Subject Name: BEM   <u>**Model Answer**</u>   Subject Code: **17302**
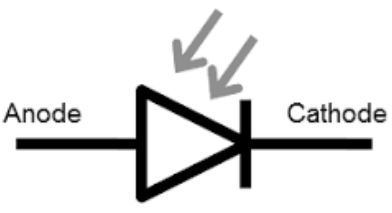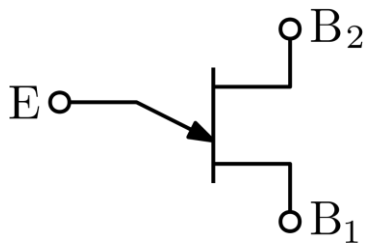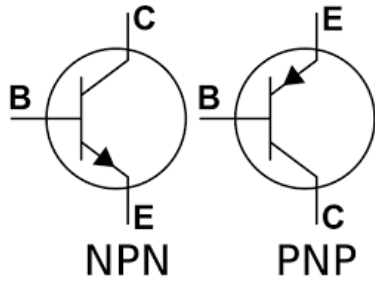
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Important Instructions to examiners:

1) The answers should be examined by key words and not as word-to-word as given in the model answer scheme.
2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.
3) The language errors such as grammatical, spelling errors should not be given more Importance (Not applicable for subject English and Communication Skills.
4) While assessing figures, examiner may give credit for principal components indicated in the figure. The figures drawn by candidate and model answer may vary. The examiner may give credit for any equivalent figure drawn.
5) Credits may be given step wise for numerical problems. In some cases, the assumed constant values may vary and there may be some difference in the candidate's answers and model answer.
6) In case of some questions credit may be given by judgement on part of examiner of relevant answer based on candidate's understanding.
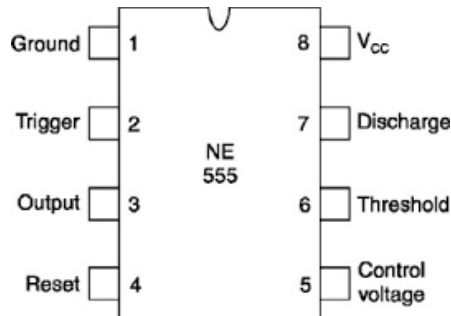7) For programming language papers, credit may be given to any other program based on equivalent concept.

Q. No.	Sub Q. N.	Answer	Marking Scheme
1	a (i)	**Draw symbol and label the terminal of:** **1. Photo diode** **2. UJT** Photodiode symbol	1 M each
	ii)	**Define Intrinsic and Extrinsic semiconductor.** Intrinsic- The pure form of the semiconductor is known as the intrinsic semiconductor Extrinsic- The semiconductor in which intentionally impurities are added for making it conductive is known as the extrinsic semiconductor.	1 M each
	iii)	**List types of BJT and draw symbols of the same with neat labels** **Types -** NPN transistor & PNP transistor	List - 1 M Symbol-

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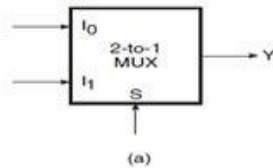
_____

NPN   **PNP**

1 M

iv) **Sketch pin diagram of IC-555 and label all pins.**

2 M

v) **Draw logical symbol of 2:1 mux, and write its truth table.**

Symbol- 1 M

TT - 1 M

(a)

S	Y
0	I_0
1	I_1

(b)

vi) **What is transducer? How they are classified?**

Transducer - It converts one form of signal into another form.

A transducer is a device that is used to convert a physical quantity into its corresponding electrical signal.

1 M each

Classification - 1. Active transducer

               2. Passive transducer

vii) **What is Mechatronics? Write its applications.**

Mechatronics is a branch of engineering that focuses on designing, manufacturing and maintaining products that have both mechanical and electronic components.

Applications

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	digitally controlled combustion engines, robots, automated guided vehicles home appliances such as dish washer and washing machines. automatic air conditioning systems unmanned aerial vehicles and automatic pilots.		1 M each

viii)

State types of real time mechatronics system

1 M each

Hard real-time: missing deadlines may cause catastrophic consequences
Examples: Airbags, ABS
Soft real-time: meeting deadlines is desirable for performance reasons, but missing them is not critical
Examples: command interpreter of the user interface

B
i)

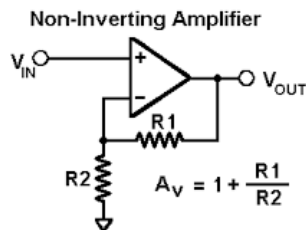### Compare microprocessor and microcontroller (any four points)

Microprocessor	Microcontroller
Do not have inbuilt RAM or ROM	Inbuilt RAM or ROM
Do not have inbuilt Timer	Inbuilt Timer
I/O Ports are not available, it required 8255 for interfacing	I/O Ports are available
Do not have inbuilt serial port, it required extra devices like 8251.	Inbuilt serial port
Program and data are stored in same memory.	Separate memory to store program and data
Boolean operation is not possible directly	Boolean operation is possible
Many instruction to access external memory access.	Few instructions for external memory access
Less multifunction pins on the IC	Many multifunction pins on the IC

1 M to each point

B
ii)

Sketch circuit diagram of non-inverting Op-amp. Calculate gain if Rf=25KΩ, Ri= 5KΩ
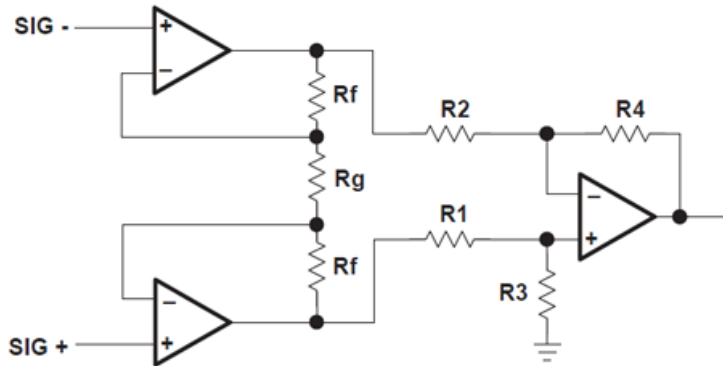
Non-Inverting Amplifier

V_{IN} + V_{OUT}

R1

R2 $A_v = 1 + \dfrac{R1}{R2}$

Av= 6

Dia- 2 M

Gain- 2M

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	B iii)	**List any four advantages and applications of CNC system** **Advantages:-** 1. CNC machines can be used continuously 24 hours a day. 2. CNC machines are programmed with a design which can then be manufactured hundreds or even thousands of times. Each manufactured product will be exactly the same. 3. Less skilled/trained people can operate CNCs unlike manual lathes / milling machines etc.. which need skilled engineers. 4. CNC machines can be updated by improving the software used to drive the machines 5. CNC machines can be programmed by advanced design software such as Pro/DESKTOP®, enabling the manufacture of products that cannot be made by manual machines, even those used by skilled designers / engineers. 6. Modern design software allows the designer to simulate the manufacture of his/her idea. There is no need to make a prototype or a model. This saves time and money. 7. One person can supervise many CNC machines as once they are programmed they can usually be left to work by themselves. **Applications-** - Lathe machine - milling machine - grinding unit - sheet metal press machine - tube bending machine - welding machine	2 M each
2.	a	**What is thermal runaway? How it is avoided?** **Thermal runaway** The problem with increasing temperature causing increasing collector current is that more current increase the power dissipated by the transistor which, in turn, increases its temperature. This self-reinforcing cycle is known as *thermal run away*, which may destroy the transistor. To avoid thermal runaway a heat sink is used. A **heat sink** is a passive heat exchanger that transfers the heat generated by an electronic or a mechanical device to a fluid medium, often air or a liquid coolant, where it is dissipated away from the device, thereby allowing regulation of the device's temperature at optimal levels.	2 M each
	b.	**Draw instrumentation amplifier and write its output voltage equation**	Draw- 3

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$$V_O = [(Sig +) - (Sig -)] \times \left[\frac{R4}{R2} \times \left[\frac{2Rf}{Rg} + 1 \right] \right]$$

R1=R2 and R3=R4

What is Barkhausen's criteria? Which type of feedback is used in an oscillator? State types of oscillator.

Barkhausen's Criteria - To obtain sustain oscillation the loop gain AB = 1 and phase shift of feedback signal should be 0^0 or 360^0 of an amplifier. it is called as barkshausen's criteria.

Positive feedback is used for oscillator.

Types - RC oscillator

        LC Oscillator

Define load regulation and line regulation

Load Regulation Load regulation is the ability of the power supply to maintain its specified output voltage given changes in the load. This does not mean the tolerance applies when there are sudden changes in load, it means over the permissible load range the regulation can change by this amount.

Line regulation Line regulation is the ability of the power supply to maintain its specified output voltage over changes in the input line voltage. It is expressed as percent of change in the output voltage relative to the change in the input line voltage.
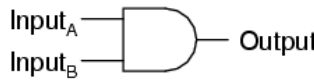
Sketch symbol and write truth table of:

2	
c	M Eq- 1 M Criteria- 2 M Feedback type- 1M Osc. type- 1M
d	2 M each

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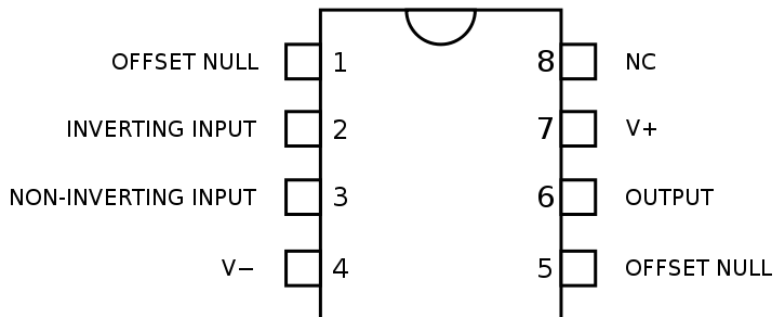|			
	e	**i) AND gate ii) NAND gate** 2-input AND gate NAND gate 	2 M each
	f	**State function and application of robotic system** **Function -** To do the work that can substitute for humans and replicate human actions **Applicatios -** Military robots Industrial robots Agriculture robots Household robots Medical robots Nano robots Swarm robots	Fun- 2 M App- 2M
3		Attempt any four	16
	a	Pin Diagram of IC741 And Function of Each Pin 	02
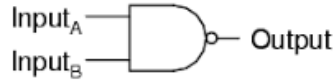
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Pin No. 1 and pin no.5 (Offset Null)

Input offset voltage must be controlled so as to minimize offset. Offset voltage is nullify by application of a voltage of opposite polarity to the offset. An offset null-adjustment potentiometer may be used to compensate for offset voltage. The null-offset potentiometer also compensates for irregularities in the operational amplifier manufacturing process which may cause an offset. Consequently, the null potentiometer is recommended for critical applications.

Pin 2 (Inverted Input): All input signals at this pin will be inverted at output pin 6. Pins 2 and 3 are very important (obviously) to get the correct input signals or the op amp can not do its work.

Pin 3 (Non-Inverted Input): All input signals at this pin will be processed normally without invertion. The rest is the same as pin 2.

Pin 4 (-V): The V- pin (also referred to as Vss) is the negative supply voltage terminal. Supply-voltage operating range for the 741 is -4.5 volts (minimum) to -18 volts (max), and it is specified for operation between -5 and -15 Vdc. The device will operate essentially the same over this range of voltages without change in timing period.

Pin 6 (Output): Output signal´s polarity will be the oposite of the input´s when this signal is applied to the op-amp´s inverting input. For example, a sine-wave at the inverting input will output a square-wave in the case of an inverting comparator circuit.

Pin 7 (+V): The V+ pin (also referred to as Vcc) is the positive supply voltage terminal of the 741 Op-Amp IC. Supply-voltage operating range for the 741 is +4.5 volts (minimum) to +18 volts (maximum), and it is specified for operation between +5 and +15 Vdc. The device will operate essentially the same over this range of voltages without change in timing period. Actually, the most significant operational difference is the output drive capability, which increases for both current and voltage range as the supply voltage is increased.

Pin 8 (N/C): The ´N/C´ stands for ´Not Connected´. There is no other explanation. There is nothing connected to this pin, it is just there to make it a standard 8-pin package.

02

b	Comparison of RC coupled Amplifier with Transformer Coupled Amplifier.

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Parameter	RC Coupling	Transformer Coupling	01 *4 = 04
Coupling Element	Resistor and Capacitor	Transformer	
Distortion	Less distortion	More Distortion	
Voltage Gain	Less Voltage gain as compared to transformer coupled amplifier.	More Voltage Gain	
Applications	For voltage Amplification	For Power Amplification	

Any other suitable and relevant Applications may be consider.

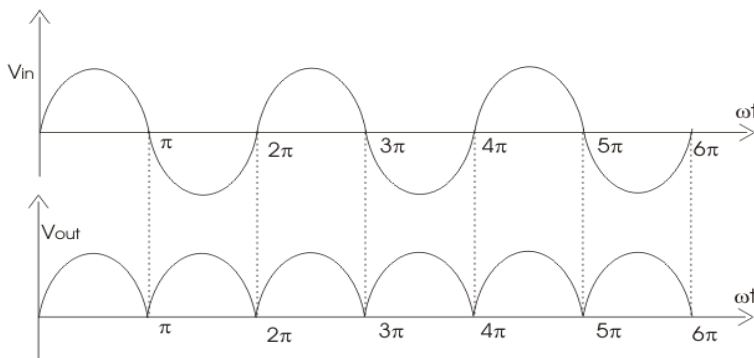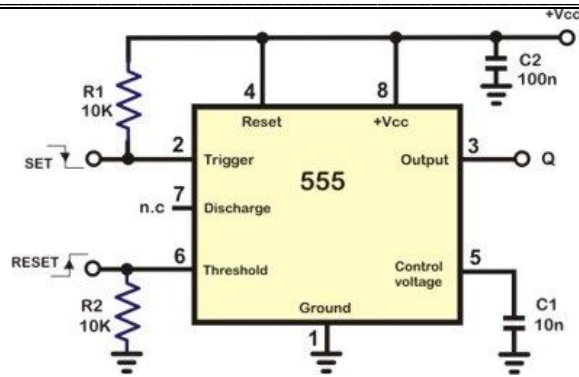|			
c	**Full Wave Bridge Rectifier:** Circuit diagram & input output waveform		

Circuit Diagram:-
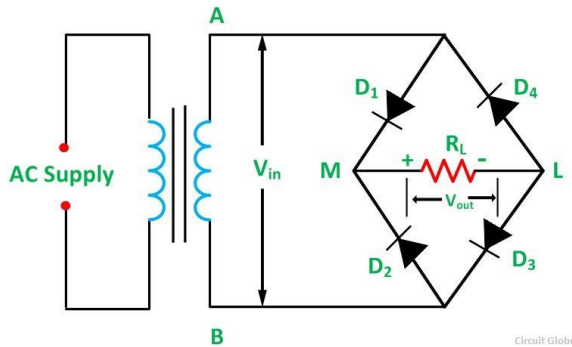
02

Input output Waveforms

02

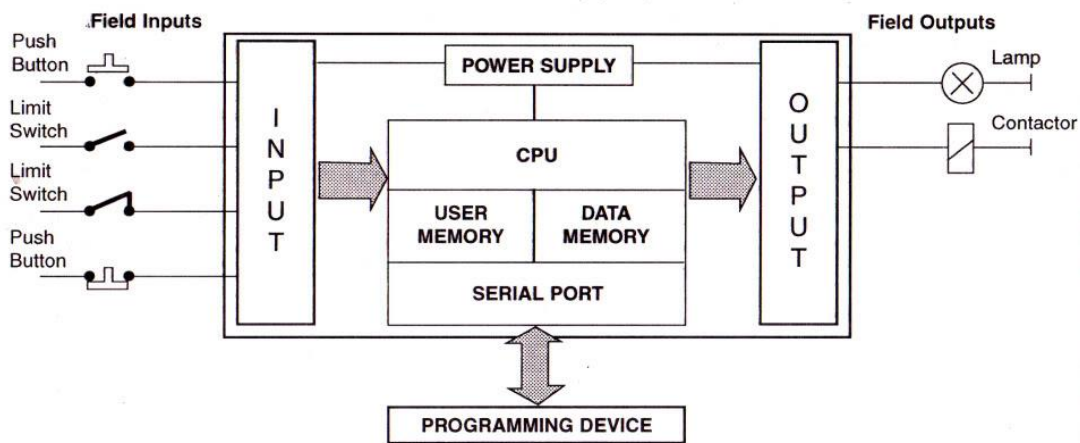| d | **Bistable Multivibrator using IC555 and its waveform:-** | |

_____

Waveforms:-
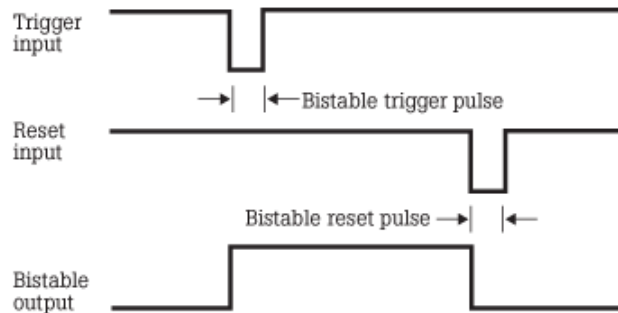
02

02

e	Block Diagram Of PLC and function of each Block	

02

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

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		all operation within PLC. The CPU makes decision and executes control instructions based on the program instruction in memory.	02

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.

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. User memory contains user's application program.

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. It is also used to troubleshoot the PLC ladder logic program. Hand held terminal (HHT) or dedicated terminal or personal computer are programming devices commonly used in most of the PLCs.

	f	**Comparison of Active and Passive Transducer**	

Active transducer	Passive transducer
The active transducer is also called as self-generating type transducer.	The passive transducer is also called as externally powered transducer.
The active transducer does not require any auxiliary (external) power supply.	The passive transducer requires auxiliary (external) power supply for transduction.
The signal conversion is simpler.	The signal conversion is more complicated.
The energy required to produce output is obtained from the physical quantity.	They also derived part of the power required for conversion from physical quantity under measurement.

01*4=04

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Example of active transducer is bourdon tube.	Example of passive transducer is LVDT (linear variable differential transformer).
It generates electric current or voltage directly in response to environmental stimulation.	It gives a change in some passive electrical quantity, such as capacitance, resistance or inductance, as a result of stimulation.

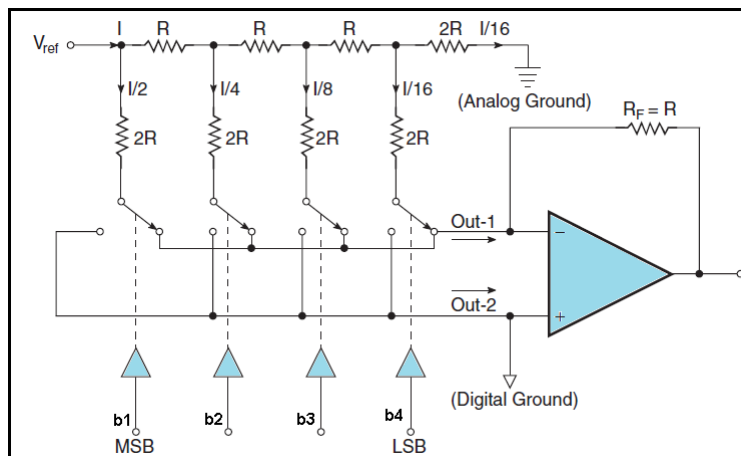**Any other suitable and relevant point may be considered.**

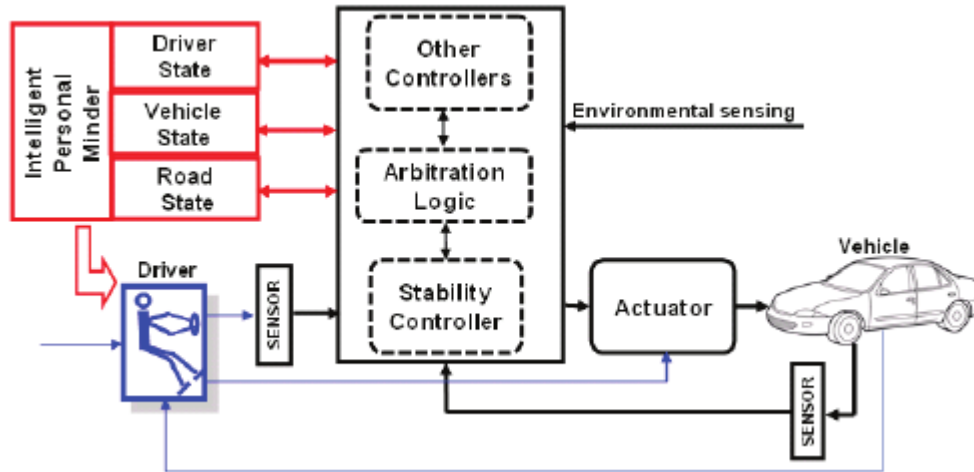| 4		Attempt any Four	16
	a	Principle of R-2R type DAC and its Applications R-2R ladder consist of ladder or network of resistor with value R and 2R, the digital input is applied to each 2R resistor and by kirchoff's law the equivalent voltage is applied at inverting input of unity gain amplifier using opamp. And output is analog which is directly proportional to digital input. **Applications:-** DACs are used in many digital signal processing applications and many more applications. Some of the important applications are. 1. Audio Amplifier 2. Video Encoder 3. Display Electronics 4. Data Acquisition Systems Any other suitable and relevant application may also be considered.	02 (Circuit diagram is also expected) Any two each of 01 Marks = 02
	b	**Advance Vehicle Condition system (AVCS)**: General block diagram is expected .only principle of AVCS is expected. The students may explain with different block diagram but	

_____

		their logic or basic should be same. So depending upon diagram student should explain the blocks. One of the block diagram is shown below. 	02marks for BD and 02marksfor explanation
	c	**Features of 8085 Microprocessor.** 1. **It is 8 bit microprocessor.** 2. **It has 16 bit address line.** 3. **Memory capacity of 64KB.** 4. **Serial input output facility is available.** 5. **256 I/O devices can be connected.** 6. **It requires only positive 5V supply.** 7. **DMA facility is also available.** 8. **Interrupt facility is available.** **Any other suitable and relevant feature may also be considered.**	Min. 8 features 0.5*8=04
	d	**Data Logger and its application** **A data logger or data recorder is an electronic device that records data over time or in relation to location either with a built in instrument or sensor or via external instruments and sensors. Increasingly, but not entirely, they are based on a digital processor (or computer).** **Applications:-** **Manufacturing Food processing** **General research Monitoring in buildings** **Automotive Public utilities** **Civil engineering Environmental monitoring**	02 + 02 (min. 2 applications) =04

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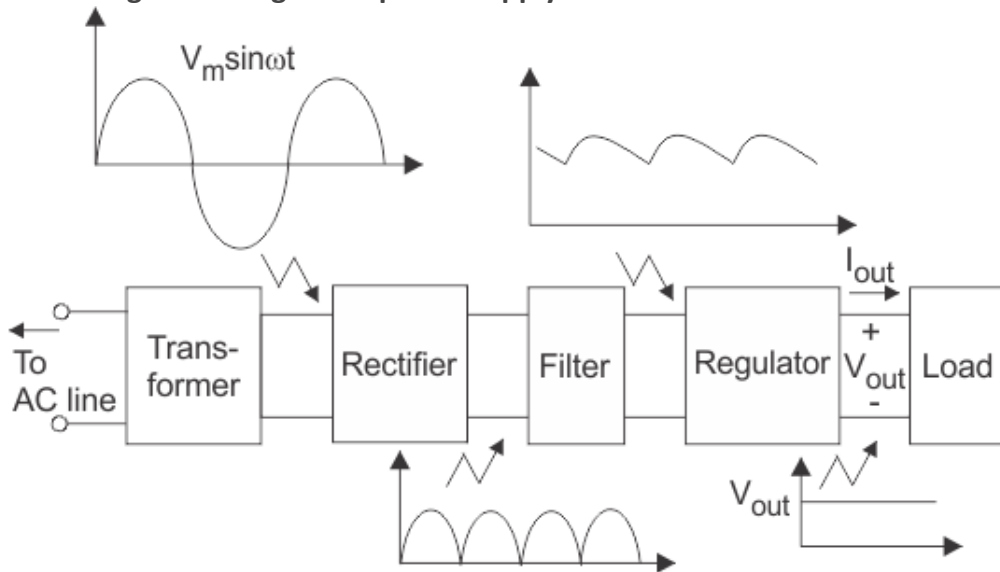|			
e		Ladder diagram for start and stop logic with one input push button for start and one push button for stop and one output for motor to activate solenoid valve.	04
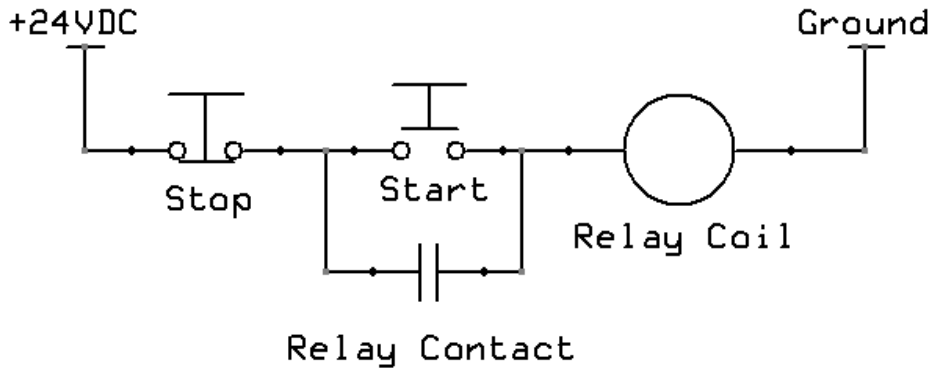
Students may exchange the positions of the switches. Logic must be same.

f		**Block diagram of Regulated power supply and function of each block.**	02

Components of typical linear power supply
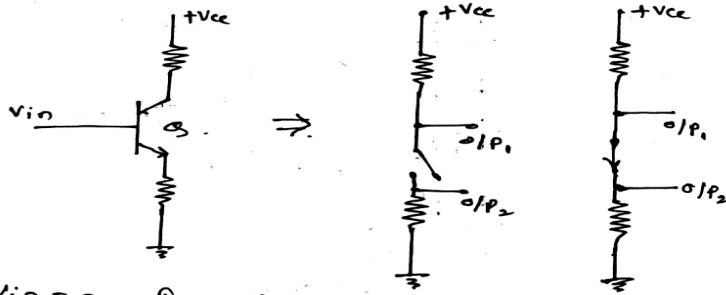
Operation of Regulated Power Supply

Step Down Transformer
A step down transformer will step down the voltage from the ac mains to the required voltage level. The turn's ratio of the transformer is so adjusted such as to obtain the required voltage value. The output of the transformer is given as an input to the rectifier circuit.

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		Rectification	02
		Rectifier is an electronic circuit consisting of diodes which carries out the rectification process. Rectification is the process of converting an alternating voltage or current into corresponding direct (DC) quantity. The input to a rectifier is ac whereas its output is unidirectional pulsating DC. Usually a full wave rectifier or a bridge rectifier is used to rectify both the half cycles of the ac supply (full wave rectification).	
		DC Filter	
		The rectified voltage from the rectifier is a pulsating DC voltage having very high ripple content. But this is not we want, we want a pure ripple free DC waveform. Hence a filter is used. Different types of filters are used such as capacitor filter, LC filter, Choke input filter, π type filter.	
		Regulation	
		This is the last block in a regulated DC power supply. The output voltage or current will change or fluctuate when there is change in the input from ac mains or due to change in load current at the output of the regulated power supply or due to other factors like temperature changes. This problem can be eliminated by using a regulator. A regulator will maintain the output constant even when changes at the input or any other changes occur. Transistor series regulator, Fixed and variable IC regulators or a zener diode operated in the zener region can be used depending on their applications. IC's like 78XX and 79XX are used to obtained fixed values of voltages at the output.	
05		Attempt any **four**	02 Marks
	a)	**Ac signal conditioning :** Ac Signal conditioning is the manipulation of a signal from a sensor or transducer in a way that prepares it for the next stage of processing. It includes amplification, modulation, sampling, filtering etc.	
		Types of circuits used in AC signal Conditioning a) Calibration and zeroing network (offset nullifying circuit) b) AC amplifier c) Phase detector d) Low pass filter e) Power supply	02 Marks
	b)	**Transistor as switch**	02 Marks
		Case I: When Vin =0 then base current of transistor will be zero hence collector current is zero. Transistor is in cutoff region. which indicates that the switch is OFF. Case II: When positive Vin is applied then base and collector current flows through the circuit. Transistor is in saturation region which indicates that the Switch is ON.	
			01 Mark

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Transistor as a switch:
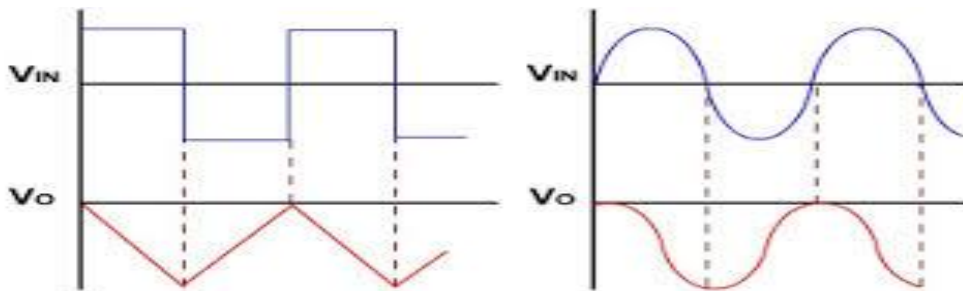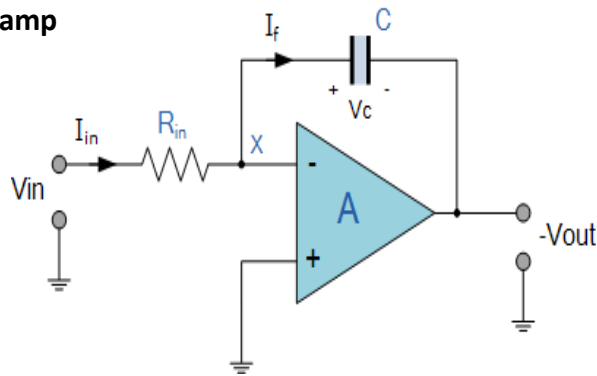
Vin = o   Transistor is off switch
Vin = +v   Transistor is on switch
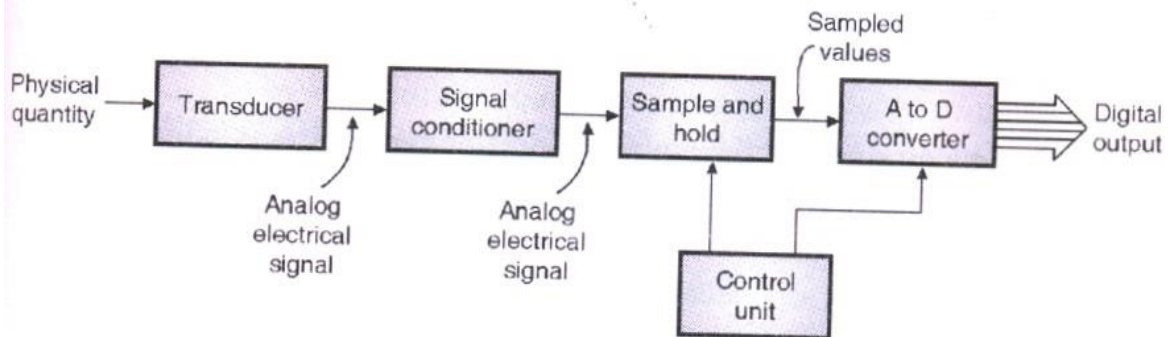One may take o/p from collector or emitter

01 Marks

c)	**Integrator using OPamp**	02 Marks	
		02 Marks	
d)	**Single channel DAS**	02 Marks	

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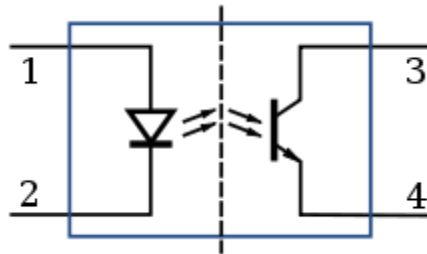
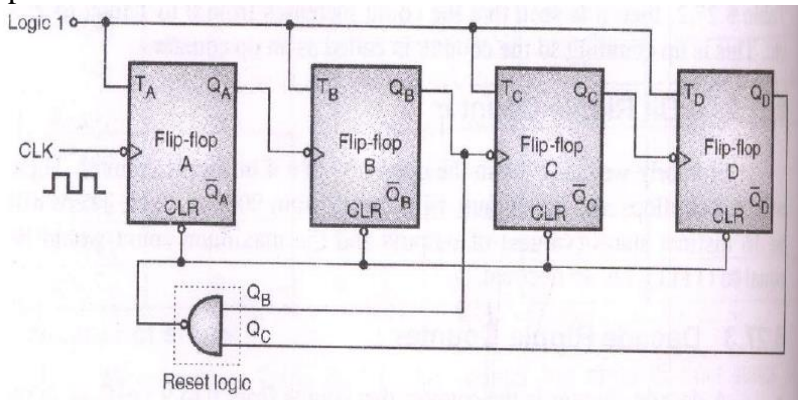|		**Explanation:**	02 Marks
		- Single channel data acquisition system is used to convert only single physical quantity into it equivalent digital form	
		- It consists of transducer, signal conditioner, sample & hold circuit and ADC.	
		- Transducer: It converts physical quantity into analog electrical signal.	
		- Signal conditioner: Analog electrical signal is processed & boost by this circuit.	
		- Sample & Hold circuit: It samples the analog signal at regular interval and converts it into discrete signal.	
		- ADC: It is used to convert each sampled value into equivalent digital signal.	
	e)	**Opto coupler**: optocoupler, photocoupler, or optical isolator, is a component that transfers electrical signals between two isolated circuits by using light. **Advantages:** - Control circuits are well protected due to electrical isolation. - Wideband signal transmission is possible. - Due to unidirectional signal transfer, noise from the output side does not get coupled to the input side. - Interfacing with logic circuits is easily possible. - It is small size & light weight device.	01 Mark 01 Mark (Any 2) 02 Marks
	f)	Decade counter using T flipflop 	02 marks

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Clock Count	Output bit Pattern				Decimal Value
	QD	QC	QB	QA	
1	0	0	0	0	0
2	0	0	0	1	1
3	0	0	1	0	2
4	0	0	1	1	3
5	0	1	0	0	4
6	0	1	0	1	5
7	0	1	1	0	6
8	0	1	1	1	7
9	1	0	0	0	8
10	1	0	0	1	9
11	Counter Resets its Outputs back to Zero				

02 marks

6 a) Decoder : It is a combination logic circuit used to select a device or decode. Decoders consist of number of inputs (N) and number of output(M) and both are related as $2^N >=$ M The standard decoders are 1:2,2:4,3:8 and so on……
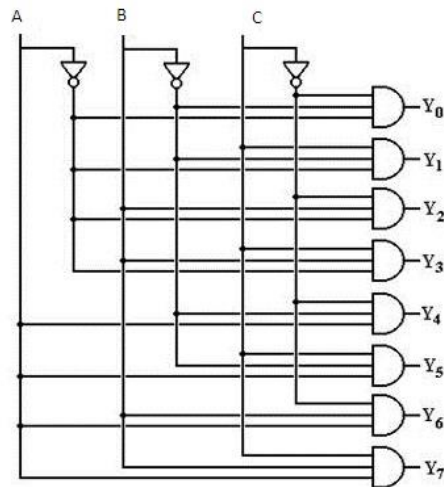
01 Mark

Truth Table

02 Mark

Inputs				Outputs							
EN	A	B	C	Y_7	Y_6	Y_5	Y_4	Y_3	Y_2	Y_1	Y_0
0	×	×	×	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	0	0	1
1	0	0	1	0	0	0	0	0	0	1	0
1	0	1	0	0	0	0	0	0	1	0	0
1	0	1	1	0	0	0	0	1	0	0	0
1	1	0	0	0	0	0	1	0	0	0	0
1	1	0	1	0	0	1	0	0	0	0	0
1	1	1	0	0	1	0	0	0	0	0	0
1	1	1	1	1	0	0	0	0	0	0	0

01 mark

b) **SELECTION CRITERIA FOR PLC (ANY 4)**

a) Type of PLC: Analog or Digital

b) Number of inputs and outputs to PLC

c) Operating voltage and operating current range

d) Scan time of PLC

e) Memory size of PLC

f) Type of memory of PLC

g) Type of programming
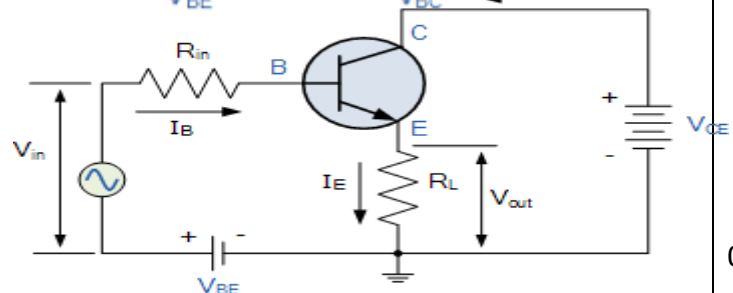
h) Reliability of PLC

i) Flexibility of PLC

01 mark for each correct answer
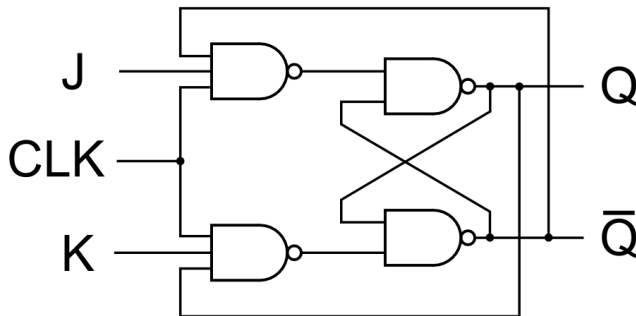
c)

CB CONFIGURATION OF BJT
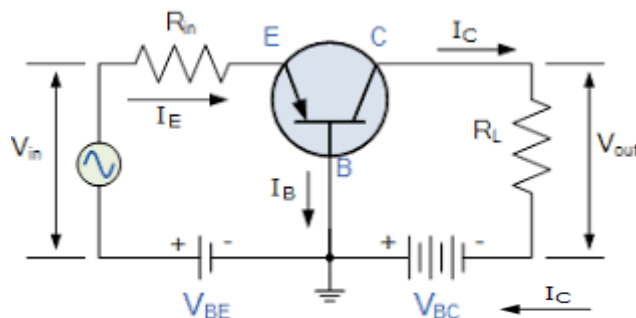
02 Marks

CE CONFIGURATION OF BJT

02 Marks

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SUMMER– 18 EXAMINATION

Subject Name: BEM   <u>**Model Answer**</u>   Subject Code: **17302**

d)			02 Marks
	Race around condition		
	- Race around condition occurs when all inputs of J-K flip flop are 1 (J=K=CLK=1).		02 Marks
	- J-K flip flop keep toggling indefinitely as long as J=K=CLK=1 and that condition is known as race around condition.		
e)	**Compare full wave rectifier and half wave rectifier**		01 mark for each correct point

Parameters	Half-Wave Rectifiers	Full-Wave Rectifiers
Number of diodes	Only 1	2 or 4
Output Voltage	Available only for half cycle of AC input	Available for both cycle of AC input
Ripple Factor	1.21	0.482
Rectification Efficiency	40.6%	81.2%

f)	The output of a flip flop can be changed by bring a small change in the input signal. This	02 Marks

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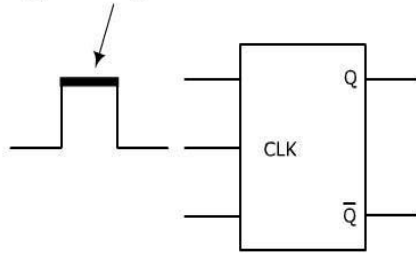**Subject Name: BEM**   <u>**Model Answer**</u>   Subject Code: **17302**

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small change can be brought with the help of a **clock pulse** or commonly known as a trigger pulse. When such a trigger pulse is applied to the input, the output changes and thus the flip flop is said to be triggered.
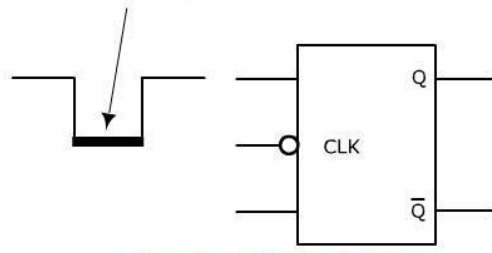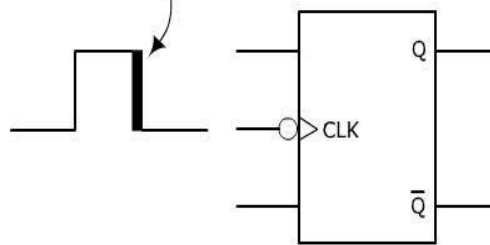
Types of triggering :

1)

High Level Triggering

2)

Low Level Triggering

03)

Negative Edge Triggering

4)
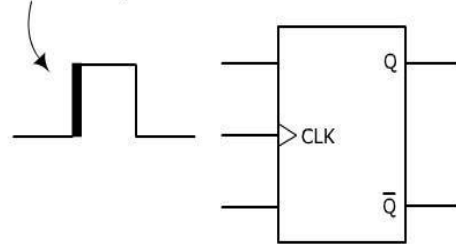
Positive Edge Triggering

½ Marks for each type and waveform