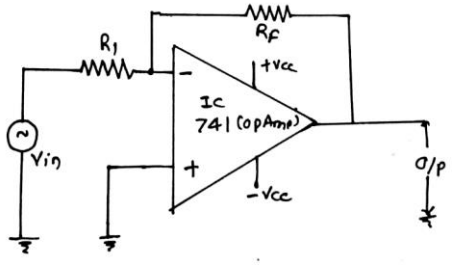
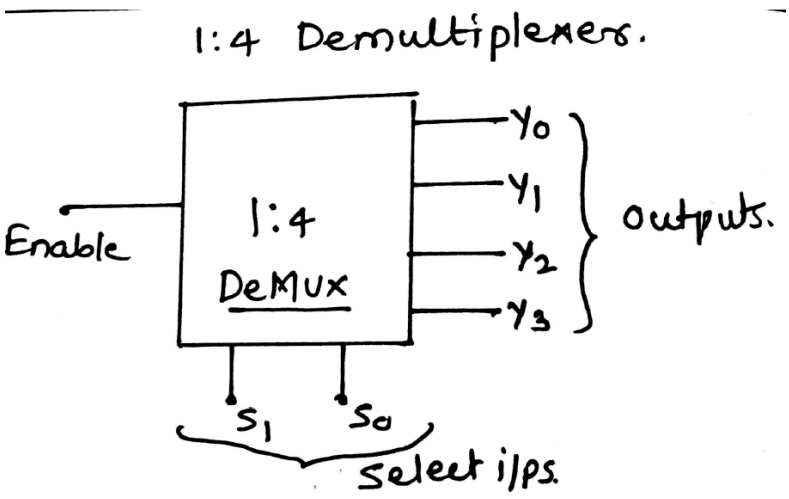
WINTER– 14 EXAMINATION

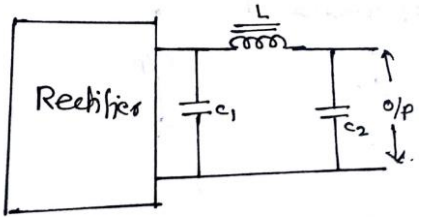
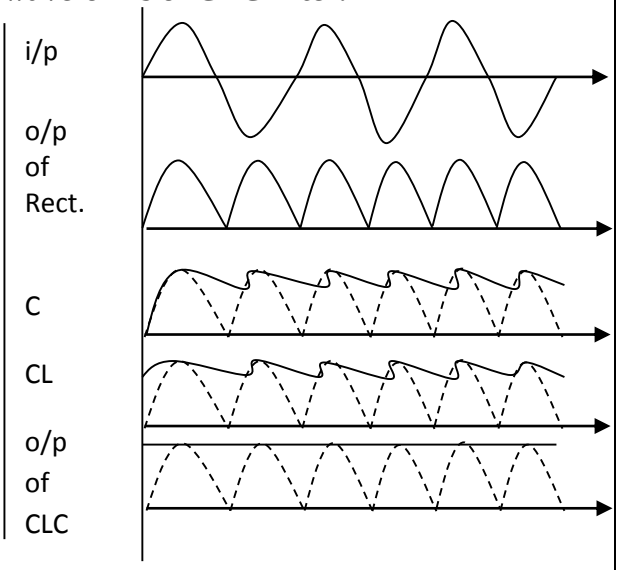
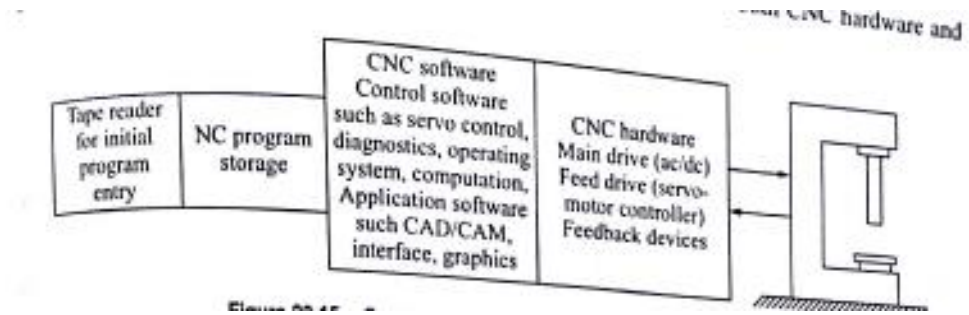
Subject Code:17302 **Model Answer**

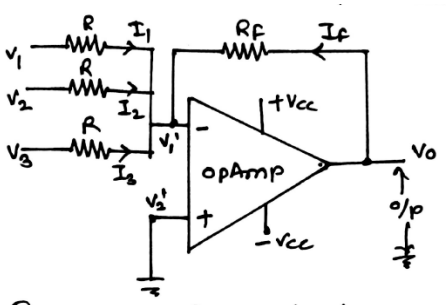
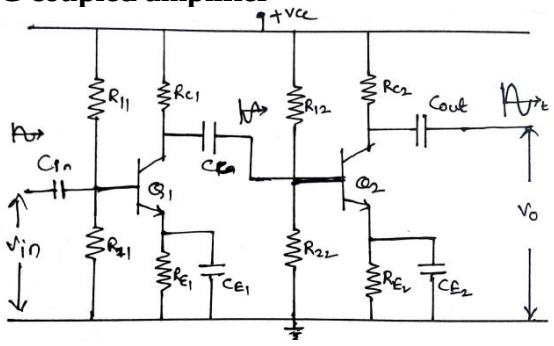
Important Instructions to examiners:

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.

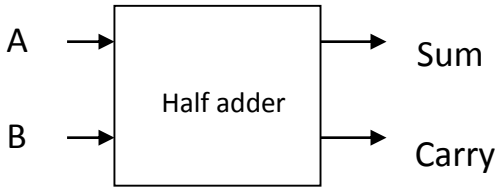
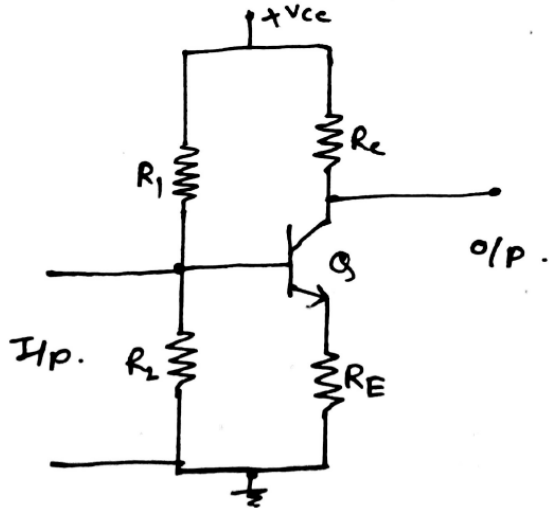
		Model Answer/Solution	Marks
1	a	Continue……	

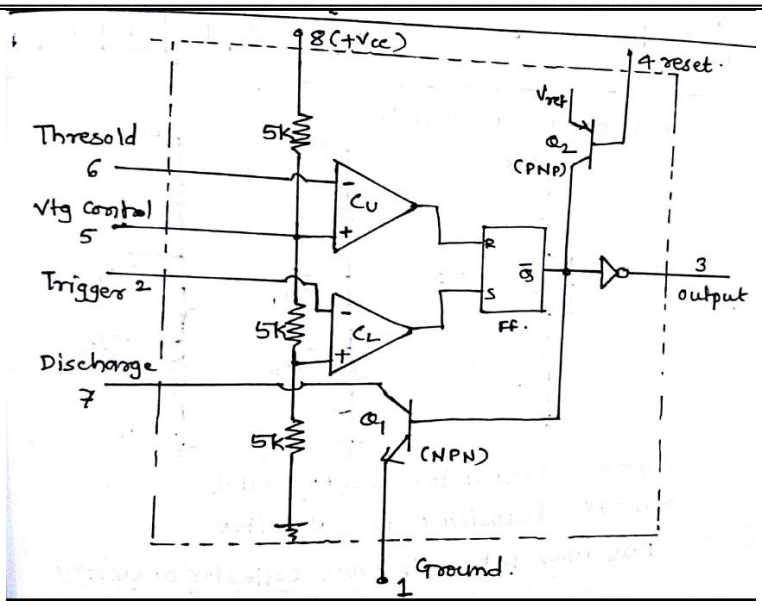
Q.No		Model Answer/Solution	Marks
1	a	Attempt any SIX of the following:	12
	i	**Symbol of Zener diode and UJT** 	01 + 01
	ii	**Rectifier :-** A device or circuit which converts AC input signal into pulsating DC output signal. **Types of rectifiers:-** Half wave rectifier Full wave rectifier – center tapped rectifier and Bridge rectifier	01 01
	iii	**Input and output terminals of CB and CE configuration.** Configuration / Input terminal / Output terminal Common Base CB / **Emitter** / **Collector** Common Emitter CE / **Base** / **Collector**	½*4 = 02
	iv	**Circuit diagram of an inverting amplifier using IC741 op-amp** 	02
	v	**Logical symbol of 1:4 demultiplexer** 	02

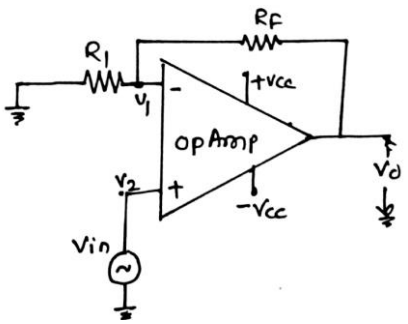
	v	<table><tr><th>Passive</th><th>Active</th></tr><tr><td>Strain Gauge</td><td>Thermocouple</td></tr><tr><td>Thermister</td><td>Photovoltaic cell</td></tr></table>	½*4=02
	vi	**Advantages of Mechatronics:-** High speed of operation More accuracy Better flexibility Better reliability Compact size Any other relevant advantage may also considered	½*4 = 02
	vii	Types of real time Mechatronics systems. 1) Programmable logic controllers 2) Computer numerical control system 3) SCADA system 4) HMI Any other relevant mechatronic systems may also considered.	½*4 = 02
1	**b**	**Attempt any Two of the following**	**08**
	i	**Circuit diagram and input and output waveforms of CLC filter.**  	**02 diagram + 02 Waveforms**
	ii	**Blok diagram of CNC system and function of each block**  **Function of each block should be explained.**	**02** **02**

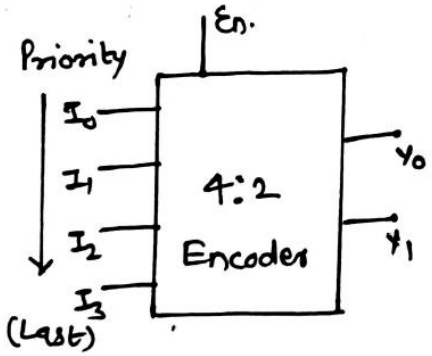
Q.No		Model Answer/Solution	Marks
1	b	Continue….	
	iii	**Op-Amp as a summing amplifier and expression for output with three inputs.**  Expression for output. By KCL, $I_1+I_2+I_3+I_f=I_B$ But $I_B=0$ $\therefore I_1+I_2+I_3=-I_f$ $I_1=\frac{V_1}{R}$, $I_2=\frac{V_2}{R}$, $I_3=\frac{V_3}{R}$, $I_f=\frac{V_o}{R_f}$ $\therefore \frac{V_1}{R}+\frac{V_2}{R}+\frac{V_3}{R}=-\frac{V_o}{R_f}$ $\therefore \boxed{V_o=-\frac{R_f}{R}(V_1+V_2+V_3)}$	04
2		**Attempt any FOUR of the following**	16
	a	**Different coupling methods of multistage amplifier** RC coupling Transformer coupling Direct coupling **Circuit diagram of RC coupled amplifier** 	01 03
	b	**Oscillator: -** A circuit which produces output without any input. Or A circuit which generates oscillations at the output. Feedback used in oscillator :- **Positive feedback** **Types of oscillator** **Sinusoidal** — **Non sinusoidal** **Low frequency** — **High frequency** — **[multi vibrator]** Wein bridge — Colpitt's osc. RC phase shift — Heartley Osc.	01 01 02

		Clap osc. Crystal osc.	

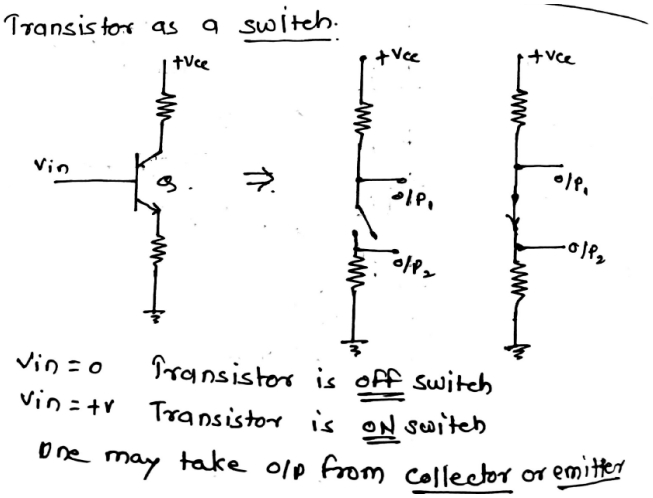
Q.No		Model Answer/Solution	Marks
2	c	**Half adder :- performs addition of two bits.** **Logical symbol**	01
			01 Logical symbol
		Truth table **A** | **B** | **Sum** | **Carry** 0 | 0 | 0 | 0 0 | 1 | 1 | 0 1 | 0 | 1 | 0 1 | 1 | 0 | 1	02 TT
	d.	**Biasing methods of BJT** Base biasing [fixed bias] Base bias with collector feedback Base bias with Emitter feedback Voltage divider biasing Emitter bias	02
		Circuit diagram of voltage divider biasing  R_1 & R_2 provides voltage divider Biasing.	02
	e	**Block diagram of IC 555**	04

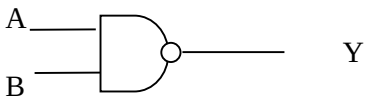
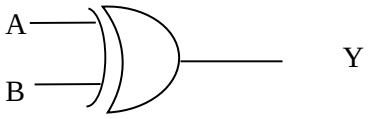


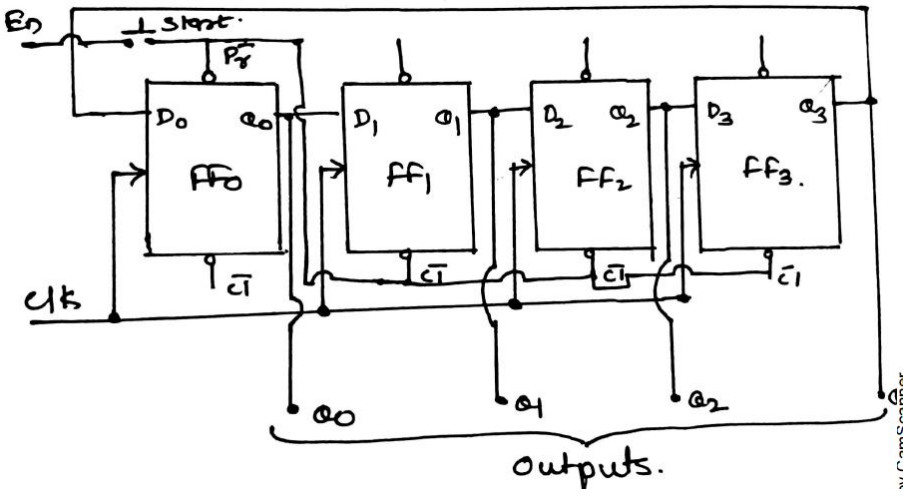
Q.No		Model Answer/Solution	Marks
2	f	**Circuit diagram of non inverting amplifier and expression for gain**	
			02
		Expression for gain **Voltage at inverting terminal by voltage divider rule** $V_1 = Vo * R_1 / [R_1 + R_f]$ **Voltage at non inverting terminal** $V_2 = Vin$ According to ideal opamp both input voltages must be equal Therefore, $V_1 = V_2$ $Vo * R_1 / [R_1 + R_f] = Vin$ Therefore, $Vo = \{ [R_1 + R_f] / R_1 \} * Vin$ $Gain = Vo / Vin = 1 + R_f / R_1$	02
3		**Attempt any FOUR of the following**	16
	a	**Encoder :-** logic circuit which encodes data. E.g. 8:3 encoder, Decimal to binary … Logic diagram for priority encoder:- Truth table	

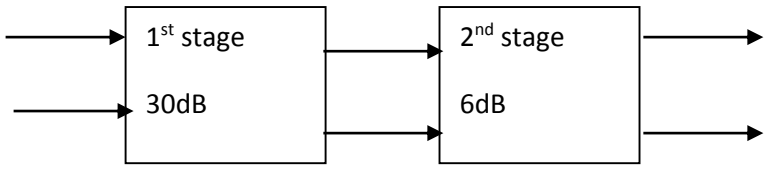


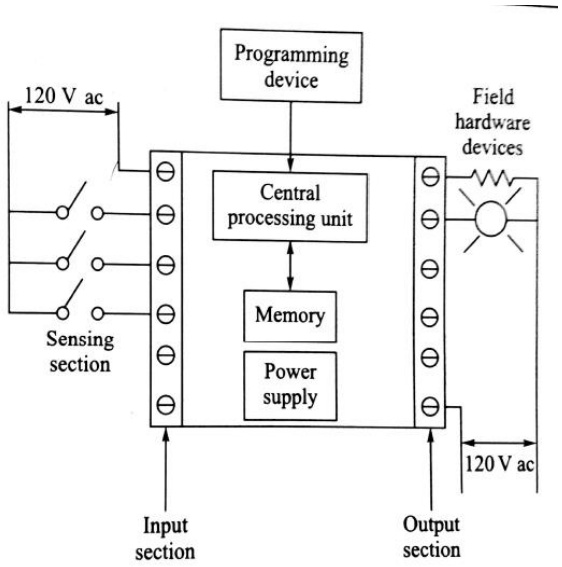
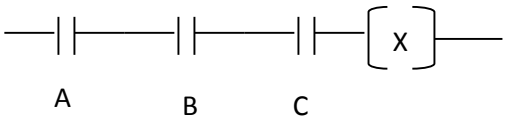
I_0	I_1	I_2	I_3	Y_0	Y_1
1	x	x	x	0	0
0	1	x	x	0	1
0	0	1	x	1	0
0	0	0	1	1	1

Q.No		Model Answer/Solution	Marks
3		**Continue….**	
	b	**Mechatronics systems are popular because of following** **Advantages** **Applications** **1) More accuracy** **1) Automobile** **2) Better flexibility** **2) Automation industry** **3) Safe and reliable** **3)Home appliances** **4) More intelligent** **4) Security system** **5) More speed of response** **6) Data storage facility** **Any other relevant and appropriate point may also be considered.**	02+02
	c	**BJT as a switch**  Vin = 0 Transistor is off switch Vin = +v Transistor is ON switch One may take o/p from collector or emitter **Theoretical explanation: Transistor acts as OFF switch when operated in cutoff region and it acts as ON switch when operated in Saturation region of its characteristics.**	02 02

	d	**Symbol and truth table of NAND gate and XOR gate** Symbol of NAND gate  Truth table **A** **B** **Y** 0 0 1 0 1 1 1 0 1 1 1 0 Symbol of XOR gate  Truth table **A** **B** **Y** 0 0 0 0 1 1 1 0 1 1 1 0	01 01 01 01

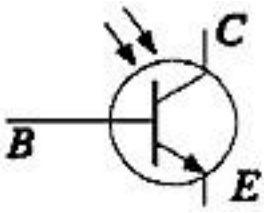
Q.No		Model Answer/Solution	Marks
3	e	**4 bit ring counter**  	04
	f	Selection Criteria for transducers: **(Any four points)** a) Nature and range of the physical parameter to be measured. b) Type of the physical quantity. c) Transducer should be compatible with measuring system. d) Performance of the transducer should be linear. e) Performance of the transducer should be stable under operating conditions. f) Transducer should have high sensitivity g) Transducer should have high accuracy h) Transducer should have better repeatability.	01*4 =

		i) It should have high input impedance and low output impedance to avoid the loading effect. j) Transducer should be free from drift, noise and offset problems. k) Transducer should have flat frequency response. l) Transducer should be easily available at low cost in the market with essential accessories for its installation. m) Transducer should be portable and light in weight. n) Any other relevant and accurate criteria may be considered.	04
4		**Attempt any FOUR of the following**	16
	a	**Working principle of LED** Light emitting diode is a semiconductor pn junction diode that's emits light when forward biased. The amount of light is directly proportional to forward current. **Application of LED:-** In Digital multi meter DMM In instrumentation system Panel boards displays In microprocessor kits Any other suitable and relevant application may also considered	02 ½*4
Q.No		Model Answer/Solution	Marks
4	b	**Multi stage amplifier**  When gains are in dB then for multistage amplifier **overall gain is the addition** of all **individual gains** Therefore , gain of multistage amplifier is **= 30dB + 6dB = 36dB** **[For normal gain we take multiplication of individual gains]**	04 Diagram is also expected
	c	**Architecture of PLC** **Advantages of PLC** **1) Speed of operation is faster** **2) It provides consistency in manufacturing** **3) It can handle both types of inputs/outputs i.e. analog/digital** **4) It provides higher reliability and easier maintenance.** **5) It ensures increased productivity.** **User can alter the PLC program.**	16

			
	d	Ladder diagram Explanation of ladder diagram using suitable example. Eg. Y= A+B+C X= A*B*C Z= A*(B+C)  Here student can take any diagram as an example but all the components of ladder diagram must be explained.	
Q.No		Model Answer/Solution	Marks
4	e	**Types of DAS** Single channel DAS Multi channel DAS **Application of DAS** **In instrumentation system of industries for measurement of Temperature, pressure, velocity, thickness etc.**	02 02
	f	**Data logger** In industries and process plants, data loggers are becoming very popular to monitor, display, measure, store and control different process variables. Data is nothing but output from different transducer and log means permanent storage of this data. The data logger handles digital information. **Applications of data logger** Data loggers are widely used in power generation plants, petrochemical industries, oil refineries industries….etc.	02 02

Q 5) Attemp any FOUR of the following (16 marks)

a) **Ans: Symbol** (2 marks)



Application: (2 marks)

- Light sensitive relay
- Darkness sensitive relay

b) Ans: Types of ADC (any 4) 2 marks

- Flash type
- Single slope ADC
- Dual slop ADC
- Counter type ADC
- Successive approximation type

Applications of DAC (any 4) 2 marks

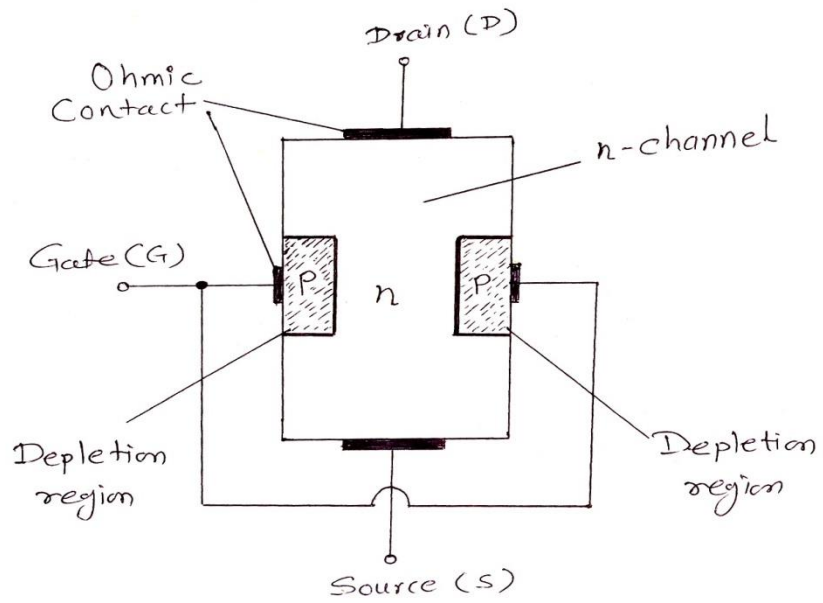
- To display information on CRT or XY plotter
- In computers
- In Data acquisition system
- In data logger system
- Electronics equipments
- In counter type ADC.

c) Ans : (any 4 points) 1 mark each

Active transducer	Passive Transducer
They do not need external power supply for operation	They need external power supply for operation
They produces voltage or current in proportion to physical quantity being measured	They varies resistance, capacitance or inductance in proportion to physical quantity being measured.

They are self generating transducers	They are not self generating transducers
Example: thermocouple, photo cell, piezoelectric transducer	Example: LDR, LVDT, Thermistor.

d) Ans: Construction of N-channel FET (2 marks)



Why it is voltage controlled device (2 marks)

- Voltage applied between controlling terminals i.e. gate and source (VGS) Controls the drain current ID .

e) Application of photodiode (1 mark each)

- In camera for sensing light intensity
- In fiber optic receiver
- In light intensity meter
- Object counting system

Applications of 7 segment display (1 mark each)

- In digital clock
- In Digital calculator
- In Digital electronics meter
- In displaying the numbers at banks counter or railway stations.

f) Decade counter, diagram (2 marks)

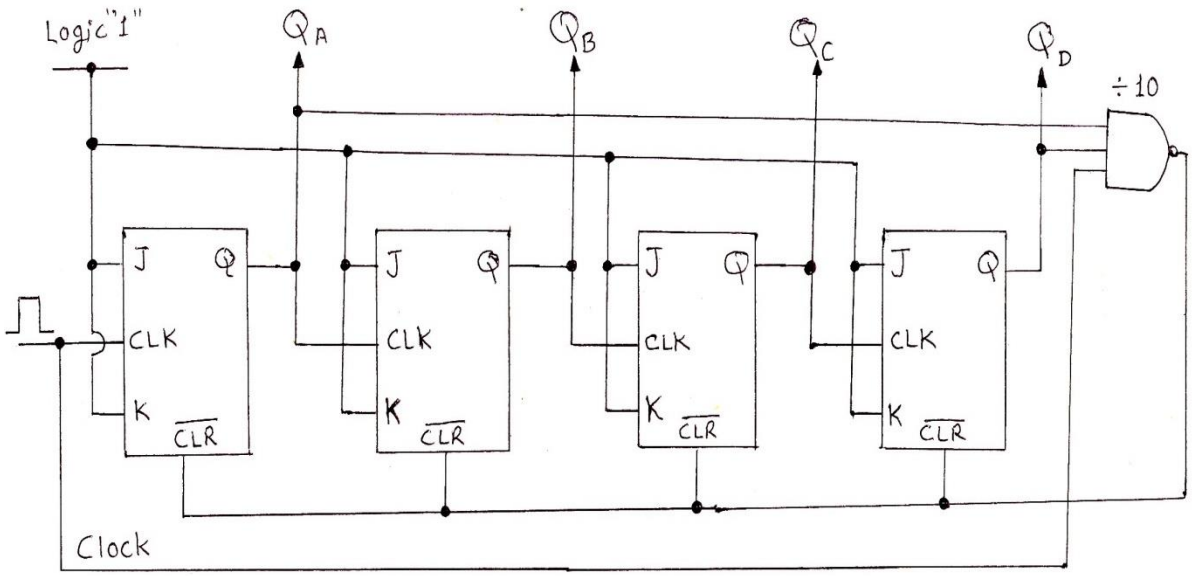


fig. Decade Counter

Truth table (2 marks)

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**				

Q 6) Attempt any FOUR of the following 16 marks

a) **Barkhausen criteria : (2 marks)**

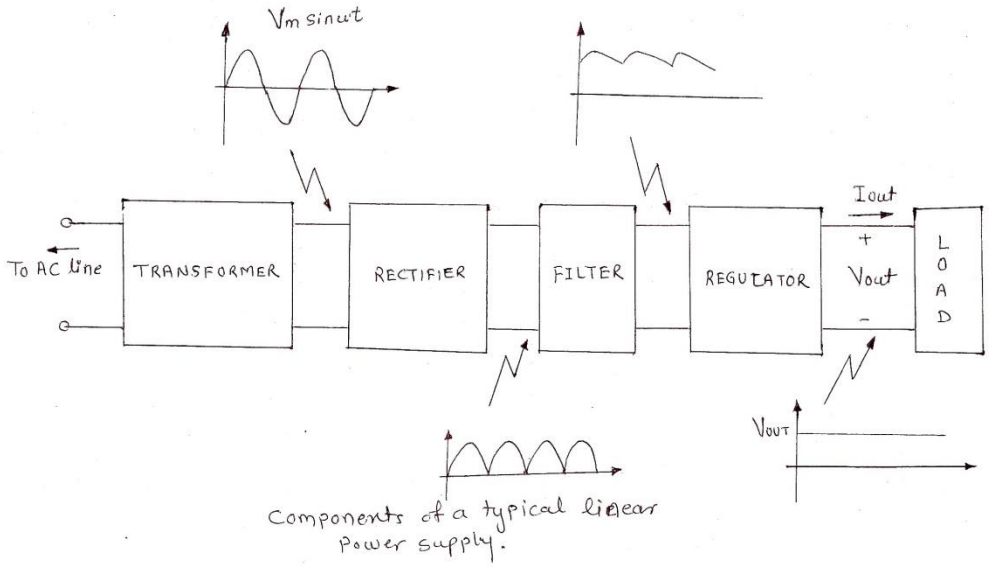
- An oscillator will operate at that frequency for which total phase around the loop is 0^o or 360^o

  Integral multiple of 360^o
- At the frequency of oscillation, the magnitude of the product of open loop gain of amplifier A and feedback factor β is equal to or greater than unity i.e. $|A\beta| \geq 1$.

Applications of LC oscillator (any 4) 2 marks:

- As local oscillator in radio
- In function generator
- In TV receiver
- In RF source
- As a high frequency generator
- Frequency synthesizer.

b) **Block diagram of regulated power supply (2 marks)**



Components of a typical linear power supply.

Explaination (2 Marks)

Step Down Transformer

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

Rectifier

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.

DC Filter

The rectified voltage from the rectifier is a pulsating dc voltage having very high ripple content. 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.

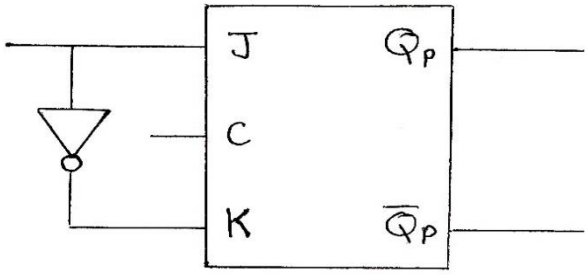
Regulation

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.

c) **Ans:**

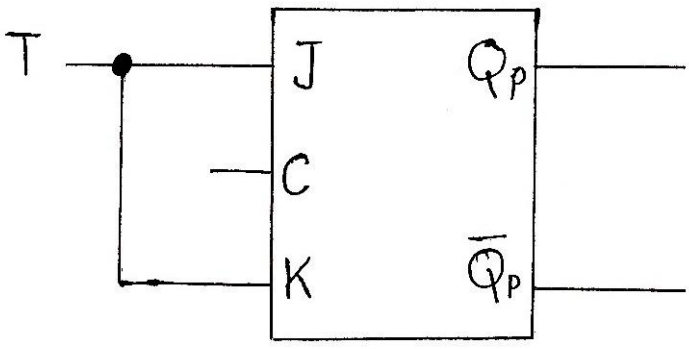
JK Flip Flop to D Flip Flop (2 marks)

D is the external input and J and K are the actual inputs of the flip flop. By shorting j and K input through invertor, we can convert JK flip flop into D flip flop and the logic diagram showing the conversion from JK to D are given below.



JK Flip Flop to T Flip Flop (2 marks)

J and K are the actual inputs of the flip flop and T is taken as the external input for conversion. By shorting J and K input and connecting them to logic one we can convert JK flip flop into T flip flop and the logic diagram are given below.



d) **Line Regulation (2 marks)**

Line regulation is a measure of the circuit's ability to maintain the specified output voltage with varying input voltage within the specified limit of 230V ±10%.

$$\text{Line regulation} = \left(\frac{\Delta V_{OUT}}{\Delta V_{IN}}\right)100\%$$

Load regulation (2 marks)

Load regulation is change in output load voltage due to change in load from no load to full load.

$$\% \text{ Regulation} = \frac{V_{no\text{-}load} - V_{full\text{-}load}}{V_{full\text{-}load}} \times 100$$

Where
$V_{no\text{-}load}$ is the no-load voltage and
$V_{full\text{-}load}$ is the full-load voltage.

e) **Features of micro**

- Processor i
- Discrete in
- Serial I/O
- Peripherals such as timer, counter, PWM generator
- Volatile memory for data storage
- ROM, EPROM, EEPROM, flash memory for program storage
- Clock generator
- ADC

f) ANS: 4 marks

$$Q = A + (B + C)$$
$$= A + B + C$$