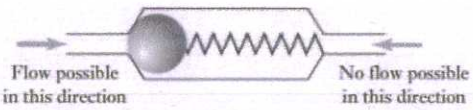
Set A

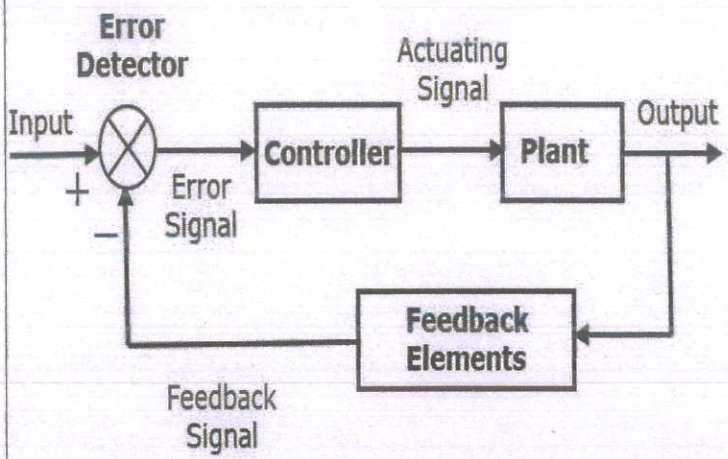
Scoring Indicators

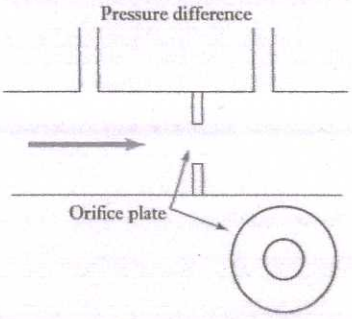
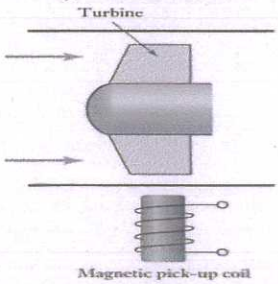
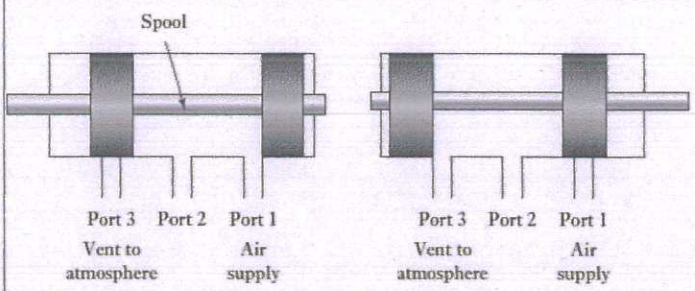
COURSE NAME : MECHATRONICS

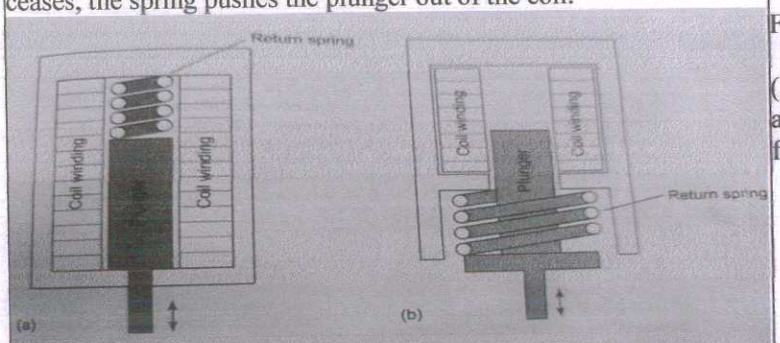
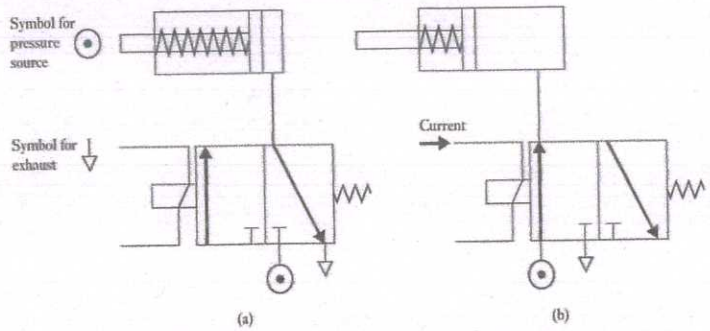
COURSE CODE :6021A **QID : 2102240019**

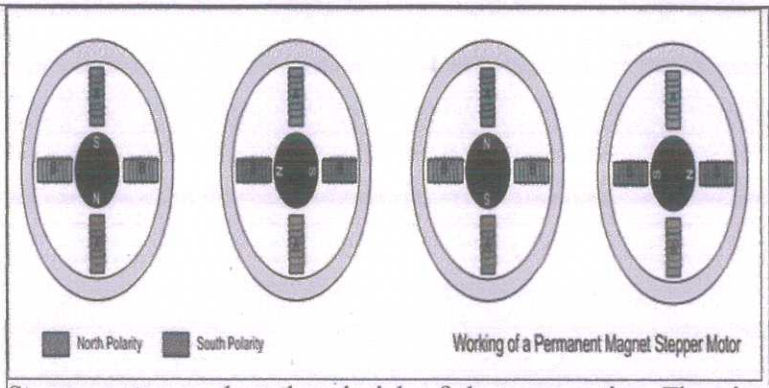
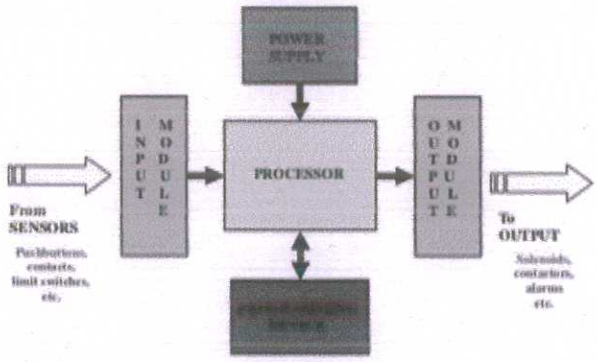
Q No	Scoring Indicators	Split score	Sub Total	Total score
	PART A			**9**
I. 1	Automation and Robotics,Smart and Autonomous Systems, Internet of Things (IoT) and Connectivity,Precision Manufacturing and 3D Printing, Biomedical Engineering and Assistive Technologies ,Digital camera and auto focus,Engine management system	Any two	2*0.5 = 1	
I. 2	Measurement system includes all components in a chain of hardware and software that leads from the measured variable to processed data		1	
I. 3	Floats, Differential Pressure	Any one	1	
I. 4	Pneumatics provides fluid power by means of pressurised air or gases.		1	
I. 5	Diode,Thyristor,Transistor	Any one	1	
I. 6	Continuous updating, Mass input/output copying	Any one	1	
I. 7	Shift Register is a digital circuit that can be used to store and transfer data sequentially.		1	
I. 8	Robotics is a branch of engineering and computer science that involves the conception, design, manufacture and operation of robots.		1	
I. 9	This can involve locating and identifying parts and then assembling them		1	
	PART B			24
II. 1	Displacement sensors are concerned with the measurement of the amount by which some object has been moved. Proximity sensors are a form of position sensor and are used to determine when an object has moved to within some particular critical distance of the sensor.	1 2	3	
II. 2	a) Bimetallic strips b) Resistance temperature detectors (RTDs) c) Thermodiodes and transistors d) Thermo couples e) Thermistors	Any three	3	
II. 3	1.The nature of the measurement required, e.g. the variable to be measured,its nominal value, the range of values, the accuracy required, the required speed of measurement, the reliability required, the environmental conditions under which the measurement is to be made.		3	

	2 The nature of the output required from the sensor, this determining the signal conditioning requirements in order to give suitable output signals from the measurement. 3 Then possible sensors can be identified, taking into account such factors as their range, accuracy, linearity, speed of response, reliability, maintainability, life, power supply requirements, ruggedness, availability, cost.			
~~II.4~~ II 5.	A diode is a semiconductor device that essentially acts as a one-way switch for current. It allows current to flow easily in one direction, but severely restricts current from flowing in the opposite direction. When a diode allows current flow, it is forward-biased. When a diode is reverse-biased, it acts as an insulator and does not permit current to flow.		3	
~~II. 5~~ II. 4	 In this valve free flow can only occur in one direction through the valve which results in the ball being pressed against the spring. Flow in the other direction is blocked by the spring forcing the ball against its seat.	Figure-1 Exaplanation-2	3	
II. 6	A programmable logic controller (PLC) is a digital electronic device that uses a programmable memory to store instructions and to implement functions such as logic, sequencing, timing, counting and arithmetic in order to control machines and processes and has been specifically designed to make programming easy.		3	
II.7	The operations that may be carried out with a PLC on data words normally include: 1 moving data – Data movemment 2 Data comparison- comparison of magnitudes of data, i.e. greater than, equal to, or less than; 3 Arithmetic operations - addition and subtraction etc. 4 Code conversion -conversions between binary-coded decimal (BCD), binary and octal.	Any three	3	
II.8	Material transfer application are defined as operations in which the primary objective is to move a part from one location to another location.They are usually considered to be among the most straightforward of robot applications to implement.The application usually requires a relatively unsophisticated robot.These applications are sometimes called pick and place operations because the robot simply picks the part from one location and places in other locather.Some material transfer applications have motion patterns that change from cycle to cycle,thus requiring a more sophisticated robot.Palletizing and depalletizing operations are examples of this case.		3	

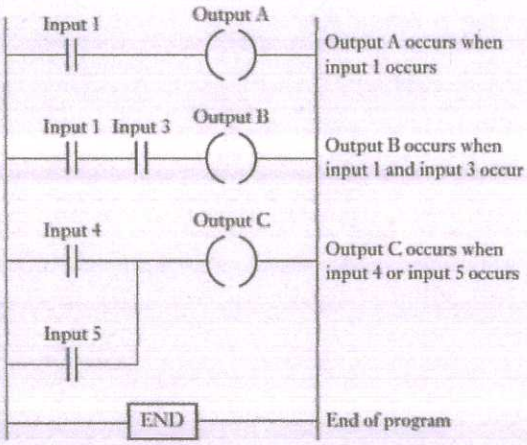
II 9	Sensor based inspection – Specific physical dimension can be determined by the robot with the help of sensors placed on the gripper fingers of a material handling robot.The specific physical size information can be obtained by the sensors and the robot can determine whether the size is within tolerance limit. Vision based inspection – It is capable of analysing a two dimensional scene.The two dimensional view of the scene is obtained from a single camera.If more features are required to be inspected, the camera is moved in to different position by robot manipulator Testing- It is a quality control activity.It is used for tests which may be destructive or non destructive.		3	
II. 10	Programming methods are classified in two types 1.Lead through Programming Lead through programming involves physically moving the robot arm over a series of points and axis to "teach" it how to perform a desired function. It is also referred as teach by showing method. 2.Textual robot language As the name suggests, this robot programming method involves writing instructions.The programmer types in the program on a CRT monitor using a high level English like language.		3	
	PART C			42
III.	 In closed loop control systems, output is fed back to the input. So, the control action is dependent on the desired output.The error detector produces an error signal, which is the difference between the input and the feedback signal. Instead of the direct input, the error signal is applied as an input to a controller.So, the controller produces an actuating signal which controls the plant. In this combination, the output of the control system is adjusted automatically till we get the desired response. Hence, the closed loop control systems are also called the automatic control systems. Example-An air conditioner.	Fig -3 Explanation 4	7	

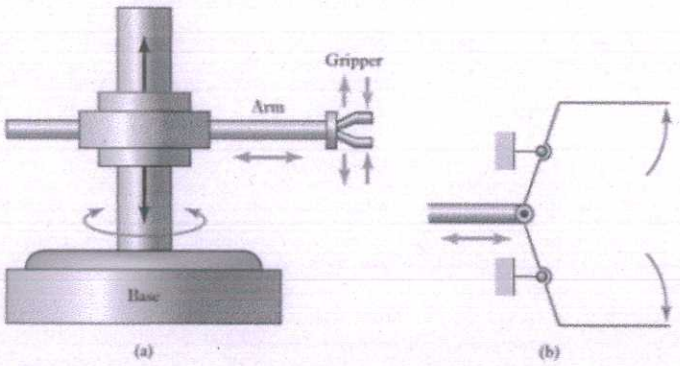
IV	a) Orifice plate  The orifice plate is simply a disc, with a central hole, which is placed in the tube through which the fluid is flowing. The pressure difference is measured between a point equal to the diameter of the tube upstream and a point equal to half the diameter downstream. The orifice plate is simple, cheap, with no moving parts, and is widely used. It does not, however, work well with slurries. b) Turbine meter  The turbine flowmeter consists of a multi-bladed rotor that is supported centrally in the pipe along which the flow occurs. The fluid flow results in rotation of the rotor, the angular velocity being approximately proportional to the flow rate. The rate of revolution of the rotor can be determined using a magnetic pick-up. The pulses are counted and so the number of revolutions of the rotor can be determined.	Figure-3 Explanation-4 Write any one	7	
V	 Spool valve is a cylinder inside a sealed outer case. There are several chambers drilled through the case from one side to the other, these are commonly known as "ports.A spool moves horizontally within the valve body to control the flow. In first figure the air supply is connected to port 1 and port 3 is closed. Thus the device connected to port 2 can be pressurised. When the spool is moved to the left (Second figure)the air supply is cut off . Port 3 is a vent to the atmosphere and so the air pressure in the system attached to port 2 is vented. Thus the movement of the spool has allowed the air firstly to flow into the system and then be reversed and flow out of the system.	Figure-3 Explanation-4	7	

VI	Solenoid consist of a coil of electrical wire with an armature which is attracted to the coil when a current passes through it and produces a magnetic field. The movement of the armature contracts a return spring which then allows the armature to return to its original position when the current ceases. The solenoids can be linear or rotary, on/off or variable positioning and operated by d.c. or a.c. In a push type linear solenoid when an electric current passes through the solenoid, the resulting magnetic field attracts the plunger and pulls it against the spring. When the current ceases, the spring restores the plunger to its original position. In pull type linear solenoid when an electric current passes through the solenoid, the plunger is pulled in to the coil. When the current ceases, the spring pushes the plunger out of the coil.  Figure Linear solenoid actuators: (a) push-type, (b) pull-type	Explanation-4 Figure-3 (Draw any one figure)	7	
VII	 Control of a single-acting cylinder with (a) no current through solenoid, (b) a current through the solenoid. Single acting cylinder is used when the control pressure is applied to just one side of the piston, a spring often being used to provide the opposition to the movement of the piston. The other side of the piston is open to the atmosphere. when a current passes through the solenoid, the valve switches position and pressure is applied to move the piston along the cylinder. When the current through the solenoid ceases, the valve reverts to its initial position and the air is vented from the cylinder. As a consequence the spring returns the piston back along the cylinder.	Figure - 3 Explanation -4	7	

VIII	 Stepper motors work on the principle of electromagnetism. There is a soft iron or magnetic rotor shaft surrounded by the electromagnetic stators. The rotor and stator have poles which may be teethed or not depending upon the type of stepper. When the stators are energized the rotor moves to align itself along with the stator. This way the stators are energized in a sequence to rotate the stepper motor. When a stator is energized, it develops electromagnetic poles. The magnetic rotor aligns along the magnetic field of the stator. The other stator is then energized in the sequence so that the rotor moves and aligns itself to the new magnetic field. This way energizing the stators in a fixed sequence rotates the stepper motor by fixed angles.	Figure-3 Explanation-4	7	
IX	**PLC BLOCK DIAGRAM**  Processor section (CPU) The processor section is brain of PLC which consists of RAM, ROM, logic solver and user memory. The central processing unit is heart of PLC. CPU controls monitors and supervises all operation within PLC. The CPU makes decision and executes control instructions based on the program instruction in memory. Input and output module The input module is a mediator between input devices and central processing unit (CPU) which is used to convert analog signal into digital signal.The output module is a mediator between output devices and central processing unit (CPU) which is convert digital signal into analog signal.	Figure-3 Explanation-4	7	

	Power supply Power supply is provided to the processor unit, input and output module unit. Power supply may be integral or separately mounted unit. Most of the PLC operates on 0 volts DC and 24 volts. Memory section The memory section is the area of the CPU in which data and information is stored and retrieved. Data Memory is used to store numerical data required in math calculation, bar code data etc. Programming device Programming devices are dedicated devices used for loading the user program into the program memory or edit it and to monitor the execution of the program of the PLC. Hand held terminal (HHT) or dedicated terminal or personal computer are programming devices commonly used in most of the PLCs.			
X	Arduino is a small microcontroller board with complementary components which has been designed to facilitate the use of the microcontroller in control projects. The basic board, Arduino UNO Revision 3, uses an 8-bit Atmel microcontroller, Atmega328. This microcontroller has a memory system, input/output ports, timer/ counter, pulse width modulation, ADC, an interrupt system and serial communication. Arduino boards can be purchased pre-assembled, from a variety of retailers. The board has a universal serial bus (USB) plug to enable it to be directly connected to a computer and a number of connection sockets to enable it to be connected to external items such as motors, relays, etc. The board can be powered by connection to an external power supply, e.g. a 9 V battery, or through the USB connection from the computer. Preprogrammed into the on-board microcontroller chip is a boot loader that directly allows the uploading of programs into the microcontroller memory. The basic boards are supplemented by accessory boards, termed shield boards, e.g. a LCD (liquid crystal display) display board, a motor board and an Ethernet board, that can be plugged on top of the basic Arduino board and into board pin-headers. Multiple shields can be stacked.The board is open source. This means that anyone is allowed to make Arduino-compatible boards. Starter kits are available, typically including such items as the Arduino board, a USB cable so that the board can be programmed from a computer, a breadboard to use for assembly of an external circuit with wires and commonly used components such as resistors, photoresistors potentiometers, capacitors, pushbuttons, temperature sensor, LCD alphanumeric display, light-emitting diodes (LEDs), DC motor, H-bridge motor driver, optocouplers, transistors and diodes		7	

XI	 It is a graphical PLC programming language.They are called "ladder" diagrams because they resemble a ladder, The horizontal lines are the rungs. Each rung can have multiple inputs, outputs, and other programming instructions. Each rung of ladder logic lies between the two vertical lines. These two vertical lines are called the PLC Rail or Power Rail. Power rail is used to provide the power source for each rung that makes a complete circuit. It can connect with AC or DC source.	Figure-4 Explanation-3	7	
XII	PLC selection criteria consists of a)Power Supply Before choosing a PLC, the first thing which comes to our mind is the power supply to the PLC. PLC can run on 24 VDC, 24 VAC, or 230 VAC depending on the model types. b) Number of Inputs and Outputs The number of Inputs and Outputs is one of the important criteria for PLC selection. PLC type selection mainly depends on the number of inputs and outputs. c) Communication Protocols It is obvious that a PLC which is installed needs to communicate with field devices as well as some other systems also. For this reason, we need to know the devices as well as other systems' communication protocols. d) Surrounding Environment Specifications The plant can be in any location where environmental conditions also vary. So PLC must be designed to withstand the surrounding environmental conditions. e) CPU Requirement PLCs are of different types like a Process PLC and Safety PLC. The scan rate of both PLCs also has a great difference. The scan rate totally depends on the CPU of the PLC. f) Application Requirements of PLC Some PLCs have libraries where pre-programmed software is stored. If you need some special type of program for your application, and that type of program is already available in the PLC, then we should consider that PLC. g) Operator Interface If the system needs operator control or interaction. In order to convey		7	

	information about machine or process status, or to allow an operator to input data, many applications require operator interfaces			
XIII	Position & Velocity sensors are used in robotics as feed back devices. Position sensors provide the necessary means for determining whether the joints have moved to correct linear or rotational locations in order to achieve the required position & orientation. The speed with which the manipulator is moved is another performance feature which must be regulated. Robots utilize a feedback system to ensure proper speed control. Position sensors consist of potentiometers,resolver,encoders Velocity sensor consist of tachometers Potentiometers - They are analog devices whose output voltage is proportional to the position of wiper.Depending upon their design, they may be used to measure either rotary or linear motion.In either case, a movable slide or wiper is in contact with a resistive material or wire winding.The slide is attached to the target object in motion.A DC or an AC voltage is applied to the resistive material.When the slide moves relative to the material, the output voltage varies linearly with the total resistance included within the span of the slide. Resolver – It is a type of rotary electrical transformer used for measuring degrees of rotation. It is an analog device whose output is proportional to the angle of rotating element with respect to fixed element. Encoders - They are sensors which converts linear or angular displacement in to digital code or pulse signal Tachometer – It is an instrument that measures the rotation speed of a shaft or disk, as in a motor or other machine. The device usually displays the revolutions per minute (RPM) on a calibrated analogue dial, but digital displays are increasingly common.		7	7
XIV	 a) Pick and Place b) Gripper The robot has three axes about which motion can occur: rotation in a clockwise or anti-clockwise direction of the unit on its base, arm extension or contraction and arm up or down; also the gripper can open or close. These movements can be actuated by the use of pneumatic cylinders operated by solenoid-controlled valves with limit switches to indicate when a motion is completed. Thus the clockwise rotation of the unit might result from the piston in a cylinder being extended and the anti-clockwise direction by its retraction. Likewise the upward movement of the arm might result	Figure-3 Explanation-4	7	

	from the piston in a linear cylinder being extended and the downward motion from it retracting; the extension of the arm by the piston in another cylinder extending and its return movement by the piston retracting. The gripper can be opened or closed by the piston in a linear cylinder extending or retracting. Hydraulic and pneumatic rams are widely used to drive robot arms since they can easily be controlled to move limbs at a relatively slow speed, while electric motors would need to operate through a gearbox. The positions of the arm and gripper are determined by limit switches. This means that only two positions can be accurately Attained with each actuator and the positions cannot be readily changed without physically moving the positions of the switches.			