



SUMMER– 2016 EXAMINATION
Model Answer

Subject Code: 17619

Page No: 1/23

Important Instructions to examiners:

- 1) The answers should be examined by key words and not as word-to-word as given in the model answer scheme.
- 2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.
- 3) The language errors such as grammatical, spelling errors should not be given more importance. (Not applicable for subject English and Communication Skills).
- 4) While assessing figures, examiner may give credit for principal components indicated in the figure. The figures drawn by candidate and model answer may vary. The examiner may give credit for any equivalent figure drawn.
- 5) Credits may be given step wise for numerical problems. In some cases, the assumed constant values may vary and there may be some difference in the candidate's answers and model answer.
- 6) In case of some questions credit may be given by judgment on part of examiner of relevant answer based on candidate's understanding.
- 7) For programming language papers, credit may be given to any other program based on equivalent concept.

Marks

1. a) Attempt any THREE of the following:	12
i) State four different types of measuring instruments used while checking signals for system diagnosis.	04
Answer : (Note: Any Four) Types of measuring instruments used while checking signals for system diagnosis: i. Digital multi-meters- It is used for measuring voltage, amperage, resistance, continuity etc. while checking the circuit. ii. Oscilloscope – It is used for checking signal waveform of the circuit. iii. Thermometers – It is used for measuring the temperature of the system. iv. Battery testers – It is used for testing the various parameters & conditions of the battery. v. Lux meters- It is used for measuring the intensity of light of the system. vi. Frequency meters- It is used for frequency.	04
ii) With a neat sketch describe the working of idle speed actuator.	04
Answer: Idle speed actuator: (Note: Equivalent Sketch- 2 marks and Working- 2 marks)	
	02



SUMMER- 2016 EXAMINATION

Subject Code: 17619

Model Answer

Page No: 2/23

Working:

In throttle body and port fuel injection systems, engine idle speed is controlled by passing a certain amount of air flow past the throttle valve in the throttle body housing. The IAC system consists of an electrically controlled stepper motor or actuator operated by the ECM. The ECM controls the idle speed by opening and closing the air passage into the intake manifold as shown in the figure. The ECM/PCM calculates the amount of air required for smooth idling based on input data such as coolant temperature, engine load, and engine speed and battery voltage. The ECM/PCM the signals the IAC motor to extend or retract the idle air control valve in the air bypass channel.

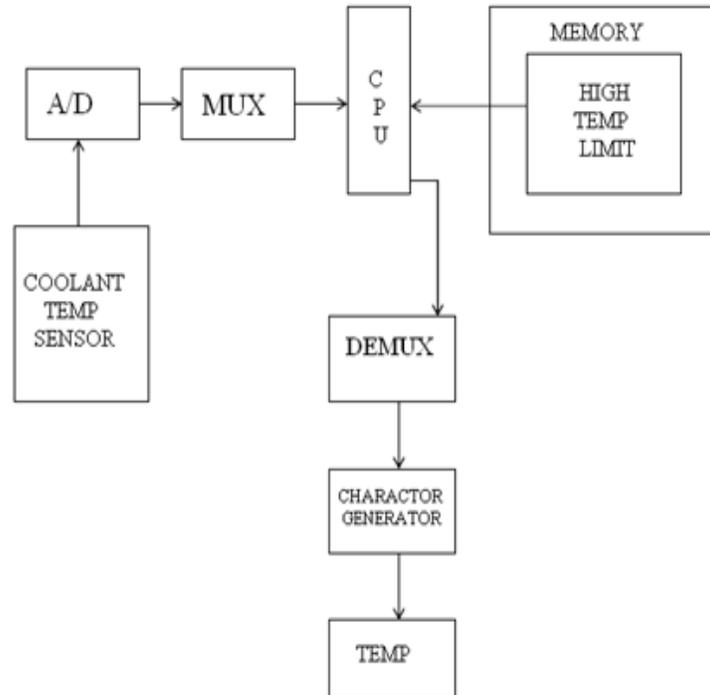
02

iii) Draw a neat block diagram to indicate measurement of temperature in vehicle instrumentation.

04

Answer: (Note: Equivalent labeled block diagram - 4 marks)

Temperature measuring instrument:



04

iv) State the different types of computer memories. Enlist the function of read only memory.

04

Answer: (Note: Any four types- 3 marks and Function of ROM- 1 marks)

Explanation of Types of computer memory: (Any Three – 3 mark)

- 1. Read only memory (ROM)** contains a fixed pattern of 1s and 0s that represent permanent stored information. ROM contains the basic operating parameters for the vehicle. This information is used to instruct the computer on what to do in response to input data. The CPU reads the information contained in the ROM, but it cannot write to it or change it. ROM memory is not lost when power to the computer is lost.
- 2. PROM: (Programmable Read only Memory)** the information in PROM is used to define or adjust the operating parameters held in ROM. It contains specific data that pertains to the exact vehicle in which the computer is installed.
- 3. EPROM: Erasable Programmable read only memory** is similar to the PROM except its contents can be erased to allow new data to be installed.
- 4. EEPROM: Electrically Erasable Programmable read only memory** allows changing the

03



SUMMER- 2016 EXAMINATION

Subject Code: 17619

Model Answer

Page No: 3/23

information electrically one bit at a time.

5. **RAM: Random access memory (RAM).** The RAM will store temporary information that can be read from or written to by the CPU.
6. **Keep Alive memory (KAM)** is a variation of RAM. KAM is connected directly to the battery through circuit protection devices. For example, the microprocessor can read and write information to and from the KAM, and erase KAM information. However, the KAM retains information when the ignition switch is turned off. KAM will lost when the battery is disconnected, if the battery drains too, or if the circuit opens.

Function of Read only memory (ROM):

- i. It contains a fixed pattern of 1s and 0s that represent permanent stored information.
- ii. ROM contains the basic operating parameters for the vehicle. This information is used to instruct the computer on what to do in response to input data. The CPU reads the information contained in the ROM, but it cannot write to it or change it.
- iii. ROM memory is not lost when power to the computer is lost.

01

1. b) Attempt any ONE of the following:

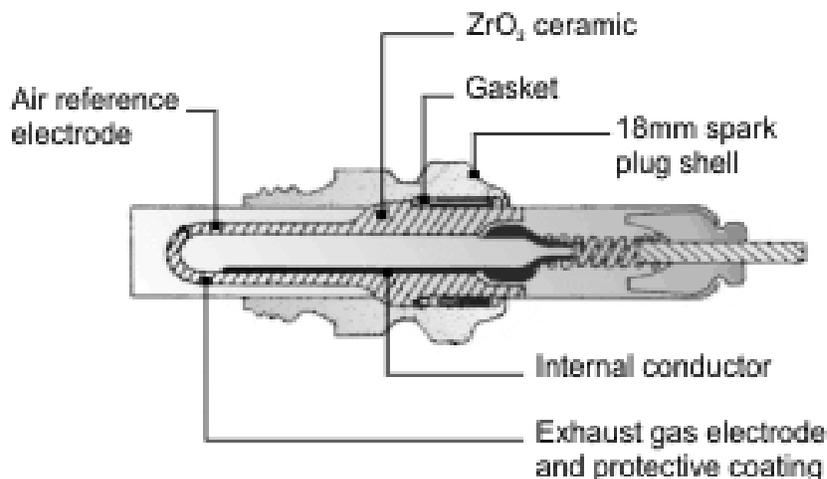
06

i) With a neat sketch describe the construction and working of oxygen sensor.

06

Answer: Construction & working of Oxygen sensor: (Note: Construction with figure-4 mark and Working-2 mark)

Construction: The core of the sensor consists of a hollow ceramic bulb or tube like structure coated with a platinum film and a protective coating. Surrounding that is a metal shield with perforations to allow exhaust gases to come in contact with the bulb. The inside of the bulb is vented to the atmosphere.



04

Operation:

The oxygen sensor operates on the basis of a difference between the oxygen partial pressure of atmospheric air and the partial pressure of oxygen in the exhaust gas. Figure shows that the sensor element is essentially a cell (battery). The plates are made from platinum which have a layer of ceramic zirconia between them which acts as an electrolyte. The platinum plates acts as a catalysts for the oxygen which makes contact with them, and they are also used to conduct electricity away from the sensor. The catalyzing action that takes place when oxygen contacts the platinum plates causes the transport of oxygen ions through the electrolyte and this creates the electric current that gives rise to the e.m.f (voltage) of the sensor.

02



SUMMER- 2016 EXAMINATION

Subject Code: 17619

Model Answer

Page No: 4/23

ii) Draw a neat block diagram to describe the function and working of electronic suspension.

06

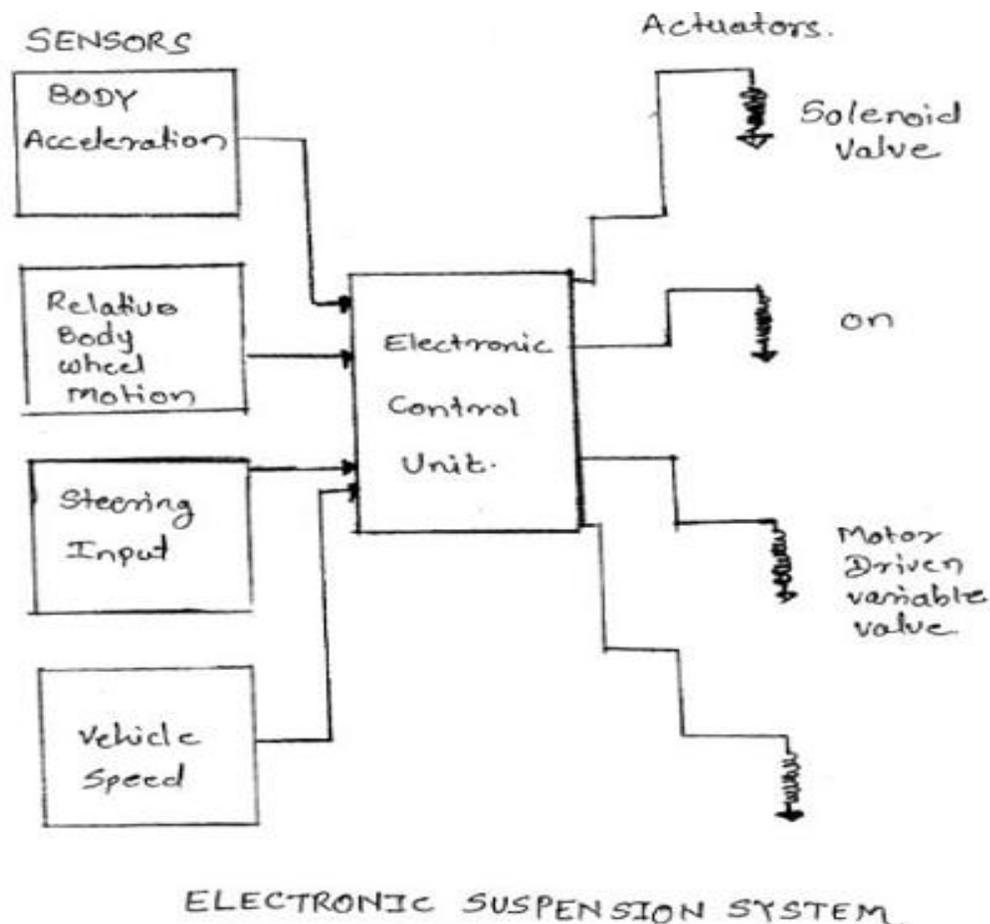
Answer:(Note: Function- 1 marks, fig. - 3 marks, Working -2 marks)

Function of Electronic suspension system:-

It consists of springs shock absorbers and various linkages to connect the wheel assembly to car frame. The purpose the suspension system is to isolate the car body motion as much as possible from wheel motion due to rough road input. The performance of suspension system is strongly influenced by the damping of shock absorber.

01

Block Diagram of Electronic Suspension:



03

Electronic suspension system:-

The control system for a typical active suspension system is shown in the block diagram. It is in the form of a micro controller or microprocessor base digital controller the inputs for each sensor are sampled converted to digital format and stored in the memory the sampling is typically at about 500 Hz. In this control configuration the relative position and motion of the wheel of the wheel body(sprung mass) acceleration, the relative position and motion of the wheel body. (unsprung or sprung mass) the steering wheel input and vehicle speed. The body acceleration measurement can be used to evaluate ride quality. The controller does this by computing weighted average of spectrum of the acceleration the relative body or wheel motion can be used to estimate tire force.

02



SUMMER– 2016 EXAMINATION

Subject Code: 17619

Model Answer

Page No: 5/23

2. Attempt any FOUR of the following	16
a) Justify the use of semi conductor diode used in voltage regulation of charging system.	04
Answer: (Note:- Justification- 4 Marks) Justification of Use of semiconductor diode in voltage regulation: To prevent the vehicle battery from being overcharged the regulated system voltage should be kept below the gassing voltage of the lead-acid battery. Accurate voltage control is vital with the ever-increasing use of electronic systems. Voltage regulation is a difficult task on a vehicle alternator because of the constantly changing engine speed and loads on the alternator. The output of an alternator without regulation would rise linearly in proportion with engine speed. Zener diode is used as the sensing element in an electronic regulator. A Zener diode is designed to operate in the break-down region. At the point that Zener voltage is reached, a large current flows in reverse bias. This prevents voltage from climbing any higher. This makes the Zener diode an excellent component for regulating voltage. If the Zener diode is rated at 15 volts, it will not conduct in the reverse direction when the voltage is below 15 volts. At 15 volts it will conduct and the voltage will not increase over 15 volts. If a semi-conductor diode is reverse-biased it will not conduct current. However, if the reverse voltage is increased, a voltage level will be reached at which the diode will conduct in the reverse direction. This voltage is called Zener voltage. Reverse current can destroy a simple PN-type diode, but the diode can be dropped with materials that will withstand reverse current.	04
b) State the importance of manifold absolute pressure sensor. Describe the principle on which this sensor works.	04
Answer: (Note: Importance- 02 marks, Description any one type of principle – 02 marks) Importance of manifold absolute pressure sensor: The manifold absolute pressure sensor provides instantaneous manifold pressure information to the engine ECU. The data is used to calculate air density and determine the engine's air mass flow rate, which in turn determines the required fuel metering for optimum combustion and influence the advance and retard of ignition timing. The MAP sensor can also be used in OBD II applications to test the EGR valve for functionality. MAP sensor principle: (Any one) There are three different types of principles on which MAP sensor works. 1. Strain gauge type:- An external tensile force/ compressive force increases/decreases the resistance by elongating/contracting it. 2. Variable capacitance type:- The capacitive transducer comprises of two parallel metal plates that are separated by the material such as air, which is called as dielectric material. In this type the distance between two plates is variable it changes its capacitance value. This change in capacitance can be measured easily and it is calibrated against the input quantity. 3. Variable inductance type:- The inductance of the coil is altered by varying position of an iron cylinder placed in the centre of the coil due to change in pressure against the diaphragm. This change in inductance is directly reflected on change in pressure.	02

SUMMER- 2016 EXAMINATION

Subject Code: 17619

Model Answer

Page No: 6/23

c) State the need of low tyre pressure monitoring system. Describe its working.

04

Answer: (Note: Need- 1 mark, Working- 3 marks credit should be given to sketch)

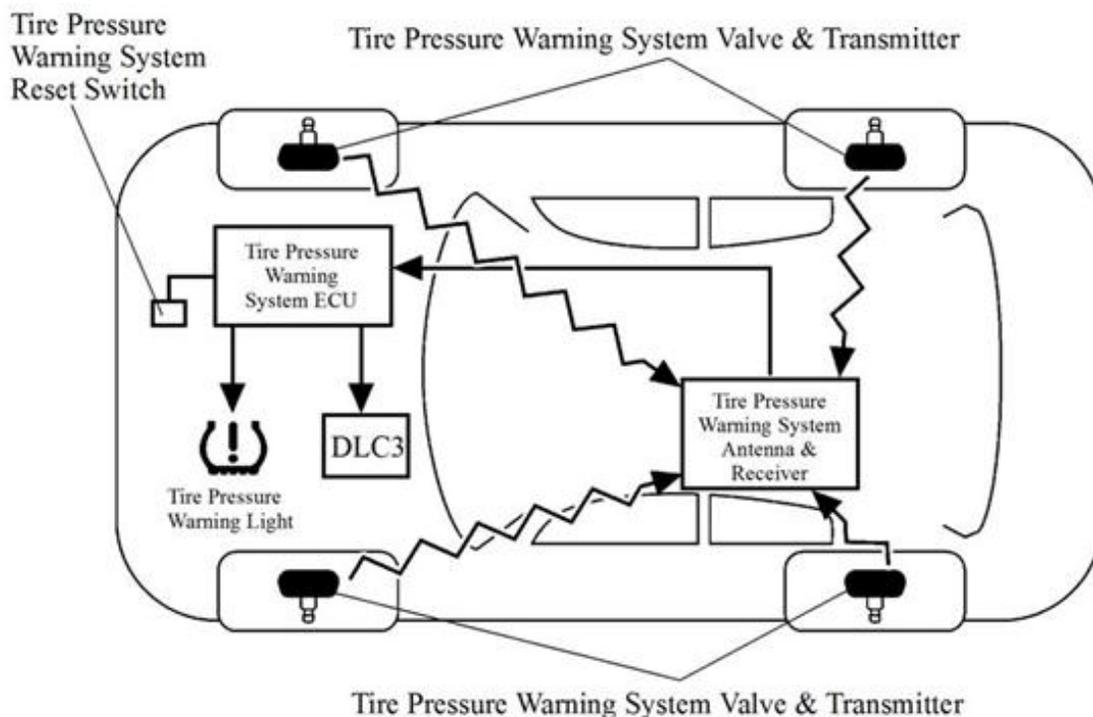
Need of Low tyre pressure monitoring system:

- i. If the vehicle continues to be driven with 1 or more of the 4 inflated to a low air pressure that could cause problems during driving, this system will illuminate the tyre pressure warning light to inform the driver of the low air pressure.
- ii. Many serious car accidents that might have been avoided had drivers known their air pressure were low.

01

Working:

This system directly senses the air pressure of each tyre through tyre pressure warning system valve & transmitter that are attached to each wheel and illuminate the tyre pressure warning light to inform the driver of the low air pressure. After tyre replacement, firstly register tyre pressure warning system valve & transmitter IDs into the tyre pressure warning system ECU, and then store the appropriate tyre pressure in the ECU using the tyre pressure warning system reset switch.



03

1. **Combination Meter:** Transmits the vehicle speed signal to the tyre pressure warning system ECU for vehicle speed correction.
2. **Tyre Pressure Warning Light:** Turns ON or blinks to warn the driver in accordance with the signal from the tyre pressure warning system ECU, Displays the 2-digit DTC (Diagnostic Trouble Code).
3. **Tyre Pressure Warning System Reset Switch:** The appropriate air pressures of the tyres currently mounted on the vehicle are stored in the tyre pressure warning system ECU by operating the tyre pressure warning system reset switch.
4. **Tyre Pressure Warning System Valve & Transmitter:** Detects the inflation pressure and internal temperature of the tyre and transmits the measured value and the ID number to the tyre pressure warning antenna & receiver.



SUMMER- 2016 EXAMINATION

Subject Code: 17619

Model Answer

Page No: 7/23

5. **Tire Pressure Warning System Antenna & Receiver:** Receives the tire pressure warning system valve & transmitter signal and transmits this data to the tire pressure warning system ECU.
6. **Tire Pressure Warning System ECU:** Receives the data from the tire pressure warning system antenna & receiver and monitors the tire inflation pressure. When the tire pressure warning system ECU detects a drop in the tire inflation pressure or a system malfunction, it outputs the respective signal to the combination meter.

d) Write the applications of following instruments:

- (i) Lux Meters
(ii) Battery tester

04

Answer: (Note: Any Two applications of each)

i. **Lux Meters:** - (Any Two – 1 Mark each)

- a. Used to measure light intensity.
b. It is used in photography and video filming.
c. Check intensity of lights in the automatic ON/OFF headlight system and automatic headlight dimming system.

02

ii. **Battery Tester:** - (Any Two – 1 Mark each)

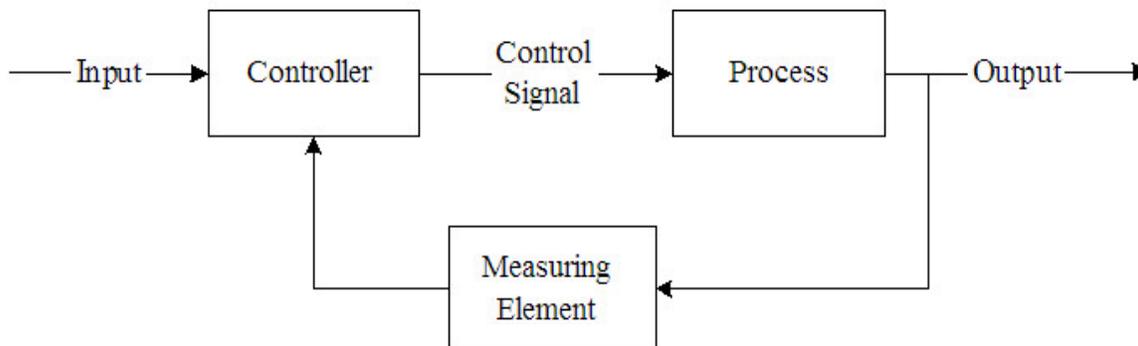
- a. Voltage measurement.
b. Resistance measurement.
c. CCA value Measurement.
d. Battery condition.
e. Battery load test etc.

02

e) Draw a neat block diagram to show the configuration of closed loop control system.

04

Answer: (Note: Block diagram -4 marks. Credit should be given to equivalent Sketch)



04

Closed Loop System

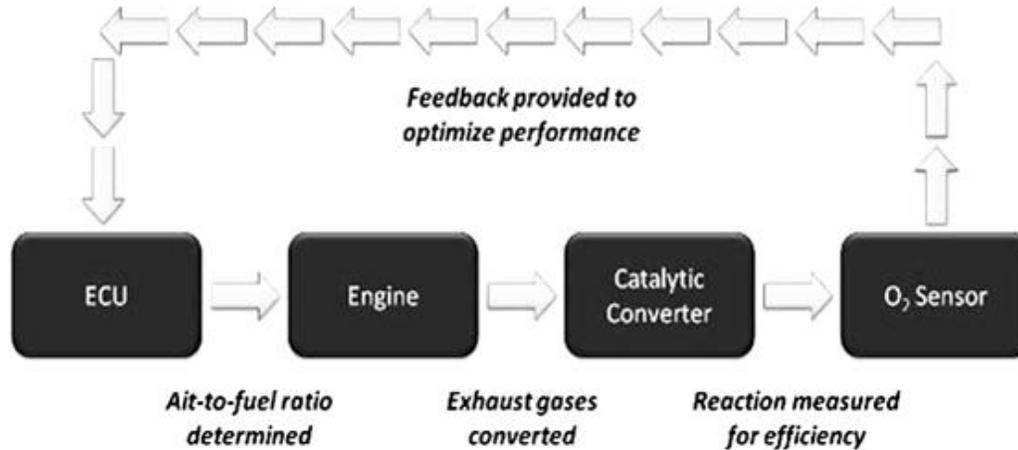
OR



SUMMER- 2016 EXAMINATION
Model Answer

Subject Code: 17619

Page No: 8/23



f) Enlist different types of communication system used in automobile. State the function of Bluetooth technology.

04

Answer:(Note: Name any four types- 2 marks, Function of Bluetooth- 2mark.)
Types of communication system used in automobile:(Any Four-1/2 mark each)

1. Bluetooth
2. Wi-Fi
3. CAN Bus
4. LIN Bus
5. GSM Network
6. Optic fibers.
7. Ethernet

02

Function of Bluetooth Technology:

Bluetooth is designed to support personal area network (PAN) to replace wired cable between nearby devices. Bluetooth is a used to pair mobile phones to vehicles. Such pairing enable hands free calling from the vehicle. It allows a vehicle embedded display unit to be used to control mobiles phones and allows a mobiles phone to use the vehicle embedded sound systems. It also enables making emergency calls during accidents, downloading digital contacts, travel information or software updates, and to access to internet.

02

3. Attempt any FOUR of the following

16

a)With a suitable example describe binary number system.

04

Answer:(Note: Explanation-4 marks)

Binary number system:

Most modern computer systems operate on the binary logic. A binary number system use only two digits namely 0 and 1. It uses a base 2 system.

04

The binary digits (0 and 1) are also called as bits. Thus the binary system is a two bit system. The left most bit in a given binary number with the highest weight is called as the most significant bit (MSB) whereas the rightmost bit in a given number with the lowest weight is called as the least significant bit (LSB). It is represented as (0, 1)

In the binary system, whole numbers are grouped from right to left. Because the system uses



SUMMER- 2016 EXAMINATION

Subject Code: 17619

Model Answer

Page No: 9/23

only two digits. The first portion must equal a 1 or a 0. To write the value of 2, the second position must be used. In binary, the value of 2 would be represented by 10 (one two and zero ones). To continue, a 3 would be represented by 11(one two and one one). Figure illustrates the conversion of binary numbers to digital base ten numbers. For example, if a thermistor is sensing 150 degrees, the binary code would be 10010110. If the temperature increases to 151 degrees, the binary code changes to 10010111.

Decimal number	Binary number code 8 4 2 1	Binary to decimal conversion
0	0000	= 0 + 0 = 0
1	0001	= 0 + 1 = 1
2	0010	= 2 + 0 = 2
3	0011	= 2 + 1 = 3
4	0100	= 4 + 0 = 4
5	0101	= 4 + 1 = 5
6	0110	= 4 + 2 = 6
7	0111	= 4 + 2 + 1 = 7
8	1000	= 8 + 0 = 8

b)Distinguish between primary memory and volatile memory.

04

Answer:(Note: Credit should be given to equivalent answer)

Primary Memory:-

Primary memory consists of two types of memory, read-only memory and read/write memory. Read-only memory (ROM) usually holds the permanent directions or instructions and data by which the individual computer is governed. Read means to find out what number is stored in a specific address. Write means to put a new number into a specific address. As the name implies, the microprocessor of a computer cannot change the data stored in its ROM. That is not to say that the data in a ROM can never be changed. The memory that remains after power is turned off is "nonvolatile" and is referred to as firmware.

02

The read write (R/W) memory is designed to hold changing data. To change these data, very specific directions are required in the program. These are still data that the microprocessor uses to function correctly.

Volatile Memory:-

"Volatile" memory is the section of computer memory that is active as long as the power is on. If the power is turned off, all the binary codes in the RAM (random access memory) are lost. When power to the RAM is reestablished, the registers are all empty but are ready to accept input. The microprocessor writes numbers into the registers of the RAM or reads those data as it processes. Data from sensors may be stored or computed data may be written into these registers. Some of the stored data may be read to make further computations.

02



SUMMER- 2016 EXAMINATION

Subject Code: 17619

Model Answer

Page No: 10/23

c) Describe the application of Global positioning system used as a navigation system in cars.

04

Answer: (Note: Description-4 marks and Credit should be given to Equivalent sketch)

04

Global positioning system (GPS):

The Global Positioning System (GPS) is a space-based navigation system that provides location and time information in all weather conditions, anywhere on or near the Earth where there is an unobstructed line of sight to four or more GPS satellites.

GPS systems are made up of 3 segments:-

- Space Segment (SS)
- Control Segment (CS)
- User Segment (US)

1. Space Segment:

GPS satellites fly in circular orbits at an altitude of 20,200 km and with a period of 12 hours. Powered by solar cells, the satellites continuously orient themselves to point their solar panels toward the sun and their antenna toward the earth. Orbital planes are centered on the Earth. Each plane has about 55° tilt relative to Earth's equator in order to cover the polar regions. Each satellite makes two complete orbits each sidereal day. Sidereal - Time it takes for the Earth to turn 360 degrees in its rotation. It passes over the same location on Earth once each day.

2. Control Segment: The CS consists of 3 entities:

i. Master Control Station:- The master control station, located at Falcon Air Force Base in Colorado Springs, Colorado, is responsible for overall management of the remote monitoring and transmission sites.

ii. Monitor station: - Each of the monitor stations checks the exact altitude, position, speed, and overall health of the orbiting satellites. The control segment uses measurements collected by the monitor stations to predict the behavior of each satellite's orbit and clock. The prediction data is up-linked, or transmitted, to the satellites for transmission back to the users.

iii. Ground Antennas: - Ground antennas monitor and track the satellites. They also transmit correction information to individual satellites.

3. User Segment: The user's GPS receiver is the US of the GPS system. GPS receivers are generally composed of an antenna, tuned to the frequencies transmitted by the satellites, receiver-processors, and a highly-stable clock, commonly a crystal oscillator. They can also include a display for showing location and speed information to the user.

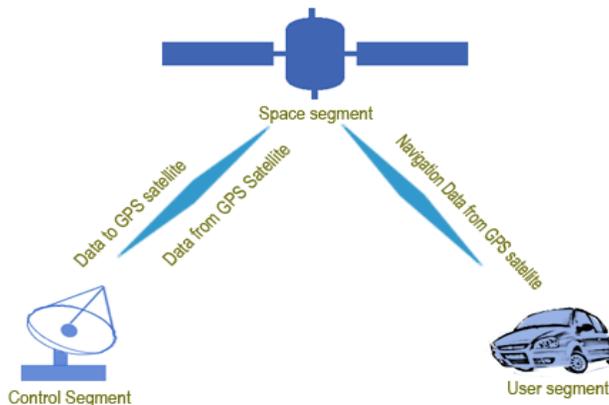


Fig. Global Positioning System



SUMMER– 2016 EXAMINATION

Subject Code: 17619

Model Answer

Page No: 11/23

d) List the six steps followed during component testing. Describe any one step.	04
<p>Answer:(Note: List - 3 marks and Description any one- 1 mark) Six step approach for components testing:- (Six- ½ mark each)</p> <ol style="list-style-type: none">1. Collect evidence.2. Analyze evidence.3. Locate the fault.4. Find the cause of the fault and remedy it.5. Rectify the fault (if different from 4).6. Test the system to verify that repair is correct.	03
<p>Six step approach for components testing:- (Any One- 1 mark)</p> <ol style="list-style-type: none">1. Collect Evidence- Collecting evidence means looking for all the symptoms that relate to the fault and not jumping to conclusions, e.g. because the system is controlled by an ECU it must be the ECU that is at fault. In order to collect the evidence it is necessary to know which components on the vehicle actually form the part of the faulty system. This is where sound basic skills come in. If an engine control system is malfunctioning because one cylinder has poor compression it is important to discover this at an early stage of the diagnostic process.2. Analyze Evidence-In the case of poor compression on one cylinder, given above as an example, the analysis would take the form of tests to determine the cause of low compression, E.g. burnt valve, blown head gasket etc. The analysis of evidence that is performed will vary according to the system under investigation. But these steps are obviously important.3. Locate the fault -The Procedure for doing this on an electronics system varies according to the type of test equipment available. It may be the case that the system has some self-diagnostics which will read you to the area of the system which is defective Let us assume that this is the case and the self- diagnostics report that an engine coolant temperature sensor is defective. How do you know whether it is the sensor, or the wiring between it and the remainder of the system? Again this is where a good basic knowledge of the make-up of the system is invaluable.4. Find the cause of the fault and remedy it- With electronic system repair it is often the case that a replacement unit must be fitted. However, this may not be the end of the matter. If the unit has failed because of some fault external to it, it is important that this cause of failure is found and remedied before fitting the new unit. It is often not just a matter of fitting a new unit.5. Give the system a thorough test -Testing after repair is an important aspect of vehicle work and especially so where electronically controlled systems are concerned. In the case of intermittent faults, such testing's may need to be extended because the fault may only occur when the engine is hot and the vehicle is being used in a particular way.6. Test the system to verify that repair is correct- It is mandatory to test the system so that it will verify that the steps followed during the testing are correct. However we can come across any fault then we have to follow the stepwise procedure of testing.	01

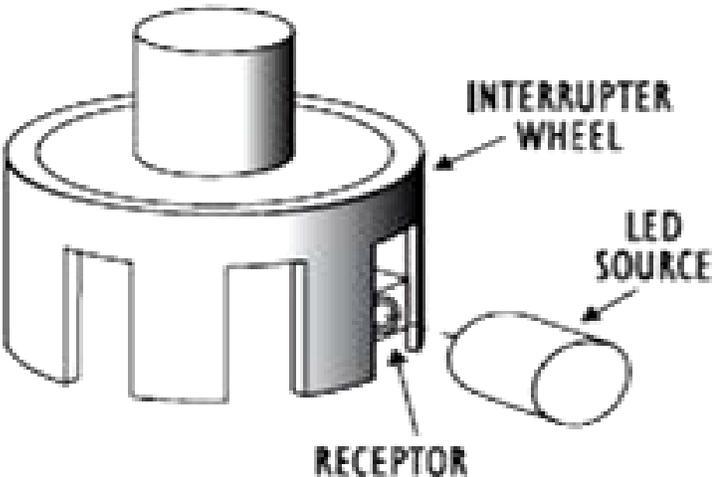


SUMMER- 2016 EXAMINATION

Subject Code: 17619

Model Answer

Page No: 12/23

e) Describe the procedure used to indicate the TDC reference mark of cylinder No.1 to the ECM.	04
Answer:(Credit should be given to equivalent procedure)	
Procedure used to indicate the TDC reference mark of cylinder No.1 to the ECM:	
<ul style="list-style-type: none">• The camshaft and crankshaft position sensors are collectively used to determine the exact position of the number 1 cylinder in respect to top dead center on the compression stroke.• These two sensors are either a Hall Effect or magnetic reluctant controlled devices. The Hall Effect-type sensor makes use of a notched ring and an electromagnetic sensor. The sensor is stationary while the notched ring, called an interrupter, passes through it.• Passing the notches on the wheel through the sensor produces a signal, which is then sent to the Power train Control Module (PCM) representing the position of the crankshaft or camshaft relative to top dead center on the number 1 cylinder.• The magnetic reluctant sensor uses a rare earth magnet and a winding of wire. As the trigger wheel passes near the sensor it generates an AC voltage signal, which is sent to the PCM.• The introduction of the crank and cam sensors helped to eliminate the variances in ignition timing signals so prevalent in a distributor controlled ignition engine.	04
4.a) Attempt any <u>THREE</u> of the following:	
i) Enlist the purpose of photo-diode and LED used in ignition system.	04
Answer:(Note: credit should be given to equivalent answer and sketch)	
Purpose of photo-diode and LED used in ignition system:	
<p>An optical triggering mechanism consist of a light emitting diode (LED) and light sensitive photo-diode (photocell or receptor) and also a slotted disc called a light beam interrupter . The slotted disc is attached to the distributor shaft. The LED and photocell are situated over and under the slotted disc opposite of each other. As the slotted disc rotates between the LED and the photo-diode, light from LED shines through the slots. The intermittent flashes of the LED are translated into voltage pulses by the photocell. Where the voltage signal occurs, the control unit turns ON the primary circuit. When the disc interrupts the light and the voltage signal is not given the control system turns the primary circuit OFF causing the magnetic field in the primary coil to collapse and sending a high voltage current to spark plug through secondary winding.</p>	04
 <p>The diagram illustrates an optical triggering mechanism. It features a central shaft with a cylindrical top. Attached to the shaft is a circular interrupter wheel with several rectangular slots. To the right of the wheel is an LED source, and below the wheel is a receptor. Arrows point from the labels 'INTERRUPTER WHEEL', 'LED SOURCE', and 'RECEPTOR' to their respective parts in the diagram.</p>	

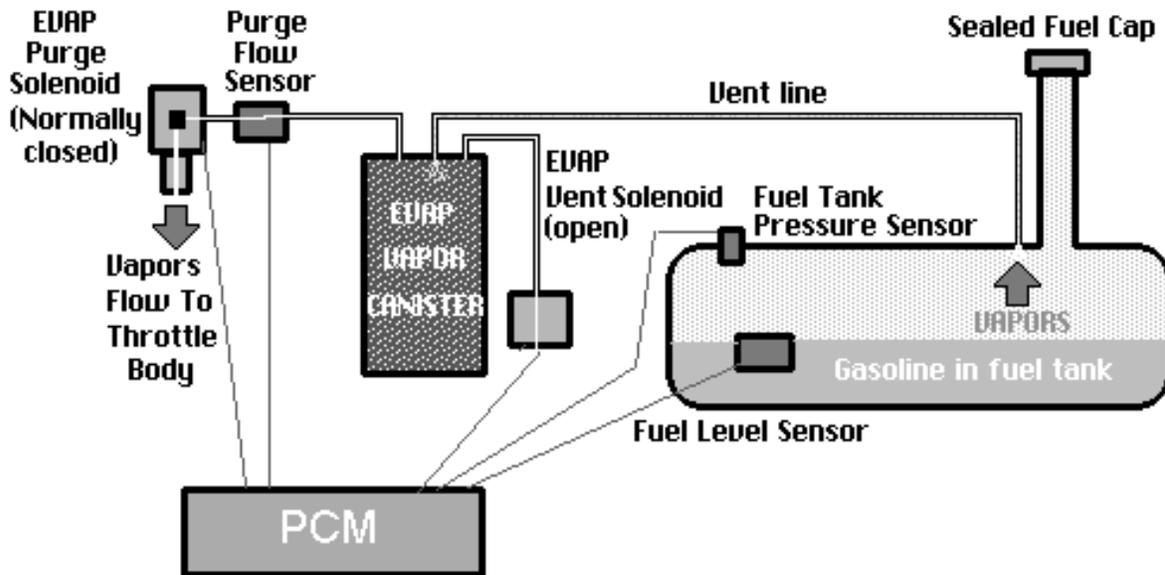
ii) Draw a neat block diagram to indicate canister purge control circuit.

04

Answer: (Note: figure- 4 marks. Credit should be given to equivalent Sketch)

Canister purge control circuit:

04



iii) With a suitable example describe the application of digital multimeter in sensor testing.

04

Answer: (Note: Any one sensor testing procedure - 4 marks)

04

Following are the applications of multimeter used in sensor testing (Any One)

1. Testing of Oxygen Sensor: - Following procedure is followed to diagnose an oxygen sensor.

- Disconnect the connector of the oxygen sensor.
- Start the engine and warm-up for 2 minutes at 3000 rpm under no load conditions.
- Raise the engine speed to 4000 rpm and release the throttle suddenly for at least 5 times.
- Within one minute after the engine has been warmed up, measure the voltage between the connector terminal and body ground.
- The voltage should be below 0.4 Volts.
- Replace the oxygen sensor if the voltages are out of the above range.

2. Testing of Intake air temperature (IAT) sensor and Engine coolant temperature (ECT) sensor: - Following procedure is followed to diagnose an IAT sensor.

- Remove IAT sensor from the engine.
- Place it in a container of water with thermometer.
- Make sure that more than half of the connector is submerged in the water.
- Connect a pair of ohmmeter leads to the sensor terminals.
- Heat the water in the container and measure the resistance at different temperatures.
- The sensor should have the specified resistance 0.98 to 1.34KΩ at 40⁰ C and 0.22 to 0.35KΩ at 80⁰.
- Replace the sensor if the resistance values are outside the range.



SUMMER– 2016 EXAMINATION

Subject Code: 17619

Model Answer

Page No: 14/23

3. Testing of Throttle position (TP) sensor:- Following procedure is followed to diagnose a TP sensor:

- With the ignition switch in the RUN position, connect a voltmeter from the sensor signal wire to ground.
- Slowly open the throttle and observe the voltmeter.
- The voltmeter reading should increase smoothly and gradually.
- Typical TPS voltage readings are 0.5V to 1V with the throttle in the idle positions, and 3.5V to 4.5V at wide open throttle.
- Always refer to the vehicle manufacturer's specifications.
- If the TPS does not have the specified voltage or if the voltage signals is erratic, replace the sensor.

iv) Describe the testing procedure to conduct a test on any one automotive sensor.

04

Answer: (Note: Any one sensor testing procedure - 4 marks)

1. Testing of Oxygen Sensor: - Following procedure is followed to diagnose an oxygen sensor.

04

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- Raise the engine speed to 4000 rpm and release the throttle suddenly for at least 5 times.
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- Heat the water in the container and measure the resistance at different temperatures.
- The sensor should have the specified resistance 0.98 to 1.34K Ω at 40⁰ C and 0.22 to 0.35K Ω at 80⁰.
- Replace the sensor if the resistance values are outside the range.

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SUMMER- 2016 EXAMINATION

Subject Code: 17619

Model Answer

Page No: 15/23

- Always refer to the vehicle manufacturer's specifications.
- If the TPS does not have the specified voltage or if the voltage signals is erratic, replace the sensor.

4. Manifold absolute pressure (MAP)sensor: - Following procedure is followed to diagnosean ECT sensor.

- Turn the ignition ON (engine OFF).
- Measure the voltage (or frequency) of the sensor output.
- Using a hand operated vacuum pump, apply vacuum to the sensor.
- A good pressure should change voltage (or frequency) in relation to the applied vacuum.
- If the signal does not change or the values are out of range according to the manufacturer's specifications, the sensor must be replaced.

4. b) Attempt any ONE of the following:

06

i) Describe the procedure of conversion of signals from analog to digital.

06

Answer: (Note: Description with equivalent sketch- 06 marks)

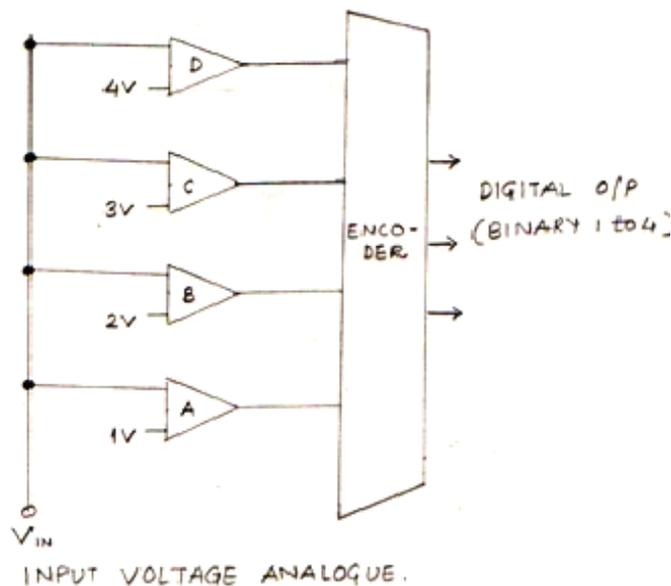
Analog to Digital Conversion:

06

Analog to digital conversion is necessary because many sensor signals are of analog (varying voltage) form. In order for the control computer (ECU) to function these analog signals must be converted to binary codes (digital signals). Conversion from an analog voltage to a digital code can be done in a number of ways. Figure shows one type of A/D converter that is known as a 'flash' converter.

The flash converter consists of four comparators and an encoder circuit which takes the comparator outputs and converts them into a binary code. An electronic comparator is a circuit which continuously compares two signals. One of the inputs, at each comparator is a reference voltage. When the input voltage matches the reference voltage the comparator outputs logic 1. The reference voltages shown in the figure are 1V up to 4 V. Table shows the input/output performance of the converter.

FLASH TYPE ANALOGUE TO DIGITAL CONVERTER.





SUMMER– 2016 EXAMINATION

Subject Code: 17619

Model Answer

Page No: 16/23

A/D converter input Voltage range	Comparator outputs				Encoder outputs	
	A	B	C	D		
0-1V	0	0	0	0	0	0
1-2V	1	0	0	0	0	1
2-3V	1	1	0	0	0	1
3-4V	1	1	1	0	0	1
4-5V	1	1	1	1	1	0

ii) Define error. State two types of errors.

06

Answer: (Note: Definition -2 marks, Any two types- 4 mark)

Error: An error is defined as: "The difference between the measured value and the actual value.

"If two persons use the same instrument for measurement for finding the same measurement, it is not essential that they may get the same results. There may arise a difference between their measurements. This difference is referred to as an "ERROR".

02

Types of error:- (Any two- 2 marks each)

1) Personal error:

An error comes into play because of faulty procedure adopted by the observer is called "PERSONAL ERROR".

Personal error comes into existence due to making an error in reading a scale. It is due to faulty procedure adopted by the person making measurement.

2) Systematic error:

The type of error arises due to defect in the measuring device is known as "SYSTEMATIC ERROR". Generally it is called "ZERO ERROR". It may be positive or negative error. Systematic error can be removed by correcting measurement device.

04

3) Random Error:

The error produced due to sudden change in experimental conditions is called "RANDOM ERROR".

Forexample: During sudden change in temperature, change in humidity, fluctuation in potential difference (voltage). It is an accidental error and is beyond the control of the person making measurement.

5. Attempt any FOUR of the following:

16

a) Draw a neat block diagram and describe CAN bus system in automobiles.

04

Answer: (Note: Description of CAN Bus system 02 marks & Block diagram – 02 marks)

CAN bus system:

CAN (Controller Area Network) is an example of an automotive digital data system. It was developed by the Robert Bosch Company in Germany. CAN is a serial synchronous communication protocol that connects electronic control modules, sensors and actuators.

02



SUMMER- 2016 EXAMINATION

Subject Code: 17619

Model Answer

Page No: 17/23

The twisted pair of the CAN bus system minimizes electrically initiated interference and virtually eliminates the possibility of messages becoming corrupted.

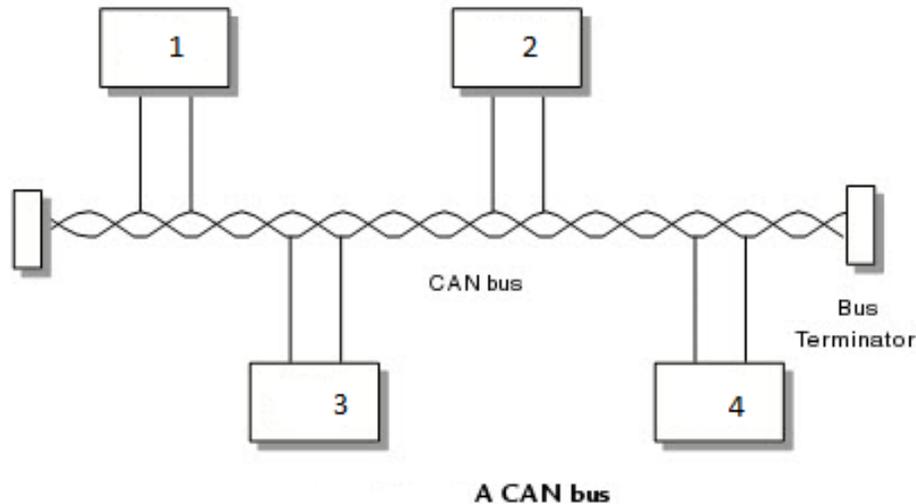
The major feature of the CAN bus system are:

- i. Priority controlled message transmission.
- ii. Low costs through the use of a low cost twisted two wire cable and use of simple protocol with low power demand.
- iii. A data transfer rate up to 1MBPS for the high speed CAN (CAN-C) and up to 125KBPS for the low speed CAN (CAN-B)
- iv. High reliability of data transfer

Block Diagram of CAN Bus System:

A typical example of the CAN bus system used in Rover vehicle is described below. A Two wire CAN bus that can operate at high data transmission speeds of up to 500k band (500000bits/sec) is shown in the below figure.

1. Automatic transmission control unit
2. Engine control module
3. ABS/ Traction control ECU
4. Instrument Pack.



02

b) State the need of electronic power steering. Enlist different sensors used in the system.

04

Answer:(Note: Need-02 marks,List of sensors- 02 marks)

Need of Electronic power steering: (Any Two- 1 mark each)

- An electronically controlled power steering adjusts the steering boost adaptively to the driving conditions.
- Using electronic control of power steering, the available boost is reduced by controlling a pressure relief valve on the power steering pump.
- Reduce the driving efforts of the driver.
- Reduce the fatigue of the driver.
- To avoid under-steer & over-steer condition of the vehicle.

02



SUMMER– 2016 EXAMINATION

Subject Code: 17619

Model Answer

Page No: 18/23

<p>The different sensors used in the system are: (Any Two- 1 mark each)</p> <ol style="list-style-type: none">1. Steering angle sensor2. Torque sensor3. Vehicle speed sensor	02
<p>c) State the application of oscilloscope as a type of measuring instrument used in system diagnosis.</p>	04
<p>Answer: (Note: Equivalent description- 04 marks)</p> <ul style="list-style-type: none">• The oscilloscope may be considered as a very fast reacting voltmeter that reads and displays voltages.• The oscilloscope allows the technician to view the voltage over time. These voltage readings appear as a trace on the oscilloscope screen.• Today most technicians use a variation of the oscilloscope called a lab scope which is a small portable unit.• The screen of a lab scope is divided into small divisions of time and voltage. The division of screen creates a grid pattern.• Time is represented by the horizontal movement of the waveform. Voltage is measured with the vertical position of the waveform. <p>For example:</p> <p>The vertical scale can be adjusted so each division represents 0.5 volts and the horizontal scale can be adjusted so each division equals 0.005 (5 milliseconds). This allows the technician to view small changes in voltage that occurs in a very short period of time. An example could be observing a fuel injector activity when certain changes occur.</p>	04
<p>d) State the importance of display devices used in automotive applications. List any two types of digital display devices.</p>	04
<p>Answer: (Note: Importance- 02 marks, List- 02 marks)</p> <p>Importance of display devices used in automotive applications:</p> <p>Function of any visual display is to communicate information to the desired level of accuracy. Most displays used in the vehicle must provide instant data but the accuracy is not always important. Analogue displays can provide almost instant feedback from one short glance. For example, if the needle of the temperature gauge is about in the middle then the driver can assume that the engine temperature is within suitable limits. A digital read-out of temperature such as 98 ° C would not be as easy to interpret. This is a good example as to why even when digital processing and display techniques are used, the actual read-out will still be in analogue form. Numerical and other forms of display are, however, used for many applications.</p>	02
<p>The different types of digital display devices are: (Any Two- 1 mark each)</p> <ol style="list-style-type: none">1. Fuel quantity level measurement2. Coolant temperature measurement3. Vehicle speed measurement4. Oil pressure measurement	02



SUMMER- 2016 EXAMINATION

Subject Code: 17619

Model Answer

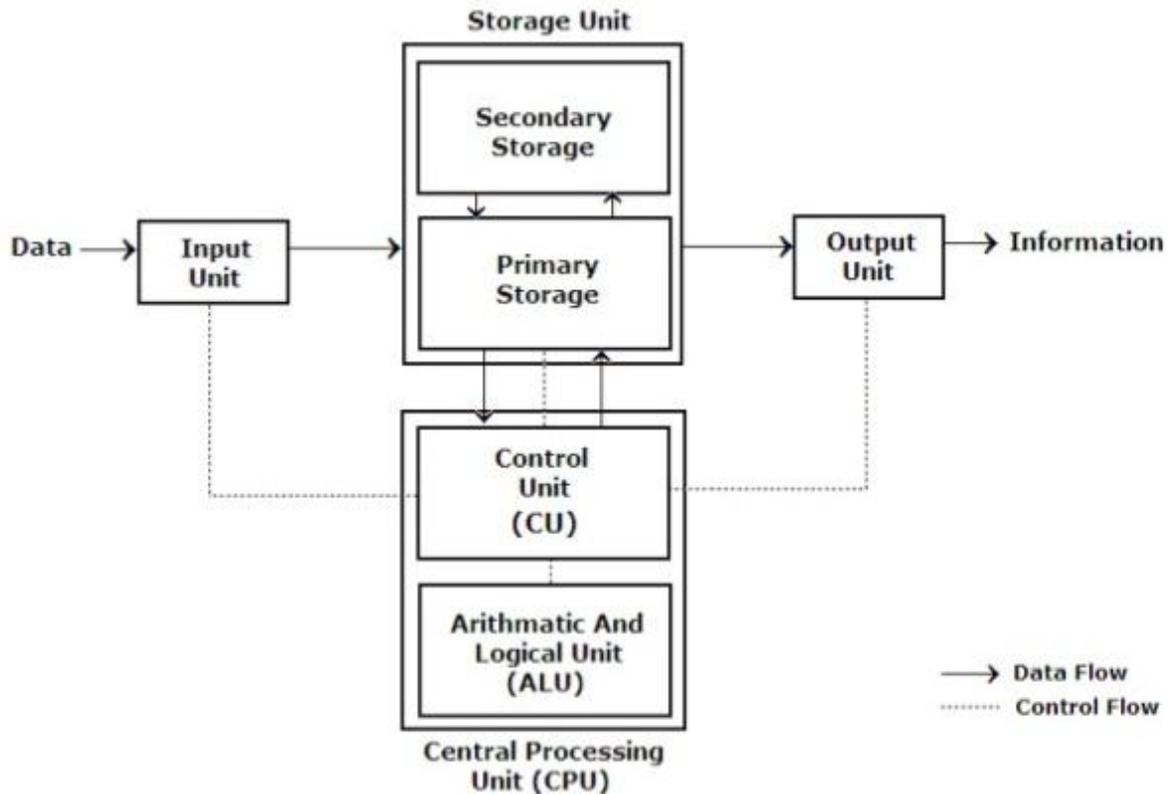
Page No: 19/23

e) Draw a neat block diagram of a basic computer used in automobiles. Enlist the function of the components. (any two)

04

Answer:(Note: Block diagram- 02 marks, function of any two components- 02 marks)

Block Diagram of Basic Computer:



02

Function of components:

1. Clock:

The clock in a computer sets the pace at which processing occurs. It is the basic input to the control unit. The clock is an electronic circuit that utilizes the piezoelectric effect of a quartz crystal to produce accurately timed electrical pulses that are used to control the actions of the computer.

02

Clock speeds are measured in the number of electrical pulses generated in one second. One pulse per second is 1 Hertz and most computer clocks operate in millions of pulses per second. One million pulses per second is 1 megahertz (1 MHz).

2. Input/output:-

This unit has the responsibility of accepting data from sensors or other types of inputs and converting those data to an acceptable form to send on to the processor. The input/output also accepts data from the processor and converts them into an acceptable form to be sent out to the actuators. The input/output unit (I/O) also takes orders from the control unit concerning when to send outputs to the actuators or when to accept inputs from the sensors.



SUMMER– 2016 EXAMINATION

Subject Code: 17619

Model Answer

Page No: 20/23

f) State the importance of use of electronics in the automobile. Mention any four potential applications of the same.	04
Answer: <i>(Note: Importance:2 marks and Applications:2 marks)</i> Importance of use of electronics in automobiles: <ul style="list-style-type: none">• Standardization of functional interfaces• Share and reuse the existing components• Comprehensive safety• A high degree of comfort• Low energy consumption• Minimal pollutant emission• Improved quality and reliability of automotive. Some of the present and potential applications for electronics are:- (Any Four) <ol style="list-style-type: none">1. Electronic engine control for minimizing exhaust emissions and maximizing fuel economy.2. Instrumentation for measuring vehicle performance parameters and for diagnosis of ON-BOARD system malfunctions.3. Power train control system4. Vehicle motion control5. Safety and convenience6. Entertainment/communication/navigation	02
6. Attempt any FOUR of the following:	16
a) Given a decimal number of 25, convert it into a binary number.	04
Answer: <i>(Note: Equivalent conversion process - 04 marks)</i> Convert 25 into binary number. Step 1: Given decimal number = 25 $\begin{array}{r} 2 \overline{) 25} \\ \underline{2 1} \\ 2 0 \\ \underline{2 0} \\ 1 1 \end{array}$ Step 2: So, $(25)_{10} = (11001)_2$ $(25)_{10} = (11001)_2$	04



SUMMER-2016 EXAMINATION

Subject Code: 17619

Model Answer

Page No: 21/23

b) With a neat block diagram describe the working of exhaust gas recirculation as an output control function of ECM.

04

Answer: (Note: Description 02 marks, block diagram 02 marks. Credit should be given to equivalent sketch)

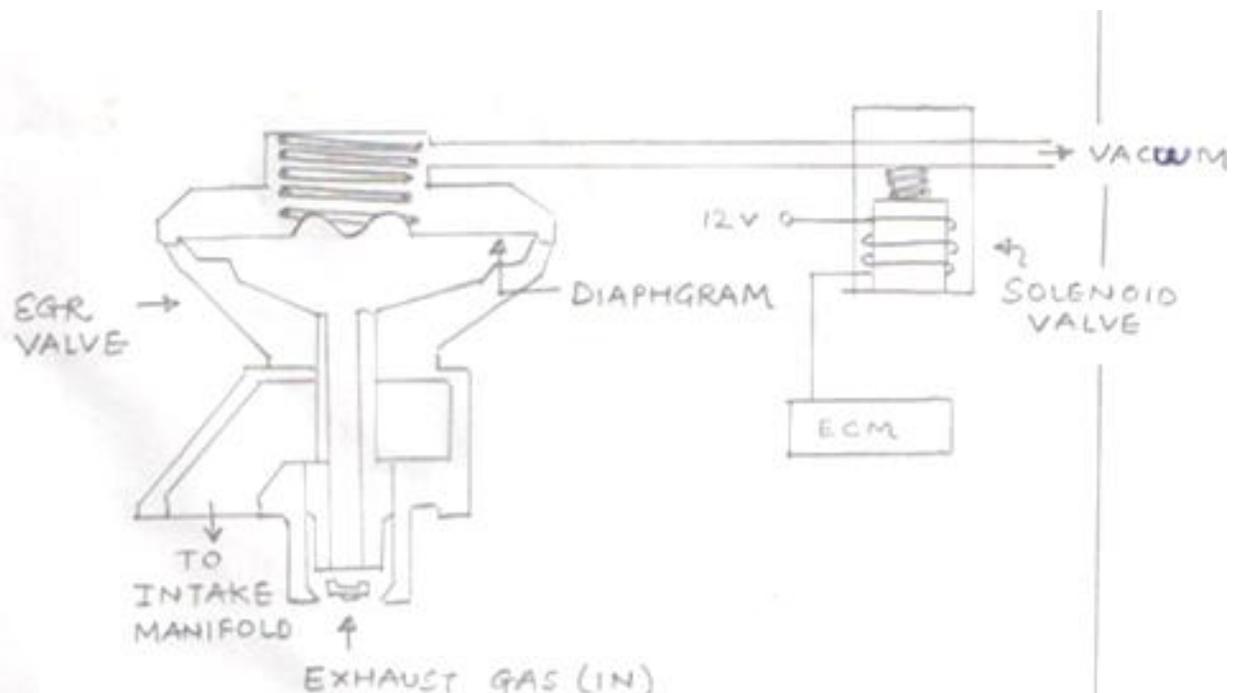
EXHAUST GAS RECIRCULATION (EGR) CONTROL:

The ECM controls a vacuum solenoid valve that is used to open close the vacuum circuit to EGR valve. When solenoid is energized, it shuts off vacuum to EGR valve.

02

When solenoid is de-energized, it allows vacuum to pass through the solenoid to the EGR system. The solenoid valve is energized when coolant temperature is below 60°C, at speed below 1200 rpm, under heavy load or at wide open throttle.

During all other engine operating i.e. part throttle conditions with coolant temperature above 65°C the ECM de-energizes the solenoid valve and allows the vacuum to open the EGR valve.



02

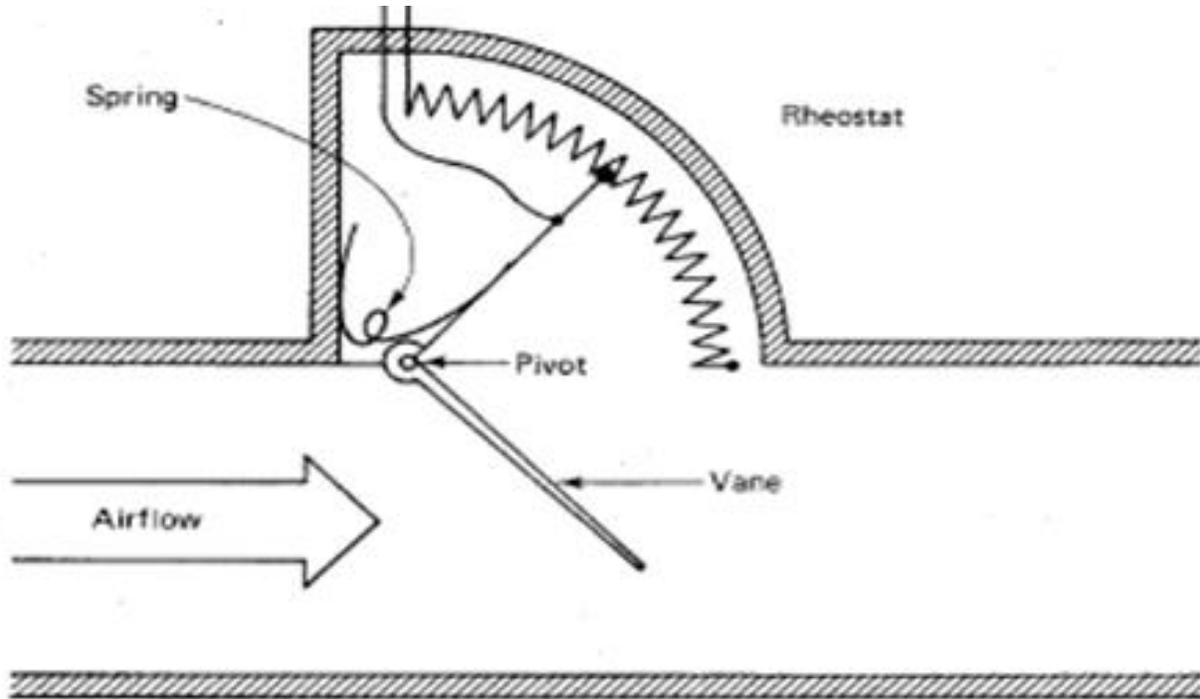
Fig: EGR SOLENOID CIRCUIT

c) Draw a neat labeled diagram indicating an air flow measurement sensor.

04

Answer:(Note: Neat labeled diagram- 04 marks. Credit should be given to equivalent sketch)

Diagram of Air flow measurement sensor:



04

d) List four different conditions to be sensed in a modern vehicle. Name two different types of principles on which pressure sensor works.

04

Answer:(*Note: Different sense conditions- 02 marks, Principles of pressure sensor- 02 marks*)

There are a number of different conditions to be sensed in a modern vehicle: (Any four)

1. Position
2. Temperature
3. Pressure
4. Speed (Engine and wheel)
5. Oxygen
6. Air flow

02

The different types of principles on which the pressure sensor works are as follows: (Any two)

1. Strain gauge type
2. Variable capacitance type
3. Variable inductance type

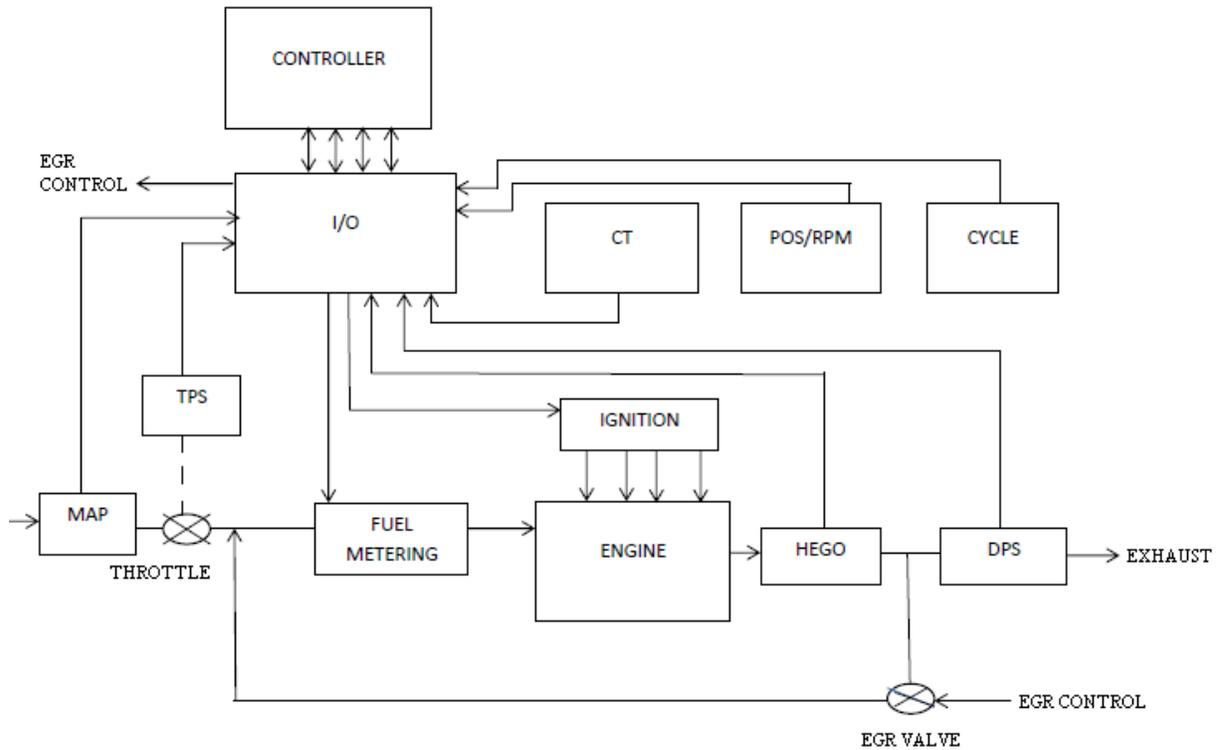
02

e) Draw a neat block diagram to indicate electronic control system used in MPFI system.

04

Answer: (*Note: Neat labeled Equivalent block diagram- 04 marks*)

Block diagram of Electronic Control System used in MPFI:



04

Fig. Electronic control system used in MPFI

- MAF: Mass air flow sensor
- CT: Coolant temperature sensor
- HEGO: Heated exhaust gas O₂ sensor
- POS/RPM: Crank shaft angle position and RPM sensor cycle
- TPS: Throttle position sensor
- DPS: Differential pressure sensor for EGR control
- EGR: Exhaust gas recirculation
- I/O: Input/ Output