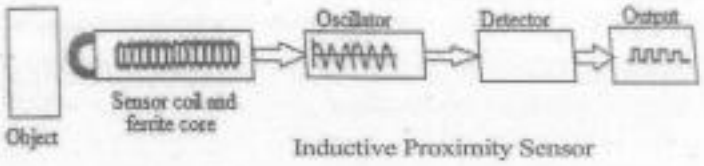
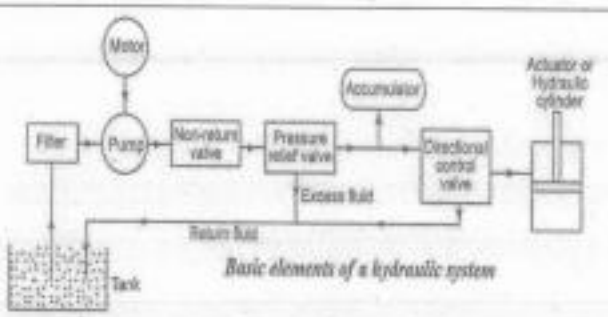
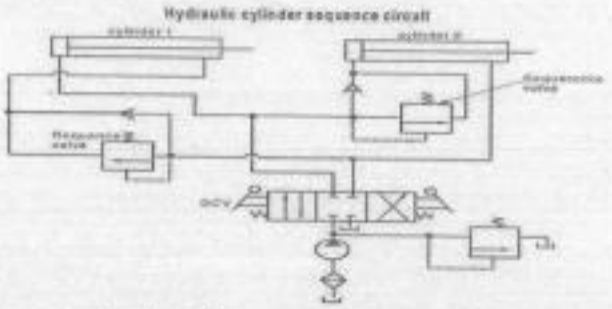
Scoring Indicator-1

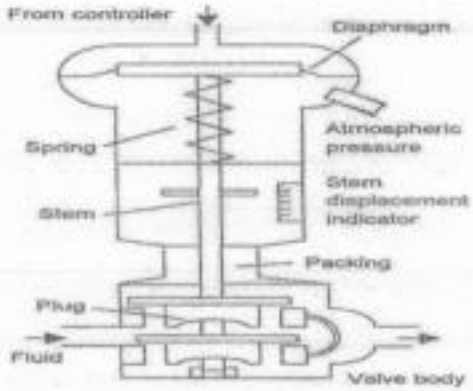
Course Name: **Mechatronics**

Course Code: **TED (21) 6021A** QID:210240021

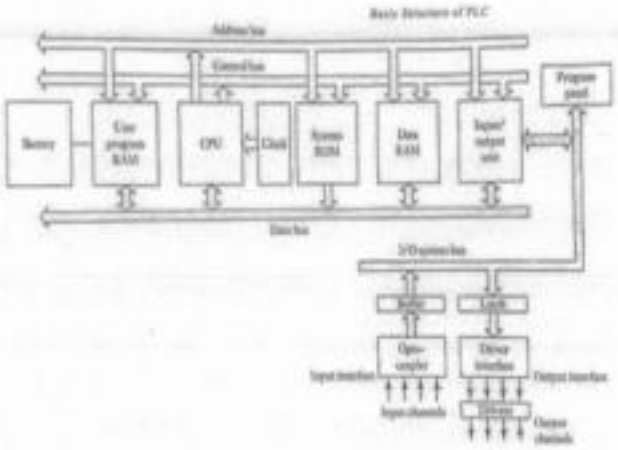
Q.No	Scoring Indicator	Split Score	Subtotal	Total Score
1.1	Smartphone, Digital camera, Printer, Robot vacuum cleaner, MRI scanner etc. **(Any one)**		1	9
1.2	Mechanical suitability, Electrical suitability, Environment suitability, Transducer performance in terms of calibration accuracy, Purchase aspects etc. **(Any one)**		1	
1.3	sensor, signal conditioner and display system. **(Any one)**		1	
1.4	Door hinges, Bicycle brakes, Car steering wheel, Robot arms, Hydraulic presses, Car suspension etc. **(Any one)**		1	
1.5	diodes, thyristors, triacs, bipolar transistors and solenoids. **(Any one)**		1	
1.6	Home Automation, Robotics, Internet of Things (IoT), Education, Art and Music **(Any one)**		1	
1.7	SFT		1	
1.8	Assembly Lines, Machine Loading/Unloading, Logistics and Warehousing etc. **(Any one)**		1	
1.9	Lead through method & Textual programming **(Any one)**		1	
	PART-B			
II.1	Orifice meter, turbine meter, Venturimeter **(1 mark each)**		3	
II.2	Float switches, Ultrasonic level sensors, Pressure sensors, Capacitive sensors, Conductive sensors,	Any three	3	
II.3	Home thermostat, Automatics washing machine, Cruise control in a car, Traffic light, Automatic pilot in an airplane	Any three	3	
II.4	In contact type measured object comes in contact with sensor. In non contact type measured object has no physical contact with sensor	1.5 each	3	
II.5	Electric motors, Hydraulic motors, Servo motors, Gear motor etc	Any three	3	
II.6	Industrial Automation(Manufacturing, Process Control, Power Generation), Building Automation(HVAC Systems, Lighting Control, Security Systems),	Any three	3	
II.7	Automotive industry, Electronics industry, Medical device manufacturing, Food and beverage industry etc	Any three	3	
II.8	It consist of three axes they are, • Rotation in a clock wise or anti-clock wise direction of the unit on its base. • Arm extension or contraction and arm up or down. • Gripper can open or close **(1 mark each)**		3	
II.9	It is defined as the process of enabling machines to follow a predetermined sequences of operations with little or no		3	

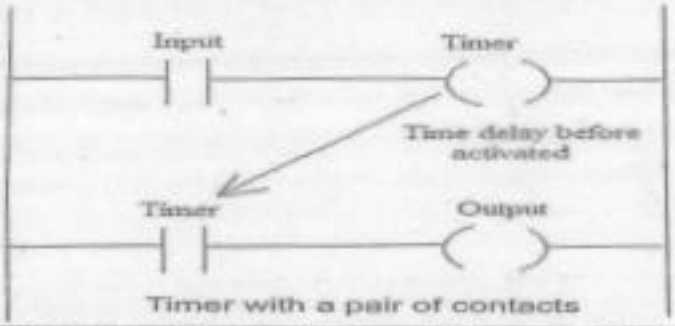
	human interventions and using specialized equipment and devices that perform and control manufacturing process and operations			
II.10	The payload capacity of the robot, The reach of the robot, The accuracy and repeatability of the robot, The speed of the robot, The safety features of the robot, The layout of the work cell, The safety of the application, The programming of the robot	Any three	3	
	PART-C			
III.	 Inductive Proximity Sensor It consist of four components, they are sensor coil and ferrite core, Detector circuit, Oscillator circuit & Solid state output circuit. The oscillator circuit generates a radio frequency electromagnetic field. This field is concentrated around the axis of the ferrite core, which shape the field, and directs it to the sensor face. When metal object approaches the face of sensor and enters the field, eddy currents are induced into the surface of object. This results a damping effect that causes a reduction in the amplitude of the oscillating signal. The detector circuit detect the changes in the oscillator amplitude and the circuit will switch on at a specific operating amplitude. This signal turns on the solid state output circuit. When the metal object leaves the sensing field, the amplitude signal of oscillator is increases. When the amplitude of the signal increases above the specific value, it is detected by the detector circuit, which is switched off causing the output signal to return to the normal or off state. This type of sensors is mainly used for detecting metallic object.	Figure – 4 Explanation - 3	7	
IV	In washing machines typically have a variety of sensors to ensure efficient and effective operation. These may include **water level sensors**: to detect the amount of water needed for each cycle. **Temperature sensors**: to regulate water temperature. **Load sensors**: to determine the size of the load and to calculate the detergent. **Vibration sensors**: to detect imbalances and prevent excessive shaking during the spin cycle. **Soil level sensors**: to gauge how dirty the clothes are and adjust the wash cycle accordingly. **Proximity sensor**: verifies that the door is closed and latched before start-up		7	

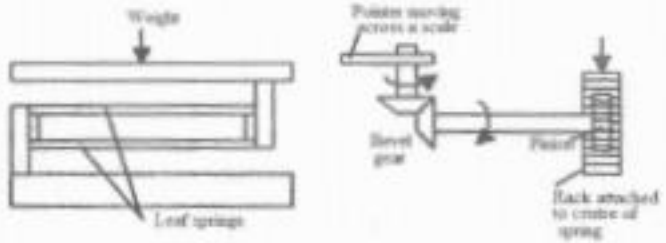
V	 *Basic elements of a hydraulic system* It consist of a pressurized liquid fluid for transmitting energy from generating source to useful work. It is a device used to convert the fluid power into mechanical power to do useful work. It may be classified into linear type or rotary type etc Pressurized oil is provided by a sump driven by an electric motor. The pump pumps the oil through a non return valve and an accumulator to the system, from which it return back to sump.Valves are used to control the direction, pressure and flow rate of a fluid flowing through the circuit. External power supply is required to drive the pump. Pressure relief valve is included for prevent pressure not exceeding the safe limit. The non return valve prevents the oil from return back to pump. Accumulator maintain a constant oil pressure in the system. Reservoir is used to hold the hydraulic liquid. Piping system carries the hydraulic oil from one place to another.Filters are used to remove any foreign particles so as to keep clean the fluid and also avoid damage to actuator valves.	Figure – 4 Explanation - 3	7	
VI.	 The sequence valve is used to control the sequence of operation of double acting cylinder. When the DCV valve is shifted to left envelope configuration, the left cylinder (1) extends fully and then the right cylinder (2) extends. When the DCV is shifted to right envelope configuration, the right cylinder (2) retracts fully and then the left cylinder retracts. The sequence of cylinder operation is controlled by the two sequence valves. When the DCV is in center position, both cylinders are hydraulically locked.	Figure – 4 Explanation - 3	7	

VII	 Process control valve is used to control the rate of flow of liquids for controlling the speed of actuators or into a tank by adjusting the flow rate. The basis of such valves in an actuator is used to move a plug into the flow pipe, so alter the cross-section of the pipe through which the fluid can flow.A common form of pneumatic actuator used with process control valve is diaphragm actuator. Valve consist of a diaphragm with the input pressure signal from controller on one side and atmospheric pressure on other side. The difference of pressure is known as gauge pressure. The diaphragm is made of rubber which is sandwitched in its centre between two circular disc. The effect of changes in the input pressure is thus to move the central part of the diaphragm. The pressure change in actuator causes diaphragm to move valve stem. The result of this movement transferred to inner-valve plug with in the valve body. The plug restricts the fluid flow and so its position determines the flow rate	Figure – 4 Explanation - 3	7	
VIII	It is special type motor that rotates in precisely defined increments of rotor position (steps). It is device which produce rotation according to the digital pulse supplied to input. It is brushless D.C motor, consist of a shaft at center. The shaft has a series of coils mounted on it, and coils are surrounding the shaft are alternately given current or not, creating magnetic fields which repulse or attract the magnets on the shaft, causing the rotor to rotate. Power must be given to one coil after another in the proper sequence in order to get the motor to turn. For obtain maximum torque, two coils are always on at any time. The coils are switched off, the motor is locked in its current position. If load on stepper motor is too high or stepping sequence is too fast , it will skip a step. It requires sequencers and driver. Sequencers indicate the direction of rotation and mode of operation. Driver changes the direction of flux in phase windings. The main feature of stepper motor are High accuracy Reliability (due to brushless)		7	

	Load independent (Motor rotates at set speed under different load with rated torque is maintained) Holding torque (each and every step the motor hold its position with out breakes) The different types of stepper motors are Variable Reluctance Motor (VRM) Permanent Magnet Motor (PMSM) Hybrid Stepper Motor (HSM)			

IX	It is a digital electronics device that uses a programmable memory to store instructions and to implement functions such as logic, sequencing, timing, counting and arithmetic word to control machines and processes The PLC consist of Central Processing Unit (CPU) Memory 3. Input / Output Circuitry. .  **1. Central processing unit (CPU):** It controls and processes all the operations with in the PLC. It consist a clock with a frequency between 1 and 8 MHz. The frequency determines the operating speed of PLC and provides the timing and synchronization for all elements in the system.Bus system carries information and data to and from the CPU, memory, and input/output units. It interprets the input signals and perform the control action according to the program stored in the memory. **2. Memory :** The various memory elements are ROM for permanent storage for operating system and fixed data. RAM for user's program. The programs in RAM can be changed by the user. A battery is used in the PLC to maintain the RAM content for a period of time, to preventing the loss of program, when supply is switched off. The number of program step that can be stored in program memory is a specification of PLC. Typically it is 300 to 1000. **3. Input / Output (I/O) circuiting**: It provides the interface between the system and outside world. It interfaces the actuators and sensors to the CPU and memory. The programs are entered into input unit from key board to screen display. The programs, alternatively entered into system by means of a link to a personal computer . The input or output channel provides signal conditioning and isolation functions so that sensors and actuators directly connected to them with out the need of other circuitry. **4. Buses:** The buses are used for the transfer of data. PLC has four buses. They are data bus, address bus, control bus, and system bus. Data bus transfers the CPU data. Address bus carries the address of the memory locations. The control bus carries timing and control signals of the CPU. System bus is used to transfer the data between the I/O ports and I/O units	Figure – 4 Explanation - 3		

X	Timer is a circuit which is specified by stating the interval to be timed and the conditions or events that are to be start and stop. PLC is incorporated with timers and these timers function with CPU clock signal. It consist relays with coils that when energized, results in the closure or opening of contacts after some preset time. So timer is treated as an output for a rung, with control being exercised pairs of contact. The different types of timers are 1) Timers with pairs of contact 2) Timers with delay  Timer with a pair of contacts	Figure – 4 Explanation 3	7	
XI	The selection of PLC the following criteria are considered Type of input/output required such as • Out-board power supply for input/output • Signal conditioning • Input/output capacity required • Size of memory required. (This is linked to the number of inputs/outputs and the complexity of program used) • Speed and power required for CPU. (This is linked to the number of types of instructions that can be handled by a PLC) • Electrical requirements (Incoming power ie. power for the control system, input device voltage and output voltage-current) • Communication requirements (Sharing data with another electronic device) • Software • Operator interface (Operator needs to convey information about machine) • Physical environments (indicates the environment where the control system is required)	Any seven point	7	

XII	The weight on the platform is used to deflect an arrangement of two parallel leaf springs. The deflection of leaf spring is transferred to the rack and pinion arrangement, where the linear movement of rack is converted into rotary motion of the pinion about the horizontal axis. The rotary motion is transferred to the movement of a pointer across a scale through bevel gears.  Another method is use of microprocessor with load cells and electrical resistance strain gauge. When the person stands on the platform the gauge suffer strain and change resistance. If the gauge are mounted in a four active-arm wheatstone bridge then the out-of-balance voltage output from the bridge is a measure of the weight of the person.	Figure – 4 Explanation 3	7	

XIII	The robot anatomy concerned with the physical construction of the body, arm, and wrist of the machine. **Manipulator:** This is the main body of the robot, the structure doing the manipulation, and consists of the links, joints and other structural elements. **End effector:** It is the hand of the robot. It is in the form of gripper, vacuum pump, blow torch etc. some robot can be change end effectors, and can be reprogrammed for a different set of tasks. **Actuator:** it acts under the command of the controller and translates the signal from the controller to the operational unit in order to perform final action. The most popular actuators for robot are electric motors that rotate a wheel or gear, compressed air or oil that cause pistons to move in cylinder etc. **Sensor:** These are used in robot to collect information about the environment, feed back purpose and about the state of its joint and link. Sensors are classified in to internal state sensor and external state sensor. Internal sensors are used for detection of variables that helps in identifying orientation of tool tip and manipulator joint etc. External sensors are used to detecting variables such as the range of target, proximity of the target etc. **Controller:** Every robot is connected to a computer, which keep the arm working together. The computer along with software is known as controller. It functions as a heart of robot. The controller allows the robot to be configured with other system, so that it arm work and coordinate with other machine, process, The controllers run the programs, which may contain a set of instruction.		7	

XIV	**Activation components** are responsible for providing the robot with the power and energy it needs to move and perform tasks. These components are include **1) Batteries:** Batteries provide robots with a portable source of electrical power. The type of battery used will depend on the size and power requirements of the robot. **2) Fuel cells:** Fuel cells convert chemical energy into electrical energy. They are more efficient than batteries and can provide robots with longer operating times. **3) Solar panels:** Solar panels convert sunlight into electrical energy. They are a sustainable option for powering robots, but they are limited by the availability of sunlight. **4) Motors:** Motors convert electrical energy into mechanical motion. They are used to power the robot's wheels, arms, and other moving parts. **Feedback components** are responsible for providing the robot with information about its environment and its own internal state. This information is used to control the robot's movements and actions. Some common feedback components include **1) Sensors:** Sensors detect changes in the environment, such as temperature, pressure, and light. They can also be used to detect objects and obstacles. **2) Encoders:** Encoders track the position and movement of the robot's joints. This information is used to control the robot's movements and ensure that they are accurate. **3) Cameras:** Cameras provide robots with a visual sense of their environment. This information can be used to navigate, avoid obstacles, and recognize objects.	One mark each	7	