2. *Answer **Question 01**, which is **compulsory** and three others.*

Question 01 (Spend approximately one hour) [40 Marks]

ANSWER ALL QUESTIONS

a) Differentiate open loop and closed loop control systems.
b) How microcontrollers differ from a microprocessor?
c) List out the different actuators used in electronic engine management and mention where they are used.
d) Give a list of the various types of sensors used in the Multi Point Fuel Injection system petrol engine.
e) Briefly explain the working of a typical relay.
f) Differentiate Throttle body Injection and Multi port fuel injection system.
g) How can the Engine Speed be monitored using a non contact type sensor?
h) What is the need of altitude and ambient temperature compensation in an electronically managed engine?
i) How is deceleration leaning of the mixture achieved in an engine having a closed loop control system?
j) What do you mean by Electromagnetic interference?

Question 02

[20 Marks]

Figure Q 2 illustrates a *Tire Slip Detector and Fuel Flow Interruptor* circuit. This circuit can detect wheel slip by detecting an unusually high rate of change of wheel speed and also can control fuel supply to the engine.

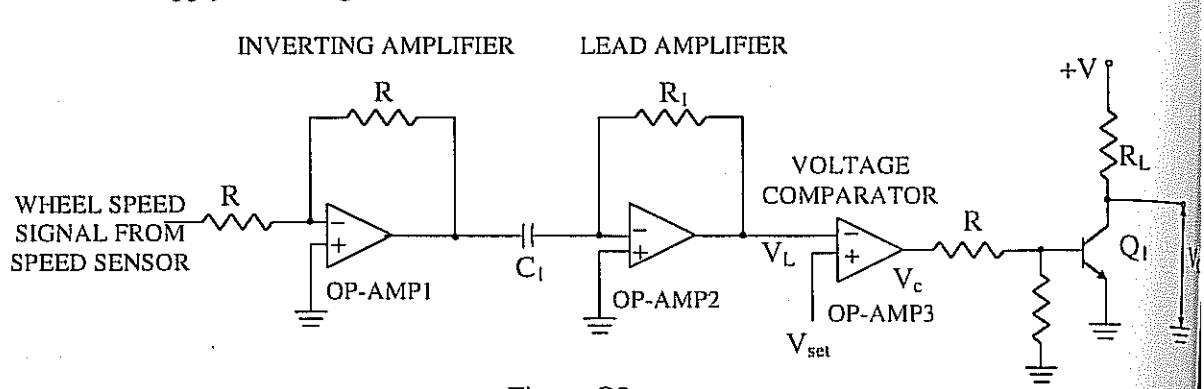

Figure Q2

a) Explain the function of each sub system of *Tire Slip Detector and Fuel Flow Interruptor* control circuit.
b) If wheel speed signal from speed sensor is V_{in} find the output voltage signal of Lead Amplifier (V_L).
c) If $V_L \leq V_{set}$ and $V_L \geq V_{set}$ draw output wave form (V_C) of comparator.
d) Explain the purpose of the Q_1 transistor. Draw output wave form of Q_1 transistor according to output of comparator.

Question 03

[20 Marks]

In automobiles knock sensors are used to detect engine knock and send a voltage signal to the ECM(Electronic Control Module)

a) Explain the operation of knock sensor?
b) Name three possible locations to detect the engine knock.
c) How do you analyze the output of a knock sensor?

Plot the typical output voltage pattern with respect to the frequency, when knock occurs.

Question 04

[20 Marks]

a) With the aid of sketches explain the construction and working of Mass Air Flow sensors and Throttle position sensors used in vehicles.
b) Draw a suitable input interfacing circuit to improve input of both sensors.
c) Explain how you are going to interface input analog signal to microcontroller or microprocessor.
d) Sketch and explain the working of solenoids and stepper motors as actuators in vehicle.
e) Draw suitable driver circuits for drive solenoids and stepper motors. State what are the safety precautions that should be taken to prevent from back emf.

Question 05

[20 Marks]

(a) List four characteristics of an ideal operational amplifier (Op-Amp). Compare the ideal values with its typical values.

(b) Explain following terms of an operational amplifier
   i. Input bias current
   ii. Output offset voltage

(c) What do you mean by the term "**Virtual ground**"?

(d) Determine an expression for the output voltage V_{out} in the circuit shown in Figure Q5. Assume that the operational amplifier is ideal.

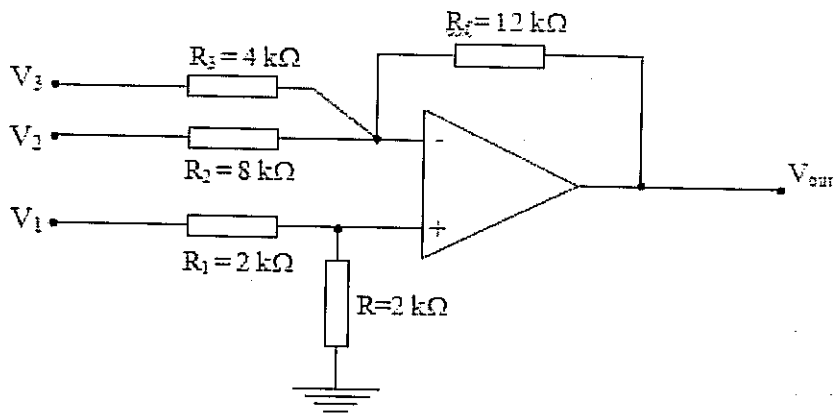

Figure Q5

If V_2=6V and V_3=4V, then find the value of V_1 to get V_{out} = 0 V.

Question 06

[20 Marks]

Pressure sensors are used at different places in automobiles. They can be used to measure intake manifold pressure, atmospheric pressure, vapor pressure in fuel tank, etc. Intake manifold pressure is measured by using MAP sensor which is also a pressure sensor.

a) Explain the operation of MAP (Manifold Absolute Pressure) sensor.
b) Why does the ECM need to know the MAP sensor signal?
c) What are the different voltage signals at Idle level and WOT (Wide Open Throttle) level?
d) How do you detect a faulty MAP sensor?
e) Why do we need to know the specific voltage drop at different pressures?

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