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	:	**MEX4142 – Applied automotive electronics**
Academic Year	:	2016/17
Date	:	07th December 2017
Time	:	0930hr-1230hr
Duration	:	3 hours

General instructions

1. Read all instructions carefully before answering the questions.
2. This question paper has **six** questions.
3. Answer **Question 1 (Q1)**, which is **compulsory** and **three** other.
4. Question 01 carries 40 marks where as others each 20 marks.

Q1 (spend approximately one hour and fifteen minutes)

The article of "Active Aerodynamics" given in below taking from "*http://www.cvel.clemson.edu/auto/systems/auto-systems.html*". Read it carefully and answer the following questions.

Active Aerodynamics

Basic Description

Aerodynamics has been incorporated into automotive design for several decades. In designing aerodynamic features on cars, two main concepts are considered: downforce and drag. Downforce uses areas of low pressure to keep the vehicle on the ground and improve handling and brake response at high speeds. However, certain aerodynamic features that increase downforce on a car also can increase drag, which forces the car to require more power to maintain a speed.

Active aerodynamics began appearing on production vehicles in the mid to late 1980's. Some of the earliest cars to carry this feature include the 1986 Porsche 959, the 1988 Volkswagen Corrado, and the 1991 Mitsubishi 3000GT VR-4. Active aerodynamic systems typically adjust certain aerodynamic features based on the speed of the vehicle. However, other information such as acceleration, yaw rate, steering wheel angle, and brake input may also be utilized. The figure Q1 given in page 2 displays several aerodynamic components that are incorporated in various vehicles today. The Hump, Rear diffuser, Turn vane, Tire vane and Aero fin are typically integrated into the frame and are not currently

part of active aerodynamic systems, while Rear spoiler, Front Vertical flaps and Air dam are active systems in certain automobiles.

Aerodynamic Vehicle Features

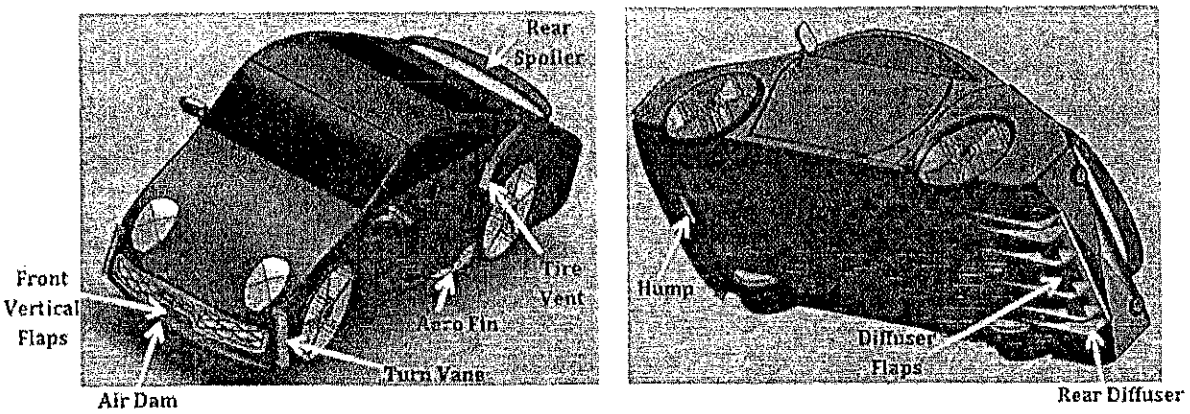


Figure Q1

The stationary aerodynamic features focus on directing the air rushing past the car to optimal locations. Tire vents, for example allow the air to cool the tires and brakes, thereby improving fuel efficiency and prolonging the life of those components. Vanes and fins direct some of the air around the car to the tire vents and increase the downforce on the car. The hump and diffuser channel the air under the car. This creates an area of low pressure, increasing the downforce and stability of the vehicle.

The active aerodynamic features enhance the performance of the stationary components. In a Porsche 911 Turbo, for example, the rear spoiler and air dam synchronously expand and retract upon reaching certain speeds. In their original, low speed position, they provide adequate downforce and stability for the car. However, their expansion at higher speeds increases stability and minimizes the drag coefficient at that speed. Front vertical flaps and rear diffuser flaps are features on the Ferrari 458 Speciale. The flaps on the rear diffuser rise to increase air extraction capacity under the car, while the front vertical flaps open to generate downforce, balancing that created by the rear flaps. The front flaps also open to direct the air flow to the turning vanes and allow more air inside the car for engine cooling.

Active Aerodynamics Demonstration

The McLaren MP4-12C has an active air brake that deploys during heavy braking at speeds above 95 kph. The air brake is a wind dam on the back of the vehicle that is deployed by a piston to its initial angle of 32 degrees. The airflow over the rear of the vehicle then forces the air brake to extend to 69 degrees. The air brake reduces braking distances by up to 20 meters.

Although most active aerodynamic systems are used in race cars, other high end vehicles have implemented some of these features. Certain BMW cars and the Ford Mustang have active grille systems that reposition at higher speeds to reduce drag when no extra cooling capacity is required. Audi also has an active design using shutters between the wheel spokes that open and close depending on the amount of air required for brake cooling.

(a) Identify the sensors and actuators used in the Active Aerodynamics System. Explain the operation of two sensors and actuators. [Marks10]

(b) Draw the block diagrams of the Active Aerodynamics System and briefly explain the operation of the system. [Marks10]

(c) Design an Active Aerodynamics System with using a microcontroller. Clearly show input/output interface circuit with sensors and actuators. [Marks10]

(d) Present an algorithm using a flow chart or pseudo-code to fulfill the function of the above Active Aerodynamics System. [Marks10]

Q2

(a) List different types of vehicle speeds sensors used in automobile. [Marks04]

(b) Write three applications of vehicles speed sensors. [Marks06]

(c) Draw the sketch of a inductive type and a optical type speed sensors and briefly explains the operation of the each sensors. [Marks 10]

Q3

(a) List different types of mass air flow sensors. [Marks 03]

(b)

i Explain the operation of Kaman Vortex air flow sensor shown in Figure Q2. [Marks 05]

ii Discuss is the reason to connect Zener diode across transistor output? [Marks 02]

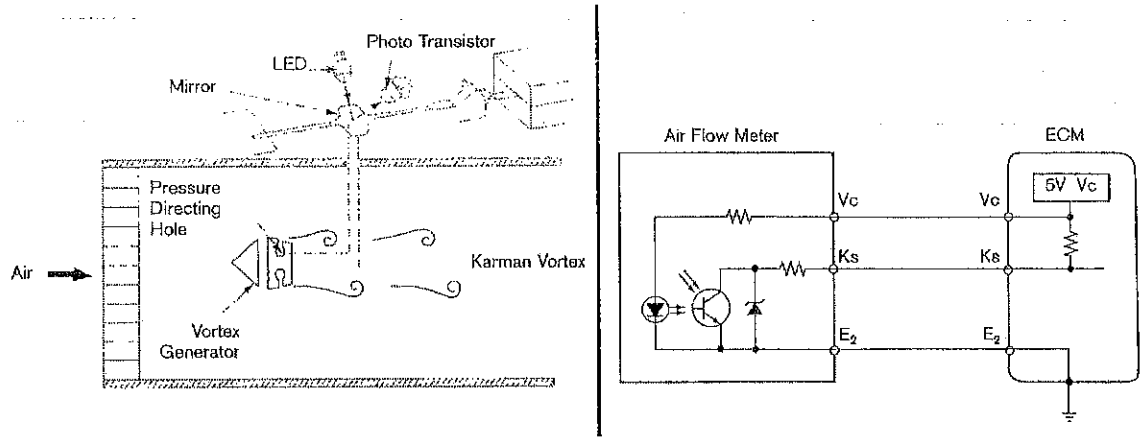


Figure Q2

(c) What is the type of output signal generated by the Kaman vortex air flow sensor? What would be the expected output when vehicle speed is increased? [Marks 05]

(d) Explain the necessary steps you have to take when a Kaman vortex air flow sensor is connected to a microcontroller. [Marks 05]

Q4

(a) Briefly explain what is an active vibration system? [Marks 04]

(b) What are the limitations of passive vibration isolation system? [Marks 06]

(c) Briefly explain the working principle of active vibration isolation system. [Marks 10]

Q5

(a) Draw the sketch of Antilock Braking Systems (ABS) and briefly explain the operation of it. [Marks 07]

(b) In ABS one of the important unit is the hydraulic modulator that is operated by an electronic control unit. Explain the operation of hydraulic modulator using diagram. [Marks 07]

(c)Antilock braking systems can be classified based on the number of channels and number of sensors employed. Distinguish the different combinations of ABS. [Marks 06]

Q6

(a) Explain the function of Dedicated Short Range Communications (DSRC) used in automobiles. [Marks 06]

(b) State four potential application of DSRC. [Marks 04]

(c) Explain how DSRC involved in Forward Obstacle Detection and Avoidance. [Marks 10]

End