Test ID:- E16

ZONE TECH

Best Institute For Assistant & Junior Engineer

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SOLUTIONS

ELECTRICAL ENGINEERING : PAPER-2

Full Length Test -16

Exam Date :- 01 March 2026

2 Marks

Q.1

Sol. Error due to temprature can be eliminated by Connecting a resistance which (10-20) times the Resistance of moving coil, in series with the moving coil. The material of this Resistance is same as that of shunt. This Resistance is called swamping Resistance.

Q.2

Sol. Main Causes of creeping

1. Over Compensation for friction is the main cause
2. Due to mechanical vibration
3. Due to stray magnetic field
4. Due to excessive voltage Across potential coil.

Q.3

Sol. The instrument which measures the quality factor of the electrical circuit at radio frequencies, such type of device is known as the Q-meter. The quality factor is one of the parameters of the oscillatory system, which shows the relation between the storage and dissipated energy

Q.4

Sol. **Aquadog Solution**

When electron strike at CRO screen they generate secondary electron. To absorb these secondary electron an aquous solution of graphite is used which is called Aquadog solution.

Q.5

Sol. According to this theorem power in polyphase system consisting of 'N' Number of conductors can be Measured with 'N' Number of wattmeter by Connecting Current coil of wattmeter in series with each conductor and pressure coil between a common point and the corresponding conductor. If one of the conductors is taken as Common point then the Number of wattmeter required is (N-1).

Q.6

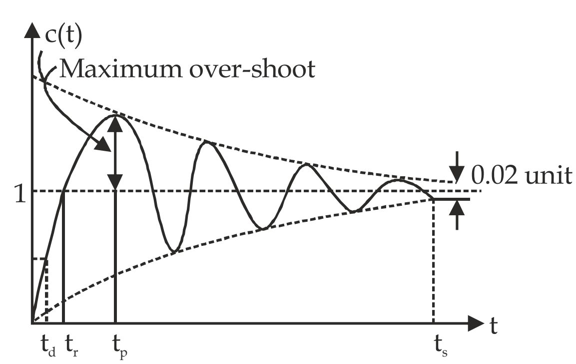
Sol. The transient response is present in the short period of time immediately after the system is turned on. If the system is asymptotically stable, the transient response disappear.whenever, if the system is unstable, the transient response will increase very quickly (exponentially). It gives us information about the system behaviour either it is oscillatory or not and the speed of the response.

Q.7

Sol. The gain margin is defined as the value of gain to be added to system, in order to bring the system to the verge of instabilityThe gain margin is given by the Reciprocol of the magnitude of open loop transfer function at phase cross over frequency. The frequency at which the phase of open loop Transfer function is 180 is called the phase cross-over frequency

Q.8

Sol.



Peak overshoot: The maximum positive deviation of the output with respect to its desired value is known as maximum overshoot.

peak overshoot, $M_p = e^{\frac{-\xi\pi}{\sqrt{1-\xi^2}}}$

Q.9

Sol. Biasing refers to providing appropriate DC voltages and DC currents to an electronic device to operate it in a desired way. Biasing of BJT is done for following purposes:

(i) To operate the BJT in active region so that it can be used as an amplifier.

(ii) To maintain I_C stable so that operating point does not drift and thermal runaway cannot take place.

Commonly used biasing circuits are:

(i) Fixed bias circuit.

(ii) Collector to base bias circuit.

(iii) Self bias circuit.

Q.10

Sol. It is the minimum forward voltage required so that the forward current flows through the diode. Cut-in voltage is also known as:

- Offset voltage
- Threshold voltage
- Knee voltage
- Break voltage

For Ge diode $V_\gamma = 0.1V - 0.5V;$ Typical value 0.2 V

For Si diode $V_\gamma = 0.6V - 0.9V;$ Typical value 0.7 V

Cut-in voltage decreases with temperature. For 1°C rise in temperature, it is reduced by 2.5 mV.

Q.11

Sol. This code detects as well as corrects the error is an information The's Codes transmitts additional parity bits in addition to information bits. These parity will are used to delects and Correct the error.

Q.12

Sol.

$$y = \overline{AB} + \overline{A}B + A\overline{B}$$

$$= \overline{A} + \overline{B} + \overline{A}B + A\overline{B}$$

$$= \overline{A} + \overline{A}B + \overline{B} + A\overline{B}$$

$$= \overline{A}[1+B] + \overline{B}[1+A]$$

$$= \overline{A} + \overline{B}$$

Q.13

Sol. The triac is a three terminal, four layer, bidirectional, semi-conductor device that controls ac power whereas an SCR controls dc power or forward biased half cycles of ac in a load. Because of its bidirectional conduction property, the triac is widely used in the field of power electronics for control purposes.

Q.14.

Sol. AMPLITUDE MODULATION

- In amplitude modulation, the amplitude of a carrier signal is varied in accordance with the instantaneous value of modulating signal, whose frequency is invariably lower than that of the carrier.
- In practice, the carrier may be high-frequency (HF) while the modulating signal is audio frequency (AF).

Q.15

Sol.
- Switch does not require any power to change its state.
- Completely controllable.
- Switch does not required an external signal.
- Low thermal impedance.

Q.16

Sol. Mnemonics are instructions or commands to perform a particular operation given by user to microprocessor e.g. MOV, ADD and SUB.

Q.17

Sol. In this type of instruction, the operands will be present in memory (M) and address of memory is present in register pair (e.g. HL pair).
It is also called "Indirect addressing mode type instruction set".

e.g.:	MOV	A, M	Memory address in HL register pair
	ADD	M	
	LDAX	B	

Q.18

Sol. Stack pointer is of 16 bits length and is used to point to the value at top of the stack for the currently executed instruction.

Q.19

Sol. The Opcode stands for operation codes in the microprocessor i.e. addition, multiplication, etc operation.
The operand contains the data or memory location in the register.

Q.20

Sol. CALL Instruction
- It is used in the main program to call a subroutine.
- When a subroutine is called, the contents of PC, which is the address of the instruction following the "CALL" instruction, is stored on the stack and the program execution is transferred to the subroutine address.

5 Marks

Q.21

Sol. Electrostatic instruments are essentially voltmeters but they can be used for measurement of current and power with the help of external components. The principle of operation of such instruments is the force of attraction of repulsion between two charged bodies. The use of this force is made to produce deflection, which is a measure of the quantity. There are two types of such instruments namely the quadrature type (which is usually used for measurement up to 20 kV) and the attracted disc type (which is usually used for measurement above 20 kV).

Q.22

Sol. **Hall Effect Transducers-** When a conductor is kept perpendicular to the magnetic field and a direct current is passed through it, it results in an electric field perpendicular to the directions of both the magnetic field and current with a magnitude proportional to the product of the magnetic field strength and current. The voltage so developed is very small and it is difficult to detect it. But in some semiconductors such as germanium, this voltage is enough for measurement with a sensitive moving coil instrument. This phenomenon is called the Hall effect.
Commercial Hall effect transducers are made from germanium or other semiconductor materials. They find applications in instruments that measure magnetic field with small flux densities. Hall effect element can be used for measurement of current by the magnetic field produced due to flow of current. Hall effect element may be used for measuring a linear displacement or location of a structural element in cases where it is possible to change the magnetic field strength by variation in the geometry of a magnetic structure.

The main advantage of Hall effect transducers is that they are non-contact devices with small size and high resolution. The main drawbacks of such transducers are high sensitivity to tem- perature variations and variation of Hall coefficient from plate to plate, thereby requiring individual calibration in each case.

Q.23

Sol. **Concept of enclosed**

- All the right hand side points of the given path direction are said to be enclosed.
- A closed loop system is said to be stable if (-1 + j0) point is not enclosed by the given polar plot

Nyquist stability criteria

$Z = P + N$

N = Number of clockwise encirclement of (-1+j0) point

P = Number of open loop pole on R.H.S of s plane.

Z = Number of closed loop pole on R.H.S of s plane.

For system to be stable $Z = 0$

If $P = 0$ For system to be stable, there is no encirclement of (-1+j0) point.

If $P \neq 0$ For system is to be stable, there is P counter clockwise encirclement of (-1+j0) point.

If there is no encirclement of (-1+j0) point means N=0, For system to be stable no. of open loop pole in right hand side of s plane should be zero.

If there is clockwise encirclement of (-1+j0) point then system is always unstable.

If there is counter clockwise encirclement of (-1+j0) point. For system to be stable there is N no. of open loop pole in right hand side of s plane.

Q.24

Sol. A linear system satisfies following two properties:

(i) **Superposition:** Consider a system that is initially at rest. Let the system be subjected to an input $x_1(t)$, producing an output $y_1(t)$. Suppose next that the same system is subjected to a different input $x_2(t)$, producing a corresponding output $y_2(t)$. Then for the system to be linear, it is necessary that the composite input $x(t) = x_1(t) + x_2(t)$ produce the corresponding output $y(t) = y_1(t) + y_2(t)$.

(ii) **Homogeneity:** Consider again a system that is initially at rest and suppose an input x(t) results in an output y(t). Then the system is said to be exhibit the property of homogeneity. When if the input x(t) is scaled by a constant factor a, the output y(t) is scaled by exactly the same constant factor a.

i.e., $x_1(t) \rightarrow y_1(t)$

$ax_1(t) \rightarrow ay_1(t)$

When a system violates either the principle of superposition or the property of homogeneity the system is said to be non-linear.

Stability of linear system determined by poles of the system.

Q.25

Sol. **Advantages:**

1. MOSFET tansconductance increase with drain current, the consequence is less distortion.
2. MOSFET consumes less power than BJT.
3. MOSFET's input impedance are very high so they do not load the circuits. Loading effect does not arise.
4. In MOSFET greater bandwidth.
5. In MOSFET thermal stability is more compared than BJT.
6. Effect of noise is less than BJT. So high signal to noise ratio.
7. MOSFET are small compare to BJT's so it fabricated easily and space saving scheme on the IC's.

Disadvantages:

1. The transconductance in MOSFET is low (gain low), i.e., bandwidth is less.
2. MOSFET is very sensitive to electrostatic charge so it may be destroy when you touch the pins of a MOSFET devices by hand.
3. MOSFET is more costlier than BJT.
4. Gain bandwidth product is lower than BJT.

Q.26

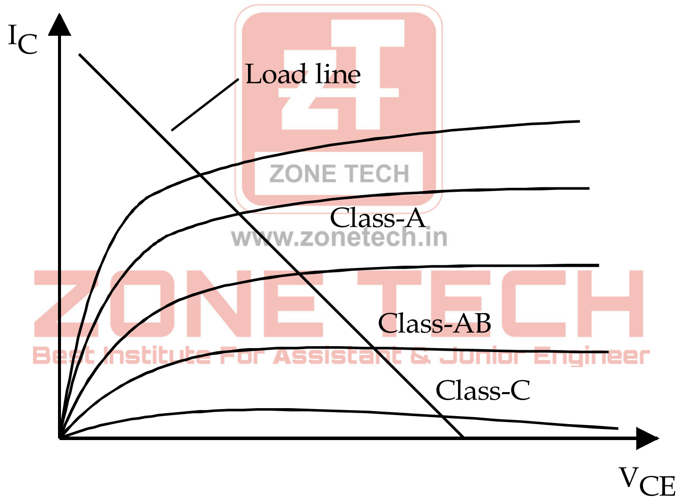
Sol. Thermal Runaway:

The maximum average power $P_{D(may)}$ which a transistor can dissipate depends upon the transistor consideration and may lie in the range from a few milliwatts to 200 W. The maximum power is limited by the temperature that collector-to-base junction can withstand. The junction temperature may rise either due to rise in ambient temperature or due to self-heating. The maximum power dissipation is usually specified for transistor enclosure (case) of ambient temperature of 25°C. The problem of self-heating results from the power dissipated at collector junction. As a consequence of junction power dissipation, the junction temperature rises, and this in turn increases the collector current, with a subsequent increase in power dissipation. If this phenomenon, referred to thermal runaway, continues, it may result in permanent damage to the transistor.

Q.27

Sol. Class-A Amplifier :

An amplifier in which operating point is located approximately at the centre of the load line is known as class-A amplifier.



Advantage: It produces least distortion in the output among all power amplifiers.

Drawback: In this power amplifier quiescent power dissipation is very large which means transistor dissipates higher power when AC input is not applied.

Application: Class-A amplifier is used as voltage amplifier. It is not preferred as power amplifier due to greater quiescent power dissipation.

Q.28

Sol.

Synchronous counter	Asynchronous counter
1. Same clock pulse is applied to individual flip flop	1. Clock signal is applied only the first flip flop
2. Any sequence can be generate	2. Fixed sequence
3. No Decoding error	3. Secoding error exist
4. Design is complex as number of bits increases Ex.- Ring counter, Johnson counter	4. Design easy, even more bits number of Ex.- Ripple up or Ripple down counter

Q.29

Sol. Average output voltage of $3-\phi$ full converter,

$$V_0 = \frac{3V_{ml}}{\pi}\cos\alpha \quad \text{for} \quad 0 < a < \pi/3$$

For $\alpha = 30^0$, $V_0 = 300$

$$V_0 = \frac{3V_{ml}}{\pi}\cos\alpha$$

$$300 = \frac{3V_{ml}}{\pi}$$

Average output voltage of $3-\phi$ full converter, for $\frac{\pi}{3} < \alpha < \frac{2\pi}{3}$

$$V_0 = \frac{3V_{ml}}{\pi}\left[1+\cos\left(\alpha+\frac{\pi}{3}\right)\right] = 300\times\left[1+\cos\left(\frac{\pi}{2}+\frac{\pi}{3}\right)\right] = 40.19 \text{ volts}$$

Q.30

Sol. When chopper is on, output voltage is (V_s - 1.5) volts and during the time chopper is off, output is zero

$\therefore$ Average output voltage $= \left(\frac{(V_s - 1.5)\,T_{on}}{T}\right) = (200-1.5)\times 0.5 = 99.25\,V$

R.M.S. value of output voltage

$$V_{OR} = \left[(V_s - 1.5)^2 \times \frac{T_{on}}{T}\right]^{1/2} = \left[(200-1.5)^2 \times 0.5\right]^{1/2} = 140.36 \text{ Volt}$$

Power output or power delivered to load

$$P_0 = \frac{V_{OR}^2}{R} = \frac{140.36^2}{20} = 985 \text{ Watts}$$

Power input to chopper

$$P_i = V_s \times I_0 = 200\times\frac{99.25}{20} = 992.5\,W$$

$\therefore$ Chopper efficiency $= \frac{P_0}{P_i}\times 100 = \frac{985}{992.5}\times 100 = 99.24\%$

Q.31

Sol. **RIM: (Read Interrupt Mask)**

- Because there are several interrupt lines, when one interrupt request is being served, other interrupt requests may occur and remain pending. The 8085 has an additional instruction called RIM (Read Interrupt Mask) to sense these pending interrupts.
- It is used to read status of masked interrupts, pending interrupts and SID (Serial I/P data).
- This instruction loads the accumulator with eight bits indicating the current status of the interrupt masks, the interrupt enable, pending interrupts, and serial input data as shown in the figure below.

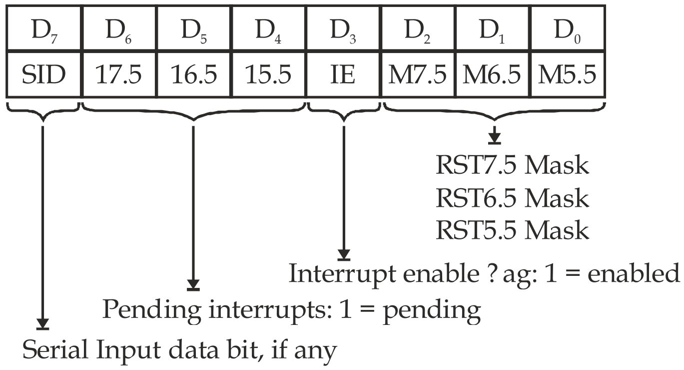


Fig.:- Interpretation of the accumulator bit pattern for RIM

Followings are the common features for instructions NOP, DI, EI, SIM and RIM:

1-byte instruction

Implied/Implicit addressing mode

Machine cycle(1)-1 opcode fetch

4T-states

No flags are affected

Q.32

Sol. **LDAX Rp: (Load accumulator indirect)**

Symbolic form: [A] ← [Rp]

Example: LDAX B; it means that load the content of memory location, whose address is in the BC register pair, into the accumulator.

1-byte instruction

Register indirect addressing mode

Machine cycles (2)-1 opcode fetch + 1 MEMR

4T + 3T = 7 T-states

No flags are affected.

CMA: (Complement the accumulator)

Symbolic form: [A] → $[\overline{A}]$

1-byte instruction

Implied/Implicit addressing mode

1 opcode fetch

Machine cycle(1)-opcode fetch

4T-states

No flags are affected

20 Marks

Q.33

Sol. **Linear Variable Differential Transformer LVDT)-** LVDT is the most widely used inductive transducer for translating the linear motion into an electrical signal. LVDT is a differential transformer consisting of one primary winding P and two identical secondary windings S_1, and S_2, wound over a hollow bobbin of non-magnetic and insulating material.

The displacement to be measured is applied to the arm attached to the soft iron core. When the core is in the centre, called the reference position, the induced voltages E_1 and E_2 are equal and opposite. Hence they cancel out and the output is zero. As the core is moved toward left from its voltage V_{out} null position, the voltage induced in secondary winding S_1 increases whereas the voltage induced in secondary winding S_2 decreases. The movement of the core toward right will have opposite effect. Secondary windings S_1 and S_2 are connected in series opposition so that the difference of the voltages induced in the secondary windings S_1 and S_2 provides the measurement of displacement.

Difference of induced voltages in secondary windings gives the amount of displacement following a linear law within a limited range of motion. In either direction of movement of the core, difference of induced voltages increases or decreases giving the idea of direction of movement.

Sensitivity of LVDT is given by expression

$$\text{Sensitivity} = \frac{\text{Output voltage}}{\text{Displacement}} \text{ in volts/mm}$$

In commercially available LVDTs, normally range for displacement varies from ± 0.01 mm to ± 25 mm.

Primary winding is connected to an ac source of voltage varying from 5 to 25 V and of frequency ranging from 50 Hz to 20 kHz.

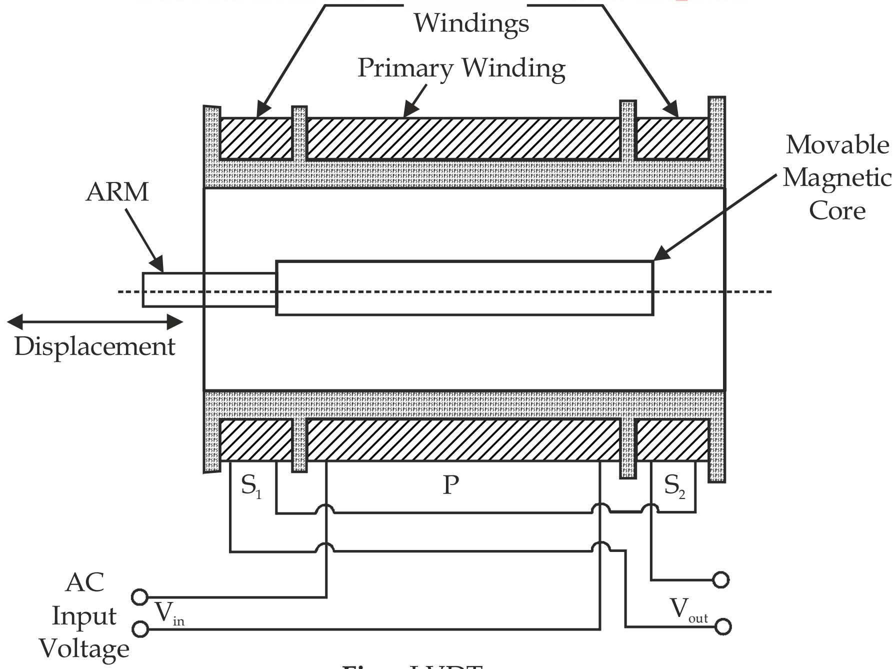


Fig.:- LVDT

LVDTS are suitable for use in applications where the displacements are too large for strain gauges to handle. For example, LVDTS can be employed for measurement of displacements that range from a fraction of a mm to a few cm.

Since the LVDTS can also be connected to other transducers, whose outputs are mechanical displacements, these are often employed together with other transducers for measurement of force, weight, pressure etc.

Q.34

Sol.

$$R_F = 20\,\Omega,\ R_L = 1000\,\Omega$$

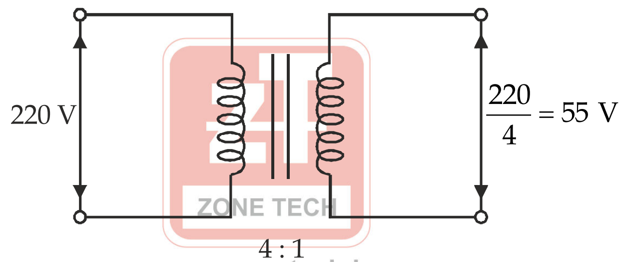
RMS voltage of secondary winding of transformer

$$V_{rms} = \frac{V_m}{\sqrt{2}} = 55$$

$$\Rightarrow \quad V_m = 55\sqrt{2} = 77.78V$$

$$I_m = \frac{V_m}{R_F + R_L} = \frac{77.78}{20+1000}$$

$$= 0.076A$$



$$V_S = \frac{N_2}{N_1} \times V_P = \frac{1}{4} \times 220$$

$$= 55V = \text{rms voltage}$$

(i) dc output current $= I_{dc} = \frac{I_m}{\pi}$

$$= \frac{76}{\pi} = 24.2mA$$

$$V_{dc} = I_{dc} R_L$$

$$\Rightarrow \quad V_{dc} = 24.2 \times 10^{-3} \times 1000$$

$$= 24.2V$$

(ii) AC output current is I'_{rms}

$$I'_{rms} = r \times I_{dc}$$

$$\Rightarrow \quad I'_{rms} = 1.21 \times 24.2$$

$$= 29.28mA$$

AC output voltage is V'_{rms}

$$V'_{rms} = r.V_{dc}$$

$$= 1.21 \times 24.2$$

$$= 29.28V$$

(iii) Since diode and R_L are in series, so dc diode current is same as dc output current

$$I_{diode,dc} = 24.2mA$$

$$v_{diode,dc} = -\frac{V_m}{\pi} = -\frac{77.78}{\pi} = -24.75V$$

(iv) $$PIV = V_m = 77.78V$$

(v) $$\%\ Efficiency = 40.5 \times \frac{R_L}{R_f + R_L}$$

$$= 40.5 \times \frac{1000}{20 + 1000} = 39.7\%$$

$$\%\ Regulation = \frac{R}{R_L} \times 100\%$$

where, $R = R_{sec} + R_f = 0 + 20 = 20\,\Omega$

$$= \frac{20}{1000} \times 100\% = 2\%$$

Q.35

Sol. **MULTIPLEXER**

A multiplexer is a logic circuit that accepts several data inputs and allows only one of them at a time to get through to the output. Multiplexers are used for data selection, data routing, operation sequencing, waveform generation, logic function generation etc. Multiplexers etc. Multiplexers are available as ICs. The standard packages are 2 : 1, 4 : 1, 8 : 1 and 16 : 1.

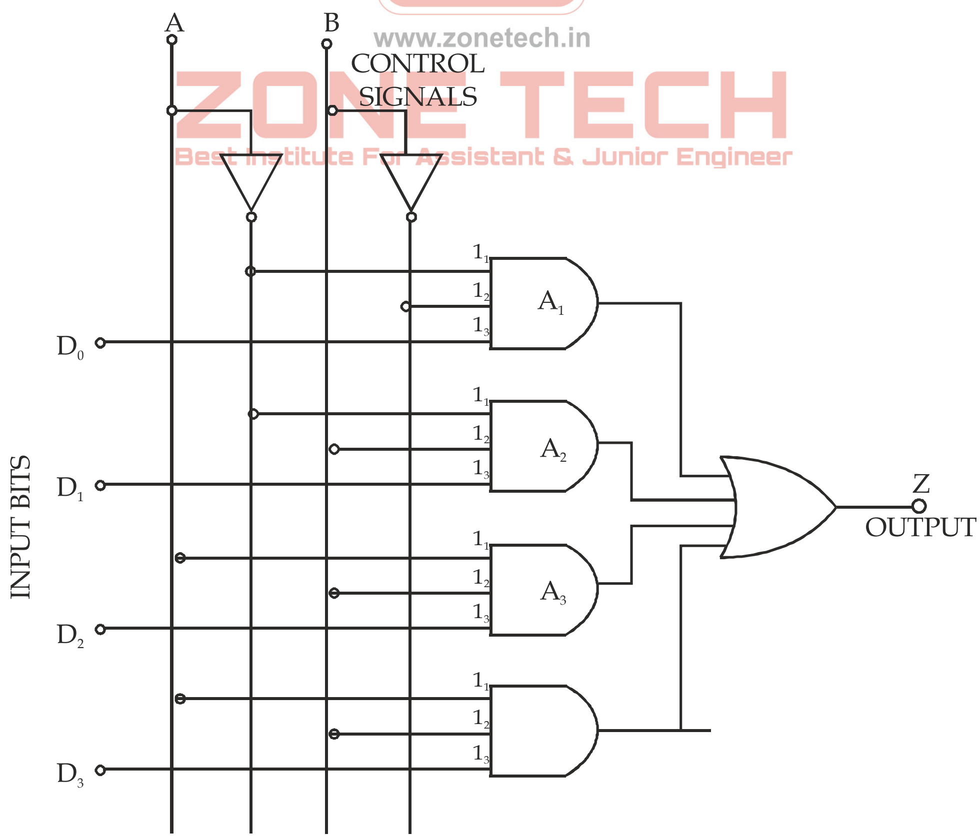


Fig.:- Fout-To-One Multiplexer

Table- Truth Table For Four-To-One MUX

Data Select Inputs		Input Selected	Input	Output
A	B	D	D	Z
0	0	D_0	0 1	0 1
0	1	D_1	0 1	0 1
1	0	D_2	0 1	0 1
1	1	D_3	0 1	0 1

There are 2^n input lines where n is the select line. The selection of a particular input line is controlled by a set of select lines.

A circuit diagram for four-to-one multiplexer is given in Fig. Truth table for four-to-one multiplexer is given in Table.

The size of the MUX is specified by the 2" of its input line and the single output line. MUX contains AND gate followed by an OR gate.

ENCODERS

An encoder converts an active input signal into a coded output signal. It has n input lines and m output lines. At a time only one of the input lines is active. Internal logic within the encoder converts this active input to a coded binary output with m bits.

One of the most commonly used input device for a digital system is a set of ten switches, one for each numeral. These switches generate 1 or 0 logic levels in response to turning them off or on. When a particular number is to be fed to the digital circuit in BCD code, the switch corresponding to that number is pressed. There is an IC available to perform this function (74147) which is a priority encoder. Circuit diagram of a decimal-to- BCD encoder is shown in Fig.

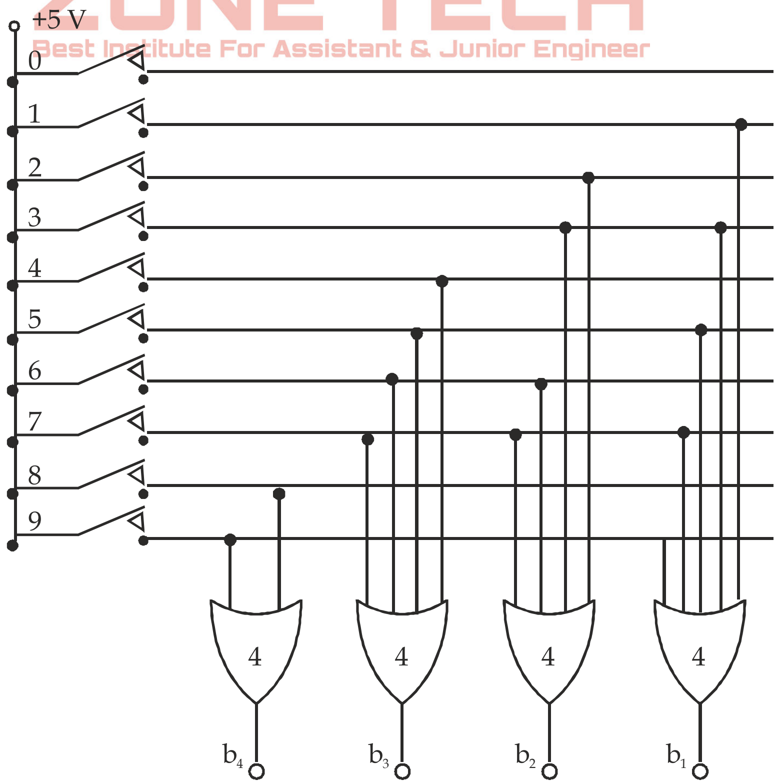


Fig.:- Decimal-To-BCD Encoder

TABLE- Truth Table For Decimal-To-BCD Encoder

Input										Output			
0	1	2	3	4	5	6	7	8	9	b_4	b_3	b_2	b_1
1	0	0	0	0	0	0	0	0	0	0	0	0	0
0	1	0	0	0	0	0	0	0	0	0	0	0	1
0	0	1	0	0	0	0	0	0	0	0	0	1	0
0	0	0	1	0	0	0	0	0	0	0	0	1	1
0	0	0	0	1	0	0	0	0	0	0	1	0	0
0	0	0	0	0	1	0	0	0	0	0	1	0	1
0	0	0	0	0	0	1	0	0	0	0	1	1	0
0	0	0	0	0	0	0	1	0	0	0	1	1	1
0	0	0	0	0	0	0	0	1	0	1	0	0	0
0	0	0	0	0	0	0	0	0	1	1	0	0	1

When switch 0 is pressed, all OR gates are inactive and so output by $b_4\ b_3\ b_2\ b_1$, is 0000 which is a BCD equivalent of decimal digit 0.

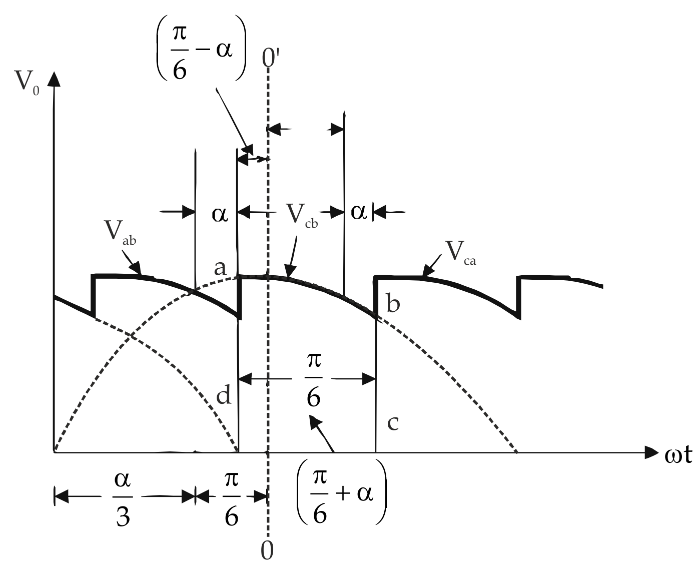
When switch 1 is pressed, only OR gate 1 is active and so output $b_4\ b_3\ b_2\ b_1$ is 0001 which is a BCD equivalent of deci- mal digit 1.

In the same way when switch 7 is pressed, OR gates 3, 2 and 1 are active, so output $b_4\ b_3\ b_2\ b_1$ is 0111 which is again BCD equivalent of decimal digit 7.

Table is a truth table for decimal-to-BCD encoder.

Q.36

Sol.



Average output voltage can be obtained by finding the dashed area abed over periodic cycle with $00'$ as the origin at the maximum value of $V_{ab'} V_0$ is given by

$$V_0 = \frac{3}{\pi}\int_{-\left(\frac{\pi}{6}-\alpha\right)}^{\left(\frac{\pi}{6}+\alpha\right)} V_{ml}\cos\omega t\,(d\omega t)$$

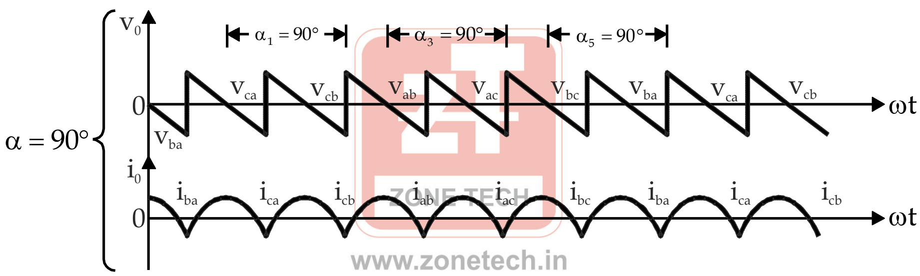
$$= \frac{3V_{ml}}{\pi}\left[\sin\left(\alpha+\frac{\pi}{6}\right)+\sin\left(\alpha-\frac{\pi}{6}\right)\right] = \frac{3V_{ml}}{\pi}\cos\alpha$$

For $\alpha < \pi/3$

$$V_0 = \frac{3}{\pi}\int_{-\left(\frac{\pi}{6}-\alpha\right)}^{\pi/2} V_{ml}\cos\omega t \times d\omega t$$

$$= \frac{3}{\pi}\left[V_{ml}\sin\omega t\right]_{-\left(\frac{\pi}{6}-\alpha\right)}^{\pi/2} = \frac{3V_{ml}}{\pi}\left(1+\cos\left(\alpha+\frac{\pi}{3}\right)\right)$$

The output voltage waveform for $\alpha = \frac{\pi}{2}$, is illustrated below.



Q.37

Sol.

$$G(s)H(s) = \frac{K(s+2)}{s(s+1)}$$

- Number of open loop poles, P = 2 at s = 0, –1
- Number open loop zeros, Z = 1 at s = –2
- Angle of asymptotes,

$$\theta = \frac{(2q+1)180°}{P-Z} = 180°,\ q = 0$$

$$\theta = 180°$$

Centroid,

$$\sigma = \frac{\sum\left(\begin{matrix}\text{real part of}\\ \text{open loop poles}\end{matrix}\right) - \sum\left(\begin{matrix}\text{real part of}\\ \text{open loop zeros}\end{matrix}\right)}{P-Z}$$

$$= \frac{0-1-(-2)}{2-1} = 1$$

- Break away point :

$$s(s+1)+K(s+2) = 0$$

$$\frac{dK}{ds} = 0 \Rightarrow (s+2)(2s+1) - s(s+1) = 0$$

$$s^2 + 4s + 2 = 0$$

$$\Rightarrow \quad s = -2 \pm \sqrt{2} = -3.414, -0.586$$