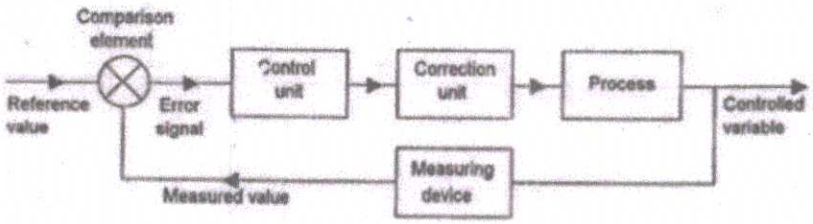
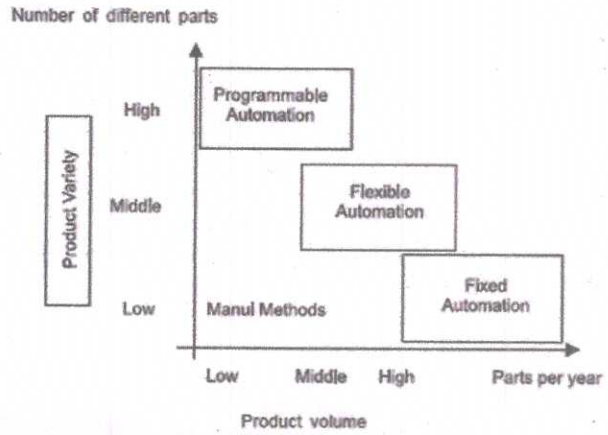
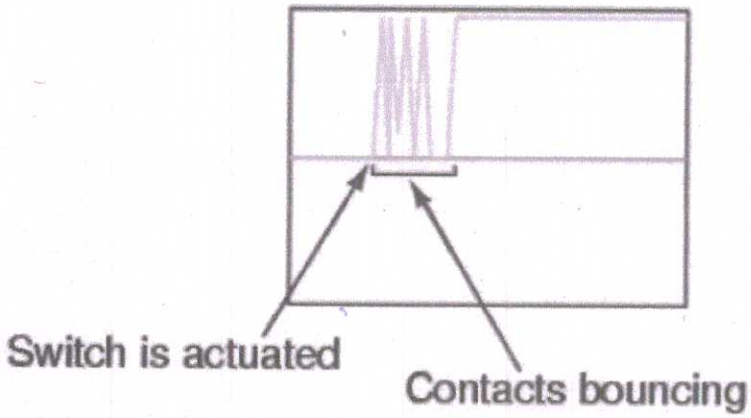
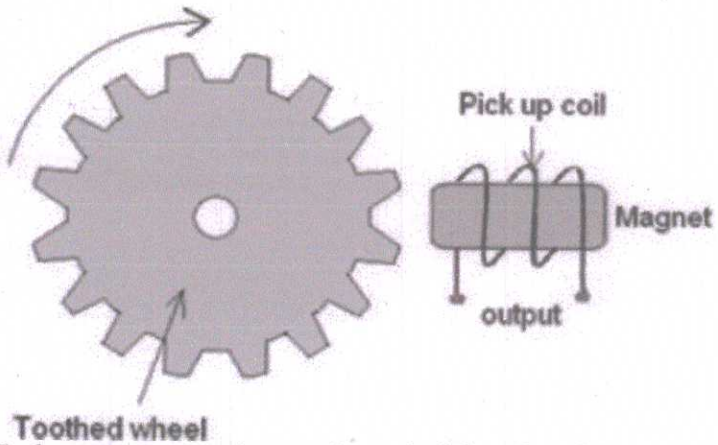
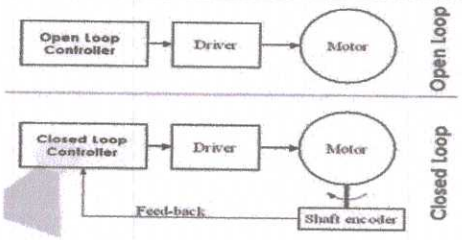
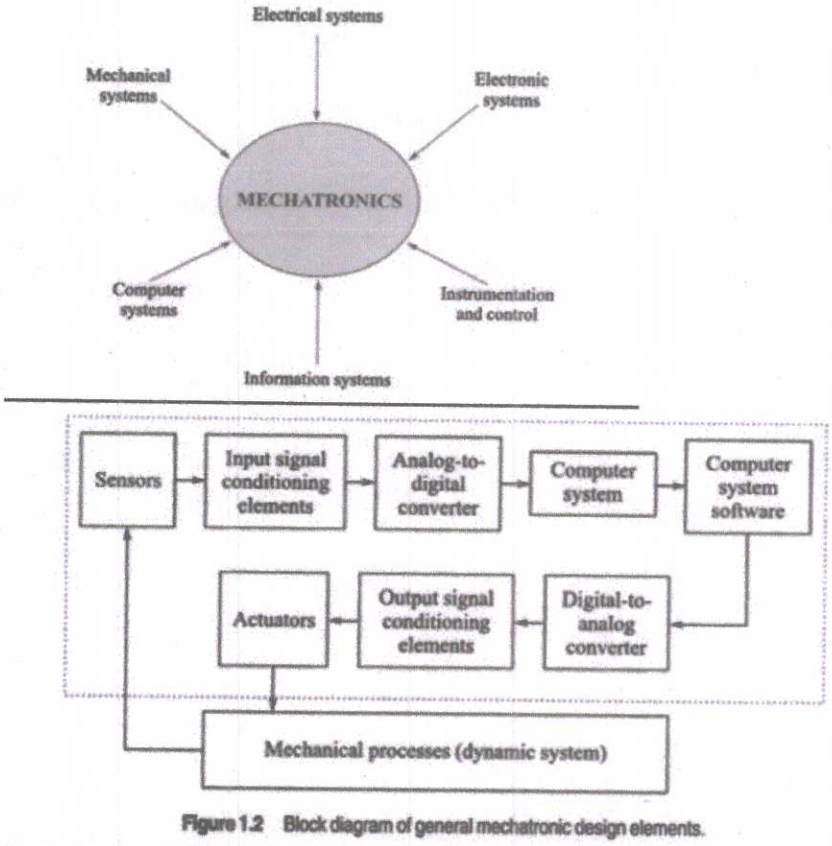
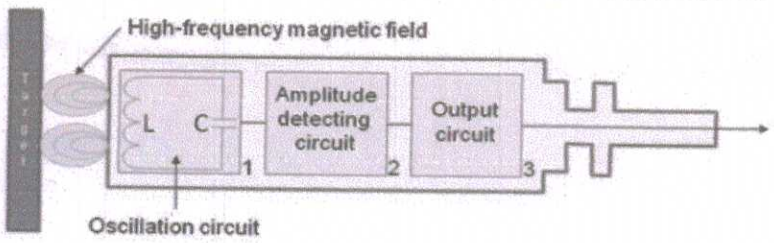
Scoring Indicators

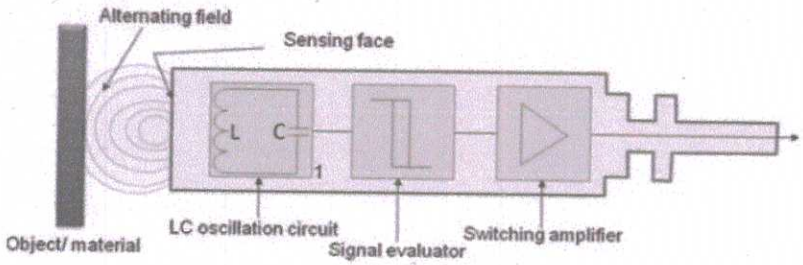
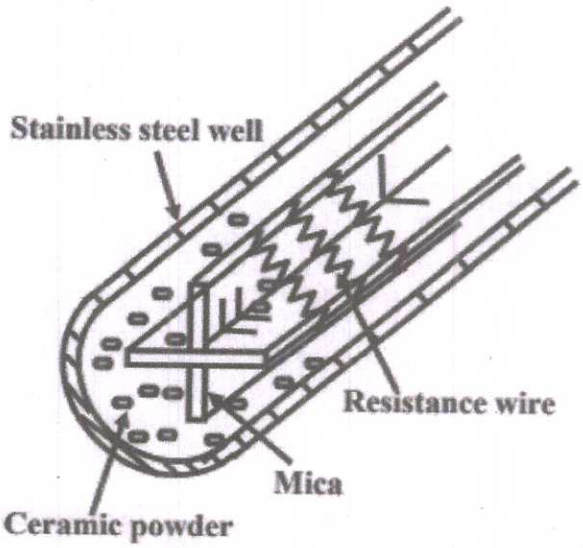
Code: TED (15) 6025 INDUSTRIAL AUTOMATION & MECHATRONICS

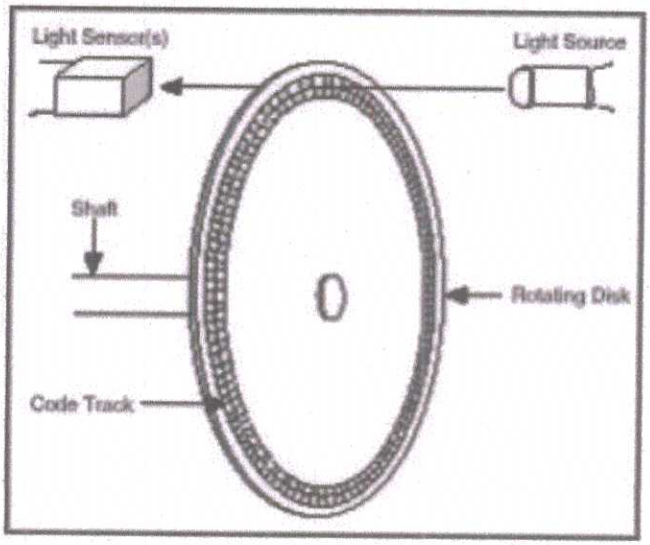
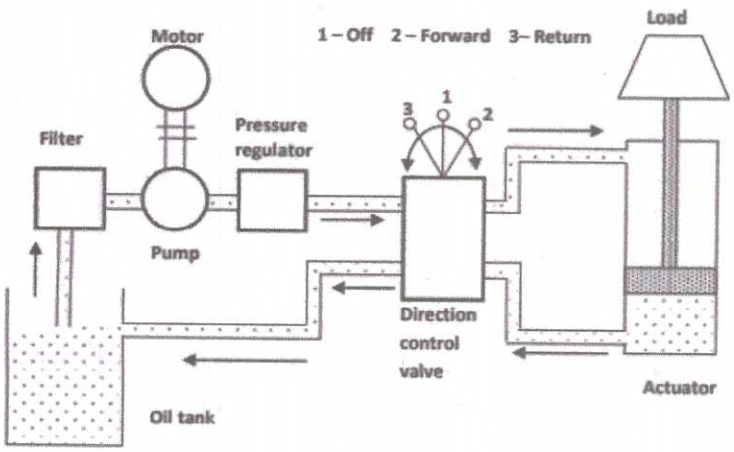
Q No.	Scoring Indicators	Split Score	Total Score
	PART A		
I.1	Automation : Process of following a predetermined sequence of operations with little or no human labour , using specialised equipment and devices that perform and control manufacturing processes	2	2
I.2	• Sensor can be used to sense a wide range of different energy forms such as movement, electrical signals, radiant energy, thermal or magnetic energy etc. • Transducers are used to convert energy of one kind into energy of another kind	2	2
I.3	➢ Thermocouples ➢ Resistor temperature detectors ➢ Thermistors ➢ Infrared sensors ➢ Semiconductors ➢ Thermometers	Any two	2
I.4	➢ a flip-flop or latch is a circuit that has two stable states and can be used to store state information.	2	2
I.5	• instruction list programming • Structured text programming • Function block diagram • Ladder diagram • Sequential function charts	Any two	2
	PART B		
II.1	Advantages commonly attributed to automation include higher production rates and increased productivity, more efficient use of materials, better product quality, improved safety, shorter workweeks for labour, and reduced factory lead times.	1 mark for each point	6
II.2	 1. Comparison element 2. Control element 3. Correction element 4. Process elements 5. Measurement elements	4 mark for figure and 2 for explanation	6
II.3	**Hydraulic system** 1. Uses liquids like water or oil	1marks for each point	6

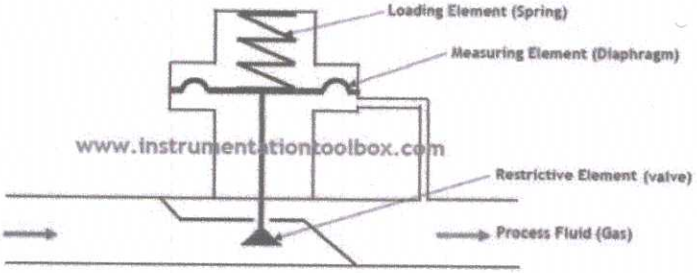
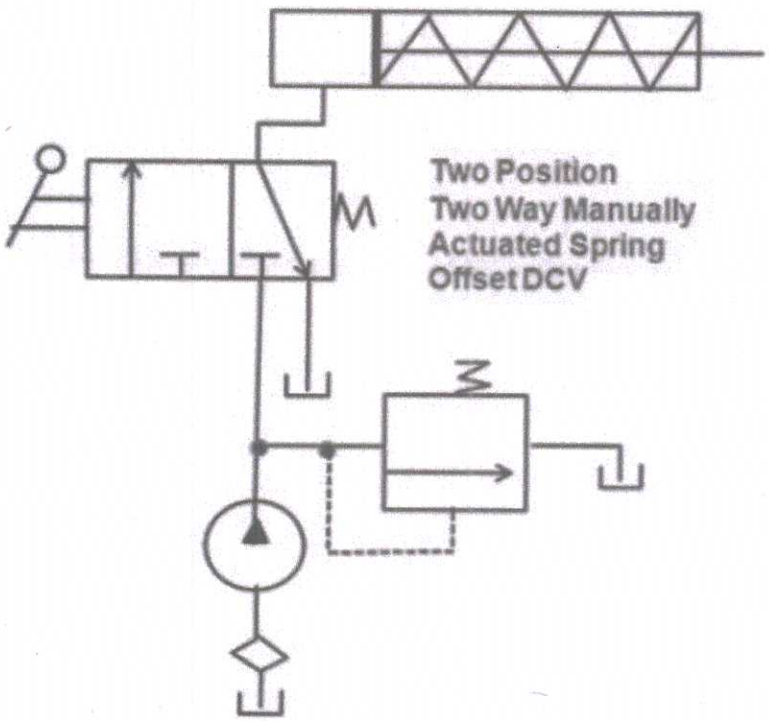
	shaping signal conditioner is used to transform the output into a number of pulses which can be counted by a counter		
II.6	a shift register is a cascade of flip flops, sharing the same clock, in which the output of each flip-flop is connected to the "data" input of the next flip-flop in the chain, resulting in a circuit that shifts by one position the "bit array" stored in it, "shifting in" the data present at its input and 'shifting out' the last bit in the array, at each transition of the clock input.	One mark for each point	6
II.7	They are rugged, withstand industrial environment, such as heat, humidity, mechanical shocks and vibrations • The interfacing for inputs and outputs is inside the controller • They are easily programmed • PLC is capable of both logic and PID control.	2 marks for each point	6
	PART C **UNIT- I**		
III. a	FIXED AUTOMATION(HARD AUTOMATION) PROGRAMMABLE AUTOMATION FLEXIBLE AUTOMATION(SOFT AUTOMATION) ***Types of production automation***  	5 marks for figure point 3 marks for explanation	8
III. b	Traditional system • It is based on traditional systems such as mechanical, hydraulic and pneumatic • Less flexibile • Less accurate • more complicate mechanism in design • involve more components and moving parts Mechatronic system • It is based on mechanical, electronics,computer technology and control engineering • More flexible • More accurate • Less complicated mechanism design • it involves fewer components and moving parts	1mark for each point	7

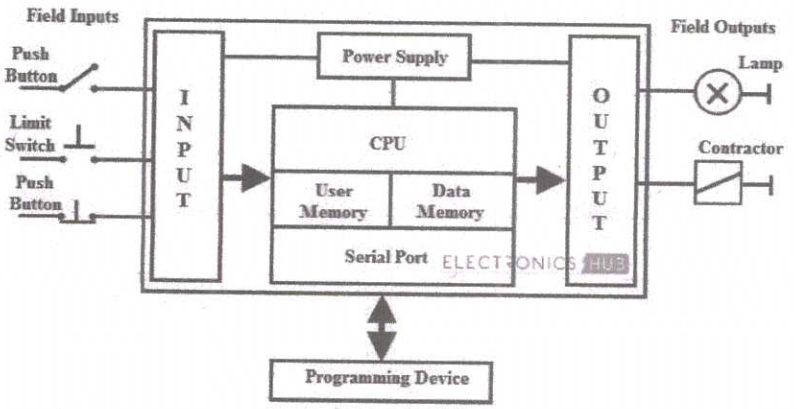
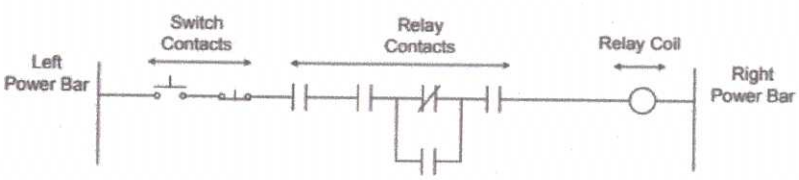
	2. Installation is complex and maintanance cost is high 3. Liquids are in compressible **Pneumatic system** 1. It uses compressed air 2. Readily compressible 3. Used for relatively low forces, fast motion	(max 3 marks in each category)	
II.4	 Switch bouncing is another real-world problem that happens too quickly for human perception but which can doom an electronics project. When a switch is toggled, contacts have to physically move from one position to another. As the components of the switch settle into their new position, they mechanically bounce, causing the underlying circuit to be opened and closed several times. For embedded systems designers, the most common exposure to the problem is with user interface switches, in which proper care must be taken to correctly count the number of times a user presses and releases a switch.	3 Marks for figure and 3 for points	6
II.5	 Tachogenerator works on the principle of variable reluctance. It consists of an assembly of a toothed wheel and a magnetic circuit as shown in figure. Toothed wheel is mounted on the shaft or the element of which angular motion is to be measured. Magnetic circuit comprising of a coil wound on a ferromagnetic material core. As the wheel rotates, the air gap between wheel tooth and magnetic core changes which results in cyclic change in flux linked with the coil. The alternating emf generated is the measure of angular motion. A pulse	3 mark for figure and 3 for explanation	6

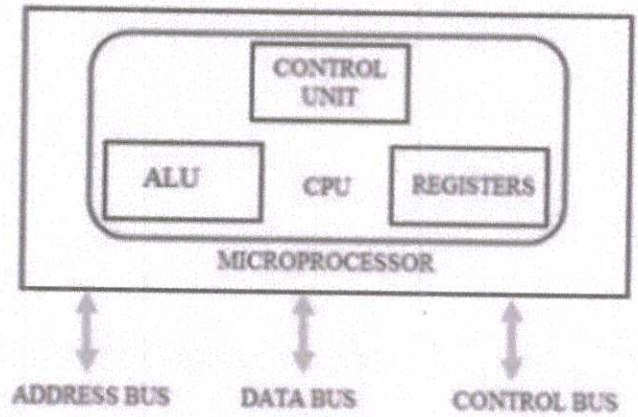
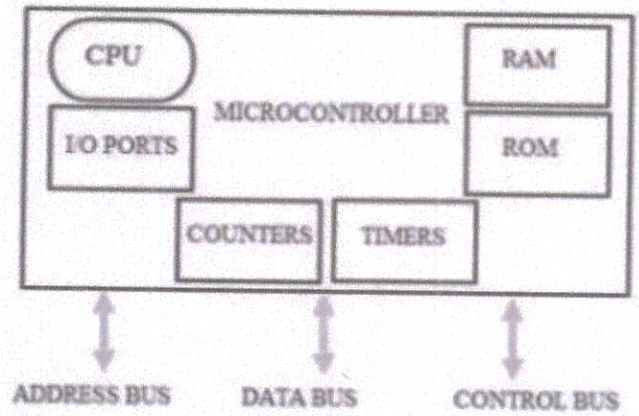
IV. a		4marks for figure point 4marks for calculation	8
IV. b	 Figure 1.2 Block diagram of general mechatronic design elements.	4 marks for figure and 1 mark for each point	7
	UNIT II		
V. a	 Eddy current proximity sensors are used to detect non-magnetic but conductive materials. They comprise of a coil, 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	4 marks for each category	8

	current. This can be used to trigger a switch at some pre-determined level of change in current. Inductive proximity sensor  Inductive proximity switches are basically used for detection of metallic objects. Figure shows the construction of inductive proximity switch. An inductive proximity sensor has four components; the coil, oscillator, detection circuit and output circuit. An alternating current is supplied to the coil which generates a magnetic field. When,a metal object comes closer to the end of the coil, inductance of the coil changes. This is continuously monitored by a circuit which triggers a switch when a preset value of inductance change is occurred.		
V. b	 Resistance thermometers, also called resistance temperature detectors, are sensors used to measure temperature. Many RTD elements consist of a length of fine wire wrapped around a ceramic or glass core but other constructions are also used. The RTD wire is a pure material, typically platinum, nickel, or copper.	1 mark +2 marks for each elements	7
VI.a	An encoder is an electrical mechanical device that converts linear or rotary displacement into digital or pulse signals. The most popular type of encoder is the optical encoder, which consists of a rotating disk, a light source, and a photo detector (light sensor). The disk, which is mounted on the rotating shaft, has patterns of opaque and transparent sectors coded into the disk (see Figure). As the disk rotates, these patterns interrupt the light emitted onto the photo detector, generating a digital or pulse signal output.	5 marks for proper diagram and 3 marks for details	8

			
VI. b	1. Accuracy and precision 2. Environment 3. Excitation 4. Signal conditioning 5. Conversion 6. Processing	1 mark for each points	7
	UNIT III		
VII. a	 Hydraulic systems are power-transmitting assemblies employing pressurized liquid as a fluid for transmitting energy from an energy-generating source to an energy-using point to accomplish useful work. Figure shows a simple circuit of a hydraulic system with basic components.	4 marks for composition and 4 for application	8
VII. b		4marks for figure and 3 marks for explanation	7

			
VIII. a	**AC Motor** The motor that converts the alternating current into mechanical power by using an electromagnetic induction phenomenon is called an AC motor. This motor is driven by an alternating current. The stator and the rotor are the two most important parts of the AC motors. The stator is the stationary part of the motor, and the rotor is the rotating part of the motor. The AC motor may be single phase or three phase. **DC Motor** The DC motor is the device which converts the direct current into the mechanical work. It works on the principle of Lorentz Law, which states that "the current carrying conductor placed in a magnetic and electric field experience a force". And that force is called the Lorentz force. The Flemming left-hand rule gives the direction of the force.	4 marks for each case	8
VIII. b	 Figure shows that the control of a single-acting,spring return cylinder using a three-way two-position manually actuated, spring offset	4 mark for figure and 3 marks for explanation	7

	direction-control valve (DCV). In the spring offset mode, full pump flow goes to the tank through the pressure-relief valve (PRV). The spring in the rod end of the cylinder retracts the piston as the oil from the blank end drains back into the tank. When the valve is manually actuated into its next position, pump flow extends the cylinder. After full extension, pump flow goes through the relief valve. Deactivation of the DCV allows the cylinder to retract as the DCV shifts into its spring offset mode.		
IX. a	 CPU, Processor or Controller: The operations within the PLC is controlled and processed by a main Central Processing Unit (CPU). Memory Unit: It stores the instructions needed to run the program, the data to be processed from input sensors and the data to be sent for output devices. It consists of ROM as a permanent storage for operating system and other data used by the CPU. Power Supply Unit: Power Supply Unit provides the necessary power to the PLC. Input / Output Modules: Input and Output Modules form the physical connections to the field modules to the main controller. I/O modules i.e. sensors and actuators allow the PLC system to interface with the outside world. Program and Programming Device: The heart of the PLC is the CPU and we need to program the CPU as per the requirement. Additional Hardware: In addition to the above mentioned components, some additional components like connectors for connecting external modules (USB, RS232, SD Card, etc.), communication interface for connecting with the network (Ethernet), chassis, etc.	4 Mark for each type and 4 marks for explanation	8
IX. b	Ladder circuits have some common characteristics. They are: 1. Power bar on the far left 2. Current flow from the switches combined to allow flow 3. One or more relay coils at the right 4. Neutral or negative power bar on the right 	5 marks for figure and 2 for explanation	7

X.a	**Microprocessor**  **Microcontroller** 	4 marks for each category	8
X.b	• Visual inspection • Multimeter • Oscilloscope • Logic probe • Logic pulser • Current tracer	7 marks	7