JNIT JAGANNATH GUPTA INSTITUTE OF ENGINEERING & TECHNOLOGY JAIPUR

I-Mid Term Examination Session 2017-2018

B.Tech .3rd. Year .6th. Semester

Branch: ECE **Subject: Control System Engg**
Time: 10:00 am-11:30am **Subject Code:6EC5A**
Date: 16/02/2018 **Max. Marks: 20**

Attempt any four questions out of following five questions. All Que carry equal marks.

Q.1 What is control system? Write difference between open loop & Close loop Control system with Example and Diagram.

ANS

1.5 Control System

A control system comprises of control element (subsystem) and plant (system) which are connected together for the purpose of controlling the response of the system. So, control is an essential part of the system and helps in obtaining the specified value of output from the system. On the other hand control is that part of system which enables the system to obtain the desired response. Combining both of them (control and system) and connecting between input and output is called control system and study of control system in engineering field is termed as Control System Engineering. For example, heat produced by the furnace depends on the flow of fuel. In this system, subsystem called fuel valve and its actuators move by which heat outputs from the furnace can be controlled to regulate the room temperature. Figure 1.2 shows the simplest form of control system to produce an output or response for a given input or excitation.

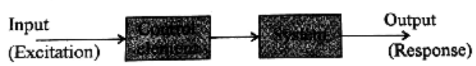


Figure 1.2 : Block diagram of a control system

For example, assume an automobile speed control system as shown in figure 1.3 is on a highway where the speed limit is 65 km/hr. The driver's control system acts as follows:

1. Actual speed is detected by the eye that observes the speedometer.
2. The brain assesses this speed in comparison with the desired speed.
3. If the brain judges the speed is too fast, it directs the foot to ease up on the accelerator and the speed is too slow then it direct the foot to make pressure on break.
4. Action is converged by the nerves in accordance to achive desired speed.

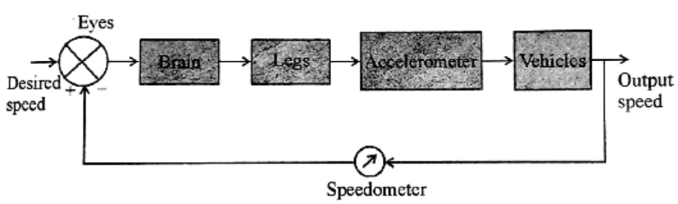


Figure 1.3 : Block diagram of automobile speed control system

.7 Differences Between Open Loop Control System and Closed–Loop Control System

able 1.1 : Difference Between Open Loop and Closed Loop Control Systems

S.No.	Open Loop Control Systems	Closed Loop Control Systems
1.	In open loop systems, the control action is independent of the output.	In closed loop systems, control action is dependent on the output.
2.	They are sensitive to external disturbances and internal variations in system parameters	They are very less sensitive to external disturbances and internal variations in system parameters.
3.	There is a need to use accurate as well as expensive components to obtain the accurate control of given plant.	We can even use less accurate as well as in–expensive components to obtain accurate control of given plant.
4.	It is used only where inputs to the system are known ahead of time.	It can be used when inputs are not known ahead of time.
5.	Number of components used in this system are less. So they are simple and cheap.	Number of components used in these system are more. So they are complex and costly.

Q.2 Explain Force-Voltage Analogy.

ANS

Force-Voltage Analogy and Torque-Voltage Analogy:

Consider a series R–L–C circuit as shown in figure 2.9.

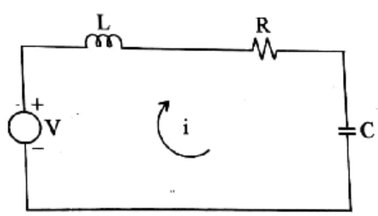


Figure 2.9 Series R–L–C circuit

Applying Kirchoff's voltage law.

$$V = Ri + L\frac{di}{dt} + \frac{1}{C}\int i\,dt$$

In terms of charge, equation becomes [i.e. $i = dq/dt$]

$$V = R\frac{dq}{dt} + L\frac{d^2q}{dt^2} + \frac{1}{C}q \quad .....(2.3)$$

Now, consider a mechanical system as shown in figure 2.7 and for that system equation of motion is given by equation (2.1) as under

$$F = M\frac{d^2x}{dt^2} + B\frac{dx}{dt} + Kx$$

If we compare a mechanical translational system with an electrical series circuit given by equation (2.3) we find similarity between them. They are therefore called analogous systems or we can say that behaviour of the mechanical system shown in figure 2.7 can be completely determined by simple R–L–C electrical circuit of figure 2.9 by making appropriate conversions of physical quantities as listed in the table.

Here the following analogies can be drawn :

1. Applied force F is analogous to applied voltage V.
2. Mass M is analogous to inductance L.
3. Coefficient of viscous friction B is analogous to resistance R.
4. Spring constant K is analogous to reciprocal of capacitance $\frac{1}{C}$.
5. Displacement x is analogous to electric charge q.

Similarly, if we compare a mechanical rotational system (figure 2.8) with an electrical series circuit (figure 2.9), we also find analogy between them. Both the analogies are given in table 2.2 below :

Table 2.2 Force voltage analogy and Torque voltage analogy

Mechanical System		Electrical System (Series R–L–C circuit)
Rotational motion	**Translational Motion**	
Torque T	Force F	Voltage V
Angular velocity ω	velocity	current i
Angular displacement q	Displacement x	charge q
Moment of inertia J	Mass M	Inductance L
Damping constant B_0	Viscous friction coefficient or damping constant B	Resistance R
Torsional constant k	Spring constant K	Capacitance 1/C

Q.3 writes the advantage and disadvantage of close loop control system .Drive an expression for close loop gain.

ANS

1.6.2 Closed Loop Control System

A closed loop control system is one in which control action some how depends on the output through a feedback path. A system with one or more feedback paths is called a closed–loop or feedback control system.

Closed–loop control systems are also called automatic control systems as these systems automatically correct for any variation in their outputs due to change in parameters, external conditions and disturbances etc. In a closed–loop control system, the output is continuously compared with the input through feedback path and difference of reference input signal and feedback signal forms an error signal through an error detector for supplying to the control element is shown in figure 1.5.

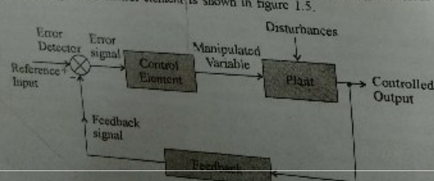


Figure 1.5 : Closed–loop control system

It is now important to note that fundamental difference between an open loop control system and closed–loop control system is that of feedback action. So, feedback is that property of closed–loop control system which allows the output to be compared with the input to the system so that the appropriate control action may be formed as a function of the output and input variable.

On the other hand, feedback is the output of the system which is appropriately and proportionately returned to modify the input in order to obtain desired output from the system. Feedback helps in achieving desired accuracy and reliability.

Feedback control systems should ideally satisfy the following requirements :

1. **Reliability**
2. **Accuracy**
3. **Linearity**
4. **Responsiveness**
5. **Isolated behaviour**
6. **Noise immunity**

A servomechanism is also a closed loop control system. In this case, controlled variable is essentially a mechanical quantity i.e. position, velocity or acceleration etc.

Feedback Path

This is the direction of flow of signal from output to input as shown in figure 4.4. Transfer function of a closed-loop system can be derived as follows : Block diagram of closed loop control system is shown in figure 4.5

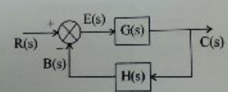


Figure 4.5 Block diagram representation of closed loop control system

where,

R(s) = Reference input

E(s) = Actuating signal or Error signal

G(s) = Forward path transfer function

C(s) = Output signal

H(s) = Feedback transfer function

B(s) = Feedback signal

From above figure 4.5

$$C(s) = G(s) \cdot E(s) \quad .....(4.1)$$

$$B(s) = H(s) \cdot C(s) \quad .....(4.2)$$

$$E(s) = R(s) - B(s) \quad .....(4.3)$$

Put the value of C(s) from equation (4.1) to equation (4.2)

$$B(s) = H(s) \cdot G(s)\ E(s) \quad .....(4.4)$$

This gives

$$\frac{B(s)}{E(s)} = G(s) \cdot H(s)$$

where, $\frac{B(s)}{E(s)}$ is open loop transfer function

Put the value of E(s) from equation (4.3) to equation (4.1)

$$C(s) = G(s)\ [R(s) - B(s)]$$

$$C(s) = R(s) \cdot G(s) - G(s) \cdot B(s) \quad .....(4.5)$$

Put the value of B(s) from equation (4.2) to equation (4.5)

$$C(s) = R(s)G(s) - G(s)H(s) \cdot C(s)$$

or $$C(s)\ [1 + G(s)H(s)] = R(s)G(s)$$

or $$\frac{C(s)}{R(s)} = \frac{G(s)}{1 + G(s)H(s)}$$

$$\frac{C(s)}{R(s)} = M(s) = \text{Closed loop transfer function} = \frac{G(s)}{1 + G(s)H(s)} \quad .....(4.6)$$

If the feedback is positive, then equation (4.6) becomes

$$\frac{C(s)}{R(s)} = \frac{G(s)}{1 - G(s)H(s)} \quad .....(4.7)$$

From equation (4.1) put the value of C(s) in equation (4.6)

$$\frac{G(s)E(s)}{R(s)} = \frac{G(s)}{1 + G(s)H(s)}$$

or $$\frac{E(s)}{R(s)} = \frac{1}{1 + G(s)H(s)} \quad .....(4.8)$$

where, $\frac{E(s)}{R(s)}$ is called error ratio

For positive feedback,

$$\frac{E(s)}{R(s)} = \frac{1}{1 - G(s)H(s)} \quad .....(4.9)$$

Put the value of C(s) from equations (4.1) to equation (4.2)

$$B(s) = H(s) \cdot G(s)E(s)$$

Put the value of E(s) that is E(s) = R(s) − B(s) in the above equation

$$B(s) = H(s) \cdot G(s)\ [R(s) - B(s)]$$

or $$\frac{B(s)}{R(s)} = \frac{G(s)H(s)}{1 + G(s)H(s)} \quad .....(4.10)$$

where, $\frac{B(s)}{R(s)}$ is called primary feedback ratio

For positive feedback

$$\frac{B(s)}{R(s)} = \frac{G(s)H(s)}{1 - G(s)H(s)} \quad .....(4.11)$$

Transfer function for unity feedback control system i.e. H(s) = 1 is shown in figure 4.6.

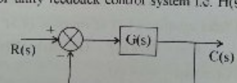
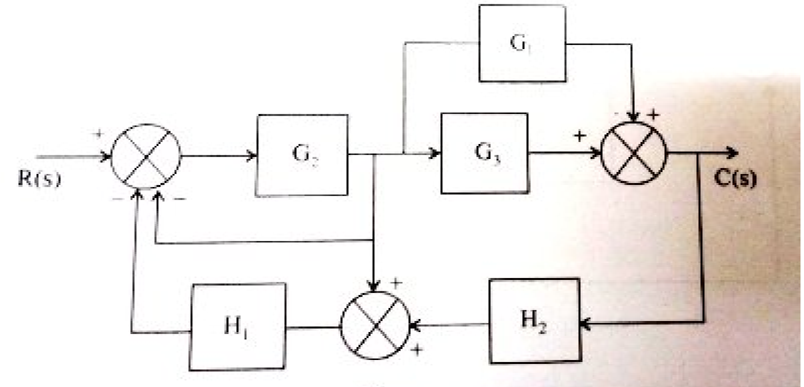


Figure 4.6 Unity feedback control system

$$\frac{C(s)}{R(s)} = \frac{G(s)}{1 + G(s)}, \text{ For negative feedback} \quad .....(4.12)$$

$$\frac{C(s)}{R(s)} = \frac{G(s)}{1 - G(s)}, \text{ For positive feedback} \quad .....(4.13)$$

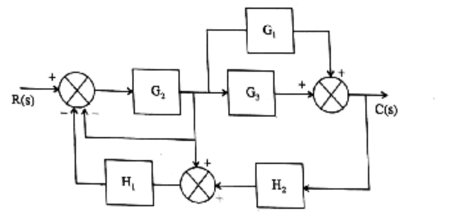
Q.4 Simplify the Block diagram given below and obtain the transfer function?



Figure

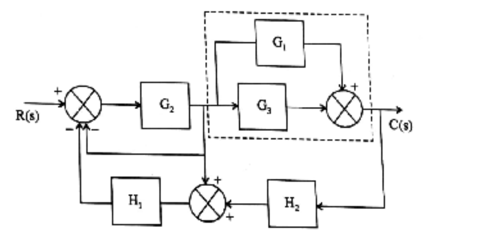
ANS

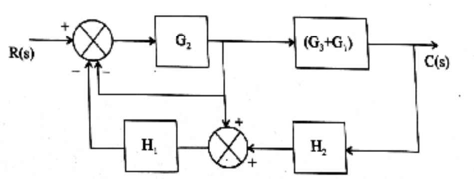
Example 10. Find the transfer function of the block diagram shown in figure below.

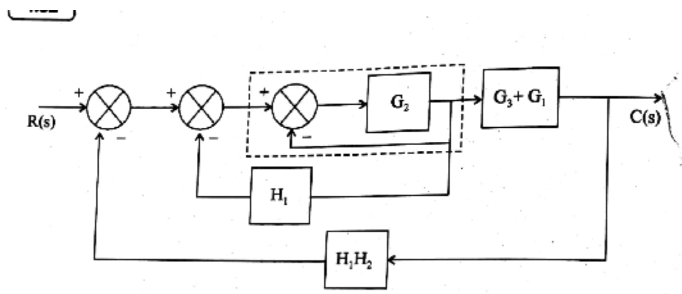


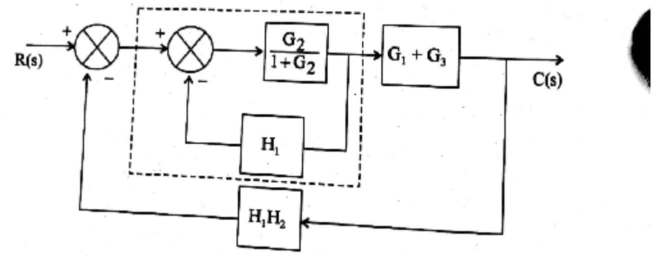
Figure

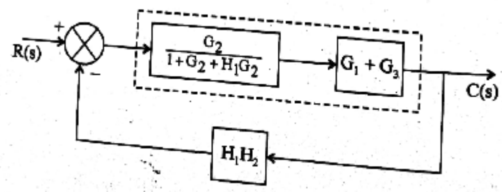
Solution:

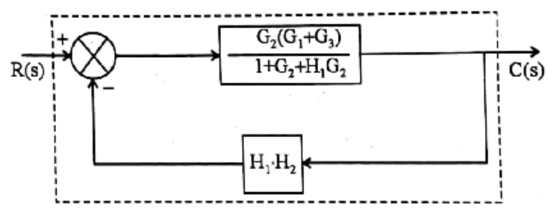


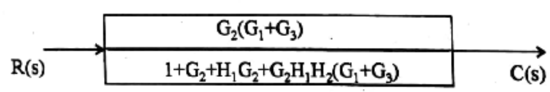






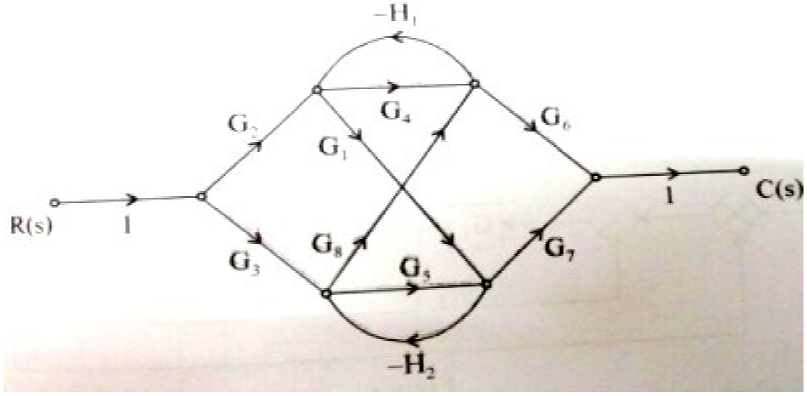






$$\frac{C(s)}{R(s)} = \frac{G_2(G_1+G_3)}{1+G_2+H_1G_2(1+H_2\,G_1+H_2G_3)}$$ **Ans.**

Q.5 The signal flow graph of a system is shown in figure .find the transfer function?



ANS

$$F_2 = G_3G_5G_7$$
$$F_3 = G_2G_1G_7$$
$$F_4 = G_3G_8G_6$$
$$F_5 = G_2G_1(-H_2)G_8G_6 = -\ G_1G_2G_6G_8H_2$$
$$F_6 = G_3G_8(-H_1)G_1G_7 = -\ G_1G_3G_7G_8H_1$$

Individual loops

$$L_{11} = G_4(-H_1) = -\ G_4H_1$$
$$L_{12} = G_5(-H_2) = -\ G_5H_2$$
$$L_{13} = (-H_1)G_1(-H_2)G_8 = H_1H_2G_1G_8$$

Two non–touching loops

$$NT_1 = (-G_4H_1)(-G_5H_2) = G_4G_5H_1H_2$$

Forward path F_1 does not touch L_{12} loop and forward path F_2 does not touch L_{11} loop. But all other paths touch both the loops. Therefore,

$$\Delta_1 = 1 + G_5H_2, \quad \Delta_2 = 1 + G_4H_1$$
$$\Delta_3 = \Delta_4 = \Delta_6 = 1$$
$$\Delta = 1 + G_4H_1 + G_5H_2 - H_1H_2G_1G_8 + G_4G_5H_1H_2$$

$$\text{T.F.} = \frac{G_2G_4G_6(1+G_5H_2) + G_3G_5G_7(1+G_4H_1) + G_2G_1G_7}{1+G_4H_1+G_5H_2-H_1H_2G_1G_8+G_4G_5H_1H_2}$$

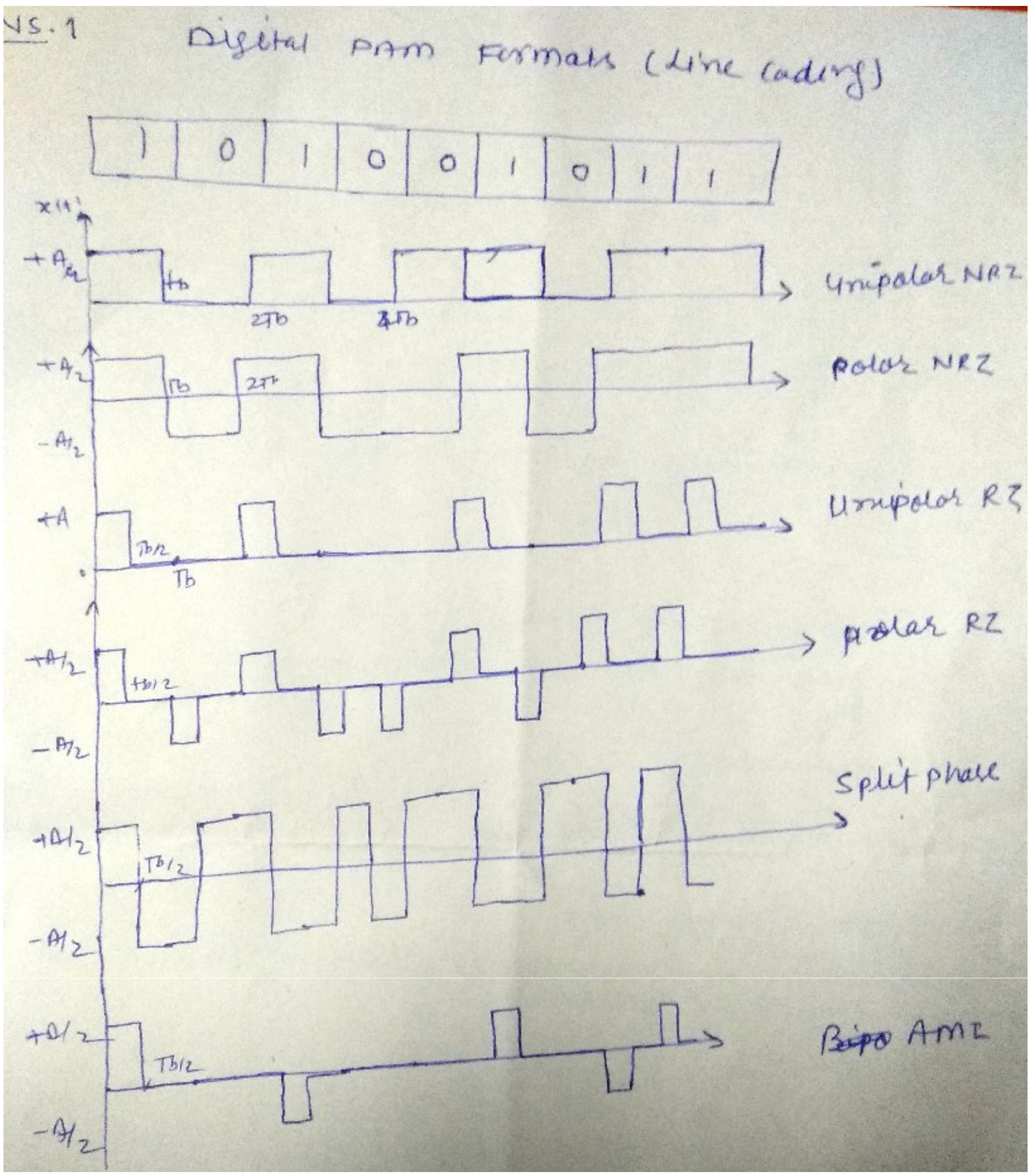
$$+\frac{G_3G_8G_6 - G_1G_2G_6G_8H_2 - G_1G_3G_7G_8H_1}{1+G_4H_1+G_5H_2-H_1H_2G_1G_8+G_4G_5H_1H_2} \quad \textbf{Ans.}$$

JNIT JAGANNATH GUPTA INSTITUTE OF ENGINEERING & TECHNOLOGY
JAIPUR
I-Mid Term Examination Session 2017-2018
B.Tech III Year VI Semester

Branch: ECE | Subject: DC
Time: 02:00-03:30 | Subject Code: 6EC4A
Date: 15 -02-18 | Max. Marks: 20

Attempt any four questions out of following five questions

Q.1 Design Digital PAM formats (line coding) for given data.



Q.2 Explain Base-Band and pass-Band transmission in details.

Ans. Communication systems can be classified into two groups depending on the range of frequencies they use to transmit information. These communication systems are classified into BASEBAND or PASSBAND system.

Baseband transmission sends the information signal as it is without modulation (without frequency shifting) while passband transmission shifts the signal to be transmitted in frequency to a higher frequency and then transmits it, where at the receiver the signal is shifted back to its original frequency. Almost all sources of information generate baseband signals.

Baseband signals are those that have frequencies relatively close to zero such as the human voice (20 Hz – 5 kHz) and the video signal from a TV camera (0 Hz – 5.5 MHz). The telephone system used for homes and offices, for example, may transmit the baseband audio signal as it is when the call is local (from your home to your neighbor's home). However, when the telephone call is a long–distance call that is transmitted via microwave or satellite links, the baseband audio signal becomes unsuitable for transmission and the communication system becomes a passband system.

Similarly, transmitting the video signal from your camera to your TV using a wire represents a baseband communication while transmitting that video signal via satellites passband transmission. Therefore, baseband transmission, which is easier than passband transmission, is usually used when communicating over wires, while over–the–air transmission requires passband transmission. Notice that even over wires, the transmission may be passband transmission in specific applications.

Baseband signals are transmitted without modulation, that is, without any shift in the range of frequencies of the signal, and are low frequency - contained within the "base" band of frequencies from close to 0 hertz up to a higher cut-off frequency or maximum bandwidth.

Baseband can be synonymous with lowpass or non-modulated, and is differentiated from passband, bandpass, carrier-modulated, intermediate frequency, or radio frequency (RF).

A passband is in contrast to baseband, whatsoever the range of frequencies or wavelengths can "pass" through a filter. For example, a radio receiver contains a bandpass filter to select the frequency of the desired radio signal out of all the radio waves by its antenna. Hence the passband of a receiver is the range of frequencies it can receive.

Q.3 A DMS emits 4 messages with probabilities 1/2, 1/4, 1/8, 1/8 respectively find following parameter.

(a) Total amount of information (b) Entropy

(c)Information Rate d) Efficiency by Using Shannon fano code

x_i	$P(x_i)$	Step 1	Step 2	Step 3	Code
x_1	1/2	0			0
x_2	1/4	1	0		10
x_3	1/8	1	1	0	110
x_4	1/8	1	1	1	111

$$I(x_1) = -\log_2 \frac{1}{2} = 1 = n_1$$

$$I(x_2) = -\log_2 \frac{1}{4} = 2\ n_2$$

$$I(x_3) = -\log_2 \frac{1}{8} = 3 = n_3$$

$$I(x_4) = -\log_2 \frac{1}{8} = 3 = n_4$$

We know that,

$$H(X) = \sum_{i=1}^{4} P(x_i) I(x_i)$$

or

$$H(X) = \frac{1}{2}(1) + \frac{1}{4}(2) + \frac{1}{8}(3) + \frac{1}{8}(3) = 1.75$$

$$L = \sum_{i=1}^{4} P(x_i)\, n_i = \frac{1}{2}(1) + \frac{1}{4}(2) + \frac{1}{8}(3) + \frac{1}{8}(3) = 1.75$$

Also

$$\eta = \frac{H(X)}{L} = 1 = 100\% \quad \textbf{Ans.}$$

Q.4 A DMS generates 5 messages with probabilities 0.4,0.19,0.16,0.15,0.1 respectively. Find Entropy and efficiency by using HUFFMAN coding.

ANS

Solution: The Shannon-Fano code is constructed as follows (see Table 9.12)

$$H(X) = \sum_{i=1}^{5} P(x_i)n_i = 0.4(1) + 0.19(2) + 0.16(2) + 0.15(3) + 0.1(3) = 2.25$$

Also, $$\eta = \frac{H(X)}{L} = \frac{2.15}{2.25} = 0.956 = 9.5.6\%$$ **Ans.**

Table 9.12.

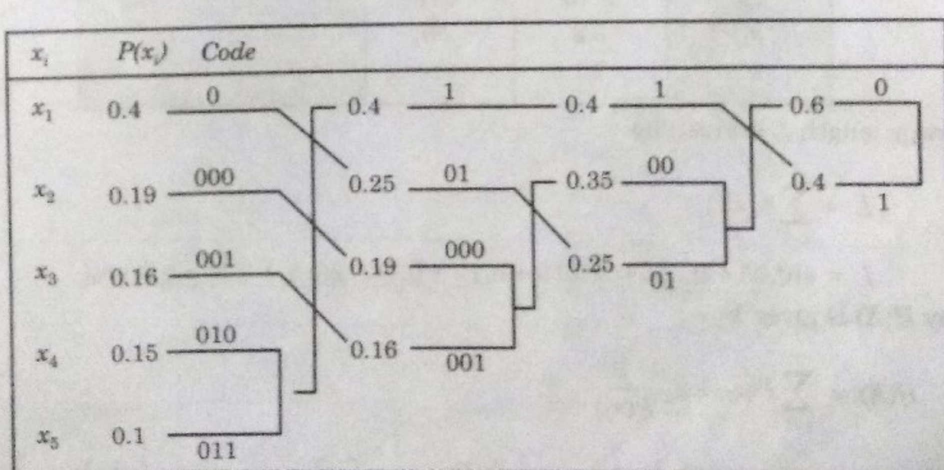
x_i	$P(x_i)$	*Step 1*	*Step 2*	*Step 3*	*Code*
x_1	0.4	0	0		00
x_2	0.19	0	1		01
x_3	0.16	1	0		10
x_4	0.15	1	1	0	110
x_5	0.1	1	1	1	111

(*ii*) The Huffman code is constructed as follows (see Table 9.13):

$$L = \sum_{i=1}^{5} P(x_i)n_i$$

or $$L = 0.4(1) + (0.19 + 0.16 + 0.15 + 0.1)(3) = 2.2$$ **Ans.**

Table 9.13.



or $$\eta = \frac{H(X)}{L} = \frac{2.15}{2.2}$$

or $$\eta = 0.977 = 97.7\%$$

Q.5 write short notes on;

A) ISI;- Unlike analog signals, which are usually smooth in nature, digital signals are composed of pulses with often vertical transitions. The fact that digital signals sometimes have vertical transitions increases their bandwidth significantly since it requires infinite bandwidth to represent a signal with vertical transitions.

Compare for example the bandwidth of two baseband signals given by a sine wave with frequency 0f and a square wave with frequency 0f . The sine wave has a single frequency component at 0f Hz. However, the square wave has infinite frequency components at 0f and integer multiples of it. If we consider the bandwidth of a signal to be the minimum frequency that encloses all frequency components of the signal (the signal has no frequency components at all above that frequency), then the sine wave will have a bandwidth of 0f Hz because it has no frequency components above that frequency, while the square wave has an infinite bandwidth because it theoretically has frequency components that extend to infinity.

The fact that any communication system has limited bandwidth to transmit digital data indicates that certainly a transmitted square pulse will be received differently at the receiver as the channel will filter some components of it. The difference depends on how narrow the bandwidth of the channel compared to the symbol rate in the signal. The effect of filtering part of the transmitted signal by the channel on the quality of the received signal may be significant that a phenomenon called "Intersymbol Interference (ISI)" occurs.

B) Channel capacity;-

How much data will a channel/medium carry in one second or what is the data rate supported by the channel? Any discussion about the design of a communication system will be incomplete without mentioning Shannon's Theorem. Shannon's information theory tells us the amount of information a channel can carry. In other words it specifies the capacity of the channel. The theorem can be stated in simple terms as follows

- A given communication system has a maximum rate of information C known as the channel capacity
- If the transmission information rate R is less than C, then the data transmission in the presence of noise can be made to happen with arbitrarily small error probabilities by using intelligent coding techniques
- To get lower error probabilities, the encoder has to work on longer blocks of signal data. This entails longer delays and higher computational requirements.

Shannon – Hartley Equation

Shannon-Hartley equation relates the maximum capacity (transmission bit rate) that can be achieved over a given channel with certain noise characteristics and bandwidth. For an AWGN the maximum capacity is given by)

$$C=Blog2(1+SN)\rightarrow(1)C=Blog2(1+SN)\rightarrow(1)$$

Here (C) is the maximum capacity of the channel in bits/second otherwise called Shannon's capacity limit for the given channel, (B) is the bandwidth of the channel in Hertz, (S) is the signal power in Watts and (N) is the noise power, also in Watts. The ratio (S/N) is called Signal to Noise Ratio (SNR). It can be ascertained that the maximum rate at which we can transmit the information without any error, is limited by the bandwidth, the signal level, and the noise level. It tells how many bits can be transmitted per second without errors over a channel of bandwidth (B \; Hz), when the signal power is limited to (S \; Watts) and is exposed to Gaussian White (uncorrelated) Noise ((N \; Watts)) of additive nature.

This question paper contains (1) no. of printed page.

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JAGANNATH GUPTA INSTITUTE OF ENGINEERING & TECHNOLOGY JAIPUR

I-Mid Term Examination Session 2016-2017

B.Tech 3 Year VI- Semester

Branch: ECE | **Subject: MP**
Time: 2.00pm -3.30pm | **Subject Code: 6EC2A**
Date: 14-02-18 | **Max. Marks: 20**

<u>Note: Attempt any four questions out of five questions.</u>

Q.1 How many flag in MP 8085. Explain ?

Flags

The ALU includes five flip-flops, which are set or reset after an operation according to the data conditions of the result in the accumulator and other registers. They are called zero (Z), carry (CY), sign (S), parity (P) and auxiliary carry (AC) flags; their bit positions in the flag register are shown in Figure 3.6. The microprocessor uses these flags to set and test data conditions. For

example, after an addition of two numbers, if the sum in the accumulator is larger than 8-bits, the flip-flop indicates a carry—called the carry flag (CY)—to set to one. When an arithmetic operation results in zero, the flip-flop called the *zero (Z) flag* is set to one.

Figure 3.6 shows this 8-bit flag register, adjacent to the accumulator.

D_7	D_6	D_5	D_4	D_3	D_2	D_1	D_0
S	Z	X	AC	X	P	X	CY

X = Not specified

Figure 3.6 Format of the flag register.

The flags are stored in the 8-bit register so that the programmer can examine these flags (data conditions) by accessing the register through an instruction. These flags have critical importance in the decision-making process of the microprocessor. The conditions (set or reset) of the flags are tested through the software instructions. For instance, the instruction JC (jump on carry) is implemented to change the sequence of a program when CY flag is set. The thorough understanding of flag is essential in writing assembly language programs.

Z (Zero) flag: This flag indicates whether the result of a mathematical or logical operation is zero or not. If the result of the current operation is zero, then this flag will be set, otherwise reset.

CY (Carry) flag: This flag indicates whether, during an addition or subtraction operation, carry or borrow is generated or not, if generated then this flag bit will be set. (This flag may also be set before a mathematical operation as an extra operand to certain instructions).

AC (Auxiliary carry) flag: It shows carry propagation from D_3 position to D_4 position. To understand it better, consider Figure 3.7.

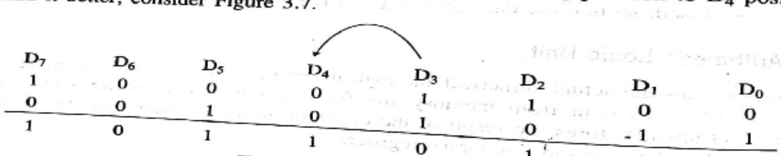

Figure 3.7 Auxiliary carry flag.

Here, a carry generates from D_3 bit position and propagates to the D_4 position. This carry is called *auxiliary carry*. This flag is never used for setting or testing a condition.

S (Sign) flag: Sign flag indicates whether the result of a mathematical operation is negative or positive. If the result is positive, then this flag will reset and if the result is negative this flag will be set. This bit, in fact, is a replica of the D_7 bit.

P (Parity) flag: This flag indicates whether the current result is of even parity (1) or of odd parity (0).

Q.2 Draw and Explain the block diagram of microprocessor 8085.
ANS:-

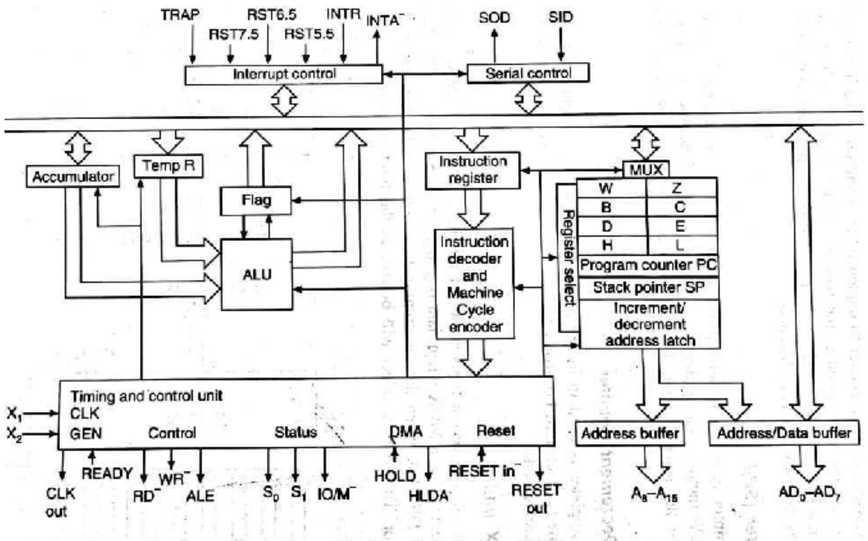

Figure 3.4 Internal architecture of 8085.

Internal Block Diagram or Fundamental Diagram or Architecture of INTEL µp IC 8085/8085A:-

µp 8085 is a 40 pin N-mos family IC Consisting of 6200 transistors having Power Supply range Vcc=0V, the different parts are described below:-

1) ADDRESS PINS:-

It Consists of 16 address pins A_{15}-A_8 and A_{D7}-A_{D0}. For selecting one memory location µp will transfer 16-bit address through these 16 address pins. 8 MSB's are transfered through 8 upper address pins A_{15}-A_8 & 8 LSB's are transfered through 8 lower address pins A_{D7}-A_{D0}. e.g. If µp will transfer 16-bit number 0000H on address pins then the very first memory location is selected.

2) DATA PINS:-

µp 8085 has 8 data pins A_{D7}-A_{D0} So A_{D7}-A_{D0} pins are Common which are used to transfer 8 LSB's of address as well as 8-bit data but address and data are transfered at different time. Hence A_{D7}-A_{D0} pins are also called time shared or time multiplexed adress data pins.

(3) GENERAL PURPOSE REGISTERS:-

µp 8085 has 6 registers of 8-bits each B, C, D, E, H, L. Each register Consists of 8 F/F's So each registers can store maximum 8-bit number.

For storing number greater than 8 bits, we have to use two register in pair. There are three register pair BC, DE, HL. Each register pair can store max. 16-bit number.

(4) ACCUMULATOR OR REGISTOR A:-

It is a 8-bit register which consists of 8 flip-flops so accumulator can store max 8-bit number.

The importance of accumulator is that in most of the arthimatic & logical operation, µp will always take first 8-bit number from accumulator, µp will perform the operation in ALU & 8 LSB's of the result obtained in ALU is stored back in accumulator.

(5) Temporary Register W, X, Z:-

Are 8-bit register each which store max 8-bit number each. But W, X, Z cannot be used by the programmer.

These registers are used only by µp for storing any intermediate data or result of any internal operation.

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6) ALU (Arithematic & logic unit):-

The ALU in µp 8085 is of 8 bits so µp 8085 is called 8-bit µp.

The different arithmatic & logical operations is performed by µp in ALU µp 8085 can perform arithmatic & logical operation of max 8 bit number at a time.

7) Special purpose Registers:-

SP (Stack pointer) + PC (Program Counter) are sixteen (16) bit register which consists of 16 F/F's So SP + PC can store max 16-bit number at a time.

8) Flag Register:-

D7	D6	D5	D4	D3	D2	D1	D0
S	Z	X	AC	X	P	X	CF

Not Used as Flags

Q.3 Explain the function of general purpose register, program counter and accumulator in the architecture of MP 8085.

ANS:-

3.4.1 Register Unit

As shown in Figure 3.3, the register unit consists of six general purpose data registers B, C, D, E, H and L, two internal registers W and Z, two 16-bit address registers PC and SP, one increment/decrement counter register and one MUX/DEMUX.

Accumulator $A_{(8)}$	Flag register
$B_{(8)}$	$C_{(8)}$
$D_{(8)}$	$E_{(8)}$
$H_{(8)}$	$L_{(8)}$
Stack pointer $(SP)_{16}$	
Program counter $(PC)_{16}$	

Figure 3.3 Registers of 8085.

General purpose data register

The 8085/8080A has six general purpose registers to store 8-bit data; these are identified as B, C, D, E, H, and L as shown in Figure 3.4. They can be combined as register pairs—BC, DE and HL—to perform some 16-bit operations. The programmer can use these registers to store or copy data into the registers by using data copy instructions.

The two internal registers W and Z are also data registers, but these registers are not available to the user. Microprocessor uses these registers internally in case of CALL and XCHG instructions.

Program counter (PC)

This 16-bit register deals with sequencing the execution of instructions. This register is a memory pointer. Memory locations have 16-bit addresses which is why this is a 16-bit register. The microprocessor uses this register to sequence the execution of the instructions. The function of the program counter is to point to the memory address from which the next byte is to be fetched. When a byte (machine code) is being fetched, the program counter is incremented by one to point to the next memory location.

(4) ACCUMULATOR OR REGISTOR A :- It is a 8-bit register which consists of 8 Flip-Flops so accumulator can store max 8-bit number.

The importance of accumulator is that in most of the arthimatis & logical operation, μp will always take first 8-bit number from accumolator, μp will perform the operation in ALU & 8 LSB's of the result obtained in ALU is stored back in accumulator.

Q.4 Explain addressing modes of microprocessor 8085 with examples.

Addressing Modes of µp 8085 :-

For performing any operation using µp, we have to give the corresponding instruction to µp. In each instruction, we have to give three information

① operation to be perform

② Adress of source of data which is required for performing of the operation

③ Address of destination of result which is obtained after the operation.

The method by which address of source of data or Address of destination of result is given in the instruction is called as addressing mode.

These are five types of addressing modes in µp 8085.

① Immediate addressing mode (IAM) :- If 8/16 bit data required for executing the instruction is given directly along with the instruction then such instructions are called immediate addressing mode instr. In most of the IAM instructions, the last alphabet is I. e.g.

MVI A, 75H

75H → [75H] A

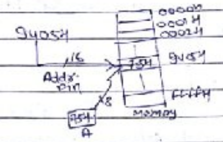
(2) Register direct or Register addressing mode :- (RDAM) If 8/16 bit data required for executing the instruction is present in 8/16 bit register/ Register pair and the name of this register/ register pair is given along with the instruction, such instructions are called register direct addressing mode instruction

MOV A, B

B → [75] B → [75H] A

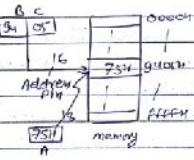
(3) Direct addressing mode (DAM) :- If 8/16 bit data required for executing the instruction is present in memory location and 16-bit address of this memory location is given along with the instruction. Such instructions are called DAM instruction. e.g.

LDA 9405H



(4) Register Indirect or Indirect addressing mode (RIAM) :- If 8/16 bit data required for executing the instruction is present in memory location, the address of this memory location is present in register pair and the name of this register pair is given with the instruction, such instruction are called RIAM instruction.

e.g. LDAX B



(5) Implicit addressing mode (IAM) :- If address of source of data as well as address of destination of result is fixed, then there is no need to give any operand along with the instruction. Such instructions are called implicit addressing mode instruction. or Inherent addressing mode instruction e.g. CMA

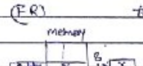
RAR

Q.5 Explain the instructions MOV A, M , SHLD A000 H, LDA DADA H with addressing Mode flag effect and machine cycle.

4) Mov Rd, M [Move data from selected memory location (FR) to destination register Rd]

Addressing mode - s → [RIAM], [SBI]

d → [RDAM], [NFAC]



MOV A, M

MOV B, M

MOV C, M

MOV D, M

MOV E, M

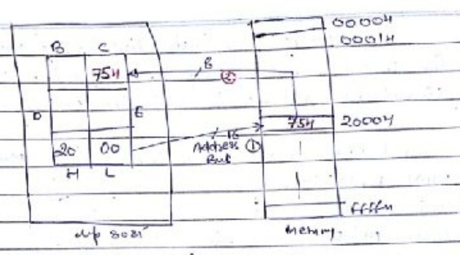
MOV H, M

MOV L, M

e.g. transfer 8-bit data of memory location 2000H into register C.

Sol: LXI H, 2000H

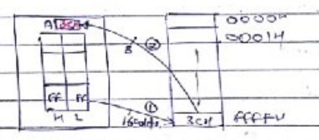
MOV C, M



e.g. Transfer 8-bit no of memory location FFFFH into Acc.

Sol - LXI H, FFFFH

MOV A, M

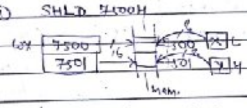


13> SHLD Addr-16 (Store H-L pair direct into two memory
(FRRWW) locations whose address is given in the instruction

S → [RDAM], [TBI] [NFAC]

d → [DAM]

e.g. ① SHLD 7500H



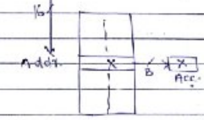
e.g. ② Store 16 bit no. of Rp D-E into two memory loc. 9000 & 9001H

MOV H, D
MOV L, E
SHLD 9000H

or

XCHG
SHLD 9000H

9> LDA Addr.(16 bit) :[Load accumulator from memory data
(FRR) whose address is given in the instruction]

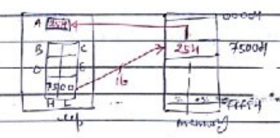


S → [DAM] ; [TBI] , [NFAC]

d → [RDAM]

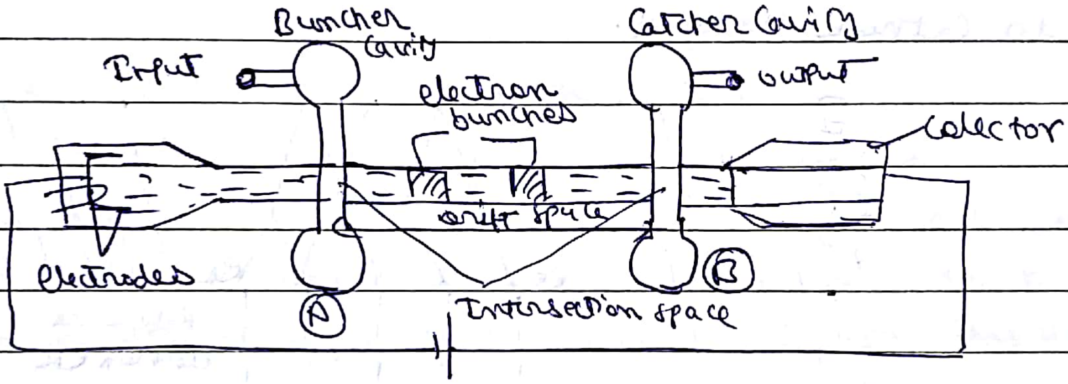
e.g. Transfer 8-bit no. of memory location 7500 H into acc. by four different methods.

Soln ① LXI H, 7500H
MOV A, M



Q1 Draw the basic schmatic & mechanics of operation of two Cavity Klystron?

In two Cavity Klystron, high velocity electron beam is formed, focused & sent down along a glass tube to a collector electrode, which is at high positive potential with respect to cathode.



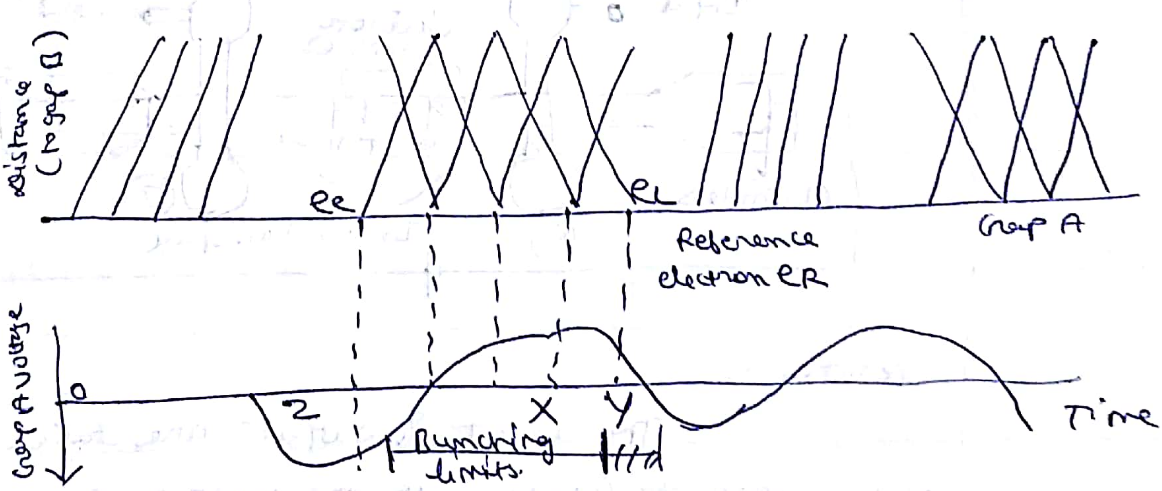
Operation:-

The input & output are taken from tube via resonant Cavity with the help of Coupling loops. The region betn buncher Cavity & Catcher Cavity is called drift space. The first electrode Controls the No. of electrons in the electron beam & serves to focus the beam. The velocity of electron in the beam is determines by the beam acclerating potential.

On leaving the region of focusing grid, the electron passes through grids of buncher Cavity - The space betn the grids is refered to as intersection space. When electron Travel through this space, they are subject to RF potential at frequency determined by Cavity Resonant frequency which is nothing but the input frequency.

Velocity Modulation :- Consider a situation where there is No voltage across the gap. Electrons passing through gap A are unaffected & continue on to the collector with same constant velocity they had before approaching gap A. When RF signal to be amplified is used for exciting the buncher cavity thereby develping an alternating voltage of signal frequency across gap A.

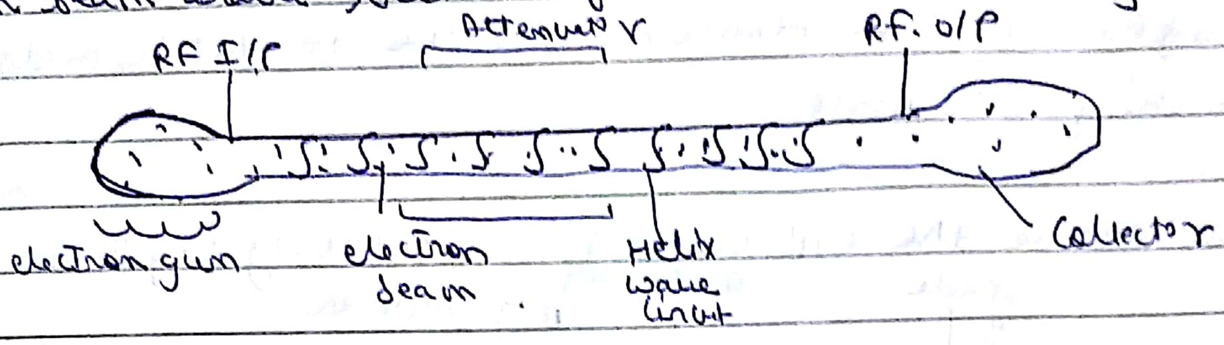
At point X on input RF cycle, alternating voltage is 0 & electron which passes through gap A is unaffected by RF signal. Set this electron is called reference electron eR which travels ~~to~~ with an uncharged velocity $V_0 = \sqrt{\frac{2eV}{m}}$, V is anode to cathode voltage.



So, when electrons passes the buncher gap, their velocity will be changed accordance to the input RF signal.

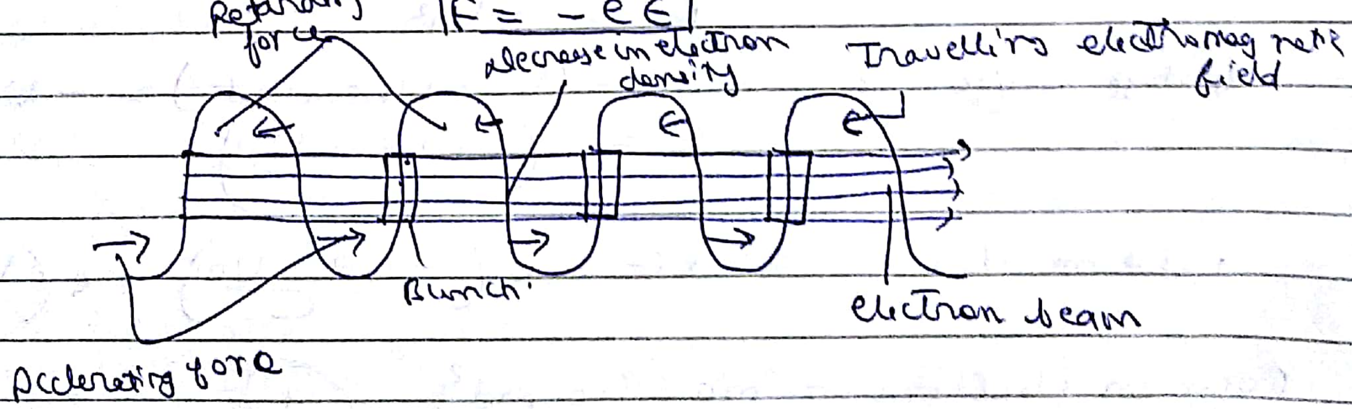
Q2. Draw the basic basic schmatic of Helix tube twt tube & explain its operation.

Sol. The TWT is a high gain, low noise & wide bandwidth amplifier which can operate a wide range of frequencies from 300 MHz - 50 GHz. TWT is also known as Helix Travelling wave tube. The TWTA is an amplifier which make use of distributed interaction bet^n an electron beam & travelling wave RF field. To make sure, the interaction bet^n an electron beam & a RF field, it is necessary to ensure that they both are travelling in the same direction with same velocity. It differs from Klystron amplifier in which electron beam travel but RF field remains stationary.



operation → In TWT, process take place continously over entire length of slow wave structure. The applied signal propagate around turns of helix & produces an electric field along axis of helix which progress along axial direction with phase velocity which is small compared to velocity of light. This axial time varying electric field produces velocity modulation in an otherwise uniform velocity which is ~~small compared to velocity of light~~ equal to phase velocity of electrons in electrons beam moving through helix axis. The velocity modulation tends to bunch the electrons. When a signal voltage is coupled into helix, axial electric field exerts a force on electron as

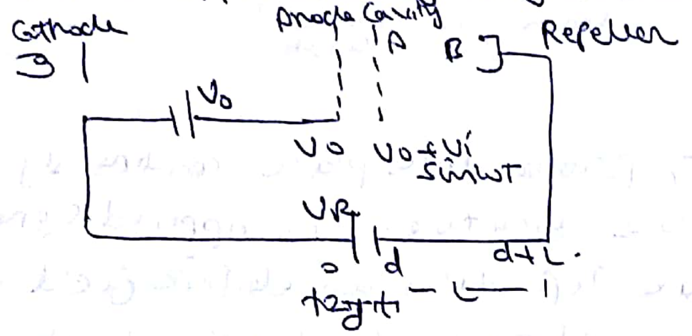
$$F = -eE$$



Consider point A, electrons ahead of it are moving more slower than average & those behind them are moving point A. Since, dc electron velocity is slightly greater than the axial wave velocity, it result into a situation in which more electron face the retarding field than the accelerating field; so energy is thus lost by the electron beam & gained by the travelling wave, resulting in an amplified signal. At next turn of helix, RF signal amplitude is more and also the electric field axis created by the RF signal is more. Hence, force due to electric field is more & bunching take place.

Q3 Derive the expression of single cavity klystron.

Sol



The electrons enter gap at $z=0$:

$$v_0 = \sqrt{\frac{2eV_0}{m}} \quad (1)$$

electrons leave gap at $z=d$

$$v_1 = v_0\left[1 + \frac{\beta_i V_1}{2V_0}\sin\left(\omega t_1 - \frac{\theta_g}{2}\right)\right] \quad (2)$$

Now, voltage at point A = $V = V_0 + V_i\sin\omega t$

" B = $-V_R$

Voltage difference, $-V_R - (V_0 + V_i\sin\omega t) = -V_R - V_0$

$$E = \left(-\frac{V_R - V_0}{L}\right).$$

force on electron, $= -eE = e\left(-\frac{V_R - V_0}{L}\right) = e\left(\frac{V_R + V_0}{L}\right) \quad (3)$

Force on electron $= ma. = \frac{md^2z}{dt^2} \quad (4)$

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Now, equating eq. 4 & eq. 3,

$$m\frac{d^2z}{dt^2} = \frac{e}{L}(V_R+V_0)$$

$$\frac{d^2z}{dt^2} = \frac{e}{mL}(V_R+V_0) \quad (5)$$

Integrating, $\frac{dz}{dt} = \frac{e}{mL}(V_R+V_0)t + c \quad (6)$

$t = t_1$, $\frac{dz}{dt} = V_1$

$$V_1 = \frac{e}{mL}(V_R+V_0)t_1 + c$$

$$c = V_1 - \frac{e}{mL}(V_R+V_0)t_1 \quad (7)$$

Substituting value of c from (7)

$$\frac{dz}{dt} = \frac{e}{mL}(V_R+V_0)t + V_1 - \frac{e}{mL}(V_R+V_0)t_1$$

$$\frac{dz}{dt} = \frac{e}{mL}(V_R+V_0)(t-t_1) + V_1 \quad (8)$$

Integrating, $z = \frac{e}{2mL}(V_R+V_0)(t-t_1)^2 + V_1 t + C \quad (9)$

At $z = 0$, $t = t_2$

$$0 = \frac{e}{2mL}(V_R+V_0)(t_2-t_1)^2 + V_1 t_2 + C_1$$

$$C_1 = -\frac{e}{mL}(V_R+V_0)(t_2-t_1)^2 - V_1 t_2 \quad (10)$$

Substituting value of C_1 :-

$$z = \frac{e}{2mL}(V_R+V_0)\left\{(t-t_1)^2 - (t_2-t_1)^2\right\} + V_1(t-t_2) \quad (11)$$

Again, when $t = t_1$, $z = 0$

$$-\frac{e}{2mL}(V_R+V_0)(t_2-t_1)^2 - V_1(t_1-t_2)=0 \quad (12)$$

$$t_2-t_1 = \frac{2mL}{e}\cdot\frac{V_1}{(V_R+V_0)}$$

From eq (2)

$$t_2-t_1 = \frac{2mL}{e(V_R+V_0)}\cdot V_0\left[1+\frac{\beta_i V_1}{2V_0}\sin\left(\omega t_1-\frac{\theta_g}{2}\right)\right] \quad (13)$$

$$\frac{2mL\cdot V_0}{e(V_R+V_0)} = T_0' \qquad (t_2-t_1) = T_0.$$

$$T_0 = T_0'\left\{1+\frac{\beta_i V_1}{2V_0}\sin\left(\omega t_1-\frac{\theta_g}{2}\right)\right\}.$$

$$\omega(t_2-t_1) = \omega T_0'\left\{1+\frac{\beta_i V_1}{2V_0}\sin\left(\omega t_1-\frac{\theta_g}{2}\right)\right\}$$

$X' = \frac{\beta_i V_1 \theta_0'}{2V_0}$ is bunching parameter of Reflex Klystron

$$\omega(t_2-t_1) = \theta_0' + X'\sin\left(\omega t_1-\frac{\theta_g}{2}\right)$$

Q4 A Reflex Klystron operates at Peak Mode, $n=2$ with Beam voltage 300V, Current = 20mA, Voltage = 40V determine, (a) Input power (b) output power (c) efficiency

Sol (a) Input power : $P_{in} = P_{dc} = V_0 I_0 = 300\times 10^{-3}$

$$P_{in} = 6\,W$$

(b) output power = $P_{ac} = V_1 I_0 \beta_i J_1(X')$ $\quad \beta_i = 1$

$$X' = \frac{\beta_i V_1}{2V_0}\theta_0'$$

$$\theta_0' = \omega T_0' = 2\pi n - \pi/2$$

$$X' = \frac{40}{2\times 300}(2\pi\cdot 2 - \pi/2)$$

$$X' = 0.734$$

At $x' = 0.734$, $x' J_1(x') = 0.253$

$J_1(x') = 0.345$

output power $P_{ac} = 40 \times 20 \times 10^{-3} \times 1 \times 0.345$

$P_{ac} = 0.276\,W$

(c) Efficiency, $\eta = \frac{P_{ac}}{P_{in}} = \frac{0.276}{6}$ $\eta = 4.6\,\%$

Q5 A helix TWT operates at 4 GHz under a beam voltage of 10 KV & beam current 500 mA. If helix impedance is 25 Ω & length is 20 cm, find o/p power gain in dB?

Sol $f = 4\,GHz$, $V_0 = 10\,KV$, $I_0 = 500\,mA$

$Z_0 = 25\,\Omega$, $l = 20\,cm$.

output gain = $A_P = -9.54 + 47.3\,NC\,dB$.

$N = \frac{l}{\lambda_e}$.

$\beta_e = \frac{2\pi}{\lambda_e} = \frac{\omega}{v_0} = \lambda_e = \frac{2\pi v_0}{\omega}$

$v_0 = \sqrt{\frac{2eV_0}{m}} = 0.593 \times 10^6 \sqrt{V_0}$

$v_0 = 0.593 \times 10^8\,m/s.$ & $\omega = 2\pi f$

$N = \frac{l\omega}{2\pi v_0} = \frac{0.2 \times 2\pi \times 4 \times 10^9}{2\pi \times 0.593 \times 10^8} = 13.49$

Coupling factor C is $C = \left(\frac{I_0 Z_0}{4V_0}\right)^{1/3}$

$C = \left(\frac{500 \times 10^{-3} \times 25}{4 \times 10 \times 10^3}\right)^{1/3}$

Teacher's Signature

$C = 0.068$

o/p power gain A_P is

$$A_P = -9.54 + 47.3\ NC.$$

$$= -9.54 + 47.3 \times 13.49 \times 0.068$$

$$= 33.85\ dB$$