CMR INSTITUTE OF TECHNOLOGY

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Internal Assesment Test – II		Sub: Mechatronics		Code: 15ME753
Date: 14/10/2019	Duration: 90 mins	Max Marks: 50	Sem: 7	Branch (sections): ME (A,B)

Answer FIVE FULL questions. Good luck!

	Marks	OBE	
		CO	RBT
1. Explain the classification and sub classification of transducers.	[10]	CO1	L1
2. Explain 1) Eddy current proximity sensor. 2) Hall effect sensor.	[10]	CO1	L1
3. Exlpain the internal architecture of Intel 8085 processor in detail.	[10]	CO1	L1
4. Differentiate between 1) Microprocessor and microcontroller 2) RISC and CISC	[6+4]	CO1	L1
5. Explain the terms: 1)Program counter 2) Register 3) Instruction register 4) Status register 5)Static RAM 6) Dynamic RAM 7) EPROM 8) EEPROM 9) Assembler 10) Clock	[10]	CO1	L1
6. Explain 1) the instruction cycle [5]. 2) Types of buses [3] 3) Store results [1] 4) Read cycle [1]			

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SOLUTION FOR IAT 2- MECHATRONICS

1) Transducers are classified based on the following factors:
a. Whether the device senses and converts or just converts physical phenomenon.

b. Method of conversion of energy.

c. Nature and Type of output signals.

d. Type of sensing element used.

e. Type and nature of measurand to be used.

f. Whether they are self generating or externally powered.

g. Its purpose in the measurement system.

a. Whether the device senses and converts or just converts physical phenomenon. They are
i. Primary transducer

ii. Secondary transducer

i. Primary transducer:
These are detectors which sense a physical phenomenon and convert it into an analogous output.
E. g: Thermocouple.

ii. Secondary transducer:
These are those which convert the analogous output of the detector, which has sensed the E.g.: Measurement of compressive force with the help of load cell.

b. Method of conversion of energy:
The energy or signal produced due to physical phenomenon or measurand are converted into another form using mechanical linkages as in the case of simple dial gauge or the properties of material like resistance, conduction, expansion etc. E.g. Strain gauges are used to measure the mechanical strain of a member due to load or force. The change in resistance of the strain gauges is the measure of force.

c. Nature and Type of output signals:
i. Analog transducer

ii. Digital transducer

i. **Analog transducer:** These are whose convert physical phenomenon into an analogous output which is a continuous function of time. Strain gauges, thermisters, LVDT, etc,are examples of analogue transducer.

ii. **Digital transducer**: These are whose convert physical phenomenon into an electrical output which is in the form of pulses. These are not many digital transducers available, although there importance is well recognized in modern microprocessor based control systems and instrumentation. Angular digital encoder and digital level transducers are examples are digital transducers.

d. Type of sensing element used:
i. Elastic elements

ii. Mass sensing elements

iii. Thermal elements

iv. Hydro pneumatic elements.

i. Elastic elements: Most pressure measuring devices use a Bourdon tube, a bellow or a diaphragm. The action of these elements is based on elastic deformation brought about by the force resulting from pressure summation.

ii. Mass sensing elements: This is based on the inertia of a concentrated mass. Vibration pick up accelerometers, liquid manometers are examples of mass sensing element transducer.

iii. Thermal elements: these elements sense the heat of a system by indicating some change in the property of the material used,which varies with the heat.

iv. Hydro pneumatic elements: The two simple examples of hydro pneumatic elements are Float and hydrometer.

e. Whether they are self generating or externally powered:
i. Active transducers

ii. Passive transducers

i. Active transducers: These are those which develop their own power. They are also know as self generating transducers, the energy required for production of output signal form the physical phenomenon being measured.

E.g.: Piezoelectric pick up, thermocouples photo voltaic cell etc.
ii. Passive transducers: These are those which required externals power of producing output signal. There also know externally power transducers.

E. g. Resistance thermometer, thermostats, differential transformers etc.
f. Its purpose in the measurement system:
i. Input transducers

ii. Output transducers

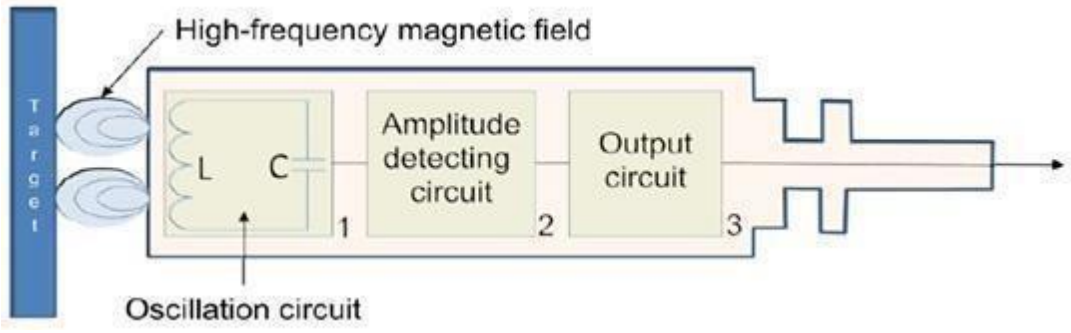
i. Input transducers: These transducers convert a non electric quality into an electric signal.

E.g. Strain gauge, photovoltaic cell etc
ii. Output transducers: These transducers convert electrical signal back into non-electrical signal according to whether they make physical contact or not. They are contact and non-contact type.

g. Its purpose in the measurement system:
Mechanical transducers for measuring quantities such as position, velocity, force, torque, displacement, pressure, vibration, strain mass etc.

2)

Eddy current proximity sensors:



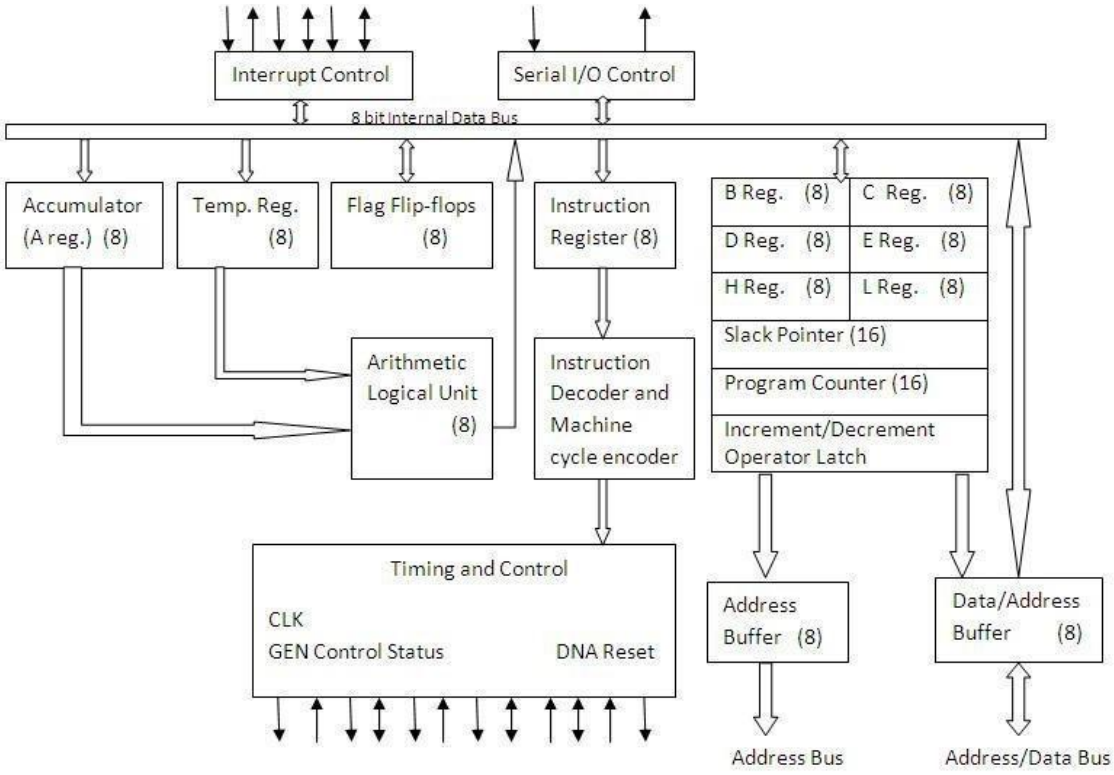
Construction of Eddy current proximity sensors Eddy current proximity sensors are used to detect non-magnetic but conductive materials. They comprise of a coil, an oscillator, a detector and a triggering circuit. Figure shows the construction of eddy current proximity switch. When an alternating current is passed thru this coil, an alternative magnetic field is generated. If a metal object comes in the close proximity of the coil, then eddy currents are induced in the object due to the magnetic field. These eddy currents create their own magnetic field which distorts the magnetic field responsible for their generation. As a result, impedance of the coil changes and so the amplitude of alternating current. This can be used to trigger a switch at some pre-determined level of change in current. Eddy current sensors are

relatively inexpensive, available in small in size, highly reliable and have high sensitivity for small displacements.

Applications of eddy current proximity sensors:

- Automation requiring precise location
- Machine tool monitoring
- Final assembly of precision equipment such as disk drives
- Measuring the dynamics of a continuously moving target, such as a vibrating element,
- Drive shaft monitoring
- Vibration measurements

3.



Register Array

8085 Microprocessor consists of six registers, one accumulator and a flag register. The typical architecture is shown in figure 6. There are six general-purpose registers B, C, D, E, H, and L, each having capacity to store 8 bit data. They are combined as BC, DE, HL to perform 16 bit operations. In addition to this Register array, two 16 bit registers viz. stack register and program counter are provided. As discussed in the earlier lecture, the „program counter" is employed to sequence the execution of instructions. It always points to the memory address from which the next byte is to be fetched. Stack Pointer points to the memory location in R/W (Read and/or write) memory. It is also termed as a „stack".

Accumulator
The accumulator is 8-bit register (can store 8 bit data). It is a part of arithmetic/logic unit (ALU). In general, after performing logical or arithmetical operations, result is stored in accumulator. Accumulator is also identified as Register A.
Flags
ALU of 8085 have five flip flops whose states (set/reset) are determined by the result data of other registers and accumulator. They are called as Zero, Carry, Sign, Parity and Auxiliary-Carry flags.
A Zero Flag (Z): When an arithmetic operation results in *zero*, the flip-flop called the Zero flag - which is set to one.
B Carry flag (CY): After an addition of two numbers, if the sum in the accumulator is larger than eight bits, then the flip-flop uses to indicate a *carry* called the Carry flag – which is set to one.
C S-Sign (S): It is set to 1, if bit D7 of the result = 1; otherwise reset. D7 is the first digit of a binary number.

Transfer
1. Load: It reads content from specified memory location and copies it to specified register location in CPU.
2. Store: It copies content of a specified register into specified memory location.

Arithmetic:
A Add: It adds contents of a specified memory location to the data in some register. B Decrement: It subtracts 1 from contents of specified location.
C Compare: It tells whether contents of a register are greater than, less than or same as content of specified memory location.
Logical:

- AND: Instruction carries out Logical AND operation with the contents of specified memory location and data in some register. Numbers are *ANDed* bit by bit.
- OR: Instruction carries out Logical OR operation with the contents of specified memory location and data in some register. Numbers are *ORed* bit by bit.
- Logical Shift: Logical shift instruction involves moving a pattern of bits in the register one place to left or right by moving a zero in the end of number.

Program Control:
• Jump: This instruction changes the sequence in which program steps are carried out. Normally program counter causes the program to be carried out sequentially in strict numerical sequence. However, JUMP causes program counter to some other specified location in the program.
• Branch: This is a conditional instruction which might „branch" if „zero" results or „branch" if „plus" results of an operation. Branch also followed if right conditions occur in the decision making process.
• Halt: This instruction stops all further microprocessor activity.

4.

Microcontroller	Microprocessor
• Micro Controller is a heart of the embedded system	• The microprocessor is the heart of Computer system
• Microcontroller has an external processor along with internal memory and input/output components	• It is just a processor. Memory and I/O components have to be connected externally
• Since memory and I/O are present internally, the circuit is small.	• Since memory and I/O has to be connected externally, the circuit becomes large
• The cost of the entire system is low	• Cost of the entire system increases
• The microcontroller has a number of registers, hence the programs are easier to write	• Microprocessor has less number of registers, hence more operations are memory based
• Used mainly in the washing machine, MP3 players	• Mainly used in personal computers

Characteristic of RISC –

1. Simpler instruction, hence simple instruction decoding.
2. Instruction come under size of one word.
3. Instruction take single clock cycle to get executed.
4. More number of general purpose register.
5. Simple Addressing Modes.
6. Less Data types.
7. Pipeling can be achieved.

Characteristic of CISC –

1. Complex instruction, hence complex instruction decoding.
2. Instruction are larger than one word size.
3. Instruction may take more than single clock cycle to get executed.
4. Less number of general purpose register as operation get performed in memory itself.
5. Complex Addressing Modes.
6. More Data types.

5.

1)Program counter: A **program counter** is a register in a computer processor that contains the address (location) of the instruction being executed at the current time.

2) Register: register is a quickly accessible location available to a computer's central processing unit. Registers usually consist of a small amount of fast storage, although some registers have specific hardware functions, and may be read-only or write-only.

3) Instruction register: In computing, the **instruction register** (IR) or current **instruction register** (CIR) is the part of a CPU's control unit that holds the **instruction** currently being executed or decoded.

4) Status register The **status register** is a hardware **register** that contains information about the state of the processor. Individual bits are implicitly or explicitly read and/or written by the machine code instructions executing on the processor.

5)Static RAM SRAM (**static RAM**) is **random access memory** (**RAM**) that retains data bits in its memory as long as power is being supplied

6) Dynamic RAM Dynamic random-access memory is a type of random access semiconductor memory that stores each bit of data in a memory cell consisting of a tiny capacitor and a transistor, both typically based on metal-oxide-semiconductor technology.

7) EPROM An EPROM, or erasable programmable read-only memory, is a type of programmable read-only memory chip that retains its data when its power supply is switched off.

8) EEPROM (also **E^2PROM**) stands for **electrically erasable programmable read-only memory** and is a type of non-volatile memory used in computers, integrated in microcontrollers for smart cards and remote keyless systems, and other electronic devices to store relatively small amounts of data but allowing individual bytes to be erased and reprogrammed.

9) Assembler n computer programming, assembly language, often abbreviated asm, is any low-level programming language in which there is a very strong correspondence between the instructions in the language and the architecture's machine code instructions.

10) Clock: **clock** refers to a microchip that regulates the timing and speed of all **computer** functions. In the chip is a crystal that vibrates at a specific frequency when electricity is applied.

6)

1) the instruction cycle: The generic instruction cycle for an unspecified CPU consists of the following stages:

a) Fetch instruction: Read instruction code from address in PC and place in IR. (IR ← Memory[PC])
b) Decode instruction: Hardware determines what the opcode/function is, and determines which registers or memory addresses contain the operands.
c) Fetch operands from memory if necessary: If any operands are memory addresses, initiate memory read cycles to read them into CPU registers. If an operand is in memory, not a register, then the memory address of the operand is known as the *effective address*, or EA for short. The fetching of an operand can therefore be denoted as Register ← Memory[EA]. On today's computers, CPUs are much faster than memory, so operand fetching usually takes multiple CPU clock cycles to complete.

d) Execute: Perform the function of the instruction. If arithmetic or logic instruction, utilize the ALU circuits to carry out the operation on data in registers. This is the only stage of the instruction cycle that is useful from the perspective of the end user. Everything else is overhead required to make the execute stage happen. One of the major goals of CPU design is to eliminate overhead, and spend a higher percentage of the time in the execute stage. Details on how this is achieved is a topic for a hardware-focused course in computer architecture.
e) Store result in memory if necessary: If destination is a memory address, initiate a memory write cycle to transfer the result from the CPU to memory. Depending on the situation, the CPU may or may not have to wait until this operation completes. If the next instruction does not need to access the memory chip where the result is stored, it can proceed with the next instruction while the memory unit is carrying out the write operation.

2) Types of buses: Types of Computer Bus

There are a variety of buses found inside the computer.

Data Bus: The data bus allows data to travel back and forth between the microprocessor (CPU) and memory (RAM).

Address Bus: The address bus carries information about the location of data in memory.

Control Bus : The control bus carries the control signals that make sure everything is flowing smoothly from place to place.

Expansion Bus: If your computer has *expansion slots*, there's an **expansion bus.** Messages and information pass between your computer and the *add-in boards* you plug in over the expansion bus.

3) Store results: Store result in memory if necessary: If destination is a memory address, initiate a memory write cycle to transfer the result from the CPU to memory. Depending on the situation, the CPU may or may not have to wait until this operation completes. If the next instruction does not need to access the memory chip where the result is stored, it can proceed with the next instruction while the memory unit is carrying out the write operation.

4) Read cycle: Fetch instruction: Read instruction code from address in PC and place.