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Internal Assessment Test 1 – Sept. 2018

Sub:	Mechatronics					Sub Code:	15ME754	Branch:	ME
Date:	08/09/2018	Duration:	90 min's	Max Marks:	50	Sem / Sec:	VII A&B		

Answer any FIVE FULL Questions

		MARKS	OBE CO	OBE RBT
1	Define Mechatronics. With a block diagram, discuss the generalized measurement system	[10]	CO1	L2
2	What are the objectives of Mechatronics? List the applications of Mechatronics.	[10]	CO1	L1
3	Define microprocessor based controllers. Explain with a block diagram, the working of an Engine Management System	[10]	CO1	L2

Scheme and Solution for IAT-1 Sept 2018

Mechatronics [15ME754]

08/09/2018 50Marks.

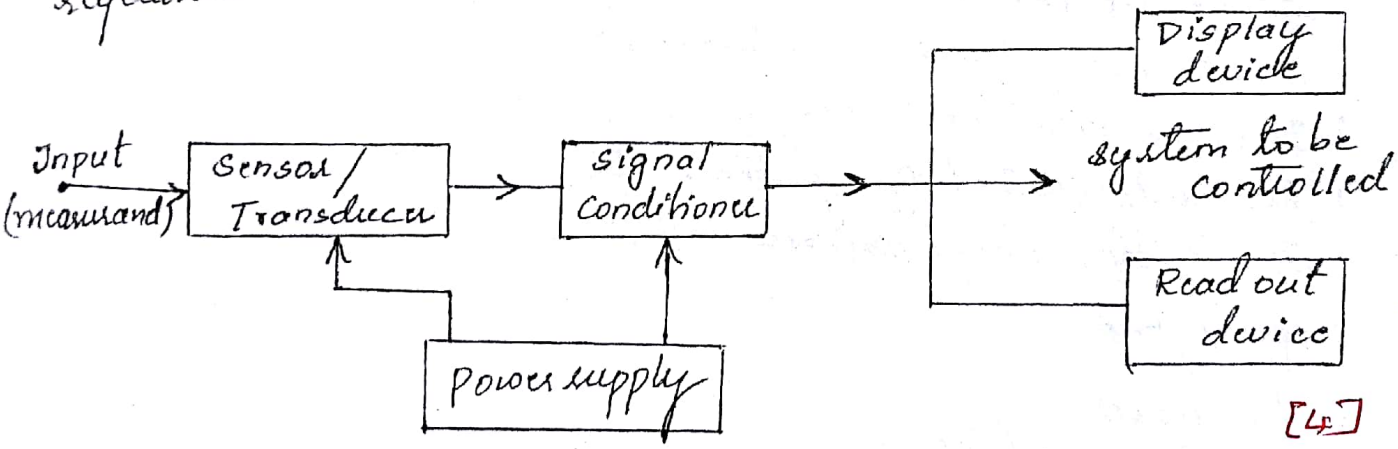
Q1. Define Mechatronics. With a block diagram, explain the generalized measurement system.

Sol. Mechatronics is the synergistic integration of Mechanics and Mechanical Engineering, Electronics, computer technology, and IT to produce (or) enhance products and system". [2]

Generally a measurement system consists of three elements. They are

a. Sensor / Transducer.
b. Signal conditioner.
c. Display / read out device.

In addition to the above, electrical power supply is also required.



[4]

Functions of each element

Sensor / Transducer:- The heart of any measurement system and also control system is the sensor / transducer. This unit senses and transforms the physical phenomenon to be measured, from one form to another form. The output of this unit is input to the signal conditioner which is the next element / unit.

Q2

- Signal conditioner :- A device connected next to the transducer which receives the output signals of the transducer and converts into suitable, usable, measurable level of signals. In case of measurement of temperature using a thermocouple the output of the thermocouple is an electrical quantity of magnitude of say some milli volts.

- Display unit :- The unit displays the output of the signal conditioner and this display will be quantitative form of measurement. Display unit may be either analog type (or) digital type.

[4]

Q2. What are the objectives of Mechatronics ? List the applications of mechatronics.

Sol Objectives

- To improve efficiency of the system.
- To reduce cost of production.
- To improve products and processes.
- To achieve higher precision and accuracy.
- To create new technology using novel concepts.
- For easy control of system.
- To develop novel mechanisms.

[5]

Applications

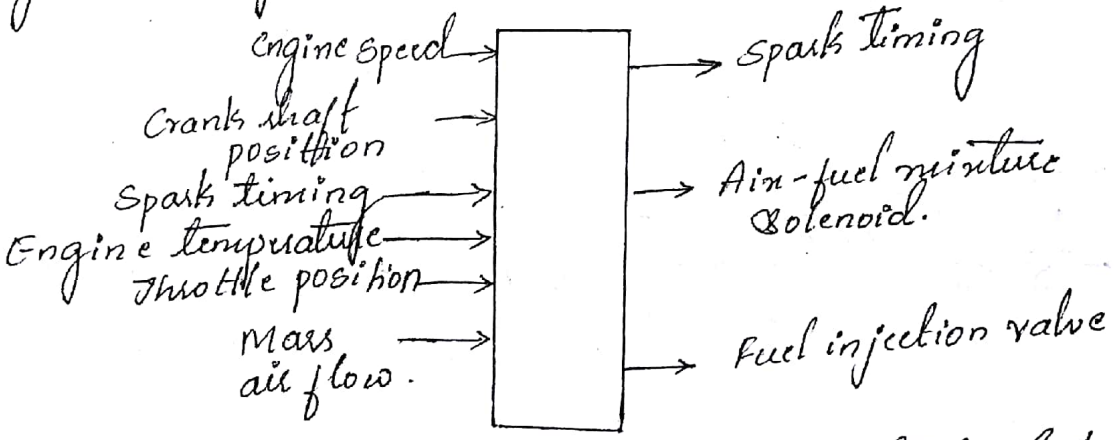
- It is used in home appliances such as dish washer and washing machines.
- Mechatronic is also used in intelligent measuring devices like calibration device, measuring and testing of sensors.
- It is used in laser optical systems.
- It is used in automation like automatic air conditioning system, security system, automatic doors system.

[5]

03. Define microprocessor based controllers. Explain with a block diagram, the working of an engine management system.

Sol It is defined as the controller which updates the process as function of measured output variable and input provided.

Engine management system



[5]

The power and speed of the engine are controlled by varying the ignition timing and the air-fuel mixture. The figure shows the basic elements of a microprocessor control system, For ignition timing the crankshaft drives a distributor which makes electrical contacts for each spark plug in turn and a timing wheel. This timing wheel generate pulses to indicate the crankshaft position. The microprocessor then adjusts the timing, it which high voltage pulses sent to the distributor so they occur at the right moments of time. To control the amount of air-fuel mixture entring a cylinder during the intake strokes, the microprocessor varies the time for which a solenoid is activated to open the intake valve on the basis of inputs received of the engine temperature and the throttle position. The amount of fuel to be injected into the air stream can be determined by an input from a sensor of the mass rate of air flow, (or) computed from other measurements, and the microprocessor then gives an output to control a fuel injection valve.

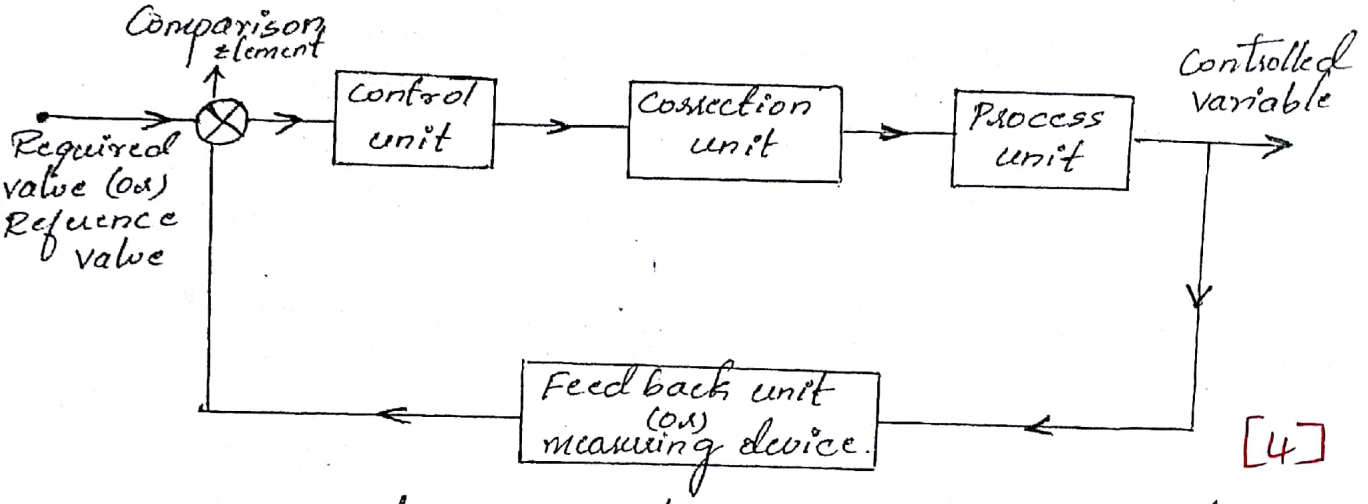
[5]

Q4

Q4 What are the basic elements of a closed loop control system? Explain with a block diagram.

Sol The basic elements of a closed loop control system are.

a. Comparison element.
b. Control unit.
c. Correction unit.
d. Process unit.
e. Feed back unit.



[4]

- Comparison element :- This unit compares the reference(or) required value with that of the measured value (or) feedback signal and produces an error signal.

- Control unit :- Control unit analyses the error signal and decides what action to be taken. The unit produces a signal ; may be to operate a switch (or) a valve (or) perhaps a signal to proportionally open (or) close a valve which depends on the size of the error. The manipulation of the control unit is such that the error will approach zero.

- Correction unit :- The modified signal from the control unit will be received by the correction unit which produces a change in the process to correct. change in process may be, allowing more power to the room heater to increase the temp (or) varying the valve opening for allowing the variations of liquid flow to enter the process.

, Process unit :- Process unit is the one which is being controlled. It could be the speed a motor, speed of a vehicle. [6]

05. Explain light sensors and state six selection factors of sensors.

sol The light sensors are semiconductor devices and this operation is based on the change in the resistance and current flow in the circuit when light falls on them. There are three basic types of light sensors.

, photo diode
, photo transistor
, photo register. [2]

Photo diode :- It is a two terminal electronic device which, when exposed to light the current starts flowing in the diode. It is operated in reverse biased mode only. It converts light energy to into electrical energy.

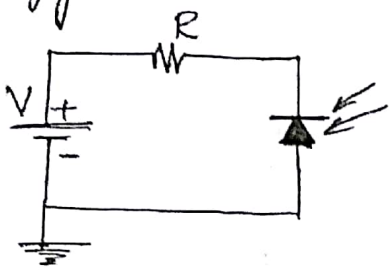
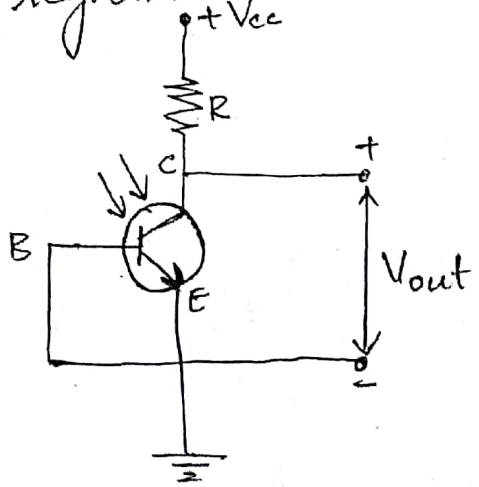
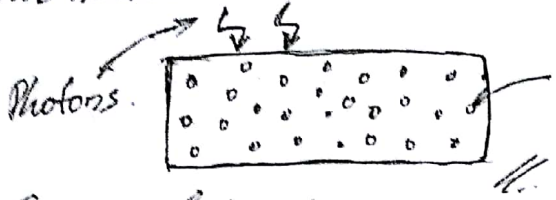


Photo transistor :- It convert the incident light into photo current. Instead of providing the base current for triggering the transistor, the light rays are used to illuminate the base region.



05

Photo resistor :- It is a type of resistor whose resistance decreases when the intensity of light increases. In other words, the flow of electric current through the photoresistor increases when the intensity of light increases.



[3]

Six selection factors of sensors.

, Range :- The range of a sensor indicates the limit b/w which the input can vary.

, Span :- The span is difference b/w the maximum and minimum values of the input.

, Sensitivity :- It is defined as the ratio of change in output value of a sensor to the per unit change in input value that causes the output change.

, Stability :- Stability is the ability of a sensor device to give same output when used to measure a constant input over a period of time.

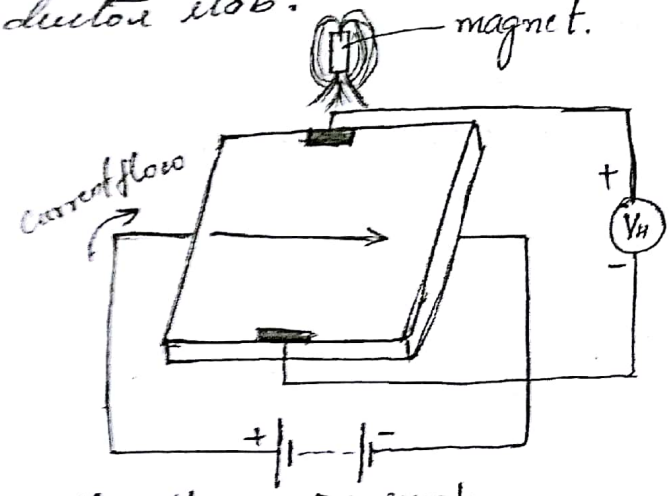
, Error :- Error is the difference b/w the result of the measurement and the true value of the quantity being measured.

, Response time :- It describes the speed of change in the output on a step-wise change of the measurand.

[5]

06 Explain working principle of Hall effect sensor. How can this sensor be used to measure the fuel level in automobile fuel tank?

Hall effect sensors consist basically of a thin piece of a rectangular p-type semiconductor material such as gallium arsenide (GaAs), indium antimonide (InSb) paving a continuous current through itself. When the device is placed within a magnetic field, the magnetic flux lines exert a force on the semiconductor material which deflects the charge carriers, electrons and holes, to either side of the semiconductor slab.



[3]

The output Hall voltage is given as:

$$V_H = R_H \left[\frac{I}{t} \times B \right]$$

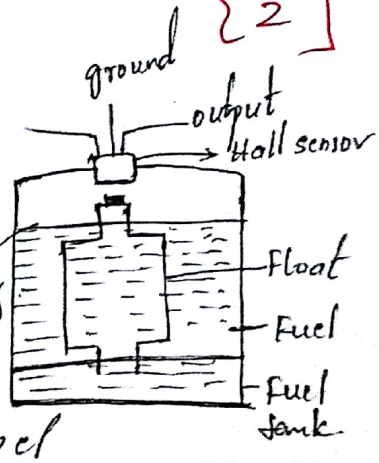
where,

V_H = Hall voltage, volts.
R_H = Hall effect co-efficient.
I = Current flow through the sensor, A.
t = thickness of the sensor, mm.
B = Magnetic flux density in Teslas.

[2]

Fluid level detector

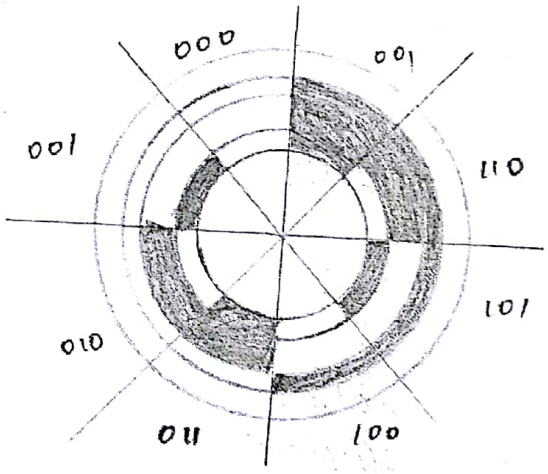
The figure shows the use of hall sensor used for determining the level of fuel in automobile fuel tanks. A magnet is attached to a float and as the level of the fuel changes the result is a Hall voltage output which is a measure of the distance of the float from the sensor and hence the level of the fuel in the tank.



[5]

Q7 with a neat diagram, explain how angular position is determined in case of an absolute optical encoder. write its application

Sol Absolute encoders to determine angular displacement. This gives an output in the form of a binary number of several digits, each such number representing a particular angular position. The rotating disc has 3 concentric circles of slots and 3 sensors to detect the light pulses. The slots are arranged in such a way that the sequential output from the sensor is a number in the binary code.



[6]

Applications

1. They are used to translate rotary (or) linear motion into digital signal.
2. Automatically determine height of beds used in hospital.
3. Moving automatic doors / bays without a limiting switch.
4. Accurately positioning multiple stabilizers for large vehicles.

[4]

08. Explain the following performance terminologies of transducers.
(i) Accuracy (ii) Repeatability (iii) Hysteresis (iv) Stability (v) Drift.

Sol (i) Accuracy :- The accuracy defines the closeness of the agreement between the actual measurement result and a true value of the measurand.
It is often expressed as a percentage of the full range output (or) full-scale deflection.

(ii) Repeatability :- It specifies the ability of a sensor to give same output for repeated applications of same input value.
It is usually expressed as a percentage of the full-range output.

(iii) Hysteresis :- It is an error of a sensor, which is defined as the maximum difference in output at any measurement value within the sensor's specified range when approaching the point first with increasing and then with decreasing the input parameter.

(iv) Stability :- Stability is the ability of a sensor device to give same output when used to measure a constant input over a period of time.

(v) Drift :- The change in the transducer output for a zero input (or) its sensitivity over a period of time, change in temperature, humidity (or) some other factor.

[2×5=10]

10

09 Same as 4th questions.

10. Explain the terms Bouncing and De-bouncing as applied to mechanical switches. Mention the various methods which can be used to tackle the problem of bouncing in mechanical switches.

10 Bouncing:- One of the major problem associated with mechanical switches is bouncing also called Contact bounce (or) chatter. When a mechanical switch of such type is operated to close the contacts, because of the elastic nature of contact, the contact vibrates (or) bounces before final contact. This is called Bouncing. when an ordinary electrical switch depending on elastic contact is closed, contacts and decontacts are made many number of times before the final contact is made.

Debouncing:- Mitigating (or) preventing the effect of switch bounce is called debouncing.

There are a number of technique adopted for debouncing. Most commonly used method are

- Specially designed mechanical switches.
- Software solution
- Electronic Hardware solution.