PANIMALAR ENGINEERING COLLEGE

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

QUESTION BANK
FOR FIFTH SEMESTER(2017-2018)

BLOOM'S TAXONOMY LEVELS (BTL)

Level 1 – Remembering (R)/Knowledge(K)

Level 2 – Understanding (U)

Level 3 – Applying (A)/(Ap)

Level 4 – Analyzing (AZ)

Level 5 – Evaluating (E)

Level 6 – Creating (C)

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EC6501DIGITAL COMMUNICATION

UNIT I
SAMPLING AND QUANTISATION

1. Give advantage and disadvantages of digital communication.(U)

(Apr-May 2011)

Advantages:

i) Circuitry becomes simpler and less expensive than analog communication.

ii) More reliable, Easy to manipulate

iii) Highly secure.

iv) Can travel long distances and can store data for long time.

v) Compatibility with other digital systems

Disadvantages:

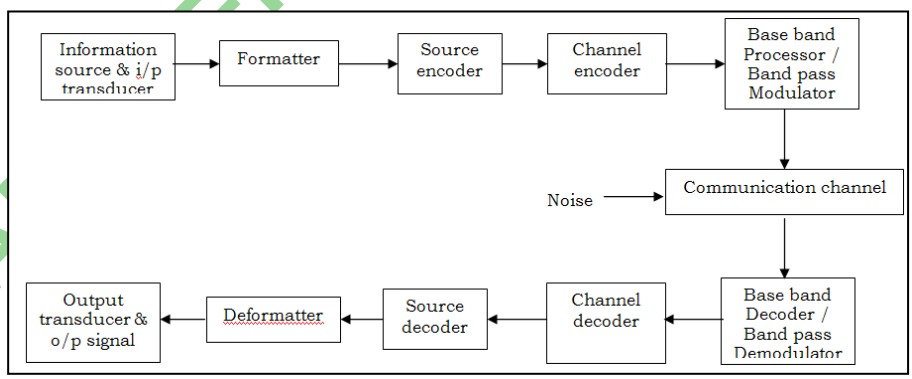
i)Sampling error

ii) Requires greater bandwidth than analog to transmit the same information

2. What is meant by distortionless transmission? (Nov-Dec 2011) (R)

Transmission is said to be distortion less if the input and output have identical wave shape.

3. Draw the basic block diagram of digital communication system.(Nov-Dec 2011) (R)



4. State Sampling theorem. (May-June 2012) (R)

A bandlimited signal of finite energy, which has no frequency components higher than W Hz, may be completely represented into and recovered from the knowledge of its samples taken at the rate of 2W samples per second.

5.Define Nyquist rate. (R)

For a bandlimited signal with bandwidth= W Hz the Nyquist rate is given as, ***Nyquist rate = 2W samples/sec***

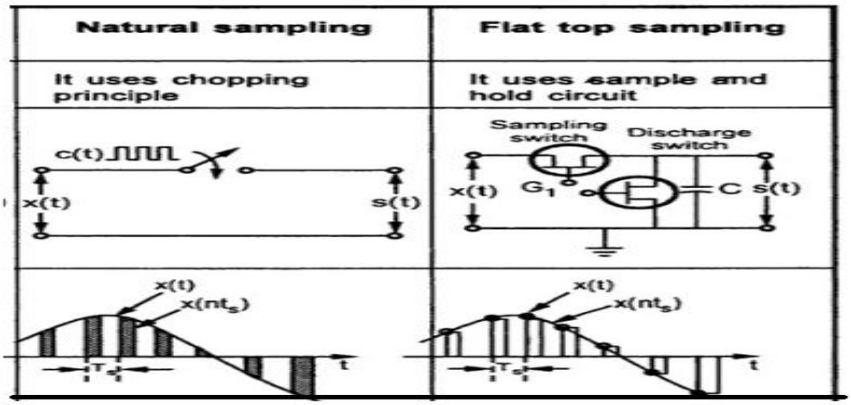
Aliasing will not take place if sampling rate is greater than Nyquist rate.

Nyquist Interval is given by ½ Wsec.

6 . What is meant by aliasing effect?(Nov-Dec 2016) (May June 2016)(R)

It refers to the phenomenon of a high frequency in the spectrum of the signal seemingly taking on the identity of a lower frequency in the spectrum in the spectrum of the sampled version. Aliasing effect takes place when sampling frequency is less than Nyquist rate. Due to aliasing, information may be lost.

7. Distinguish between natural and flat top sampling. (U)



8.Interpret the use of prefiltering done before sampling? (Apr-May 2011) (U)

Prefiltering is done so that the new maximum frequency is reduced to $\frac{f_s}{2}$ or less. Thus there will be no aliased components.

9. A signal is sampled at Nyquist rate of 8 KHz and is quantized using 8 bit uniform quantizer. Assuming SNR for a sinusoidal signal, calculate the SNR and BW. (A)

We know that for a sinusoidal signal $(S/N)db \leq (4.8+6v)$dB

given v= 8 bit

SNR= (4.8+ 6*8)dB

=52.8dB

Bandwidth is given by BT ≥.v.*fm*

= 8*8KHz

=64KHz

10. What is meant by quantization? (May-June 2012) (R)

Quantization is defined as the process of transforming the continues sample amplitude of the message signal m(nTs) at time t=nTs into a discrete amplitude V(nTs). This process is memory less and instantaneous. Sample value obtained by the sampling process is rounded off to the nearest standard level.

11. What you mean by non-uniform quantization?[MAY 2011] (R)

Step size is not uniform. Non-uniform quantizer is characterized by a step size that increases as the separation from the origin of the transfer characteristics is increased. Non-uniform quantization is otherwise called as ***robust quantization***

12.Illustrate the difference between uniform and non-uniform quantization. (Nov-Dec 2011) (U)

In uniform quantization, the step size or the difference between two quantization levels remain constant over the complete amplitude range. The SNR varies with input amplitude.

In non-uniform quantization the step size or the difference between the two quantization level varies. SNR remains constant.

13. Describe the twofold effect of quantization process.(Nov/Dec 2015)(U)

i) The peak to peak range of input sample values is subdivided into a finite set of decision levels, or decision thresholds, that are aligned with the **"Risers"** of the staircase.

ii) The peak to peak range of input sample values is subdivided into a finite set of decision levels, or decision thresholds, that are aligned with the **"Treads"** of the staircase.

14. Define quantization noise (or) error [AUC APR/MAY 2011] (U)

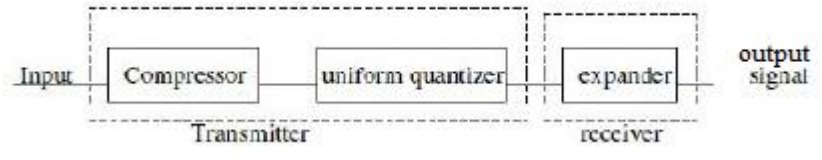
When the signal is converted from analog to digital form, the analog sample amplitude is assigned the nearest available quantization amplitude level. The difference between the quantized value and the actual value of the sample introduces permanent distortion in the signal. It is called quantization error or quantization noise.

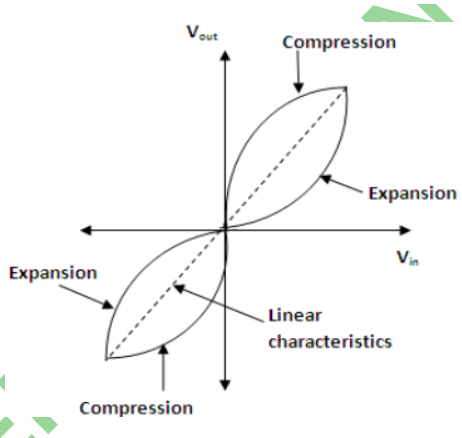
15.Discuss the need for non uniform quantization. (U)

At low signal levels SNR can be increased by decreasing step size Δ. This means step size should be varied according to the signal level to keep SNR at the required value. Hence non uniform quantization is needed.

16. What is Companding?Sketch the input-output characteristics of a compander and Expander. (Nov-Dec 2016)(May-June 2016)(R)

Compression of the signal at the transmitter and Expansion of the signal at the receiver is known as Companding. The use of companding allows signals with a large dynamic range to be transmitted over facilities that have a smaller dynamic range capability.





17. Point out the μ-law of compression.(Az)

μ-law: $$|v| = \frac{\log_e(1+\mu|m|)}{\log_e(1+\mu)}$$

$$\frac{d|m|}{d|v|} = \frac{\log(1+\mu)}{\mu}(1+\mu|m|)$$

μ-law is approximately linear at low input levels corresponding to μ|m|<<1, and approximately logarithmic at high input levels corresponding to μ|m|>>1.

18. Mention the types of companding? (R)

Types of companding:

1. μ law companding
2. A law companding

19. Application of PCM (U)

1. PCM is used in digital telephony
2. Digital audio in computers and compact discs.
3. PCM is used in space communication; space craft transmits signals to earth.

20. What is meant by PCM? (R)

Pulse code modulation (PCM) is a method of signal coding in which the message signal is sampled; the amplitude of each sample is rounded off to the nearest one of a finite set of discrete levels and encoded so that both time and amplitude are represented in discrete form. This allows the message to be transmitted by means of a digital waveform.

21. Write an expression for bandwidth of binary PCM with N messages each with a maximum frequency of *fm* Hz.(R)

If v number of bits are used to code each input sample, then bandwidth of PCM is given as, BT ≥ N.v.*fm* , Here v. *fm* is the bandwidth required by one message.

22. The signal to quantization noise ratio in a PCM system depends on what criteria? (U)

The signal to quantisation noise ratio in PCM is given as, $(S/N)db \leq (4.8+6v)$dB Here v is the number of bits used to represent samples in PCM. Hence signal to quantization noise ratio in PCM depends upon the number of bits or quantization levels.

23. What are the advantages of PCM? [MAY 2009] (U)

1. PCM provides high noise immunity.
2. Due to digital nature of the signal, we can place repeaters between the transmitter and receiver. Infact, the repeaters regenerate the received PCM signal. Repeater further reduce the effect of noise.
3. PCM signal can be stored due to its digital nature.
4. PCM can use various coding techniques so that only the desired person can decode the received signal.

24. What are the limitations of PCM? [MAY 2009] (U)

1. The encoding, decoding and quantizing circuitry of PCM is Complex.
2. PCM requires a large bandwidth as compared to the other systems.

25.Distinguish between the two basic multiplexing techniques (U)

The two basic multiplexing techniques are:

Frequency division multiplexing (FDM) can be used with analog signals. A number of signals are carried simultaneously on the same medium by allocating to each signal a different frequency band.

Time Division Multiplexing (TDM) can be used with digital signals or analog signals carrying digital data. In TDM, data from various sources are carried in respective frames. Each frame consists of a set of time slots and each source is assigned a time slot per frame.

26.Why sync pulse is required in TDM? (U)

In TDM, in each frame time slots are pre-assigned and are fixed for each input sources. In order to identify the beginning of each frame, a sync pulse is added at the beginning of every frame.

27.Summarize the advantages and disadvantages of TDM. (U)

Advantages of TDM :

1. Full available channel bandwidth can be utilized for each channel.
2. lntermodulation distortion is absent.
3. TDM circuitry is not very complex.
4. The problem of crosstalk is not severe.

Disadvantages of TDM :

1. Synchronization is essential for proper operation.
2. Due to slow narrowband fading, all the TDM channels may get wiped out.

PART – B Questions

1. State and prove Nyquist sampling theorem. (**Nov-Dec 2010)(May-June 2016) (R)**

2. Explain what is natural sampling and flat-top sampling.(May-June 2012) **(U)**

3. State the Nyquist sampling theorem. Demonstrate its validity for an analog signal x(t) having a Fourier transform X(f) which is zero outside the internal[-fm<f<fm]. Explain a non uniform quantization process [AUC NOV/DEC

2010]**(U)**

4. Describe the process of sampling and how the message signal is reconstructed from it's sample. Also illustrate the effect of aliasing with neat sketch. **(Nov-Dec 2015) (U)**

5. The signal x(t)=4cos 400Πt+12cos360 Πt is ideally sampled at a frequency of 300 samples per second. The sampled signal is passed through a unit gain low pass filter with a cut off frequency of 220Hz, List the frequency Components present at the output of the low pass filter**.(E)**

6. A compact disc (CD) records audio signals digitally using PCM. Assume the audio signal bandwidth to be 15 KHz.

(i)What is the Nyquist rate? If the Nyquist samples are quantized to L = 65, 536 levels and then binary coded, determine the number of bits required to encode a sample. Assuming that the signal is sinusoidal and that the maximum signal amplitude is 1 volt; determine the quantization step and the signal-to-quantization noise ratio.

(ii) Determine the number of bits per second (bit/s) required to encode the audio signal. For practical reasons, signals are sampled at above the Nyquist rate, as discussed in class. Practical CDs use 44,000 samples per second. For L = 65, 536 determine the number of bits per second required to encode **(A)**

7. Let the maximum spectral frequency component (fm) in an analog information signal be 3.3kHz .Can you identify the frequency spectra of sampled signal under the following relationships between the sampled frequency (fs) and maximum analog signal frequency (fm)

(i) fs=2fm . (6)

(ii) fs>2fm & fs<2fm . **(Az)**

8. Explain non-uniform quantization process.(Apr-May 2010/Apr-May 2011)**(U)**

9. What is the need for Companding in PCM and explain its types**(U)**

10. Illustrate and describe the types of quantiser.Describe midrise and midtread characteristics of uniform quantiser with the necessary diagram**.(Nov-Dec 2016)(U)**

11. Describe PCM waveform coder and decoder with neat sketch and list the merits compared with analog coders**.(Nov-Dec 2015**) **(May-June 2016) (U)**

12. With neat block diagram, explain pulse code modulation and demodulation system. (May-June2012) **(R)**

13. Explain in detail the TDM. **(Nov-Dec 2016)(R)**

14.Explain the PCM technique and evaluate the expression for SNR in PCM. What important functions are performed by the regenerator? Why is Equalization carried out? **(Az)**

15.With an example explain how multiplexed PCM channels are transmitted using T1 carrier system. **(R)**

UNIT II

WAVEFORM ENCODING

1. What is meant by temporal waveform coding?(Nov-Dec 2011) (R)

Temporal waveform coding is a scheme in which time domain waveform is encoded. Bit allocation depends upon time domain features. Bit rate is high compared to signal bandwidth and reconstruction is perfect.

2.Differentiate the principle of temporal waveform coding and model based coding (Az)

Temporal Waveform Coding
The signal which varies with time can be digitized by periodic time sampling and amplitude quantization.This process is called temporal waveform coding. DM,ADM,DPCM are example of temporal waveform coding

Model Based Coding
The signal is characterized in various parameter. This parameter represent the model of the signal.LPC is an example model based coding

2. What is the role of a predictor in DPCM system? (Nov-Dec 2016)(U)

A predictor will predict the value of the next sample taking into account all the previous sample values. This will reduce the error to a very small value which needs a small number of bits for its encoding. This will reduce the signaling rate of DPCM to a great extent.

3.Mention the merits of DPCM. (U)

1 Bandwidth requirement of DPCM is less compared to PCM.

2.Quantization error is re uced because of prediction filter

3.Numbers .of bits used to represent from one sample value are also reduced compared to PCM

4.What is the main difference in DPCM and DM?(U)

DM encodes the input sample by one bit. It sends the information about + δ or -δ, that is the increase or decrease in the sample value.

DPCM can have more than one bit of encoding the sample. It sends the information about difference between actual sample value and the predicted sample value.

5.What is a linear predictor? On what basis are the predictor coefficients determined? (May-June 2016) (U)

Linear prediction is a mathematical operation where future values of a discrete-time signal are estimated as a linear function of previous samples.

coefficient of determination, denoted R^2 or r^2 and pronounced "R squared", is a number that indicates the proportion of the variance in the dependent variable that is predictable from the independent variable(s)

6.What do you understand from adaptive coding?(U)

In adaptive coding, the quantization step size and prediction filter coefficients are changed as per properties of input signal. This reduces the quantization error and number of bits to represent the sample value. Adaptive coding is used for speech coding at low bits rates.

7. What is meant by adaptive delta modulation? (R)

In adaptive delta modulation, the step size is adjusted as per the slope of the input signal. Step size is made high if slope of the input signal is high. This avoids slope overload distortion.

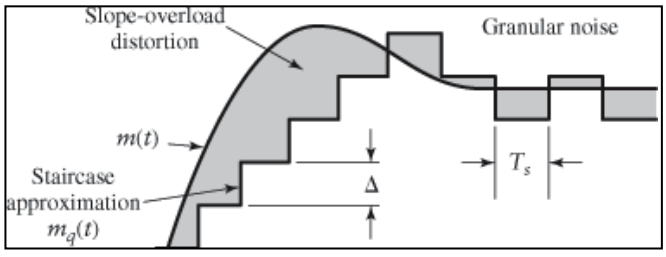
8.What is the advantage of delta modulation over pulse modulation schemes? (U)

Delta modulation encodes one bit per samples. Hence signalling rate is reduced in DM

9.What are the two limitations of delta modulation? (Nov-Dec 2015)(R)

1 Slope of overload distortion.

2. Granular noise.



10.How does Granular noise occurs?(U)

It occurs due to large step size and very small amplitude variation the output signal. That is when the input signal is decreasing at a faster rate the step size assigned by the delta modulator will be large this causes granular noise.

11.What are the advantages of the Delta modulation?(May-June 2016) (U)

1.Delta modulation transmits only one bit for one sample. Thus the signalling rate and transmission channel bandwidth is quite small for delta modulation.

2.The transmitter and receiver implementation is very much simple for delta modulation. There is no analog to digital converter involved delta modulation.

12.Mention the use of adaptive quantizer in adaptive digital waveform coding schemes. (U)

Adaptive quantizer changes its step size according variance of the input signal. Hence quantization error is significantly reduced due to the adaptive quantization. ADPCM uses adaptive quantization. The bit rate of such schemes is reduced due to adaptive quantization.

13. Define APF and APB. (Nov-Dec 2015) (R)

Adaptive prediction with forward estimation.Here unquantized samples of the input signal are used to derive forward estimates of the predictor coefficients.

Adaptive prediction with backward estimation.Here samples of the quantizer output and the prediction error, are used to derive backward estimates of the predictor coefficients.

14. Define AQF and AQB (R)

Adaptive quantization with forward estimation. Here un quantized samples of the input signal are used to derive forward estimate.

Adaptive quantization with backward estimation.Here samples of the quantizer output are used to derive backward estimate

15. What are the drawbacks in delta modulation? (R)

- Granular noise (or) hunting
- Slope overloading

16.State the principle of model based encoding.(R)

The signal is characterized in various parameters, These parameters represent the model of the system. The parameters are encoded and transmitted to the receiver. The receiver synthesizes the signal from encoded parameters. This is called model based encoding.

Ex: LPC

17.List any four speech encoding methods (R)

Pulse Code Modulation [PCM]

Differential Pulse Code Modulation [DPCM]

Delta Modulation [DM]

Linear Predictive Coding [LPC]

Part-B questions

1.Explain the need of predictor by DPCM to make voice and video transmission comparable to that of PCM.**(U)**

2.Explain Prediction filtering.**(R)**

3.Explain the working of Differential PCM and hence derive the expression of signal to noise ratio. (Apr-May 2010) **(U)**

4.Write notes on temporal waveform coding. (Apr-May 2011**)(R)**

5.Explain a DPCM system. Derive the expression for slope overload noise of the system. Show that SNR of DPCM is better than that of PCM [AUC NOV/DEC2012] **(U)**

6. A delta modulator with a fixed step size of 0.75V is given a sinusoidal message signal. If the sampling frequency is 30 times the Nyquist rate, what is the best maximum permissible amplitude of the message signal if slope overload is to be avoided. **(May-June2016)(A)**

7. Describe delta modulation system in detail with a neat block diagram also illustrate the two forms of quantization errors in delta modulation.**(Nov-Dec2016/2015) (U)**

8. Draw the block diagram of ADPCM system and explain its functions **(May-June 2016) (U)**

9. Compare PCM with DM**(May June2016(U)**

10. Explain with the help of block diagram that the Adaptive Delta modulation system reduces the slop error at the expense of quantization error? Draw the

wave forms comparing the response of the ADM and linear DM and ADPCM**.(Nov-Dec 2016)(May-June 2016) (U)**

11.Illustrate how the adaptive time domain coders codes the speech at low bit rate and compare it with the frequency domain coder. **(Nov-Dec 2015)(U)**

12.Explain Adaptive delta modulation system. (**R)**

13.Explain in detail about Linear predictive coding **(R)**

UNIT III

BASEBAND TRANSMISSION

1.What is baseband binary data transmission system? (R)

The data transmission system which makes use of baseband channel for transmitting a binary data is known as baseband data transmission i.e., the system using a channel whose bandwidth equal to the bandwidth of the message signal, called a baseband channel is referred to as baseband data transmission system.

2.State any four desirable properties of line code[AUC NOV/DEC 2012] (R)

The signal should have adequate timing content,

The signal should immune to channel noise and interference

The signal should allow error detection and error correction

The signal should be transparent to digital data being transmitted

3.What is meant by transparency with respect to line codes.(Apr-May 2011) (R)

A line code should be so designed that the receiver does not go out of synchronization for any sequence of data symbols. A code is not transparent if for some sequence of symbols, the clock is lost.

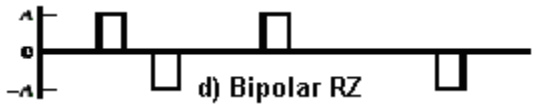
4.What are Line Codes? Name some popular Line codes.(May-June2016)(R)

In telecommunication, a **line code** is a code chosen for use within a communications system for transmitting a digital data in the form of digital signal. Some line codes are **digital baseband modulation** or **digital baseband transmission** methods, and these are baseband line codes that are used when the line can carry DC components. The common types of line encoding are unipolar, polar, bipolar, and Manchester encoding.

5. Summarise the need for Line coding. (U)

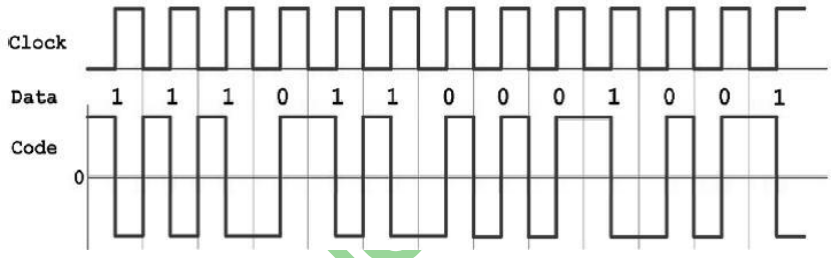
Line Coding is needed to
1. Minimize transmission hardware
2. Facilitate synchronization
3. Ease error detection and correction
4. Minimize spectral content
5. Eliminate a dc component

6.Draw the RZ-Bipolar line code format for the information (0010100100010). (Nov-Dec 2011/2016) (A)

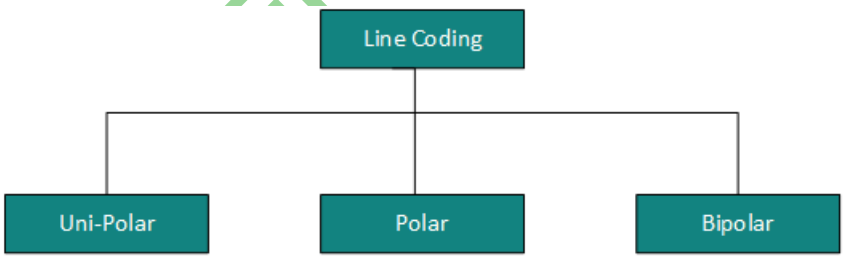


7.What is Manchester code? Show the Manchester format for the data stream 1110110001001? [AUC APR/MAY 2012] (A)

In Manchester code each bit of data is signified by at least one transition. Manchester encoding is therefore considered to be self-clocking, which means that accurate clock recovery from a data stream is possible. In addition, the DC component of the encoded signal is zero. Although transitions allow the signal to be self-clocking, it carries significant overhead as there is a need for essentially twice the bandwidth of a simple NRZ or NRZI encoding



8. Categorise the Line coding techniques. (U)



Basically Line codes are classified into unipolar, polar and Bipolar based on the polarity levels of the pulses. Further this can be either NRZ (Non-Return-to-Zero) where the current or voltage does not return to zero between the bits or RZ(Return-to-Zero) .

9. Interpret ISI in baseband binary PAM system.(May-June 2016)(U)

In baseband binary PAM, symbols are transmitted one after another. These symbols are separated by sufficient time durations. The transmitter, channel and receiver acts as a filter to this baseband data. Because of the filtering characteristics, transmitted PAM pulses spread in time. Hence the

required output bits gets interfered by the presence of other bits . This effect is called ISI. The receiving filter output y(t) sampled at time $t_i=iT_b$ of a baseband system is

$$y(t_i) = \mu \sum_{k=-\infty}^{\infty} a_k P(iT_b - kT_b)$$

$$= \mu a_i + \mu \sum_{\substack{k=-\infty \\ i \neq k}}^{\infty} a_k P(iT_b - kT_b)$$

The first term μa_i is produced by the i^{th} transmitted bit. The second term represents the residual effect of all other transmitted bits on the decoding of i^{th} bit, this residual effect is called intersymbol interference.

In the absence of ISI, $y(t_i) = \mu a_i$.

10. Justify the statement 'ISI can-not be avoided'.(Az)

Pulse contains high frequency components so the components of two nearby pulses will definitely interfere and there is no practical filter available to completely eliminate.

11.Write Nyquist criterion for zero ISI.(Nov-Dec 2007, Nov-Dec 2011) (R)

Nyquist proposed a condition for pulses $p(t)$ to have zero–ISI when transmitted through a channel with sufficient bandwidth to allow the spectrum of all the transmitted signal to pass. Nyquist proposed that a zero–ISI pulse $p(t)$ must satisfy the condition

Time domain : $p[(i-k)T_b] = \begin{cases} 1 & for\, i = k \\ 0 & for\, i \neq k \end{cases}$

Frequency domain : $\sum_{n=-\infty}^{\infty} P(f - nf_b) = T_b$

12. What is raised cosine spectrum? (R)

In the raised cosine spectrum, the frequency response P(f) consists of a flat portion and a roll off portion as follows. That is it decreases towards zero gradually and there is no abrupt transition.

$$p(f)=\begin{cases}\dfrac{1}{2B_0} & for -f_1 < f < f_1 \\ \dfrac{1}{4B_0}\left\{1+\cos\left[\dfrac{\pi(f-f_1)}{2B_0-2f_1}\right]\right\} & for f_1 < f < 2B_0 - f_1 \\ 0 & elsewhere \end{cases}$$

13.Discuss How pulse shaping reduce inter symbol interference?[AUC NOV/DEC 2010] (U)

The shape of the pulse is selected such that the instant of detection, the interference due to all other symbol is zero. The effect of ISI totally eliminates if the signal is sampled at Tb, 2Tb, 3Tb... and so on.

14. Describe the roll off factor.(U)

The raised cosine spectrum is given as

$$P(f)=\begin{cases}\dfrac{1}{2W}, & 0 \le |f| < f_1 \\ \dfrac{1}{4W}\left\{1-\sin\left[\dfrac{\pi(|f|-W)}{2W-2f_1}\right]\right\}, & f_1 \le |f| < 2W - f_1 \\ 0, & |f| \ge 2W - f_1 \end{cases}$$

The frequency parameter f_1 and bandwidth are related by

$$\alpha = 1 - \frac{f_1}{W}$$

'α' is the roll-off factor.

The transmission bandwidth is given by

$$B_T = 2W - f_1$$
$$= W(1 + \alpha)$$

15.What is correlative coding? (Nov-Dec2016) (R)

Correlative level coding is used to transmit a baseband signal with the signalling rate of 2Bo over the channel of bandwidth Bo. This is made physically possible by allowing ISI in the transmitted in controlled manner. This ISI is known to receiver. The correlative coding is implemented by **duobinary signalling** and modified **duobinary signalling.**

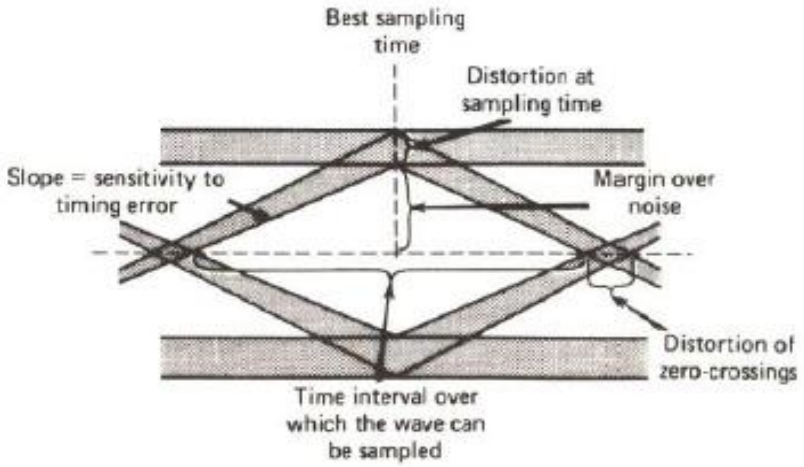
16. What is the necessity of equalization?(May-June 2007) (U)

When the signal is passed through the channel distortion is introduced in terms of 1) amplitude 2) delay this distortion creates problem of ISI. The detection of the signal becomes difficult in order to remove these distortions we use equalization technique or equalizer.

17. Define the principle of adaptive equalization. (U)

The filters adapt themselves to the dispersive effects of the channel that is the coefficients of the filters are changed continuously according to the received data. The filter coefficients are changed in such a way that the distortion in the data is reduced.

18.Draw the eye diagram. (R)



19.What are the information that can be obtained from eye pattern regarding the signal quality? (May-June 2012) (U)

i) The width of eye opening define the interval over which the received wave can be sampled without error from ISI.

ii) The sensitivity of the system to tuning error is determined by the rate of closure of eye as the sampling time is varied.

iii) The height of eye opening, at specified sampling time is called margin over noise.

Part – B Questions

1. Derive the expression for error probability of on-off and polar signaling. **(Nov-Dec 2011**) **(A)**

2. List & Explain the Properties of Line codes **(Dec 2011& May 2013) (R)**

3. Compare the various line coding techniques and list their merits and demerits**.(May-June2016) (U)**

4. Sketch the power spectra of Polar NRZ and Bipolar RZ signals**(May-June 2016) (R)**

5.Determine the power spectral density of NRZ bipolar and unipolar data format , assume that 1s and 0s of input binary data occur with equal probability **(Dec 2015). (A)**

6.Summarize power spectral density of Manchester code**(A)**

7. Explain how ISI occurs in base-band binary data transmission system**(U)**

8. Discuss on signal design for ISI elimination. **(Apr-May 2011)(R)**

9. State Nyquist's pulse shape criterion for zero ISI and explain.(May-June2012) (or) Explain how Nyquist's criterion eliminates interference in the absence of noise for distortionless baseband binary transmission**.(Nov-Dec 2016) (Az)**

10. Sketch the time response and frequency response of signal with raised cosine pulse spectrum**.(R)**

11. Explain in detail the principle of correlation receiver**.(U)**

12. Draw the block diagram of duo-binary signaling scheme for controlled ISI. Explain the scheme with and without Precoder. (May- June2012**)(May-June2016) (U)**

13. Explain the need for the Precoder in a duobinary signaling. For input binary data 1011101 obtain the output of the Precoder & output of duobinary coder. Explain how data can be detected at the receiver **(Az**)

14. Describe Modified Duobinary signaling Scheme without & with Precoder and its performance by illustrating it's frequency and impulse responses**.(Nov-Dec 2015) (U)**

16. Describe how eye pattern illustrates the performance of data transmission system with respect to ISI with neat sketch**.(Nov-Dec 2015/2016) (R)**

17. What does the term equalization refer to? Explain how it is carried out by using transversal filters. (Nov-Dec 2010) **(U)**

18. Explain about adaptive equalization. (Apr-May 2010) (Nov-Dec 2006, Apr-May 2010)**(May-June 2016) (R)**

19. Explain zero-forcing equalizer with neat diagram. (May-June2012) **(R)**

20. Illustrate the modes of operation of an adaptive equalizer with neat block diagram**(Nov-Dec2015) (U)**

UNIT-IV

DIGITAL MODULATION SCHEME

1. List the advantages of Passband transmission. (R)

i. Long distance.
ii. Analog channels can be used for transmission.
iii. Multiplexing techniques can be used for bandwidth conservation.
iv. Transmission can be done by using wireless channel also.

2.List the requirements of Passband transmission. (R)

i. Maximum data transmission rate.
ii. Minimum probability of symbol error.
iii. Minimum transmitted power.

3. How is the performance of digital communication system evaluated?(R)

The performance of digital communication system is evaluated depending upon i) Spectral efficiency ii) Bit error rate (BER).

4.How can BER of an system be improved [AUC NOV/DEC2012](U)

i. Increasing the transmitted signal power
ii. Employing modulation and demodulation technique
iii. Employing suitable coding and decoding methods
iv. Reducing noise interference with help of improved filtering

5.Explain the concept of memory less modulation?(R)

When the digital signal modulates amplitude, phase or frequency of the carrier without any reference to previous symbols it is called as memory less modulation. ASK, FSK, PSK are the examples of memory less modulation.

6.Differentiate baseband and passband transmission(U)

Base band	Pass band
Signal is transmitted without any modulation	The signal modulates a high frequency carrier.
Used for short distance transmission	Used for long distance transmission
Used for LANs, printers, short distance links.	Used for transmission of digital data, video and speech

7. Why are the signals represented geometrically?(U)

The signals are represented geometrically so that

i) The probability of error in transmission can be studied.

ii) Distance or separation between individual messages can be determined.

8.What is meant by coherent and non-coherent detection?(May –June 2012/ May-June 2016/Nov-Dec 2016/) (R)

In **coherent** detection, the local carrier generated at the receiver is phase locked with carrier at the transmitter. Hence it is called synchronous detection.

In **non-coherent** detection, no need to be synchronized. It is simple but it has high probability of error.

9.What are the advantages of BPSK? (R)

BPSK has a bandwidth which is lower than of BFSK is the best of all systems in the presence of noise. It gives the minimum possibility of error and it has very good noise immunity.

10.What are the drawbacks of binary PSK system? (May –June 2012)(R)

The carrier in the receiver is generated by squaring $b(t)\sqrt{2P}\cos(2\pi f_0 t+\theta)$ If the received signal is $-b(t)\sqrt{2P}\cos(2\pi f_0 t+\theta)$,then squared input signal has changed its sign. Therefore, it is not possible to determine whether the received signal is equal to b(t) or –b(t). This result in ambiguity in output signal.

11.What are the advantages and disadvantages of Differential Phase Shift Keying? (U)

Advantages:

i.No need to generate the carrier at the receiver end. This means that complicated circuitry for generation of local carrier is avoided.

ii.The bandwidth required for DPSK is less compared to binary PSK.

Disadvantages:

The probability of error is high compared to binary PSK.

12.A BPSK signal operated with a carrier frequency of 140 MHz, modulated by data bits at a rate of 2400 bits/sec. What is the bandwidth requirement? (A)

f_b = 2400 bits/sec = 2400 Hz.

BW = $2f_b$ = 2 x 2400 = 4800 Hz.

13.What is signal constellation diagram?(U)

Signal constellation refers to a set of possible message points. Suppose that in each time slot of duration T seconds, one s2(t), . . sM(t) is transmitted with equal probability, 1/M For geometric representation, the signal si (t), i = 1, 2, ... , M, is applied to a bank of correlators. The correlator outputs define the signal vector si. The set of message points corresponding to the set of transmitted signals {si(t))} i=1..M is called a signal constellation.

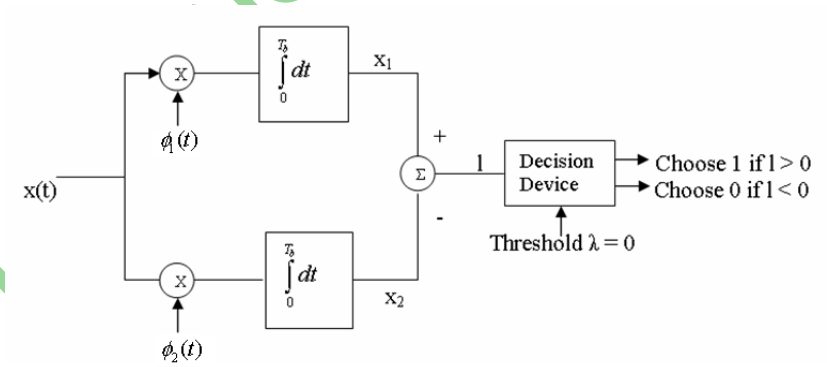
14.What are Antipodal signals? (R)

Pair of sinusoidal wave that differs only in a relative phase shift of 180 degrees is referred as Antipodal signals.

15.What are the advantages and disadvantages of binary FSK signals? (R)

Binary FSK has poorer error performance than PSK or QAM and consequently, is seldom used for high performance digital radio systems. Its use is restricted to low performance, low cost, asynchronous data modems that are used for data communications. The peak frequency deviation is constant and always at its maximum value.

16.Draw the block diagram of a coherent BFSK receiver?(Nov-Dec 2015/2016) (R)



17.Compare the probability of Error of PSK with that FSK? (U)

In PSK the probability of error Pe=1/2 erfc (square root (Eb/No) Where as in FSK Pe=1/2 erfc (square root (Eb/2No) Comparing these two equations in FSK the bit energy to noise density ratio has to be doubled to maintain the same bit error as in PSK. So FSK needs double the bandwidth of PSK. In PSK, the error probability is less whereas in FSK the error probability is high.

18.Highlight the major difference between a QPSK signal and a MSK signal. (U)

- QPSK is a phase modulation
- MSK is frequency modulation
- Band width of QPSK is f_b where as MSK is 1.5 f_b

19.What is the error probability of MSK and DPSK?(R)

For coherent MSK P(e)=1/2 erfc (square root (E_b/N_o))

For DPSK P(e)=1/2 exp(-E_b/N_o)

20.Write the expression for bit error rate for Coherent Binary FSK. (R)

For coherent binary FSK $P_e = \frac{1}{2} erfc \sqrt{\frac{E_b}{2N_0}}$ or $P_e = \frac{1}{2} erfc \sqrt{\frac{0.6E_b}{4N_0}}$

21.Compare the Bandwidth Efficiency of M-ary PSK signals and M-ary FSK signals (R)

The bandwidth efficiency of M-ary PSK signal is

$\rho = R_b/B = \log_2 M/2$

The bandwidth efficiency of M-ary

$\rho = R_b/B = 2\log_2 M/M$

22.Why is PSK always preferable over ASK in coherent detection?(NOV-DEC 2011).(U)

ASK has amplitude variations, hence noise interference is more,PSK method has less noise interference. It is always preferable.

23.What are the advantages of QPSK as compared to BPSK? (U)

Advantages of QPSK are for the same bit error, the bandwidth required by QPSK is reduced to half as compared to BPSK because of reduced bandwidth, the information transmission rate of QPSK is higher variation in offset QPSK amplitude is not much. Hence carrier power almost remains constant.

24.What happens to the probability of error in M-ary FSK as the value of M increases? (U)

The probability of error will remain constant as the value of M increases

Pe≤1/2(M-1)erfc($\sqrt{E/2N_o}$)

25.What are the advantages of M-ary signaling schemes? (R)

The main advantages of M-ary signaling is it increases or improves the spectral efficiency or bandwidth efficiency

26.What are the error probabilities of a binary FSK system? (R)

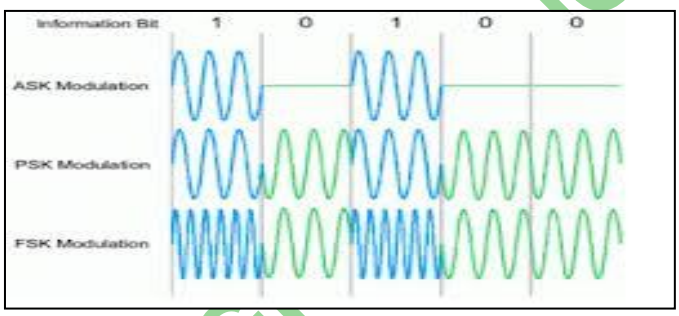
For non-coherent FSK

$$P(e)=1/2\exp(-E_b/2N_o)$$

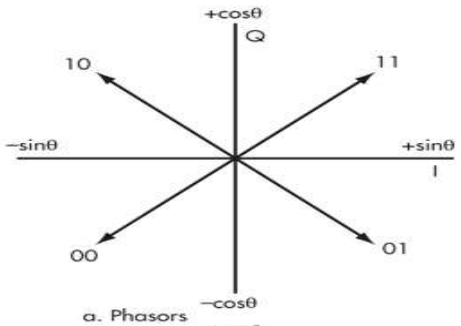
For coherent FSK

$$P(e)=\text{erfc}\left(\sqrt{E_b/N_o}\right)$$

27.Sketch the waveform representation of ASK, FSK, PSK for a NRZ coded binary sequence and represent also each case mathematically. (R)



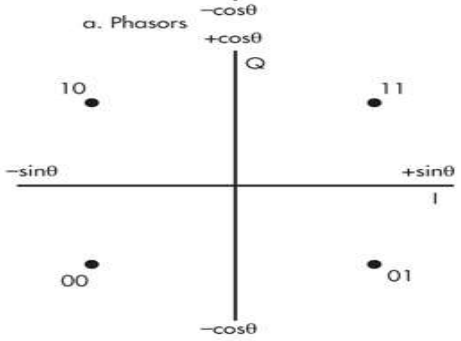
28.Draw the signal constellation of QPSK and give comments on QPSK.(U)



a. Phasors

Input bits	Output phase
00	−135°
01	−45°
10	+135°
11	+45°

b. Table



Note:
$\theta = 2\pi ft$

Quaternary phase shift keying or quadrature psk is an other form of angle modulated constant amplitude digital modulation. QPSK is an M-ary encoding technique where M is 4. Four output phases are possible for a single

carrier frequency. Because there are four different output phases there must be four different input conditions.

28.How is the performance of the QPSK system related to the distances between the symbols in the signal space. (U)

$$P_e \le \sum_{k=2}^{M} \frac{1}{2} erfc \sqrt{\frac{d^2_{k1}}{4N_0}}$$

Here 'M' is the number of signal points, and d_{k1} is the distance between s_1 and s_k in the signal space.

29.Define QPSK and write the expression for the signal set of QPSK (May-June 2016)(R)

As with binary PSK, this modulation scheme is characterized by the fact that the information carried by the transmitted wave is contained in phase.
In QPSK (Quadriphase – Shift Keying), the phase of the carrier takes on one of the four equally spaced values such as $\frac{\pi}{4}, \frac{3\pi}{4}, \frac{5\pi}{4}$ and $\frac{7\pi}{4}$ as given by

$$S_i(t) = \sqrt{\frac{2E}{T}} \cos(2\pi f_c t + (2i-1)\frac{\pi}{4} \qquad 0 \le t \le T.$$

30.A binary frequency shift keying system employs two signaling frequencies f_1 and f_2. The lower frequency f_1 is 1200 Hz and signaling rate is 500 Baud. Calculate f_2.(A)

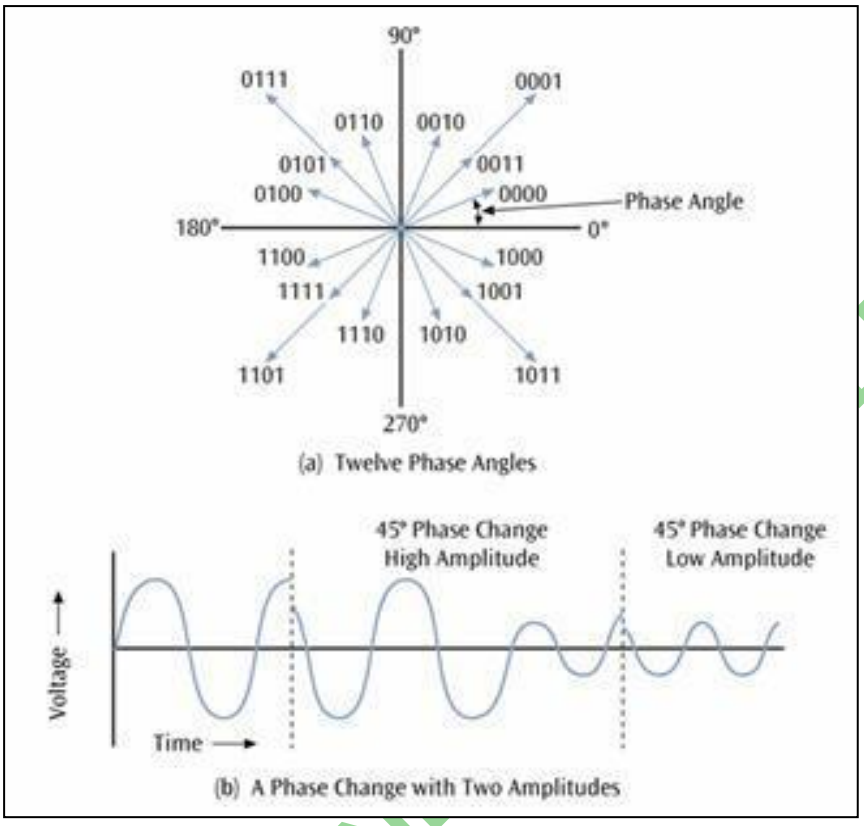
f_1 = 1200 Hz.

Signaling rate = 500 Baud, $\therefore f_2$ = 1200 + 500 = 1700 Hz.

31.What is meant by DPSK?(R)

In DPSK, the input sequence is modified. Let input sequence be d(t) and output sequence be b(t). Sequence b(t) changes level at the beginning of each interval in which d(t)=1 and it does not changes level when d(t)=0.When b(t) changes level, phase of the carrier is changed. And as stated above, b(t) changes t=its level only when d(t)=1. This means phase of the carrier is changed only if d(t)=1. Hence the technique is called Differential PSK.

32. Define QAM and draw its constellation diagram. ? (R)



The phase as well as amplitude of the quadrature carriers is modulated.Hence it is called as QAM or Quadrature Amplitude Phase shift keying.

33.A BPSK system makes errors at the average rate of 1000 errors per delay. Data rate is 1 kbps . The single-sided noise power spectral density is 10-20 W/Hz. Assuming the system to be wide sense stationary, what is the average bit error probability? [AUC NOV/DEC 2012] (A)

24*60*60=86400sec

86.4*106

Bit error probability Pe=100/86.4*106

=1.1157*10-6

34.What are the three broad types of synchronization ?(R)

1. Carrier synchronization
2. Symbol & Bit synchronization
3. Frame synchronization.

35.What is carrier synchronization ?(R)

The carrier synchronization is required in coherent detection methods to generate a coherent reference at the receiver. In this method

the data bearing signal is modulated on the carrier in such a way that the power spectrum of the modulated carrier signal contains a discrete component at the carrier frequency.

36.What are the two methods for carrier synchronization.(R)

1. Carrier synchronization using M^{th} Power loop
2. Costas loop for carrier synchronization

Part – B Questions

1.Explain geometric representation of signals.**(May-June2012)(U)**

2.Explain in detail the Gram-Schmidt orthogonalisation procedure. **(Nov-Dec 2011)(U)**

3.Derive the bit error probability due to coherent PSK ,FSK and QPSK systems. Compare the performance of these systems. **(Apr-May 2011)(A)**

4.Illustrate the transmitter, receiver and the generation of non coherent version of PSK with neat sketch**(Nov-Dec 2015)(U)**

5. Describe the generation and detection of coherent binary PSK signals and illustrate the power spectra of binary PSK signal **(May-June 2015/ Nov-Dec2016)(R)**

6. Describe the generation and detection of QPSK signaling. (May-June2012/ **Nov-Dec 2016/2015)(R)**

7.Derive the bit error probability due to QPSK receiver. Compare the performance of QPSK receiver with that of PSK receiver**. (Nov-Dec2016/2015)(A)**

8.Distinguish between coherent and non-coherent detection. **(Nov-Dec 2010)(U)**

9.Explain non-coherent detection methods of binary frequency shift keying scheme**. (Nov-Dec 2010/ May-June2016)(R)**

10. Draw the block diagram & Explain the operation of BFSK transmitter & receiver **(Dec 2010)(R)**

11.Obtain the probability of bit error for coherently detected BPSK and compare its probability of bit error performance with QPSK scheme. (Nov-Dec 2010)(A)

12.Draw the functional block diagram Of Generation and detection of QAM

and explain its operation. **(May-June2012)(R)**

13.A set of binary data is sent at the rate of R_b = 100 kbps over a channel with 60 dB transmission loss and power spectral density $\eta=10^{-12}$ W/Hz at the receiver. Determine the transmitted power for a bit error probability P_e = 10^{-3} for the following modulation schemes**. (Nov-Dec 2011) (A)**

i)Coherent ASK

ii)Non-coherent ASK

iii)FSK

iv)PSK

v)DPSK

vi)16 QAM

14. Explain in detail about the Principle of DPSK**.(R)**

15. Explain in detail about the structure of Non-coherent Receivers**.(R)**

16. Explain in detail about the carrier synchronization **(Apr-May 2010)(R)**

UNIT V

ERROR CONTROL CODING

1.What is hamming distance?(Apr-May 2008, Nov-Dec 2009,Nov-Dec 2010)(R)

The hamming distance between two code vectors is equal to the number of elements in which they differ. For example, let the two code words be,

X = (101) and Y= (110)

These two code words differ in second and third bits. Therefore the hamming distance between X and Y is two.

2. Define code efficiency.(R)

The code efficiency is the ratio of message bits in a block to the transmitted bits for that block by the encoder i.e.,Code efficiency= (k/n) k=message bits n=transmitted bits.

3. What is meant by systematic and non-systematic codes? (R)

In a Systematic block code, message bits appear first and then check bits. In the non-systematic code, message and check bits cannot be identified in the code vector.

4.What is meant by linear code?(Nov-Dec 2010/ May-June 2015) (R)

A code is linear if modulo-2 sum of any two code vectors produces another code vector. This means any code vector can be expressed as linear combination of other code vectors.

5.What are the error detection and correction capabilities of hamming codes? (Apr-May 2008, May-June 2009) (R)

The minimum distance (dmin) of hamming codes is 3. Hence it can be used to detect double errors or correct single errors. Hamming codes are basically linear block codes with dmin =3.

1. To detect up to 's' errors per word, $d_{min} \geq S+1$
2. To correct up to 't' errors per word, $d_{min} \geq 2t+1$
3.

6.What is meant by cyclic codes? Mention its properties.(Nov-Dec 2011) (Nov-Dec 2015)(R)

Cyclic codes are the subclasses of linear block codes. They have the property that a cyclic shift of one codeword produces another code word.

Properties :

i) Linearity: The sum, of any 2 code words in the code is also a code word.

ii)Cyclic property: Any cyclic shift of a code word in the code is also a code word.If X = (x_{n-1}, x_{n-2}…, x_1, x_0) Then X' = (x_{n-2}, x_{n-3} ……, x_1, x_0, x_{n-1}) which is another code vector.X" = (x_{n-3}, x_{n-4}……., x_1, x_0, x_{n-1}, x_{n-2}) which is a valid code vector.

7.How syndrome is calculated in Hamming codes and cyclic codes?(U)

In hamming codes the syndrome is calculated as, $S=YH^T$

Here Y is the received codeword and H^T is the transpose of parity check matrix.

8.What is BCH code? (R)

BCH codes are most extensive and powerful error correcting cyclic codes. The decoding of BCH codes is comparatively simpler. For any positive integer „m and „t

(where $t<2^{m-1}$)there exists a BCH code with following parameters:

Block length: $n= 2^{m-1}$

Number of parity check bits : n-k<=mt

Minimum distance: $d_{min}>=2t+1$

10.What is RS code? (R)

These are non binary BCH codes. The encoder for RS code operates on multiple bits simultaneously. The (n, k) RS code takes the groups of m- bit symbols of incoming binary data stream. It takes such „k number of symbols in one block. Then the encoder acts (n – k) redundant symbols to form the code word of „n symbols.

RS code has:

Block Length : $n=2^m-1$ symbols

Message size: K symbols

Parity check size: n-k= 2t symbols

Minimum distance: dmin=2t+1 symbols

11.What is difference between block codes and convolutional codes? (U)

Block codes takes k number of bits simultaneously form n bit code vector. This code vector is also called block. Convolutional code takes one message bits at a time and generates two or more encoded bits. Thus convolutional codes generate a string of encoded bits for input message string.

12.Define constraint length in convolutional code?(May-June 2016) (R)

Constraint length is the number of shifts over which the single message bit can influence the encoder output. It is expressed in terms of message bits.

13.Define free distance and coding gain. (R)

Free distance is the minimum distance between code vectors. It is also equal to minimum weight of the code vectors.

Coding gain is used as a basis of comparison for different coding methods. To achieve the same bit error rate the coding gain is defined as,

$$A = \frac{(E_b / N_o)Encoded}{(E_b / N_o)coded}$$

For convolutional coding, the coding gain is given as,

$A = rd_f / 2$

Here „r is the code rate

And „d_f is the free distance.

14.What is convolution code?(May-June 2012) (R)

Convolutional codes are generated by convolution between message sequence and generating sequence. Each message bit is encoded separately. For every message bit, two or more encoded bits are generated (i.e) coding is bit by bit.

15.What is meant by syndrome of linear block code? (R)

The non zero output of the produce YH^T is called syndrome & it is used to detect errors in y. Syndrome is denoted by S & given as,$S=YH^T$

16.What are the advantages and disadvantages of convolutional codes? (U)

Advantages:i)The decoding delay is small in convolutional codes since they operate on smaller blocks of data. ii)The storage hardware required by convolutional decoder is less since the block sizes are smaller.

Disadvantages:i)Convolutional codes are difficult to analyze since their analysis is complex. ii)Convolutional codes are not developed much as compared to block codes.

17.Define states of encoder? (U)

The constraint length of the given convolutional encoder is K=2. Its rate is ½ means for single message bit input, two bits x1 and x2 are encoded at the output. S_1 represents the input message bit and S_2 stores the previous message bit. Since only one previous message bit is stored, this encoder can have states depending upon this stored message bit. Lets represent,

$S_2 = 0$ state a

and $S_2 = 1$ state b

18.Compare between code tree and trellis diagram? (U)

S.No	Code Tree	Trellis Diagram
1	Code tree indicates flow of the coded signal along the nodes of the tree.	Trellis diagram indicates transitions from current to next states.
2	Code tree is lengthy way of representing coding process.	Code trellis diagram is shorter or compact way of representing coding process.

19.Write the features of BCH Codes? (R)

BCH codes are most extensive and powerful error correcting cyclic codes. The decoding of BCH codes is comparatively simpler. The decoding schemes of BCH codes can be implemented on digital computer. Because of software implementation of decoding schemes they are quite flexible compared to hardware implementation of other schemes.

20.What is Golay codes? (R)

Golay code is the (23,12) cyclic code whose generating polynomial is, $G(p) = p^{11}+p^9+p^7+p^6+p^5+p+1$ This code has minimum distance of $d_{min} = 7$. This code can correct upto 3 errors. But Golay code cannot be generalized to other combinations of n and k.

21.Define Hamming weight and Minimum Hamming distance. (Nov-Dec 2010) (R)

Hamming weight of a code vector is defined as the number of non-zero elements in the code word or it is the distance between the code vector and all zero code vector.

Hamming distance is defined as the number of locations in which their respective elements differ or the minimum distance is defined as the smallest Hamming distance between any pair of codevectors in the code or the minimum distance is defined as the smallest Hamming weight of the non-zero code vectors in the code.

22.State Channel coding theorem. (Nov-Dec 2016/Nov-Dec 2015)(R)

if $\frac{H(s)}{T_s} \leq \frac{C}{T_c}$

There exists a coding scheme for which the source output can be transmitted over the channel and be reconstructed with an arbitrarily small probability of error.The parameter $\frac{C}{T_c}$ is called critical rate.

Conversly, if $\frac{H(s)}{T_s} > \frac{C}{T_c}$

it is not possible to transmit information over the channel and reconstruct it with an arbitrarily small probability of error.

Part – B Questions

1. Explain error detecting and correcting capabilities of linear block code. **(May-June2012) (U)**

2. Find the (7,4) linear systematic block code word corresponding to 1101. Assume a suitable generator matrix**. (Apr-May 2011) (Az)**

3. Describe how the errors are corrected using hamming code with an example.**(Nov-Dec 2016) (A)**

4.For a systematic linear block code, the three parity check digits p1,p2,p3 are given by pk,n-k= $\begin{bmatrix} 101 \\ 111 \\ 110 \\ 011 \end{bmatrix}$

(a) Construct the generated matrix

(b) Construct the code generated by the matrix

© Determine the error correcting capacity

(d) Decode the received words with the example **(Nov-Dec 2015) (A)**

5. Consider a (7,4) linear block code whose parity check matrix is given by

$$H = \begin{bmatrix} 1110100 \\ 1101010 \\ 1011001 \end{bmatrix}$$

i) Find the generator matrix.

ii) How many errors this code can detect?

iii) How many errors can this code be correct?

iv) Draw circuit for encoder and syndrome computation.(May-June2012/**May June 2015**) **(A)**

6. i) Determine the generator polynomial g(X) for a (7,4) cyclic code and find the code vector for the following data vector 1010, 1111 and 1000 (12)

ii) Briefly describes the concept of error free communication **(A)**

7. Describe the cyclic codes with the linear and cyclic property. Also represent the cyclic property of a code in polynomial notation**.(Nov-Dec 2016) (U)**

8.List the different types of errors detected by CRC code. **.(Nov-Dec 2016) (U)**

9. The code vector [1 1 1 0 0 1 0] is sent, the received vector is [1 1 0 0 0 1 0] calculate the syndrome. **.(Nov-Dec 2016) (Az)**

10. The generator polynomial of a (7,4) cyclic code is $1+x+x^2$. Develop encoder and syndrome calculator for this code**(May-june 2016)(A)**

11.Assume a (2,1) convolutional coder with constraint length 6. Draw the tree diagram, state diagram and trellis diagram for the assumed coder. **(Apr-May 2011) (A)**

12. Explain how encoding is done by convolutional codes with a suitable example**. (Nov-Dec 2010)(U)**

13. Explain the tree diagram, trellis diagram and state transition diagram of convolutional codes. **(Nov-Dec 2010)(U)**

14. Explain the transform domain approach analysis of convolutional code. **(May-June2012)(U)**

15.For the Convolutional encoder with constraint length of 3 & rate ½ draw

the state diagram & Trellis diagram.Decode the sequence 01000100 by using viterbi algorithm**.(A)**

16. A Convolutional encoder is described by g1=[1 0 0]: g2=[1 0 1]: g3=[1 1 1]

(a) Draw the encoder corresponding to this code

(b) Draw the stae transition diagram for this code

© Draw the trellis diagram

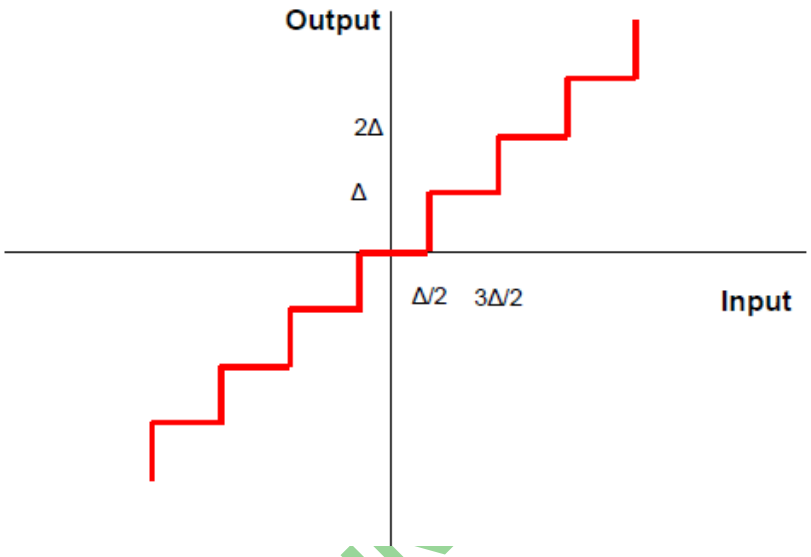
(d) Find the transfer function. **(Nov-Dec 2015) (A)**

17. Explain Viterbi decoding algorithm for Convolutional Code**.(May-June 2016)(U)**

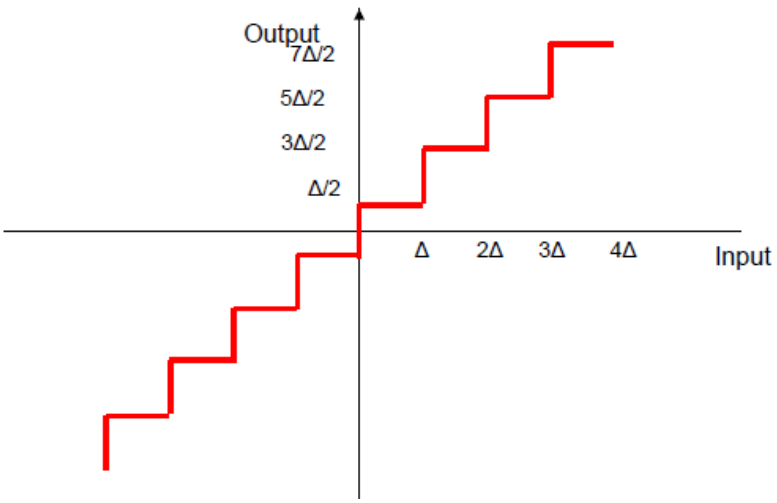
ASSIGNMENT QUESTIONS

Unit I

1. A sinusoidal signal with an amplitude of 3.5V is applied to a uniform quantiser of midtread type whose output takes on the values 0, ±1, , ±2, ±3 volts as shown in the figure.sketch the wavwform of the resulting quantizer output for one complete cycle of the input.**(Az)**



2. Repeat the evaluation for the case when the quantiser is of the midriser type whose output takes on the values ±0.5, ±1.5, ±2.5, ±3.5 volts as shown in the figure **(Az)**



3.A sine wave is applied to the input of a compressor using the μ-law with μ=255 plot the waveform of one complete cycle of the compressor output. **(Az)**

Unit II

1. Consider a speech signal with maximum frequency of 3.4KHZ and maximum amplitude of 1volt. This speech signal is applied to a delta modulator whose bit rate is set at 20kilobits per second. Discuss the choice of an appropriate step size for the modulator. **(Az)**
2. The ramp signal x(t) = αt is applied to a delta modulator that operates with a sampling period T_s and step size Δ=2δ. **(E)**
   (a) Show that slope overload distortion occurs if $\delta < \alpha T_s$
   (b) Sketch the modulator output for the following three values of step size (i) $\delta = 0.75\alpha T_s$
   (ii) $\delta = \alpha T_s$
   (iii) $\delta = 1.25\alpha T_s$
3. 1KHz signal sampled by 8KHz is to be encoded by using 12bit PCM and DM system. If 20cycles of 1KHz signal are digitized, state how many bits will be there in digital output in each case. State signaling rate and bandwidth in each case. **(E)**

Unit III

1.A computer puts out binary data at the rate of 56kilobits per second. The computer output is transmitted using a baseband binary PAM system that is designed to have a raised cosine spectrum. Determine the transmission bandwidth required for each of the roll off factor **(A)**

(a) α = 0.25
(b) α = 0.5
(c) α = 0.75
(d) α = 1

2.The binary data 011100101 is applied to the input of a modified duo binary system. Construct the modified duo binary coder output and corresponding receiver output without a precoder. Suppose that due to error during transmission, the level produced by the third digit is reduced to zero. Construct the new receiver output. **(A)**

3.Show that for the bipolar format, the autocorrelation function $R_A(n)$, that is $E[A_k A_{k-n}]$ is zero for n>1, Where A_k is a random variable representing the k^{th} bit of the input binary sequence. Assume statistically independent and equally likely message bits.**(Az)**

Unit IV

1.Sketch the wave form for inphase and quadrature component of the QPSK signal produced by the input binary sequence 1100100010**.(A)**

2.Show that the probability of error for QPSK is same as that of BPSK for one bit duration**.(Az)**

3. A communication system operates at a bit rate of 10kbps with a transmitter power of 50w with a BER of 10-7 using BPSK(uncoded). If a channel coder of coding gain 3dB is incorporated into the system, calculate the transmitter power required to maintain the same BER. (Assume the modulation scheme remains the same). State the disadvantages of including the channel coder, if there is any**.(E)**

Unit V

1.The generator polynomial of a (15,11) hamming code is given by $g(D)=1+D+D^4$. Develop the encoder and syndrome calculator for this code using systematic form of the code**.(A)**

2.Construct an encoder for a rate=1/2 , constraint length =4 convolutional code. Determine the encoder output produced by the message sequence 10111 using transform domain approach and also construct the code tree, code trellis and state diagram**.(Az)**

3.For a linear block code which corrects single error per code vector, prove that $n \geq k+\log_2(n+1)$ and hence design a linear code with a minimum distance of three and a message block size of eight bits**.(C)**

PANIMALAR ENGINEERING COLLEGE

DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

EC6502 PRINCIPLES OF DIGTIAL SIGNAL PROCESSING

UNIT –I-DISCRETE FOURIER TRANSFORM
PART- A

1) Write down DFT pair of equations (Analysis & Synthesis Equations). [May' 06]

$$X(k)=\sum_{n=0}^{N-1}x(n)e^{-j\frac{2\pi k}{N}n} \quad ; \quad k = 0,1,2,\text{-------- } (N-1) \qquad \textbf{(R)}$$

$$x(n)=\frac{1}{N}\sum_{k=0}^{N-1}X(k)e^{j\frac{2\pi k}{N}n} \quad ; \quad n = 0,1,2,\text{------- } (N-1)$$

2) Write the differences & similarities between DIT & DIF-FFT algorithms. [May' 06] **(U)**

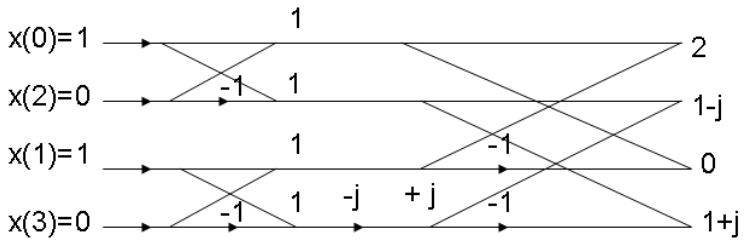
S.NO	DIT	DIF
1.	Decimation occurs in Time Domain.	Decimation Occurs in Frequency Domain.
2.	Input is bit reversed & Output is in Natural Order.	Input is in Natural & Output is bit reversed.

Similarities:

a) Both algorithms require same number of operations to compute the DFT.

b) Both algorithms can be done in place and both need to perform bit reversal at some place during the computation.

3) Given x(n) ={ 1, 1, 0, 0 } , find X(k) using FFT. [Nov' 06] **(U)**



4) Calculate % saving in computing through radix -2, DFT algorithm of DFT coefficients. Assume N = 512. [Nov' 06] **(U)**

a) Direct DFT: No. of complex multiplications: $N^2 = (512)^2 = 262144$.

b) Using FFT : No. of complex multiplications: $\frac{N}{2}\log_2 N = \frac{512}{2}\log_2 2^9 = 9\times 256 = 2304$.

% Saving = $\frac{262144 - 2304}{262144} = 99.12\%$

5) Find the values of W_N^K when N = 8 and K = 2 and also for K = 3.[May' 07] (U)

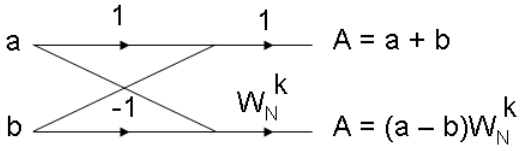
(i) $w_8^2 = \left(e^{-j2\pi}\right)^{2/8} = e^{-j\pi/2} = \cos\frac{\pi}{2} - j\sin\frac{\pi}{2} = -j$

(ii) $w_8^3 = \left(e^{-j2\pi}\right)^{3/8} = e^{-j\frac{3\pi}{4}}$ $= \cos\frac{3\pi}{4} - j\sin\frac{3\pi}{4} = -\frac{1}{\sqrt{2}} - \frac{j}{\sqrt{2}}$

6) List any four important properties of DFT. [Nov' 07] **(R)**

a) Periodicity property ; x(n+N) = x(n) & X(k+N) = X(k)
b) Time – Delay ; DFT[x(n-n_0)] = X(k)$e^{-j2\pi kn}$
c) Time Reversal ; DFT[x(N-n)] =X(N-k)
d) Complex Conjugate ; DFT[x^*(n)] = X*(N-K)

7) Draw basic structure of Radix-2 DIF butterfly structure. [Nov' 07] **(R)**



8) Compute the DFT of the four point sequence x(n) = {1,-1,1,-1}. [May' 08] **(U)**

$$\begin{bmatrix} 1 & 1 & 1 & 1 \\ 1 & -j & -1 & j \\ 1 & -1 & 1 & -1 \\ 1 & j & -1 & -j \end{bmatrix} \begin{bmatrix} 1 \\ -1 \\ 1 \\ -1 \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ 4 \\ 0 \end{bmatrix}$$

9) How many multiplication and addition is needed for Radix-2 FFT? [May' 08] **(R)**

No of Additions → N$\log_2$N.
No of Multiplications → (N/2) $\log_2$N.

10) Show the saving in time in performing FFT as against DFT. [Nov' 08] **(U)**

For N = 4,
a) Direct DFT: No. of complex additions : N(N-1) = 12
No. of complex multiplications: N^2 =16.
b) Using FFT: No. of complex additions : N $\log_2$N = 8
No. of complex multiplications: (N/2) $\log_2$N = 4.
Speed Improvement Factor:
For Additions : 12/8 = 1.5,
For multiplications : 16/4 = 4.

11) What is Zero padding? What are its uses? [May' 09] **(R)**

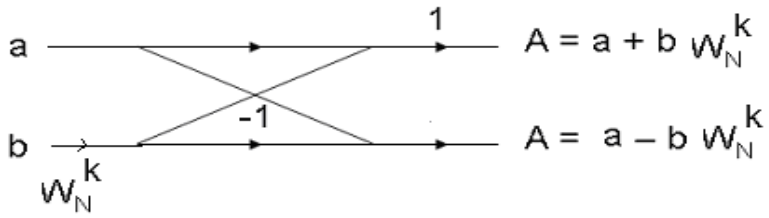
Appending (adding) zeros to a sequence correctly is known as zero padding.
Uses: Better display of the frequency spectrum & DFT can be used in linear filtering.

12) Calculation the multiplication reduction factor, α in computing 1024 pt DFT, in a radix – 2 FFT algorithm. [May' 09] **(U)**

Direct DFT: No. of complex multiplications: $N^2 = 1024^2$ = 1,048,576
FFT : No. of complex multiplications: (N/2) $\log_2$N = (1024/2)$\log_2$1024 = 5120.

Speed Improvement Factor : 1048576 / 5120 = 204.8.

13) Draw the basic butterfly diagram for the computation in the radix-2 DIT- FFT algorithm. [Nov' 09] (R)



14) What is inplace computation? [May' 10] (R)

Once the computation of 'A' and 'B is done then, values of 'a ' and 'b' are not required. So instead of storing 'A' and 'B' at other memory locations; these values are stored at the same place where 'a' and 'b' were stored. That means 'A' and 'B are stored in the place of 'a' and 'b'. This is called as in place computation. In place computation reduces the memory size.

15) State and prove Parseval's Theorem. [May' 11] (R)

If DFT[x(n)] =X(k) & DFT[y(n)] =Y(k), then

$$\sum_{n=0}^{N-1} x(n)y^*(n) = \frac{1}{N}\sum_{k=0}^{N-1} X(k)Y^*(k)$$

16) Compute the DFT of the four point sequence x(n) = [0,1,2,3] [May' 11] (U)

$$\begin{bmatrix} 1 & 1 & 1 & 1 \\ 1 & -j & -1 & j \\ 1 & -1 & 1 & -1 \\ 1 & j & -1 & -j \end{bmatrix} \begin{bmatrix} 0 \\ 1 \\ 2 \\ 3 \end{bmatrix} = \begin{bmatrix} 6 \\ -2+j2 \\ -2 \\ -2-j2 \end{bmatrix}$$

17) What is FFT? (R)

The fast fourier transform is an algorithm used to compute the DFT.It will reduce the computation . The FFT algorithm provides speed increase factors ,when compared with direct computation of the DFT,of approximately 64 & 205 for 256 – point & 1024 point transforms respectively.

18) The first five DFT coefficients of a sequence x(n) are X(0) = 20, X(1) = 5+j2, X(2) = 0, X(3) = 0.2+j0.4, X(4) = 0.Determine the remaining DFT coefficients. (U)

W.K.T, $X(k) = X^*(N-k)$.

$X(5) = X^*(8-5) = X^*(3) = 0.2-0.4j$

$X(6) = X^*(8-6) = X^*(2) = 0$

$X(7) = X^*(8-6) = X^*(1) = 5-j2$.

19) What is the main advantage of FFT algorithm over direct computation of DFT. **(R)**

Reduces computation time required by DFT.

20) What are the applications of FFT algorithm. **(R)**

a) Spectral analysis of signals.
b) Analysis of systems in frequency domain .
c) Fast convolution of signal using frequency domain.

21) Given X(k) = { 6, -2+j2, -2, -2-j2 }, find x(n). **(U)**

$x(n) = (1/4)W^{*}_{4}X_4 = (1/4)$

$$\begin{bmatrix} 1 & 1 & 1 & 1 \\ 1 & j & -1 & -j \\ 1 & -1 & 1 & -1 \\ 1 & -j & -1 & j \end{bmatrix} \begin{bmatrix} 6 \\ -2+j2 \\ -2 \\ -2-j2 \end{bmatrix} = \begin{bmatrix} 0 \\ 1 \\ 2 \\ 3 \end{bmatrix}$$

22) State the properties of DFT. **(R)**

Periodicity, Linearity and symmetry, Multiplication of two DFTs, Circular convolution, Time reversal, Circular time shift and frequency shift, Complex conjugate & Circular correlation.

23) Define Circular Convolution. **(R)**

Let $x_1(n)$ and $x_2(n)$ are finite duration sequences both of length N with DFTs $X_1(K)$ and $X_2(k)$.

If $X_3(k)=X_1(k)X_2(k)$, then the sequence $x_3(m)$ can be obtained by circular convolution defined as,

$$x(m) = \sum_{n=0}^{N-1} x_1(n)x_2((n-m))_N \, , where...m = 0,1,2,.....(N-1)$$

24) How to obtain the output sequence of linear convolution through circular convolution? **(U)**

Consider two finite duration sequences x(n) and h(n) of duration L samples and M samples. The linear convolution of these two sequences produces an output seq of duration L+M-1 samples, whereas , the circular convolution of x(n) and h(n) give N samples where N=max(L,M).In order to obtain the number of samples in circular convolution equal to L+M-1, both x(n) and h(n) must be appended with appropriate number of zero valued samples. In other words by increasing the length of the sequences x(n) and h(n) to L+M-1 points and then circularly convolving the resulting sequences we obtain the same result as that of linear convolution.

25) Define Sectioned Convolution. **(R)**

If the data sequence x(n) is of long duration it is very difficult to obtain the output seq y(n) due to limited memory of a digital computer. Therefore, the data seq is

divided up into smaller sections. These sections are processed separately one at a time and controlled later to get the output.

26) What are the two methods used for the sectional convolution? (R)

The two methods used for the sectional convolution are
1) Overlap-add method and 2) Overlap-save method.

27) What is meant by radix-2FFT? (R)

The FFT algorithm is most efficient in calculating N point DFT. If the number of output points N can be expressed as a power of 2, i.e., N =2M, where M is an integer.

28) Distinguish between linear convolution and circular convolution of two sequences. (R)

Linear convolution :
a) If x(n) is a sequence of L number of samples and h(n) with M number of samples, after convolution y(n) will have N=L+M-1 samples.
b) It can be used to find the response of a linear filter.
c) Zero padding is not necessary to find the response of a linear filter.

Circular convolution :
a) If x(n) is a sequence of L number of samples and h(n) with M samples, after convolution y(n) will have N=max(L,M) samples.
b) It cannot be used to find the response of a filter.
c) Zero padding is necessary to find the response of a filter.

29) What are differences between overlap-save and overlap-add methods. (U)

Overlap-save method :
a) In this method the size of the input data block is N=L+M-1.
b) Each data block consists of the last M-1 data points of the previous data block followed by L new data points
c) In each output block M-1 points are corrupted due to aliasing as circular convolution is employed
To form the output sequence the first M-1 data points are discarded in each output block and the remaining data are fitted together.

Overlap-add method :
a) In this method the size of the input data block is L
b) Each data block is L points and we append M-1 zeros to compute N point DFT
c) In this no corruption due to aliasing as linear convolution is performed using circular convolution.
d) To form the output sequence the last M-1 points from each output block is added to the first M-1 points of the succeeding block.

PART-B

1) Derive and draw the **radix-2 DIT** algorithm for FFT of 8 points. **[May' 07]** **(U)**

2) Compute the DFT for x(n) = {1, 2, 0, 0, 0, 2,1,1}, using **radix- 2 DIF FFT**. **[May' 07]** **(A)**

3) Derive and draw the **radix-2 DIF** algorithm for FFT of 8 points. **[Nov' 07]** **(U)**

4) Compute the DFT for x(n) = {1, 0, 0, 2, 2, 0, 0,1}, using **radix- 2 DIF FFT. [Nov' 07]** **(A)**

5) i) If N pt DFT of x(n) is X(k) then.
Prove that, **DFT $[x_1(n)\ x_2(n)] = (1/N)\ X_1(k)$ (N) $X_2(k)$]** . **(U)**
ii) Find 8 point DFT of x(n) = 0.5, $0 \le n \le 3$
0, $4 \le n \le 7$ using **DIT FFT**. **[May' 08]** **(A)**

6) Given x(n)= {0,1,2,3,4,5,6,7} find X(k) using **DIT FFT** algorithm. **[Nov' 08]** **(A)**

7) Given $x(n)=2^n$ compute X(k) using **DIF FFT** algorithm for N=8 and $n \ge 0$. **[Nov' 08]** **(AZ)**

8) Find the 8 point DFT of x(n) = {1,1,1,1,1,1,1,1} using **DIT FFT** algorithm. **[May' 09]** **(A)**

9) i) Compute the DFT of x(n) = {0,1,2,3,4,5,6,7} using **DIF FFT** radix 2 algorithm.
ii) Mention the **differences & similarities** between DIT and DIF FFT. **[Nov'09]** **(A)**

10) i) List the steps involved for the radix-2 **DIT-FFT** algorithm. Explain. **(U)**
ii) Using radix-2 **DIT FFT**, convolve x(n)= {1,-1, 2} and h(n) = { 2,2}. **[Nov'09]** **(AZ)**

11) i) Obtain the DFT of x(n)={8,7,6,5,4,3,2,1} using **DIF FFT**. **(A)**
ii) How can you compute **IDFT** using FFT? **[May' 10]** **(U)**

12) Multiplication of the DFTs of two sequences is equivalent to the circular convolution of the two sequences in the time domain. **Prove this property** by the following two seqs: $x_1(n)$={2,1,2,1} and $x_2(n)$={1,2,3,4}. **[May'10]** **(AZ)**

13) i) Explain, how **linear convolution** of two finite sequences are obtained via DFT.
ii) Compute the **DFT** of x(n) = [1,0,-1,0] & x(n) = [j,0,j,1] when $j=\sqrt{-1}$. **[Nov' 10]** **(AZ)**

14) Draw the flowchart for N=8 using radix-2 **DIF** algorithm for finding DFT coefficients. **[Nov'10]** **(U)**

15) By means of the **DFT and IDFT**, determine the response at the FIR filter with the impulse response h(n)=[1,2,3] and the input sequence x(n)=[1,2,2,1]. **[May'11]** **(AZ)**

16) Compute the DFT using the **DIF FFT** algorithm x(n)=[1,-1,-1,-1,1,1,1,-1] **[May'11]** **(A)**

17) Compute the DFT of $x(n) = e^{-0.5n}$, $0 \le n \le 5$. **(AZ)**

18) Prove the following properties of DFT when X (K) is the DFT of an N-point sequence h(n) .

a) X (K) is real and even when x(n) is real and even.

b) X(K) is imaginary and odd when x(n) is real and odd. **(U)**

19) Determine the IDFT of X(K) = $\{\{1, -2-j, 0, -2+j\}$ **(A)**

20) Perform the linear convolution of finite duration sequences h(n) ={ 3,2} and x (n) ={1,2, −1,3,2, −3, −2, −1} by overlap – add method. **(A)**

21) Compute the N-point DFT of x(n) = $\begin{cases} 1 & for\ n\ even \\ 0 & for\ n\ odd \end{cases}$ **(AZ)**

22) Compute the 8-point DFT of the sequence x(n) = {0.5,0.5,0.5,0.5,0,0,0,0} using radix-2 DIT algorithm. **(A)**

22) Compute an IDFT of the following sequence X(K) = $\{1, 1+j, 1-2j, 1, 0, 1+2j, 1+j\}$ using DIF algorithm. **(A)**

UNIT II - IIR FILTER DESIGN

PART –A

1) What does "frequency warping" mean? (or) What is warping effect? [May' 06] **(R)**

In Bilinear Transformation, the relationship between the frequency variables of the analog filters and the digital filters is given as $\Omega = \frac{2}{T}\tan\frac{\omega}{2}$. For low frequencies, the relationship between Ω and ω are linear. For higher frequencies the relationship between ω and Ω becomes non-linear and distortion is introduced in the frequency scale of the digital filters of the analog filter. This is known as warping effect.

2) Find the transfer function for normalized butter worth filter of order 1 by determine the pole values. [May' 06] **(U)**

Pole values, $s_k = e^{j\Phi_k}$, $\phi_k = \frac{\pi}{2} + \frac{(2k-1)\pi}{2N}$ $k = 1, 2, \ldots, N$ **where**

Here, N =1 & k =1. $\Phi_1 = \pi/2 + \pi/2 = \pi$.

$s_1 = e^{\Phi} = \cos\Phi + j\sin\Phi = \cos\pi + j\sin\pi = -1$.

Transfer function = $\frac{1}{s - s_1} = \frac{1}{s+1}$.

3) What are the properties that are maintained same in the transfer of analog filter into a digital filter? [Nov' 06] **(R)**

- The j Ω axis of s plane should map on the unit circle in the z plane.
- The left half of the s plane should be mapped inside the unit circle in z plane.

4) Mention the technique for digitizing the transfer function of an analog filter. [Nov' 06] **(R)**

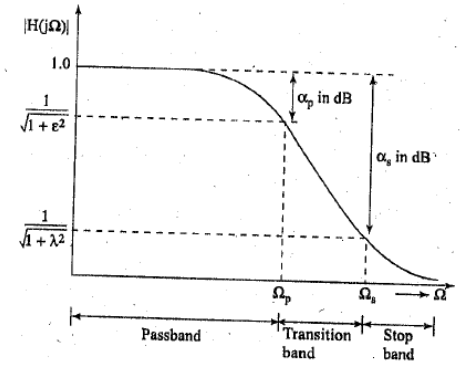
1. Impulse Invariant Transformation
2. Bilinear Transformation

5) Write the equation for frequency transformation from LPF to BPF. [May'07] **(R)**

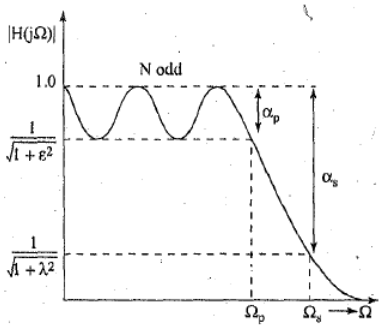
$H(s)_{BPF} = H(s)$. Replace **s** by $s \rightarrow \frac{Q(s^2 + \Omega_0^2)}{\Omega_0 s}$.

Where, $\Omega_0 = \sqrt{\Omega_1 \Omega_2}$ and $Q = \frac{\Omega_0}{\Omega_2 - \Omega_1}$.

6) Draw the response curve for butterworth, chebyshev and elliptic filters? [May'07]. **(U)**



Butterworth filter



Chebyshev (Type I)

7) Find digital filter equivalent for $H(s)=\frac{1}{s+8}$. [May'07] **(U)**

Using Impulse Invariant method,

$$\frac{A_i}{s-p_i} \xrightarrow{\text{(is transformed to)}} \frac{A_i}{1-e^{p_i T}z^{-1}}$$

$$H(z)=\frac{1}{1-e^{-8T}z^{-1}} = \frac{1}{1-e^{-8}z^{-1}}$$

[$\mathbf{p_1}$= 1 sec & **T** = 1 sec].

$$= \frac{1}{1-0.00034z^{-1}}$$

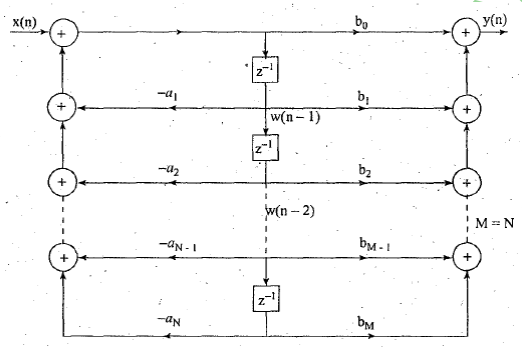
8) Find H(z) for the IIR filter, whose $H(s)=\frac{1}{s+6}$? [Nov'07] **(U)**

$$\frac{A_i}{s-p_i} \xrightarrow{\text{(is transformed to)}} \frac{A_i}{1-e^{p_i T}z^{-1}}$$

Using Impulse Invariant method,

$$H(z)=\frac{1}{1-e^{-6}z^{-1}} = \frac{1}{1-0.00248z^{-1}}$$

9) Draw the basic block diagram for IIR filter using direct form –II? [Nov'07] **(R)**



10) What are the advantages of bilinear mapping? [May' 08] **(R)**

- ✓ It provides one to one mapping.
- ✓ Stable continuous system can be mapped in to realizable, stable, digital s/m.
- ✓ There is no aliasing.

11) State the relationship between the analog and digital frequencies when converting an A to D filter using bilinear transformation. [Nov' 08] **(U)**

$\Omega = \frac{2}{T}\tan\frac{\omega}{2}$, where, **Ω** - analog frequency & **ω** - digital frequency.

12) Convert $H(s)=\frac{1}{s^2+16}$ **into a digital filter using Approx.of derivatives.[Nov'08]**

(U)

$H(z)=H(s)$ **If** Replace **s** by $s=\frac{1-z^{-1}}{T}$.

$$H(z)=\frac{1}{\left(1-z^{-1}\right)^2+16} \quad =\frac{1}{z^{-2}-2z^{-1}+17} \quad [\ \textbf{T = 1 sec}\ ]$$

13) Convert $H(s)=\frac{1}{s^2+1}$ **into H(z) using Approx. of derivatives with T = 0.1 sec.**

[Nov' 09] **(U)**

$H(z)=H(s)$ **If** Replace **s** by $s=\frac{1-z^{-1}}{T}$.

$$H(z)=\frac{1}{\left(1-z^{-1}\right)^2+1} \quad = \quad \frac{1}{z^{-2}+2z^{-1}+2}$$

14) Compare IIR filters & FIR filters. [Nov' 09] **(U)**

S.No	IIR Filters	FIR Filters
1	These filters do not have Linear phase.	These filters have Linear phase.
2	Less flexilbility, usually limited to specific kind of filters.	Greater flexibility to control the shape of these magnitude response.
3	Round off noise in IIR filters are more.	Errors due to round off noise are severe in FIR filters.

15) Indicate the location in the Z plane to which the ±∞ points on the jω axis in the s plane go to due to the bilinear transformation. [May' 10] **(U)**

Z = 1.

16) Convert $H(s)=\frac{1}{(s+0.2)(s+0.6)}$ **to H(z) using Impulse Invariant method. [May' 10]**

Using Impulse Invariant method,

$$H(s)=\frac{A}{s+0.2}+\frac{B}{s+0.6} \quad =\frac{2.5}{s+0.2}-\frac{2.5}{s+0.6} \qquad \frac{A_i}{s-p_i} \xrightarrow{\text{(is transformed to)}} \frac{A_i}{1-e^{p_i T}z^{-1}}$$

$$H(z)=\frac{2.5}{1-e^{-0.2}z^{-1}}-\frac{2.5}{1-e^{-0.6}z^{-1}} \qquad [\ \mathbf{p_1} = 0.2 \ \ \& \ \ \mathbf{p_2} = 0.6\ ].$$ **(U)**

17) What are the limitations of impulse invariant method of designing digital filters? [Nov' 10] **(R)**

(a) Mapping from s-plane to z-plane is many – to – one.
(b) Spectrum aliasing.

18) Give the magnitude function of Butterworth filter. What is the effect of varying order of N on magnitude and phase response? (U)

The magnitude function of the Butterworth filter is given by

$$|H(j\Omega)| = \frac{1}{\left[1 + \left(\frac{\Omega}{\Omega_c}\right)^{2N}\right]^{\frac{1}{2}}} \quad N = 1, 2, 3, \ldots$$

Where N is the order of the filter and Ω_c is the cutoff frequency. The magnitude response of the Butterworth filter closely approximates the ideal response as the order N increases. The phase response becomes more non-linear as N increases.

19. Give any two properties of Butterworth filter. (R)

1. The magnitude response of the Butterworth filter decreases monotonically as the frequency Ω increases from 0 to ∞.
2. The magnitude response of the Butterworth filter closely approximates the ideal response as the order N increases.
3. The poles of the Butterworth filter lie on a circle.

20. What are the properties of chebyshev filter? (R)

1. The magnitude response of the chebyshev filter exhibits ripples either in pass band or in stop band according to type.
2. The poles of the chebyshev filter lie on an ellipse.

21. Distinguish between Butterworth and chebyshev filter. (U)

1. The magnitude response of the Butterworth filter decreases monotonically as the frequency Ω increases from 0 to ∞, whereas The magnitude response of the chebyshev filter exhibits ripples either in pass band or in stop band.
2. The transition band is more in Butterworth filter compared to chebyshev filter.
3. The poles of the Butterworth filter lie on a circle whereas the poles of the chebyshev filter is lie on an ellipse.

22. What is bilinear transform? (R)

The bilinear transform is a mapping that transform the left half of S-plane into the unit circle in the Z-plane only once, thus avoiding aliasing of frequency components.

The mapping from the s-plane to the z-plane in bilinear transformation is

$$s = \frac{2}{T}\left[\frac{1 - z^{-1}}{1 + z^{-1}}\right]$$

23. Define an IIR filter. (R)

The filter designed by considering all the infinite samples of impulse response are called IIR filter. The impulse response is obtained by taking inverse Fourier transform of ideal frequency response.

24. ***By impulse invariance method obtain the digital filter transfer function and the differential equation of analog filter*** $H(s) = \frac{1}{s+1}$.

For $H(s) = \frac{1}{s+1}$

$$h(t) = e^{-t}$$
$$h(nT) = e^{-nT}$$
$$H(z) = \sum_{n=0}^{\infty} e^{-nT} z^{-1} = \frac{1}{1 - e^{-T} z^{-1}}$$

The differential equation can be obtained from

$$\frac{Y(s)}{X(s)} = \frac{1}{s+1}$$
$$sY(s) + Y(s) = X(s)$$

Taking inverse Laplace transform on both sides we get

$$\frac{d}{dt} y(t) + y(t) = x(t)$$

(U)

25. Compare impulse invariant and bilinear transformation. **(U)**

Impulse Invariant transform	Bilinear Transform
1. It is many to one mapping 2. The relation between analog and digital frequency is linear 3. To prevent the problem of aliasing the filter should be band limited 4. The magnitude and phase response of analog filter can be preserved	1. It is one to one mapping 2. The relation between analog and digital frequency is nonlinear 3. There is no problem of aliasing and so the analog filter need not be band limited. 4. Due to the effect of warping the phase response of analog filter can not preserved

26. What is impulse invariant transformation? **(R)**

The transformation of analog filter to digital filter without modifying the impulse response of the filter is called impulse invariant transformation.

i.e.

$$\frac{A_i}{s - p_i} \xrightarrow{\text{(is transformed to)}} \frac{A_i}{1 - e^{p_i T} z^{-1}}$$

27. Mention the important features of IIR filter. **(R)**

1. The physically realizable IIR filter does not have linear phase.
2. The IIR filter specification includes the desired characteristics for magnitude response only.

PART – B

1) Design a digital filter using $H(s)=\frac{1}{s^2+9s+18}$ with T= 0.2sec. **[May'07]** **(A)**

2) Design a second order band reject filter with ω_1 and ω_2 as cut-off frequency and sampling interval as T. **[May'07]** **(A)**

3) Realize the given transfer function using direct form-1 and parallel methods.

$H(Z)=\frac{4Z^2+11Z-2}{(Z+1)(Z-3)}$ **[May'07]** **(A)**

4) If H(s)=$\frac{1}{(S+1)(S+2)}$ find H(Z) using impulse invariance method for sampling frequency of 5 samples/sec. **[May'07]** **(A)**

5) a) Design a digital filter with H(s)=$\frac{1}{s^2+7s+12}$ for T=1sec. **[Nov'07]** **(AZ)**

b) Realize the given transfer function using direct form-I format.

$H(z)=\frac{8z^{-2}+5z^{-1}+1}{7z^{-3}+8z^{-2}+1}$ **[Nov'07]** **(A)**

6) Design a digital filter using bilinear transformation method for **[Nov'07]** **(AZ)**

$H(s)=\frac{2}{(s+1)(s+2)}$ for cutoff freq of 100rad/sec, and sampling period T=1.4ms.

7) Design a low pass butterworth filter that has a 3dB cutoff frequency of 1.5KHz and an attenuation of 40dB at 3.0KHz. **[May' 08]** **(AZ)**

8) a) Use the impulse invariance method to design a digital filter from an analog prototype that has a system function, $Ha(s)=\frac{s+a}{((s+a)^2+b^2)}$ **(A)**

b) Determine the order of cheybshev filter that meets the following specification. 1dB ripple in the pass band $0\le|\omega|\le 0.3\pi$ & atleast 60dB attenuation in the stopband $0.35\pi\le|\omega|\le\pi$. Use bilinear transformation. **[May' 08]** **(AZ)**

9) Determine H(z) for a butterworth filter satisfying the following constraints.

$\sqrt{0.5}\le|H(e^{jw})|\le 1 \quad 0\le\omega\le\frac{\pi}{2}$ & $|H(e^{jw})|\le 0.2 \quad 3\pi/4\le\omega\le\pi$.

with T=1s. Apply impulse invariant transformation. **[Nov'08]** **(AZ)**

10) Determine H(z) for a chebyshev filter satisfying the following constraints.

$0.707\le|H(e^{jw})|\le 1 \quad 0\le\omega\le 0.2\pi$

$|H(e^{jw})|\le 1 \quad 0.5\pi\le\omega\le\pi$

With T=1s. Apply bilinear transformation. **[Nov'08]** **(AZ)**

11) Design an analog Chebyshev filter with following specification:
Passband ripple : 1dB for $0 \le \Omega \le 10 rad/\sec$
Stopband attenuation : 60dB for $\Omega \ge 50 rad/\sec$ **[May'09]** **(AZ)**

12) Design a second order high pass digital filter with following specification:
Passband ripple : 1dB & Passband edge frequency :100Hz
Sampling frequency:400Hz. Monotonic response in the stopband.
Use $s \rightarrow \frac{2(1-z^{-1})}{T(1+z^{-1})}$ type of mapping **[May'09]** **(AZ)**

13) Explain in detail the steps involved in the design of IIR filter using bilinear transformation**. [Nov'09]** **(R)**

14) Determine the cascade and parallel realization for the system, described by the system function.

$$H(Z) = \frac{10\left(1-\left(\frac{1}{2}\right)z^{-1}\right)\left(1-\left(\frac{2}{3}\right)z^{-1}\right)\left(1+2z^{-1}\right)}{\left[\left(1-\left(\frac{3}{4}\right)z^{-1}\right)\left(1-\left(\frac{1}{8}\right)z^{-1}\right)\left(1-\left(\frac{1}{2}+j\frac{1}{2}\right)z^{-1}\right)\left(1-\left(\frac{1}{2}-j\frac{1}{2}\right)z^{-1}\right)\right]}$$ **[Nov'09]** **(A)**

15) Design a digital low pass butterworth filter using bilinear transformation method to meet the following specifications:
Pass band ripple ≤ 1.25dB, pass band edge = 200Hz,
stop band attenuation ≥ 15dB, stop band edge=300Hz,
sampling frequency=2KHz. **[May'10]** **(AZ)**

16) (a) Find the transfer function of a Analog chebyshev LPF to meet the following requirements.
Pass band edge 1rad/sec, pass band ripple 0.1dB,
Stop band attenuation is atleast 40dB for 2rad/sec. **(AZ)**
(b) Compare FIR and IIR filter. **[May'10]** **(U)**

17) Design a digital LPF using Bilinear transformation, Given that $H_a(s) = \frac{1}{(s+1)(s+1.732s+1)}$. Assume sampling freq of 100rad/sec. **[Nov'10]** **(AZ)**

18) Design FIR filter using impulse invariance technique.
Given that, $H_a(s) = \frac{1}{(s+5s+6)}$ and implement the resulting digital filter by adder, multipliers and delays. Assume sampling period T=1sec. **[Nov'10]** **(AZ)**

19) Find the H(z) corresponding to the impulse invariance design using a sample rate of 1/T samples/sec for an analog filter H(s) specified as follows $H(s) = \frac{A}{S+\alpha}$
[May'11] **(A)**

20) Design a digital LPF using the bilinear transform to satisfy the following characteristics.
i) monotonic stop band and pass band
ii) -3dB cutoff frequency of 0.5π rad
iii) magnitude down atleast -15dB at 0.75π rad. **[May'11]** **(AZ)**

21) Design an IIR filter using impulse invariance for the given $H_a(s)=\frac{1}{s^2+17s+12}$
Assume T=1sec. Realize this filter using direct form I & II. **[May'11]** **(A)**

22) Design a chebyshev low pass filter with the specifications α_p = 1db ripple in the pass band $0 \le \omega \le 0.2\pi$, α_s = 15 db ripple in the stop band $0.3\pi \le \omega \le \pi$ using Bilinear transformation **(AZ)**

23) Using bilinear transformation design a digital band pass Butterworth filter with the following specifications
Sampling frequency of 8 KHz
α_p = 2 db in the pass band 800Hz $\le$ f $\le$ 1000 Hz
α_s = 20 db in the stop band 0 $\le$ f $\le$ 400 Hz and 2000Hz $\le$ f $\le$ ∞ **(AZ)**

24) Design a chebyshev low pass filter with the specifications
i) α_p = 1 db ripple in the pass band $0 \le \omega \le 0.2\pi$
ii) α_s = 15 db ripple in the stop band $0.3\pi \le \omega \le \pi$
Using Bilinear Transformation **(AZ)**

25) For the given specifications design a digital high-pass filter using BLT
i) α_p = 3db
ii) α_s = 15 db
iii) Ω_p=1500 rad/sec
iv)Ω_s =500 rad/Sec **(A)**

UNIT III-FIR FILTER DESIGN

PART– A

1. What is a FIR filter? (R)

The specifications of the desired filter will be given in terms of ideal frequency response Hd(w). The impulse response hd(n) of the desired filter can be obtained by inverse fourier transform of Hd(w), which consists of infinite samples. The filters designed by selecting finite number of samples of impulse response are called FIR filters.

2. What are the different types of filters based on impulse response? (R)

Based on impulse response the filters are of two types

1. IIR filter
2. The IIR filters are of recursive type, whereby the present output sample depends on the present input, past input samples and output samples.

3. why FIR filter is named so? (R)

The FIR filters are of non recursive type, whereby the present output sample depends on the present input, and previous output samples.

4. What are the different types of filter based on frequency response? (R)

The filters can be classified based on frequency response. They are I) Low pass filter ii) High pass filter iii) Band pass filter iv) Band reject filter.

5. Distinguish between FIR and IIR filters. (NOV 2010) (U)

FIR FILTER

- These filters can be easily designed to have perfectly linear phase.
- FIR filters can be realized recursively and non-recursively.
- Greater flexibility to control the shape of their magnitude response.
- Errors due to roundoff noise are less severe in FIR filters, mainly because feedback is not used.

IIR FILTER

- These filters do not have linear phase.
- IIR filters can be realized recursively.
- Less flexibility, usually limited to kind of filters.
- The roundoff noise in IIR filters are more.

6. What are the techniques of designing FIR filters? (NOV 2011) (R)

There are three well-known methods for designing FIR filters with linear phase. These are

1) windows method
2) Frequency sampling method
3) Optimal filter design.

7. State the condition for a digital filter to be causal and stable. (R)

- A digital filter is causal if its impulse response h(n) = 0 for n<0
- A digital filter is stable if its impulse response is absolutely summable,

8. What is the reason that FIR filter is always stable? (R)

FIR filter is always stable because all its poles are at origin.

9. What are the properties of FIR filter? (APRIL 2011) **(R)**

1. FIR filter is always stable.
2. A realizable filter can always be obtained.
3. FIR filter has a linear phase response.

10. How phase distortion and delay distortions are introduced? **(U)**

The phase distortion is introduced when the phase characteristics of a filter is not linear within the desired frequency band.

The delay distortion is introduced when the delay is not constant within the desired frequency range.

11. Write the steps involved in FIR filter design. **(R)**

- Choose the desired (ideal) frequency response Hd(w).
- Take inverse fourier transform of Hd(w) to get hd(n).
- Convert the infinite duration hd(n) to finite duration h(n).
- Take Z-transform of h(n) to get the transfer function H(z) of the FIR filter.

12. What are the advantages of FIR filters? (Nov 2011) **(R)**

- Linear phase FIR filter can be easily designed.
- Efficient realization of FIR filter exist as both recursive and nonrecursive structures.
- FIR filters realized nonrecursively are always stable.
- The round off noise can be made small in nonrecursive realization of FIR filters.

13. What are the disadvantages of FIR filters? **(R)**

- The duration of impulse response should be large to realize sharp cutoff filters.
- The non-integral delay can lead to problems in some signal processing applications.

14. What is the necessary and sufficient condition for the linear phase characteristic of an FIR filter? (May 2012) **(U)**

The necessary and sufficient condition for the linear phase characteristic of an FIR filter is that the phase function should be a linear function of w, which in turn requires constant phase and group delay.

$$\text{Phase delay, } \alpha = \frac{N-1}{2} \text{ (i.e., phase delay is constant)}$$

Group delay $= -d\,\theta(\omega)/d\omega = \alpha$

Impulse response, h(n) = h(N-1-n) (i.e., impulse response is symmetric)

15. What are the conditions to be satisfied for constant phase delay in linear phase FIR filters? **(U)**

The conditions for constant phase delay are

- Phase delay, $\alpha = (N-1)/2$ (i.e., phase delay is constant)
- Impulse response, h(n) = h(N-1-n) (i.e., impulse response is symmetric)

16. How constant group delay & phase delay is achieved in linear phase FIR filters? (U)

The following conditions have to be satisfied to achieve constant group delay & phase delay.
Phase delay, $\alpha = (N-1)/2$ (i.e., phase delay is constant)
Group delay, $\beta = \pi/2$ (i.e., group delay is constant)
Impulse response, $h(n) = -h(N-1-n)$ (i.e., impulse response is Anti-symmetric)

17. What are the possible types of impulse response for linear phase FIR filters? (R)

There are four types of impulse response for linear phase FIR filters

- Symmetric impulse response when N is odd.
- Symmetric impulse response when N is even.
- Antisymmetric impulse response when N is odd.
- Antisymmetric impulse response when N is even.

18. List the well-known design techniques of linear phase FIR filters. (R)

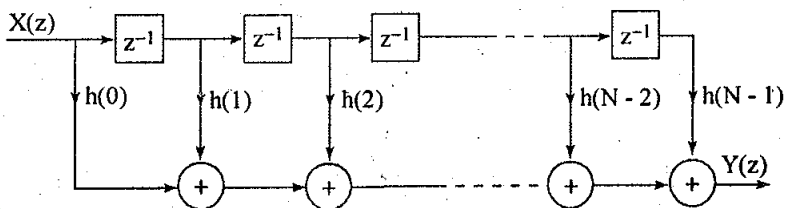
There are three well-known design techniques of linear phase FIR filters. They are

- Fourier series method and window method
- Frequency sampling method.
- Optimal filter design methods.

19. What is Gibb's phenomenon (or Gibb's Oscillation)? (MAY 2012) (R)

In FIR filter design by Fourier series method the infinite duration impulse response is truncated to finite duration impulse response. The abrupt truncation of impulse response introduces oscillations in the passband and stopband. This effect is known as Gibb's phenomenon (or Gibb'sOscillation).

20. Draw the direct form realization of FIR system. (R)



21. When cascade form realization is preferred in FIR filters? (U)

The cascade form realization is preferred when complex zeros with absolute magnitude less than one.

22. What are the desirable characteristics of the frequency response of window function? (NOV2011) (R)

The desirable characteristics of the frequency response of window function are

- The width of the mainlobe should be small and it should contain as much of the total energy as possible.
- The sidelobes should decrease in energy rapidly as w tends to π.

23. Write the procedure for designing FIR filter using frequency-sampling method. (R)

Choose the desired (ideal) frequency response Hd(w).

- Take N-samples of Hd(w) to generate the sequence
- Take inverse DFT of to get the impulse response h(n).
- The transfer function H(z) of the filter is obtained by taking z-transform of impulse response.

24. What are the drawback in FIR filter design using windows and frequency sampling method? How it is overcome? (NOV 2008) (U)

The FIR filter design using windows and frequency sampling method does not havePrecise control over the critical frequencies such as wp and ws.
This drawback can be overcome by designing FIR filter using Chebyshev approximationtechnique. In this technique an error function is used to approximate the ideal frequency response, in order to satisfy the desired specifications.

25. Write the characteristic features of rectangular window. (R)

- The mainlobe width is equal to 4π/N.
- The maximum sidelobe magnitude is –13dB.
- The sidelobe magnitude does not decrease significantly with increasing w.

26. List the features of FIR filter designed using rectangular window. (R)

- The width of the transition region is related to the width of the mainlobe of windowspectrum.
- Gibb's oscillations are noticed in the passband and stopband.
- The attenuation in the stopband is constant and cannot be varied.

27. Why Gibb's oscillations are developed in rectangular window and how it can be eliminated or reduced? (U)

The Gibb's oscillations in rectangular window are due to the sharp transitions from 1 to 0 at the edges of window sequence. These oscillations can be eliminated or reduced by replacing the sharp transition by gradual transition. This is the motivation for development of triangular and cosine windows.

28. List the characteristics of FIR filters designed using windows. (R)

- The width of the transition band depends on the type of window.
- The width of the transition band can be made narrow by increasing the value of N
  where N is the length of the window sequence.
- The attenuation in the stop band is fixed for a given window, except in case of Kaiserwindow where it is variable.

29. Write the characteristic features of hanning window spectrum. (R)

- The mainlobe width is equal to 8π/N.
- The maximum sidelobe magnitude is –41dB.
- The sidelobe magnitude remains constant for increasing w.

30. What is the mathematical problem involved in the design of window function? (R)

The mathematical problem involved in the design of window function(or sequence) is that of finding a time-limited function whose Fourier Transform best approximates a bandlimited function. The approximation should be such that the maximum energy is confined to main lobe for a given peak side lobe amplitude.

31. List the desirable features of Kaiser window spectrum. (NOV 2012) (R)

- The width of the mainlobe and the peak sidelobe are variable.
- The parameter α in the Kaiser window function is an independent variable that can be
- varied to control the sidelobe levels with respect to mainlobe peak.
- The width of the mainlobe in the window spectrum can be varied by varying the length
  N of the window sequence.

32. Compare the hamming window and Kaiser window. (U)

Hamming Window

- The width of mainlobe in window spectrum is 8π/N
- The maximum sidelobe magnitude in window spectrum is –41dB.
- In window spectrum the sidelobe magnitude remains constant.
- In FIR filter designed using hamming window the minimum stopband attenuation is44dB.

Kaiser Window

- The width of mainlobe in window spectrum depends on the values of α & N.
- The maximum sidelobe magnitude with respect to peak of mainlobe is variable using the parameter α.
- In window spectrum the sidelobe magnitude decreases with increasing w.
- In FIR filter designed using Kaiser window the minimum stopband attenuation is variable and depends on the value of α.

33. What are called symmetric and antisymmetric FIR filters? (MAY 2012) (U)

Symmetric FIR filter

Phase delay, α = (N-1)/2

Impulse response, h(n) = h(N-1-n)

Antisymmetric FIR filter

Phase delay, α = (N-1)/2
Group delay, β = π/2
Impulse response, h(n) =- h(N-1-n)

34. Give the equations for Hamming window. (NOV2010) (R)

Hamming window: The equation for Hamming window is given by

$$\omega_H(n) = 0.54 + 0.46\cos\frac{2\pi n}{N-1} \qquad \text{for} -\left(\frac{N-1}{2}\right) \le n \le \frac{N-1}{2}$$

$$= 0 \qquad \text{otherwise}$$

PART – B

1) Design a Linear phase FIR digital filter

$$H_d(\omega) = e^{-j3\omega} \; for |\omega| \le \frac{\pi}{6},$$

for $\frac{\pi}{6} < \omega \le \pi$. **[May' 07]** **(AZ)**

2) Determine the coefficient h(n) of a linear phase FIR filter M =15,which has a symmetric unit sample response and a frequency response.

$H_r(2\pi k/15) = 1$ for k = 0,1,2,3

0 for k = 4,5,6,7. **[May' 07]** **(AZ)**

3) Explain in detail about finite word length effects in Digital filter. **[May' 07]** **(R)**

4) Design a Linear phase FIR digital filter

$$H_d(\omega) = 1 \; for |\omega| \le \frac{\pi}{6},$$

for $\frac{\pi}{6} < \omega \le \pi$. **[Nov' 07]** **(AZ)**

5) Design a Linear phase FIR digital filter.

$$H_d(e^{j\omega}) = \begin{cases} e^{-j3\omega}, -3\pi/4 \le \omega \le 3\pi/4 \\ 0, 3\pi/4 < |\omega| \le \pi \end{cases}$$ **[Nov' 07]** **(AZ)**

6) Determine the coefficients of a linear phase 5 tap FIR filter using Rectangular window.

$$H_d(\omega) = 1 \; for |\omega| \le \frac{\pi}{6},$$

0 for $\frac{\pi}{6} < \omega \le \pi$. **(AZ)**

7) Determine unit sample response h(n) of a linear phase FIR filter of length M=4 for which the freq response at ω=0 & ω=π/2 is given as Hr(0),Hr(π/2)=1/2. **[May' 08]** **(AZ)**

8) The desired frequency response of a low pass filter is

$H_d(e^{j\omega}) = e^{-j2\omega}, -\pi/4 \le \omega \le \pi/4$

$0 \quad , \pi/4 < |\omega| \le \pi$.

Determine $h_d(n)$ .Also determine $h(n)$ using the rectangular window with M=5.

Determine the frequency response $He^{j\omega}$ of the designed filter. **[Nov' 08]** **(AZ)**

9) Design a symmetric FIR LPF whose desired frequency is given as

$$H_d(\omega) = e^{-j\omega\tau} \; for |\omega| \le \omega_c,$$

0 otherwise. **[May' 09]** **(AZ)**

The length of the filter should be 7 & ω_c = 1 rad/sample. Use rectangular window.

10) Design a LPF to be used in an A/D – H(z) – D/A structure that will have a -3dB cutoff at 30π rad/sec & an attenuation of 50dB at 45rad/sec. The filter is required to have a linear phase & a sampling rate of 100samples/sec. **[May' 09]** **(AZ)**

11) Design a LPF using rectangular window by taking 9 samples of w(n) with cut-off frequency of 1.2 rad/sec & also draw the structure. **[Nov' 10]** **(AZ)**

12) Design & obtain the coefficients of a 15 tap Linear phase FIR low pass filter using Hamming window to meet the given frequency response

$$H_d(\omega) = 1 \; for |\omega| \leq \frac{\pi}{6},$$

$0 \quad$ for $\frac{\pi}{6} < \omega \leq \pi$. **[May' 11]** **(AZ)**

13) An a FIR filter is given by the difference equation

$y(n) = 2\,x(n) + \frac{4}{5}\,x(n-1) + \frac{3}{2}\,x(n-2) + \frac{2}{3}\,x(n-3)$ Determine its lattice Form **(A)**

14) Design a digital filter with

$$H_d(e^{j\omega}) = \begin{cases} 1 & for\ 2 \leq |\omega| \leq \pi \\ 0 & O.W. \end{cases}$$

Using Hamming window with N= 7. Draw the frequency response. **(AZ)**

15) For the desired response

$$H_d(e^{j\omega}) = \begin{cases} e^{-j3\omega} & -\frac{\pi}{8} \leq \omega \leq \frac{\pi}{8} \\ 0 & \frac{\pi}{8} \leq |\omega| \leq \pi \end{cases}$$ **(AZ)**

Determine $H(e^{j\omega})$ for N= 7and design FIR low pass filter using Hanning window

16) Design a filter with

$$H_d(e^{j\omega}) = \begin{cases} e^{-j5\omega} & -\frac{\pi}{2} \leq \omega \leq \frac{\pi}{2} \\ 0 & \frac{\pi}{2} \leq |\omega| \leq \pi \end{cases}$$

Using Blackman window with N=11 **(AZ)**

UNIT IV- FINITE WORD LENGTH EFFECTS

PART – A

1. What do finite word length effects mean? (R)

The effects due to finite precision representation of numbers in a digital system are called finite word length effects.

2. List some of the finite word length effects in digital filters. (MAY 2007) (R)

1. Errors due to quantization of input data.
2. Errors due to quantization of filter co-efficient
3. Errors due to rounding the product in multiplications
4. Limit cycles due to product quantization and overflow in addition.

3. What are the different formats of fixed-point representation? (R)

a. Sign magnitude format
b. One's Complement format
c. Two's Complement format.

4. Explain the floating-point representation of binary number. (NOV 2011) (R)

The floating-point number will have a mantissa part. In a given word size the bits allotted for mantissa and exponent are fixed. The mantissa is used to represent a binary fraction number and the exponent is a positive or negative binary integer. The value of the exponent can be adjusted to move the position of binary point in mantissa. Hence this representation is called floating point.

5. What are the types of arithmetic used in digital computers? (R)

The floating point arithmetic and two's complement arithmetic are the two types of arithmetic employed in digital systems.

6. What are the two types of quantization employed in digital system? (R)

The two types of quantization in digital system are Truncation and Rounding.

7. What is truncation? (MAY 2012) (R)

The truncation is the process of reducing the size of binary number by discarding all bits less significant than the least significant bit that is retained. In truncation of a binary number of b bits all the less significant bits beyond bth bit are discarded.

8. What is rounding? (MAY 2012) (R)

Rounding is the process of reducing the size of a binary number to finite word sizes of b-bits such that, the rounded b-bit number is closest to the original unquantized number.

9. Explain the process of upward rounding? (R)

In upward rounding of a number of b-bits, first the number is truncated to b-bits by retaining the most significant b-bits. If the bit next to the least significant bit that is retained is zero, then zero is added to the least significant bit of the truncated

number. If the bit next to the least significant bit that is retained is one then one is added to the least significant bit of the truncated number.

10. What are the errors generated by A/D process? (R)

The A/D process generates two types of errors. They are quantization error and saturation error. The quantization error is due to representation of the sampled signal by a fixed number of digital levels. The saturation errors occur when the analog signal exceeds the dynamic range of A/D converter.

11. What is quantization step size? (R)

In digital systems, the numbers are represented in binary. With b-bit binary we can generate 2b different binary codes. Any range of analog value to be represented in binary should be divided into 2b levels with equal increment. The 2b levels are called quantization levels and the increment in each level is called quantization step size. If R is the range of analog signal then, Quantization step size, q = R/2b

12. Why errors are created in A/D process? (U)

In A/D process the analog signals are sampled and converted to binary. The sampled analog signal will have infinite precision. In binary representation of b bits. we have different values with finite precision. The binary values are called quantization levels. Hence the samples of analog are quantized in order to fit into any one of the quantized levels. This quantization process introduces errors in the signal.

13. What is steady state output noise power due to input quantization? (R)

The input signal to digital system can be considered as a sum of unquantized signal and error signal due to input quantization. The response of the system can be expressed as a summation of response due to unquantized input and error signal. The response of the system due to error signal is given by convolution of error signal and impulse response. The variance of response of the system for error signal is called state output noise power.

14. What is meant by coefficient inaccuracy? (R)

In digital computation the filter coefficients are represented in binary. With b-bit binary, we can generate only 2b different binary numbers and they are called quantization levels. Any filter coefficient has to be fitted into any one of the quantizat6ion levels. Hence the filter coefficients are quantized to represent in binary and the quantization introduces errors in filter coefficients. Therefore the coefficients cannot be accurately represented in a digital system and this problem is referred to as coefficient inaccuracy.

15. How the digital filter is affected by quantization of filter coefficients? (U)

The quantization of the filter coefficients will modify the value of poles & zeros and so the location of poles and zeros will be shifted from the desired location. This will create deviations in the frequency response of the system. Hence the resultant filter will have a frequency response different from that of the filter with unquantized coefficients.

16. How the sensitivity of frequency response to quantization of filter coefficients is minimized? (U)

The sensitivity of the filter frequency response to quantization of the filter coefficients is minimized by realizing the filter having a large number of poles and zeros as an interconnection of second order sections. Hence the filter can be realized in cascade or parallel form, in which the basic buildings blocks are first order and second order sections.

17. What is meant by product quantization error? (NOV 2010) (R)

In digital computations, the output of multipliers i.e., the product are quantized to finite word length in order to store them in registers and to be used in subsequent calculations. The error due to the quantization of the output of multiplier is referred to as product quantization error.

18. Why rounding is preferred for quantizing the product? (MAY 2012) (U)

In digital system rounding due to the following desirable characteristic of rounding performs the product quantization

1. The rounding error is independent of the type of arithmetic
2. The mean value of rounding error signal is zero.
3. The variance of the rounding error signal is least.

19. Define noise transfer function (NTF)? (R)

The Noise Transfer Function is defined as the transfer function from the noise source to the filter output. The NTF depends on the structure of the digital networks.

20. What are the assumptions made regarding the statistical independence of the various noise sources in the digital filter? (R)

The assumptions made regarding the statistical independence of the noise sources are,

1. Any two different samples from the same noise source are uncorrelated.
2. Any two different noise source, when considered, as random processes are uncorrelated.
3. Each noise source is uncorrelated with the input sequence.

21. What are limit cycles? (NOV 2012) (R)

In recursive systems when the input is zero or some nonzero constant value, the nonlinearities die to finite precision arithmetic operations may cause periodic oscillations in the output. These oscillations are called limit cycles.

22. What are the two types of limit cycles? (MAY 2010) (R)

The two types of limit cycles are zero input limit cycles and overflow limit cycles.

23. What is zero input limit cycle? (NOV 2009) (R)

In recursive system, the product quantization may create periodic oscillations in the output. These oscillations are called limit cycles. If the system output enters a limit cycles, it will continue to remain in limit cycles even when the input is made zero. Hence these limit cycles are also called zero input limit cycles.

24. What is dead band? (NOV 2012) (R)

In a limit cycle the amplitudes of the output are confined to a range of values, which is called dead band of the filter.

25. How the system output cam be brought out of limit cycles? (U)

The system output can be brought out of limit cycle by applying an input of large magnitude, which is sufficient to drive the system out of limit cycle.

26. What is saturation arithmetic? (R)

In saturation arithmetic when the result of an arithmetic operation exceeds the dynamic range of number system, then the result is set to maximum or minimum possible value. If the upper limit is exceeded then the result is set to maximum possible value. If the lower limit is exceeded then the r4esult is set to minimum possible value.

27. What is overflow limit cycle? (MAY 2012) (R)

In fixed point addition the overflow occurs when the sum exceeds the finite word length of the register used to store the sum. The overflow in addition may lead to oscillations in the output which is called overflow limit cycles.

28. How overflow limit cycles can be eliminated? (MAY 2012) (U)

The overflow limit cycles can be eliminated either by using saturation arithmetic or by scaling the input signal to the adder.

29. What is the drawback in saturation arithmetic? (R)

The saturation arithmetic introduces nonlinearity in the adder which creates signal distortion.

PART- B

1. Find the steady state variance of the noise in the output due to quantization of input for the first order filter y(n) = ay(n-1) + x(n) **(A)**

2. Study the limit cycle behavior of the following system and find the dead band of the filter. y(n)= 0.65 y(n-2) +0.52 y(n-1) +x(n) **(AZ)**

3. Derive the quantization Noise power from a digital system **(U)**

4. Find the effect of coefficient quantization on pole locations of the given second order IIR system, when it is realized in direct form I and in Cascade form. Assume a word length of 4 bits through truncation.

$$H(z) = \frac{1}{1-0.9z^{-1}+0.2z^{-2}}$$ **(AZ)**

5. Consider the transfer function H(Z) = $H_1(Z)$. $H_2(Z)$ Where

$$H_1(Z) = \frac{1}{1-a_1 z^{-1}} \qquad H_2(Z) = \frac{1}{1-a_2 z^{-1}}$$

Find the output round off noise power. Assume a_1 = 0.5 and a_2 = 0.6 **(AZ)**

6. Explain the characteristics of a limit cycle oscillation with respect to the system described by difference equation

y(n) =0.7y(n-1) +x(n) .

Determine the dead band of the above systems **(AZ)**

UNIT V- DSP APPLICATIONS
PART - A

1. What is multirate DSP? (NOV 2011) (R)

The processing of discrete time signals of different sampling rate in different parts of a system is called multirate DSP.

2. What is a multirate DSP system? (R)

The discrete time system that employs sampling rate conversion while processing the discrete time signal is called multirate DSP systems

3. What are the various basic methods of sampling rate conversion in digital domain? (R)

The basic methods of sampling rate conversion are decimation (or downsamp ling) and interpolation (or upsampling).

4. What is decimation? (NOV 2012) (R)

Decimation (or downsampling) is the process of reducing the sampling rate by an integer factor D.

5. What is interpolation? (NOV 2012) (R)

Interpolation (or ups amp ling) is the process of increasing the sampling rate by an integer factor L.

6. Given any two applications of multirate DSP system. (MAY 2012) (R)

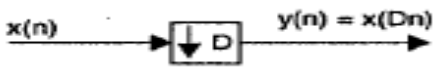
1. Sub-band coding of speech signals and image compression.
2. Oversampling AID and *Di* A converters for high quality digital audio systems and digital storage systems.

7. Write some advantages of multirate processing. (R)

1. The reduction in number of computations.
2. The reduction in memory requirement.
3. The reduction in finite word length effects.

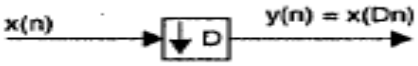
8. What is a decimator? Draw the symbolic representation of a decimator. (R)

The device which performs the process of decimation (or downsampling) is called decimator (or downs ampler) The symbolic representation of a decimator for decimation by an integer factor D is shown below



9. Show that the decimator is a time variant system. (U)

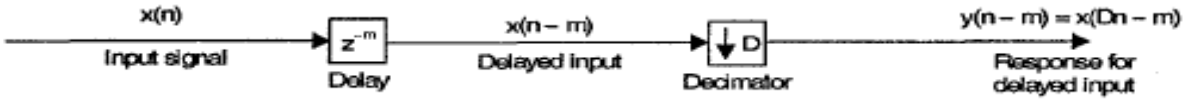
Consider the decimator



The input-output relation of a decimator is, y(n) =x(Dn)

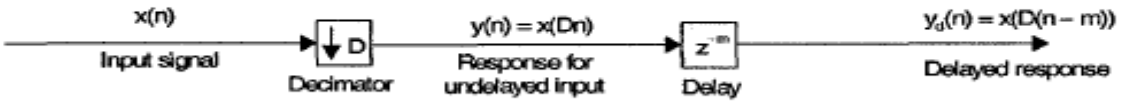
Test 1 : Response for delayed input

let, y(n – m) = Response for delayed input



Test 2 : Delayed response

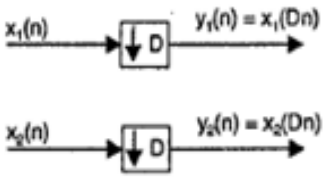
Let, $y_d(n)$ = Delayed response



Conclusion : Here, $y(n-m) \neq y_d(n)$, therefore the decimator is time variant system.

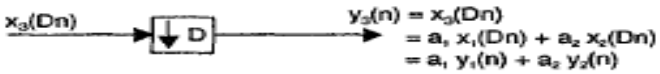
10. Show that the decimator is linear system. (U)

Let $x_1(n)$ and $x_2(n)$ be two different inputs to a decimator. Let $y_1(n)$ and $y_2(n)$ be the corresponding outputs.



Let, $x_3(n) = a_1 x_1(n) + a_2 x_2(n)$

Let, $y_3(n)$ be output of decimator for the input $x_3(n)$.



Since, $y_3(n) = a_1 y_1(n) + a_2 y_2(n)$, the decimator is linear system.

11. Write the expression for output spectrum, $y(e^{jw})$ of decimator in terms of input spectrum, $x(e^{jw})$. (R)

$$\text{Output spectrum, } Y(e^{j\omega}) = \frac{1}{D}\sum_{k=0}^{D-1} X\left(e^{j(\omega-2\pi k)/D}\right)$$

where, D = Integer sampling rate reduction factor of decimator.

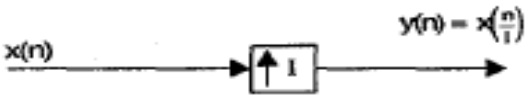
12. What is anti aliasing filter? (R)

The low pass filter used at the input of decimator is called anti-aliasing filter. It is used to limit the bandwidth of an input signal to π/D in order to prevent the aliasing of output spectrum of decimator for decimation by D

13. What is interpolator? Draw the symbolic representation of an interpolator. (R)

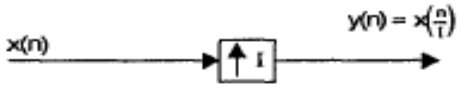
The device which performs the process of interpolation(or upsampling) is called an interpolator(or upsampler)

The symbolic representation of interpolator for interpolation by an interger factor 'I' is shown in fig.



14. Show that the interpolator is a time variant system (U)

Consider the interpolator



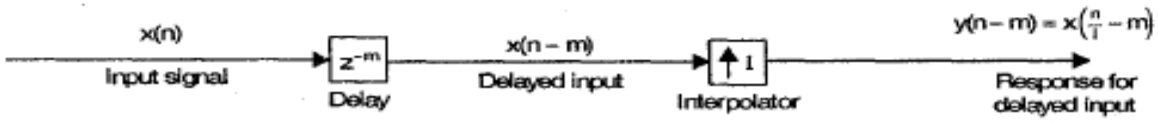
Interpolator.

The input-output relation of an interpolator is,

$$y(n) = x\left(\frac{n}{I}\right)$$

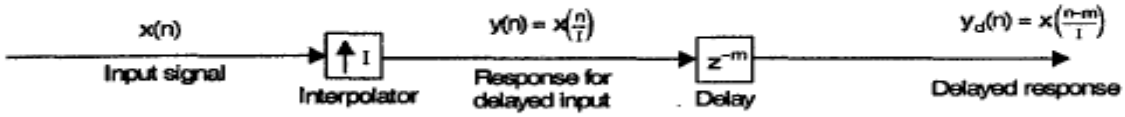
Test 1 : Response for delayed input

Let, y(n – m) = Response for delayed input



Test 2 : Delayed response

Let, $y_d(n)$ = Delayed response



Conclusion : Here, $y(n-m) \neq y_d(n)$, therefore the interpolator is a time variant system.

15. Write the expression for output spectrum, $Y(e^{j\omega})$ of an interpolator in terms of input spectrum $X(e^{j\omega})$ (R)

Output spectrum, $Y(e^{j\omega}) = X(e^{j\omega})$

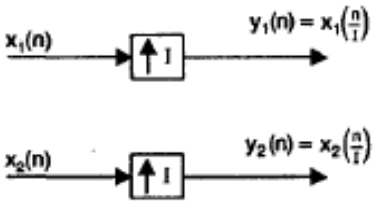
Where, I= integer sampling rate multiplication factor of interpolator

16. What is an anti-imaging filter? **(R)**

The low pass filter used at the output of an interpolator is called anti-imaging filter. It is used to eliminate the multiple images in the output spectrum of the interpolator

17. Show that the interpolator is a linear system. **(U)**

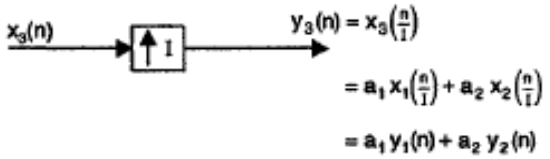
Let $x_1(n)$ and $x_2(n)$ be two different inputs to an interpolator. Let $y_1(n)$ and $y_2(n)$ be the corresponding outputs.



Let, $x_3(n) = a_1 x_1(n) + a_2 x_2(n)$

A linear combination of inputs $x_1(n)$ and $x_2(n)$.

Let, $y_3(n)$ be output of interpolator for the input $x_3(n)$.



Since, $y_3(n) = a_1 y_1(n) + a_2 y_2(n)$, the interpolator is linear system.

18. Write a short note on sampling rate conversion by a rational factor. **(R)**

The sampling rate conversion is required by a non-integer factor, and then sampling rate conversion is performed by the rational factor *I/D*. In this method, the signal is first interpolated by an integer factor *I*, then passed through a low pass filter with bandwidth minimum of (π/I, π/D), and finally decimated by an integer factor, *D*.

19. Write a short note on multistage implementation of sampling rate conversion. **(R)**

When the sampling rate conversion factor I or D is very large then the multistage sampling rate conversion will be computationally efficient realization.

In the multistage implementation, the interpolation by I is realized as cascade of interpolators with sampling rate multiplication factors I_1, I_2,... I_L, where $I = I_1 \times I_2 \times \ldots I_L$

In the multistage implementation, the decimation by D is realized as a cascade of decimators with sampling rate reduction factors D_1, D_2,... D_L, where $D = D_1 \times D_2 \times \ldots D_L$

20. What is Polyphase decomposition (OR) Polyphase filter?(MAY 2012) (R)

The process of dividing a filter into a number of sub-filters which differ only in phase characteristics is called polyphase decomposition.

PART - B

1. Explain sampling rate conversion by a rational factor and derive input and output relation in both time and frequency domain. **(NOV '12)** **(AZ)**
2. Explain the multistage implementation of sampling rate conversion. **(NOV '12)** **(A)**
3. Explain the narrow band filter design using sampling rate conversion. **(NOV'12)** **(A)**
4. Explain the application of sampling rate conversion in subband coding. **(NOV'12)** **(A)**
5. Explain the concept of decimation and interpolation of discrete time signal**.** **(MAY 2012)** **(U)**
6. State the application of multirate signal processing. **(MAY 2011)** **(U)**
7. Explain how the various sound effects can be generated with help of DSP. **(MAY 2011)** **(AZ)**
8. Explain how DSP can be used for speech processing. **(MAY 2011)** **(AZ)**
9. Explain the effect of tranversal structure for decimator and interpolator **(MAY 2011)** **(AZ)**
10. Explain the polyphase structure of decimator and interpolator **(NOV 2010)** **(AZ)**
11. Discuss the procedure to implement digital filter bank using multirate signal processing. **(NOV 2010)** **(AZ)**

ASSIGNMENT QUESTIONS
UNIT I

1. Check for following systems are linear, causal, time in variant, static.
   (i) y(n) = x(1/2n) (ii) y(n) = sin (x(n)) (iii) y(n) = x(n) cos(x(n)) (iv) y(n) =x(-n+5)
   (v) y (n) = x(n) + n x (n+2). **(A)**

2. Discuss whether the following are energy or power signals (i) x(n) = (3/2)n u(n)
   (ii) x (n) = Ae^{jwn} **(A)**

3. Check whether the following are periodic. (i) x (n) = cos (3πn) (ii) x(n) = sin(3n) **(A)**

4. Determine the N – point DFT of the following sequences
   (a) x(n) = δ(n) (b) x(n) = δ(n-1) **(AZ)**

5. Compute linear and circular convolution of the two sequence $x_1(n)$ = {1, 2, 2, 2} and
   x_2 (n) = {1, 2, 3, 4}. **(A)**

6. Compute 8 point circular convolution i) x(n)= {1,1,1,1,0,0,0,0}
   ii) x(n)= sin ((3πn)/8), 0≤n≤7 **(A)**

7. Perform the linear convolution of the sequence x(n) = {1, -1, 1, -1} and
   h(n) ={1,2,3,4} using DFT method **(AZ)**

8. Compute the linear convolution of finite duration sequences h(n) = {1,2} and
   x(n) = {1,2, -1, 2, 3, -2, -3, -1, 1, 1, 2, -1} by Overlap add method **(AZ)**

9. Compute a 8 point DFT of the sequence using DIT – FFT algorithm
   x(n)= {1,2,3,2,1,0} **(AZ)**

10. Compute the eight point DFT of the sequence x(n)= {1,2,3,4,4,3,2,1} using Radix-2
    DIT algorithm. **(AZ)**

11. Compute an 8 point DFT of the sequence x(n)= {1,0,1,-1,1,1,0,1} **(AZ)**

12. Compute the 8 point DFT for the following sequences using DIT – FFT algorithm
    x(n)= { 1, for -3≤n≤3
    0, otherwise **(AZ)**

13. Compute the DFT of the sequence whose values for one period is given by x(n) = {1,1,-2,-2} **(AZ)**

14. Find the IDFT of the sequence X(K)= {6, -2+2j, -2, -2-2j} using Radix 2 DIF algorithm. **(AZ)**

UNIT II

1. Obtain the cascade form realization of the digital system y(n)=3/4 y(n-1)- (1/8)y(n-2) +1/3x(n-1)+x(n) **(A)**

2. Obtain the direct form I, direct form II and cascade form realization of the following system functions y(n)=0.1y(n-1)+0.2y(n-2)+3x(n)+3.6x(n-1)+0.6x(n-2) **(A)**

3. Convert the following analog transfer function in to digital using impulse invariant mapping with T=1sec, $H(s) = \frac{3}{(S+3)(S+5)}$ **(A)**

4. Design a digital second order low pass Butterworth filter with cut off frequency 2200 Hz using bilinear transformation. Sampling rate is 8000 Hz. **(AZ)**

5. Design a digital Butterworth filter using impulse invariance method satisfying the constraints

$0.8 \le |H(e^{jw})| \le 1, \quad 0 \le w \le 0.2\pi$

$|H(e^{jw})| \le 0.2, \quad 0.6\pi \le w \le \pi$ Assume T=1sec **(AZ)**

6. Apply Bilinear Transformation and Impulse invariant to $H(s) = \frac{2}{(S+2)(S+3)}$ with T=0.1sec. **(A)**

7. Design a analog Butterworth filter that has a 2db pass band attenuation at a frequency of 20 r/sec & at least 10db stop band attenuation at 30 r/sec **(AZ)**

8. Design a low pass Butterworth digital filter with the following specification : Ws= 4000, Wp= 3000, Ap= 3 d B, As= 20 d B, T= 0.0001 sec. **(AZ)**

9. Design a HPF with passband cut off frequency of 1000Hz and down 10dB at 350 Hz the sampling frequency of 5000 Hz. **(AZ)**

10. Determine the system function H(z) of the chebyshev low pass digital filter with the specifications

i) α_p = 1 db ripple in the pass band $0 \leq \omega \leq 0.2\pi$

ii) α_s = 15 db ripple in the stop band $0.3\pi \leq \omega \leq \pi$

Using bilinear transformation (assume T=1sec) **(AZ)**

UNIT III

1. Design a high pass filter with a frequency response

$$H_d(e^{j\omega}) = 1 \ , -\pi/2 \leq |\omega| \leq \pi$$

$$0 \ , \ |\omega| \leq \pi/4 .$$ **(AZ)**

Find the values of *h(n)* for N = 11 using hamming window. Find *H(z)* and determine the magnitude response.

2. Design a FIR low pass filter having the following specifications using Hanning window

$$H_d(e^{j\omega}) = 1 \ , -\pi/6 \leq |\omega| \leq \pi/6$$

0 , otherwise . Assume N = 7 **(AZ)**

3. Design an FIR filter using hanning window with the following specification

$$H_d(e^{j\omega}) = 1 \quad , \pi/4 \leq \omega \leq \pi/4$$

$e^{-j2\omega}$, $, \pi/4 \leq |\omega| \leq \pi$. Assume N = 5 **(AZ)**

4. Design an FIR low pass digital filter using the frequency sampling method for the following specifications

Cut off frequency = 1500Hz, Sampling frequency = 15000Hz

Order of the filter N = 10, Filter Length required L = N+1 = 11 **(AZ)**

5. Design a digital FIR band pass filter with lower cut off frequency 2000Hz and upper cut off frequency 3200 Hz using Hamming window of length N = 7. Sampling rate is 10000Hz. **(AZ)**

6. Determine the frequency response of FIR filter defined by

y(n) = 0.25x(n) + x(n – 1) + 0.25x(n – 2) **(A)**

7. Using a rectangular window technique, design a low pass filter with pass band gain of unity cut off frequency of 1000Hz and working at a sampling frequency of 5 kHz. The length of the impulse response should be 7. **(AZ)**

8. Consider an FIR lattice filter with coefficients $k_1 = \frac{1}{2}$; $k_2 = \frac{1}{3}$; $k_3 = \frac{1}{4}$. Determine the FIR filter coefficients for the direct form structure **(A)**

9. Obtain the linear phase realization of the system function

$H(z) = \frac{1}{2} + \frac{1}{3} z^{-1} + z^{-2} + \frac{1}{4} z^{-3} + z^{-4} + \frac{1}{3} z^{-5} + \frac{1}{2} z^{-6}$ **(A)**

10. Realize the system function by linear phase FIR structure $H(z) = \frac{2}{3} z + 1 + \frac{2}{3} z^{-1}$ **(A)**

UNIT IV

1. Explain the characteristics of a limit cycle oscillation with respect to the system described by difference equation

   y(n) =0.95y(n-1) +x(n) ; x(n)=0, y(n-1)=13

   Determine the dead band of the above systems **(AZ)**

2. Consider a second order IIR filter with

   H(Z)= $\frac{1.0}{(1-0.5z^{-1})(1-.45z^{-1})}$. Find the effect on quantization on pole location of a given system function in direct and cascade form. Assume b=3 bits **(AZ)**

3. Determine the dead band of a system y(n)= 0.2y(n-1)+0.5 y(n-2)+x(n). Assume 8 bits are used for system representation. **(AZ)**

UNIT V

1. A signal x(n) is given as x(n)={0,1,2,3,4,5,6,0,1,2,3…}
   i) Obtain the decimated signal with a factor of 2
   ii) Obtain the interpolated signal with a factor of 2 **(A)**

2. Implement a two stage decimator for a following specification
   Sampling rate of input signal=20,000Hz, M=100, Pass band=0 - 40Hz,
   Transition band=40 - 50Hz, Pass band ripple= 0.01, Transition band ripple=0.002.
   (AZ)

PANIMALAR ENGINEERING COLLEGE

DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

EC6503 TRANSMISSION LINES AND WAVEGUIDES

UNIT I TRANSMISSION LINE THEORY

PART-A

1. Define Transmission line. (R)

Transmission line is a conductive method of guiding electrical energy from a source component to a load component. A transmission line is also known as feeder. (Or)

A transmission line is a conducting line designed to guide electrical energy from one point to another point.

2. State the various types of transmission lines used in practice. (R)

The various types of transmission lines used are,

1. Parallel line
2. Twisted Pair line
3. Shielded Pair
4. Coaxial cable
5. Optical fiber cable
6. Waveguide
7. Strip Line

3. What are the primary constants of transmission line? (R)

The primary constants of a transmission line are:

1. Resistance (R)
2. Inductance (L)
3. Capacitance (C)
4. Conductance (G)

4. Define the line parameters or primary constants of transmission line. (R)

The line parameters of transmission line are, R, L, C, G

Resistance (R) is defined as the loop resistance per unit length of the wire. Its unit is ohm/Km.

Inductance (L) is defined as the loop Inductance per unit length of the wire. Its unit is Henry/Km

Capacitance (C) is defined as the loop capacitance per unit length of the wire. Its unit is Farad/Km

Conductance (G) is defined as the loop conductance per unit length of the wire. Its unit is mho/Km

5. What is the difference between lumped parameters and distributed parameters? (U)

The parameters like Resistance, Inductance, capacitance which is physically separable are called as lumped parameters.

In transmission lines, the parameters like Resistance, Inductance, and capacitance are distributed along the length of the line. They are not physically separable.

6. What are the secondary constants of a line? (R)

The secondary constants of a line are,

1. Characteristic Impedance
2. Propagation Constant

7. Define characteristic impedance (Or)

What is characteristic impedance? [AU:May'15][AU:DEC'06] (Or) (R)

Define characteristic impedance of a transmission line. (2) **[AU-NOV2006]**

In a uniform transmission line, it is the ratio of the voltage amplitude to the current amplitude of a single wave traveling down it. This is also called as "Surge impedance". (Or)

The impedance measured at any point in a transmission line is called as characteristic impedance. It is denoted as Z_o.

It is given by, $Z_o = \sqrt{\frac{Z}{Y}} = \sqrt{\frac{R + j\omega L}{G + j\omega C}}$ ohms/Km.

8. Define propagation constant of a transmission line. (2) [AU-NOV2007] [AU:NOV2012] (Or) (R)

What is propagation constant? What are its 2 components? [AU:MAY'09][AU:DEC'07][AU:MAY'13] (R)

Propagation constant is defined as the natural logarithm of the ratio of the sending end current or voltage to the receiving end current or voltage of the line.

Propagation constant is a complex quantity and is expressed as

$\gamma = P = \alpha + j\beta$ Where, The real part is called the attenuation constant and the imaginary part is called as the phase constant.

$$\gamma = P = \sqrt{ZY} = \sqrt{(R + j\omega L)(G + j\omega C)}$$

9. State the important properties of infinite line. [AU:MAY'04, DEC'11] (U)

An infinite line is a line in which the length of the transmission line is infinite.

A finite line, which is terminated in its characteristic impedance, is termed as infinite line. So for an infinite line, the input impedance is equivalent to the characteristic impedance.

No waves will ever reach receiving end hence there is no reflection.

10. What is an infinite line? (R)

An infinite line is a line in which the length of the transmission line is infinite.

A finite line, which is terminated in its characteristic impedance, is termed as infinite line. So, for an infinite line, the input impedance is equivalent to the characteristic impedance.

11. Write the expression of characteristic impedance (Z_o) for symmetrical T-network. (R)

$$Zo = \sqrt{\frac{Z_1^2}{4} + Z_1 Z_2}$$

12. What is the relationship between Z_o and Z_{oc}, Z_{sc}? (U)

$$Zo = \sqrt{Z_{OC} \times Z_{SC}}$$

13. What is the relationship between characteristic impedance and propagation constant? [AU:JUN'09][AU:May'10] (U)

$$P.Zo = R + j\omega L$$

$$\frac{P}{Z_O} = G + j\omega C$$

14. How will you find out the propagation constant if the values of open and short circuited impedances are given? (U)

Propagation constant can be determined by

$$\tanh \gamma l = \sqrt{\frac{Z_{SC}}{Z_{OC}}}$$

15. Give the input impedance of Short circuited and open circuited line. (R)

For Short circuited line, $\mathbf{Z_{SC} = Z_O \tanh \gamma l}$ and

For Open circuited line, $\mathbf{Z_{OC} = Z_O \coth \gamma l}$

16. What is a short line? (R)

The short line means a practical line of "Finite Length". A finite line which is terminated in its characteristics impedance behaves as an infinite

line. This means that its input impedance will be Z_o and there will be no reflection.

17. Define attenuation constant. (R)

The term **attenuation constant** is the attenuation of an electromagnetic wave propagating through a medium per unit distance from the source. It is the real part of the propagation constant and is measured in nepers per metre. A neper is approximately **8.686 dB**. Attenuation constant can be defined by the amplitude ratio.

18. Define phase constant. (R)

The **phase constant** is the imaginary component of the propagation constant for a plane wave. It represents the change in phase per metre along the path travelled by the wave at any instant and is equal to the angular wavenumber of the wave.

It is represented by the symbol β and is measured in units of radians per metre.

19. What is the significance of Reflection coefficient? [AU:Jan'16] [AU:NOV'14] (U)

It is a measure of the mismatch between the load impedance Z_R and the characteristic impedance Z_o of the line.

when $Z_R=Z_O$; K=0 ;No reflection

$Z_R=0$; $K=1\angle 180°$;Reflection is maximum

$Z_R=\infty$; $K=1\angle 0°$; Reflection is maximum

20. Define wavelength of the line. (2) **[AU:Jan'16] [AU:DEC'04] [AU-NOV2014] (R)**

The distance the wave travels along the line while the phase angle is changing through 2π radians is called a wavelength.

$$\lambda = \frac{2\pi}{\beta}$$

21. Give the formula for velocity of propagation. (R)

$$\vartheta_p = \frac{\omega}{\beta}$$

22. State the equation of transmission line. (R)

The equation for voltage and current at any point in a transmission line is

$$E = \frac{E_R}{2}\left(1+\frac{Z_O}{Z_R}\right)\left[e^{\sqrt{ZYS}} + \left(\frac{Z_R - Z_O}{Z_R + Z_O}\right)e^{-\sqrt{ZYS}}\right]$$

$$I = \frac{I_R}{2}\left(1+\frac{Z_R}{Z_O}\right)\left[e^{\sqrt{ZYS}} - \left(\frac{Z_R - Z_O}{Z_R + Z_O}\right)e^{-\sqrt{ZYS}}\right] \textbf{ (OR)}$$

$$E = E_R.\text{Cosh}\sqrt{ZY}\ s + I_R.Z_O.\text{Sinh}\sqrt{ZY}\ .s$$

$$I = I_R.\text{Cosh}\sqrt{ZY}\ s + \frac{E_R}{Z_O}\text{Sinh}\sqrt{ZY}\ .s$$

23. Write the condition for a distortionless line.[AU:MAY'09] (R)

The condition for a distortionless line is, $\frac{R}{L} = \frac{G}{C}$

24. Write the expression for input impedance and transfer impedance in terms of Z_O, Z_R and P. (R)

$$Z_S = Z_{in} = Z_O\left(\frac{Z_R Cosh\gamma l + Z_O \sinh\gamma l}{Z_O Cosh\gamma l + Z_R \sinh\gamma l}\right)$$

$$Z_T = Z_R\ \text{Cosh}\,\gamma 1 + Z_O\ \text{Sinh}\,\gamma 1$$

25. What are the various types of distortion in a line? (Or)

What are the types of line distortions? (R)

The distortions occurring in the transmission line is called as waveform distortion or line distortion. Waveform distortion is of two types:

a) Frequency distortion

b) Phase or Delay Distortion.

26. How frequency distortion occurs in a line? (U) (Or)

What is frequency distortion? (R)[AU:MAY'07][AU:DEC'08] (R)

When a signal having many frequency components are transmitted along the line, all the frequencies will not have equal attenuation and hence the received end waveform will not be identical with the input waveform at the sending end because each frequency is having different attenuation. This type of distortion is called frequency distortion.

27. How to avoid the frequency distortion that occurs in the line? (U)

In order to reduce frequency distortion occurring in the line,

a) The attenuation constant should be made independent of frequency.

b) By using equalizers at the line terminals which minimize the frequency distortion.

28. What is delay distortion?(Or) What is phase distortion? [AU:MAY'06][AU:DEC'08][AU:DEC'09][AU:DEC'10] (R)

When a signal having many frequency components are transmitted along the line, all the frequencies will not have same time of transmission, some frequencies being delayed more than others. So the received end waveform will not be identical with the input waveform at the sending end because some frequency components will be delayed more than those of other frequencies. This type of distortion is called phase or delay distortion.

29. How to avoid the delay distortion that occurs in the line? (U)

In order to reduce frequency distortion occurring in the line,

a) The phase constant β should be made dependent of frequency.

b) The velocity of propagation is independent of frequency.

c) By using equalizers at the line terminals which minimize the frequency distortion.

30. What is a distortion less line? What is the condition for a distortion less line? [AU:MAY'09][AU:MAY'10] (R) (Or)

What is meant by distortionless line? (R) (2) [AU-NOV2015] (Or) (Or)

How distortion can be reduced in a transmission line?[AU:MAY'11] (U) (Or) If a line is to have neither frequency nor delay distortion, how do you relate attenuation constant and velocity of propagation to frequency? [AU:DEC'11] (U)

A line, which has neither frequency distortion nor phase distortion is called a distortion less line.

The condition for a distortion less line is RC=LG. Also,

a) The attenuation constant should be made independent of frequency.

b) The phase constant β should be a product of 'ω' with some constant (made dependent of frequency).

c) The velocity of propagation is independent of frequency.

31. When reflection occurs in a line? (U)

When the load impedance (Z_R) is not equal to the characteristic impedance (Z_o) of transmission line (i.e., $Z_R \neq Z_o$), reflection takes place.

Reflection occurs because of the following cases:

1) when the load end is open circuited

2) when the load end is short-circuited

3) when the line is not terminated in its characteristic impedance

32. What are the conditions for a perfect line? What is a smooth line? (R)

For a perfect line, the resistance and the leakage conductance value were neglected. The conditions for a perfect line are **R=G=0**.

A smooth line is one in which the load is terminated by its characteristic impedance and no reflections occur in such a line. It is also called as **flat line.**

33. What is impedance mismatch condition or impedance mismatching? (R)

If the load impedance is not equal to the source impedance ($Z_R \neq Z_O$), then all the power that is transmitted from the source will not reach the load end and hence some power is wasted. This is called impedance mismatch condition.

34. What is reflection co-efficient? (Or) Define reflection coefficient (R)

Reflection Coefficient can be defined as the ratio of the reflected voltage or current to the incident voltage or current at the receiving end of the line.

It is denoted by 'k' or 'r' or 'ρ'

$$\text{Reflection Coefficient, } k = \frac{\text{Reflected Voltage or current at load}}{\text{Incident voltage or current at the load}}$$

$$k = Vr/Vi$$

$$k = \frac{Z_R - Z_O}{Z_R + Z_O}$$

35. Define reflection loss.[AU:May'15] [AU:May'08] (R)

If the load impedance is not equal to the Characteristics impedance ($Z_R \neq Z_O$), then the energy delivered to the load under mismatch condition is always less than the energy which would be delivered to the load under matched condition. This is called as reflection loss. (Or)

Reflection loss is defined as the number of nepers or decibels by which the current in the load under image matched conditions would exceed the current actually flowing in the load.

36. Define reflection factor. (R)

The ratio which indicates the change in current in the load due to reflection at the mismatched function is called as reflection factor.

Reflection loss is inversely proportional to the reflection factor.

$$\text{Reflection Factor} = \left[\frac{2\sqrt{Z_R Z_O}}{Z_R + Z_O}\right]$$

37. Define insertion loss.(2) [AU-MAY2015] (R)

The insertion loss of a line or network is defined as the number of nepers or decibels by which the current in the load is changed by the insertion.

Insertion loss = Current flowing in the load without insertion of the network to Current flowing in the load with insertion of the network

38. What is return loss? (R)

Return loss is defined as the ratio of the power at the receiving end due to incident wave to the power reflected by the load. Return loss is inversely proportional to reflection-coefficient.

$$\text{Return Loss} = 20 \log \left[\left| \frac{Z_R + Z_O}{Z_R - Z_O} \right| \right] \text{dB.}$$

40. Define group velocity. (R)

The velocity which is produced by a group of frequency traveling along the system is called group velocity. It is defined as,

$V_g = d\omega / d\beta$

41. What is phase velocity and group velocity?[AU:DEC'05] (R)

The velocity of the wave along the line decided by ω and phase constant β is called as phase velocity.

$$v_p = \frac{\omega}{\beta}$$

The velocity which is produced by a group of frequency traveling along the system is called group velocity. It is defined as,

$$v_p = \frac{d\omega}{d\beta}$$

42. Write the expressions for the phase constant and velocity of propagation for telephone cable.[AU:DEC'10] (R)

The phase constant of a telephone cable is given by,

$$\beta = \sqrt{\frac{\omega RC}{2}} \; rad / km$$

the velocity of propagation is given by,

$$v_p = \frac{\omega}{\beta} = \frac{\omega}{\sqrt{\frac{\omega RC}{2}}} = \sqrt{\frac{2\omega}{RC}} m / \sec$$

43. What is meant by loading? [AU:DEC'03] (R)

The process of achieving condition of distortionless line artificially by increasing L or decreasing C is called as loading of a line.

44. What is the need for inductance loading of telephone cables? [AU-NOV2013]. (U)

To reduce distortions (Frequency and Phase) at high frequencies, the telephone cables are loaded.

45. What is the drawback of using ordinary telephone cables? (2) [AU-MAY2015]. (U)

In ordinary telephone cables, at high frequencies, both phase and frequency distortions occur. Also attenuation increases as frequency increases.

46. State the disadvantages of reflection? (U)

- Reflected wave appears as echo at the sending end
- Efficiency is reduced
- The output reduces as load rejects part of the energy

PART-B

1. Obtain the general solution of transmission line. (10) **[AU-NOV2006] [AU-MAY2015] (Or) (AZ)**

   Derive the general transmission line equations for voltage and current at any point on a line. **[AU-NOV2008] (Or) (AZ)**

   Derive the expression for voltage and current at any point on a transmission line in terms of receiving end voltage and current. (10) **[AU-MAY2009] (AZ) (Or)**

   Derive the transmission line equations and hence obtain expressions for the voltage and current on a transmission line. (10) **(AZ) [AU-NOV2013] (AZ)**
2. Obtain the expression for current and voltage at any point along a line which is terminated in Z_o. **[AU-NOV2014] (AZ)**
3. Derive the expressions for the input impedance of a transmission line. (10) **[AU-NOV2007] (Or) (AZ)**

   Derive the expressions for input impedance of open and short circuited lines (6) **[AU-NOV2015] (AZ)**
4. Explain in detail about the reflection on a line not terminated in its characteristic impedance (Zo). (6) **[AU-MAY2007] (U)**

5. Explain in detail about the waveform distortion and also derive the condition for distortion less line. (10) **[AU-MAY2008] (Or) (AZ)**

   Discuss the two types of waveform distortion on a transmission line and obtain the condition for distortion less line. (10) (AZ) **[AU-NOV2006] (Or)** Discuss in detail about the waveform distortion and also derive the condition for distortionless line (10) **[AU-NOV2015] (AZ)**
6. Write a brief note on frequency and phase distortions. (4) **[AU-NOV2008] (R)**
7. Discuss in detail about inductance loading of telephone cables and derive the attenuation constant (α), Phase constant (β) and velocity of signal transmission (v) for the uniformly loaded cable. (10) **[AU-MAY2007] (AZ)**
8. A cable has been uniformly loaded by an inductance such that ωL >> R . Assuming leakage conductance to be nil, deduce an expression for attenuation and phase constant without neglecting R. (8) **[AU-NOV2007] (AZ)**
9. Derive Campbell's Equation. (8) **[AU-MAY2009] (AZ)**
10. Derive the expression for transfer impedance of a Transmission line. (6) **[AU-MAY2008] (AZ)**
11. Discuss the following: i) Reflection on a line not terminated in Z_o. ii) Open and short circuited lines. (8 + 8) **[AU-MAY2012] (U)**
12. Discuss the types of waveform distortion introduced by a transmission line. Derive the conditions for the distortionless operation of a transmission line. (10) **[AU-NOV2013] (AZ)**
13. For a transmission line terminated in Z_o, Prove $Z_o = \sqrt{Z_{SC} Z_{OC}}$ that. The following measurement are made on a 25km line at a frequency of 796 Hz. Z_{SC} = 3220∠-79.29° Ω, Z_{OC} = 1301∠76.67° Ω. Determine the primary constants of the line. **[AU-NOV2014] (A)**
14. Explain about different type of transmission line. (8) **[AU-MAY2015] (U)**
15. Discuss the following: reflection loss and return loss. (8) **[AU-MAY2015] (U)**

PROBLEMS

1. A line has the following primary constants R = 100 Ω/Km, L = 0.001 H/Km, G = 1.5 μmho/ Km, C = 0.062 μF/Km. Find the characteristics impedance and the propagation constant. (6) **[AU-MAY2009] (A)**
2. Find the attenuation and phase shift constant of a wave propagating along the line whose propagation constant is 1.048×10^{-4} ∠88.8°. (2) **[AU-NOV2008] (A)**

   $\gamma = \alpha + j\beta = 1.048 \times 10^{-4} \angle 88.8°$

   $= 2.1947 \times 10^{-6} + j1.04777 \times 10^{-4}$

$\alpha = 2.1947 \times 10^{-6}$ Np/m

$\beta = 1.04777 \times 10^{-4}$ rad/m

3. Find the reflection coefficient of a 50 ohm line when it is terminated by a load impedance of 60+j 40 ohm. (2) **[AU-NOV2015][AU:MAY'08] (A)**

$Z_R = (60+j40)\Omega$

$Z_O = 50\Omega$

The reflection coefficient is given by,

$$K = \frac{Z_R - Z_O}{Z_R + Z_O} = \frac{(60 + j\,40) - 50}{(60 + j\,40) + 50} = \frac{10 + j40}{110 + j40} = \frac{41.231\angle 75.96°}{117.0469\angle 19.98°} = 0.3522\angle 55.98°$$

$K = 0.3522\angle 55.98°$

4. Calculate the load reflection coefficient of an open and short circuited line. (2) **[AU-MAY2007] (A)**
5. A transmission line has the following constants R = 10.4 Ω/km, L = 3.666 mH/km, G = 0.8 x 10^{-6} mho/km and C = 0.00835 μf/km. Calculate its characteristic impedance, attenuation, phase constant and phase velocity. (8) **[AU-MAY 2012]. (A)**
6. A telephone cable 64 km long has a resistance of 13 Ω/km and a capacitance of 0.008 μf /km. Calculate the attenuation constant, velocity and wavelength of the line at 1000 Hz. (6) **[AU-NOV2006] [AU-MAY2015]. (A)**
7. A line has R = 10.4 Ω/km, L = 3.67 mH/km, G = 0.8 x 10^{-6} mho/km and C = 0.00835 μf/km. Determine the characteristic impedance, propagation constant and sending end current for f = 1000 Hz, E_s = 1.0 volts and length = 100 km. (6) **(A)** **[AU-NOV2006]**
8. How much inductive loading is required to make a 16 gauge cable distortionless? The line parameters are R=42.1Ω /km, G=1.5 mho/km, C=0.062 μf/km and L=1mH/km. (2) **(AZ)** **[AU-NOV2006]**
9. A transmission line operating at 500 MHz has Zo = 80 Ω, α = 0.04 Np/m, β = 1.5 rad/m. Find the line parameters series resistance (R Ω/m), series inductance (L H/m), shunt conductance (G mho/m) and capacitance between conductors (C F/m). (10) **(A)** **[AU-MAY2007]**
10. A transmission line has the following parameters per km R = 15 ohm, C = 15 μf, L = 1 mH and G = 1 micro mho. Evaluate the additional inductance to give distortion-less transmission. Calculate attenuation and phase constant for the loaded line. (8) **(E)** **[AU-NOV2007]**
11. Calculate the characteristic impedance of a transmission line if the following measurements have been made on the line Z_{OC} = 550∠-60 degree ohm and Z_{SC} = 500∠30 degree. **(A)** **[AU-NOV2007]**

12. A transmission line has L = 10 mH/m, C = 10^{-7} F/m, R = 20 Ω/m and G = 10^{-5} mhos/m. Find the input impedance at a frequency of $\left(\frac{5000}{2\pi}\right)$ Hz, if the line is very long. (6) **[AU – NOV 2013]. (A)**

13. A transmission line has $Z_o = 745\angle 12°$ Ω and is terminated in Z_R=100Ω. Calculate reflection loss in dB. [AU:MAY'11]. **(A)**

$$\text{ReflectionFactor} = k = \frac{2\sqrt{Z_R Z_O}}{|Z_R + Z_O|}$$

$$= \frac{2\sqrt{(100)(745)}}{|100 + j0 + 728.72 - j154.894|} = \frac{545.8937}{843.0711} = 0.6475$$

$$\text{Reflection loss} = 20\log\frac{1}{|k|} = 20\log\frac{1}{0.6475} = 3.7751\,dB$$

ASSIGNMENT PROBLEMS

1. A transmission line has a characteristic impedance of 400 Ω and is terminated by a load impedance of (650-j475) Ω. Determine the reflection coefficient**. [AU-NOV2013]. (A)**
2. A 50 ohm line is terminated in load Z_R = 90+j60 ohm. Determine the reflection coefficient. (2) **[AU-NOV2007]. (A)**
3. A line having characteristic impedance of 50 Ω is terminated in load impedance (75 + j75) Ω. Determine the reflection coefficient. (2) **[AU-NOV2014]. (A)**
4. A 2 meter long transmission line with characteristics impedance of 60+j 40 ohm is operating at ω = 10^6 rad / sec has attenuation constant of 0 rad /m. If the line is terminated by a load of 20+j50 ohm, determine the input impedance of this line. (6) **[AU-NOV2015]. (A)**
5. A Distortion less transmission line has attenuation constant (α) 1.15x10^{-3} Np/m and capacitance of 0.1nF/m. The characteristic resistance $\sqrt{L/C}$ = 50 Ω. Find the resistance, inductance and conductance per meter of the line. (6) **[AU-MAY2007]. (A)**
6. A cable has the following parameters, R = 48.75 ohm/km, L = 1.09 mH/km, G = 38.75 μ mho/km and C = 0.059 μF/km. Determine the characteristic impedance, propagation constant and wavelength for a source of f = 1600 Hz and Es = 1.0 volts. (6) **[AU-NOV2007]. (A)**
7. A Parallel wire transmission line is having the following line parameters at 5 KHz. Series resistance (R = 2.59x10^{-3} Ω /m), Series inductance (L = 2μH/m), shunt conductance (G = 0 Ω /m) and capacitance between conductors (C = 5.56 pF/m). Find the characteristic impedance, attenuation

constant (α Np/m), Phase shift constant (β rad/m), velocity of propagation and wavelength. (10) **[AU-MAY2008] [AU-NOV2015]. (A)**

8. The characteristic impedance of a 805m-long transmission line is 94∠-23.2° ohm, the attenuation constant is 74.5×10^{-6} Np/m and the phase shift constant is 174×10^{-6} rad/m at 5KHz. Calculate the line parameters R, L, G and C per meter and the phase velocity on the line. (12). **(A) [AU-NOV2008]**
9. A low loss transmission line of 100 ohms characteristic impedance is connected to a load of 200 ohms. Calculate the voltage reflection co-efficient and the standing wave ratio. (6) **[AU-MAY 2012]. (A)**
10. A transmission line has the following per unit length parameters: L=0.1µ H, R=5Ω, C=300pF and G= 0.01mhos. Calculate the propagation constant and characteristic impedance at 500 MHz. (8) **(A) [AU-NOV 2010]**
11. The characteristic impedance of a uniform transmission line is 2309.6 ohms at a frequency of 800 Hz. At this frequency, the propagation constant is 0.054(0.0366+j0.99). Determine R and L, (6) **[AU-NOV 2010][AU-NOV 2013]. (A)**
12. Characteristic impedance of a transmission line at 8 MHz is (40-2j) ohm and the propagation constant is (0.01+j0.18) per meter. Find the primary constants. (16) **[AU-NOV 2012]. (A)**
13. Evaluate how an infinite line equal to finite line terminated in its characteristic impedance.(8) **(E)**

UNIT II HIGH FREQUENCY TRANSMISSION LINES

PART - A

1. State the standard assumptions made for radio frequency line.

(Or) What are the assumptions to simplify the analysis of line performance at high frequencies?[AU:May'15] (R)

The standard assumptions made for radio frequency line are,

1. Due to the skin effect, the currents are assumed to flow on the surface of the conductor and the internal inductance is zero.
2. Due to skin effect, the resistance R increases with $\sqrt{f}$ while the line reactance ωL increases directly with frequency f.
   Hence the second assumption is ωL>>R.
3. The third assumption is that the line at RF is constructed such that the leakage conductance G is zero.

2. Define skin effect. (R)

At very high frequency, skin effect is considerable. Skin effect is defined as the effect in which the current may flow on the surface of conductor. Now the internal inductance of conductor becomes zero.

3. Define the term SWR. (Or)What is Standing Wave Ratio? [AU:MAY'06] [AU:DEC'06] [AU: DEC '03] [AU: DEC '11] [AU:MAY'13] (R)

The ratio of the maximum to minimum magnitudes of voltage or current on a line having standing waves called standing waves ratio.

$$S = \frac{|E_{max}|}{|E_{min}|} = \frac{|V_{max}|}{|V_{min}|} = \frac{|I_{max}|}{|I_{min}|}$$

4. What is the relation between SWR and |K|? (R)

$$VSWR = \frac{1+|K|}{1-|K|}$$

5. What are standing waves? (2)[AU:MAY'05] (Or) Define standing wave ratio. **(2) [AU-NOV2006] (R)**

If the transmission is not terminated in its characteristic impedance, then there will be two waves traveling along the line which gives rise to standing waves having fixed maxima and fixed minima.

6. What is the range of values of standing wave ratio? (R)

The range of values of standing wave ratio is theoretically 1 to infinity.

7. Define node and antinode. (Or)

What are nodes and antinodes on a line? [AU:DEC'05] (R)

The points along the line where magnitude of voltage or current is zero are called **nodes** while the points along the lines where magnitude of voltage or current first maximum are called **antinodes or loops**.

8. State the relation between standing wave ratio S and reflection co-efficient, K.

(Or) Write the expression for SWR interms of i) Reflection co-efficient ii) Z_L and Z_o. [AU:Jan'16]

(Or) Write the expression for standing wave ratio in terms of reflection co-efficient. [AU:May'15] (Or)

Write the expression for VSWR in terms of (a) the reflection coefficient, (b) VSWR in terms of Z_L and Z_o. (2) [AU-MAY2012] (R)

The relation between standing wave ratio S and reflection co-efficient k is,

$$S = \frac{1+|K|}{1-|K|}$$

$$S = \frac{|Z_R|}{|Z_O|} = \frac{R_R}{R_O} \text{ (for } R_R > R_O)$$

9. What is the value of SWR for open circuit, short circuit and matched line?[AU:MAY'04] (Or)

Give the minimum and maximum value of SWR and reflection coefficient. (2) [AU-NOV2008] (Or)

Find the VSWR and reflection coefficient of a perfectly matched line with no reflection from load? (2) [AU-MAY2007]. (R)

When the load is either open circuit or short circuit, the value of $|K|$ is '1'. Hence the value of SWR is '∞'.

When the load is matched with characteristic impedance, the value of $|K|$ is '0'. Hence the value of SWR is '1'.

10. What is zero dissipation line/dissipationless line? (R)

A line for which the effect of resistance R is completely neglected is called dissipationless line or Zero dissipation Line.

11. What is the nature and value of Z_0 for the dissipationless line? (Or) What is the value of Z_0 for the dissipationless line?[AU:JUN'09] (R)

For dissipationless line, the value of Z_O is purely resistive and given by, $Z_O = R_O = \sqrt{\frac{L}{C}}$

12. State the values of α and β for the dissipation less line [AU:DEC'03] (R)

$\alpha = 0$

$\beta = \omega \sqrt{LC}$ rad /Km

13. For the zero dissipation line, what will be the values of attenuation constant and characteristic impedance? (2) [AU-NOV2015] (Or)

Write down primary constants and secondary constants for the line of zero dissipation. [AU:DEC'03] (Or)

Write the conditions to be satisfied by a dissipationless line. [AU-NOV2013]. (R)

$Z_O = R_O = \sqrt{\frac{L}{C}}$

$P = \gamma = \alpha + j\beta = j\omega\sqrt{LC}$

$\alpha = 0$

$\beta = \omega\sqrt{LC}$

14. Give the input impedance of a dissipationless line. [AU:MAY'06]. (R)

The input impedance of a dissipationless line is given by

$$Z_S = Z_{in} = R_O \left[\frac{1 + |K|\angle\phi - 2\beta s}{1 - |K|\angle\phi - 2\beta s}\right]$$

15. Give the maximum and minimum input impedance of the dissipationless line. (R)

The maximum input impedance is

$$Z_{S(max)} = R_O \left[\frac{1 + |K|}{1 - |K|}\right] = R_O.S$$

The minimum input impedance is

$$Z_{S(min)} = R_O \left[\frac{1 - |K|}{1 + |K|}\right] = \frac{R_O}{S}$$

16. Give the input impedance of open and short circuited lines.[AU:DEC'10] (Or)

Write the expression for the input impedance of open and short circuited dissipationless line. [AU:DEC'16]. (R)

The input impedance of open and short circuited lines is given by,

$$Z_{OC} = -jR_O \cot\beta s = -jR_O \cot\left(\frac{2\pi}{\lambda}.s\right)$$

$$Z_{SC} = jR_O \tan\beta s = jR_O \tan\left(\frac{2\pi}{\lambda}.s\right)$$

17. List the parameters of the open wire line at high frequencies. (2) [AU-NOV2014]. (R)

$$L = \frac{\mu_o}{\pi} \ln\left(\frac{d}{a}\right) H/m$$

$$C = \frac{\pi\varepsilon_o}{\ln\left(\frac{d}{a}\right)} F/m$$

18. List the parameters of the coaxial cable at high frequencies. (R)

$$L = \frac{\mu_o}{2\pi} \ln\left(\frac{b}{a}\right) H/m$$

$$C = \frac{2\pi\varepsilon_o}{\ln\left(\frac{b}{a}\right)} F/m$$

19. Why the point of voltage minimum is measured rather than voltage maximum? (U)

The point of a voltage minimum is measured rather than a voltage maximum because it is usually possible to determine the exact point of minimum voltage with greater accuracy.

PART-B

1. Define standing wave ratio and obtain the expression of VSWR in terms of reflection coefficient (8) **[AU-MAY2009]. (AZ)**
2. Derive an expression for the input impedance of dissipationless lines. Deduce the input impedance of open and short circuited dissipationless lines. **[AU-NOV2013] (AZ)**
3. Explain the parameters of open wire line and coaxial cable at RF. Mention the standard assumptions made for radio frequency line. (16) **[AU-NOV2014] (R)**
4. Discuss the various parameters of open wire and coaxial lines at radio frequency. (16) **[AU-NOV2015] (U)**

5. Derive the expression that permit easy measurements of power flow on a line of negligible losses. (10) **[AU-NOV2015] (AZ)**

PROBLEMS

1. If the reflection coefficient of a line is 0.3∠-66°. Calculate the standing wave ratio (2) **[AU-MAY2009]. (A)**

   Solution:

   K=0.3∠-66°

   |k|=0.3, ∠φ =-66°

   SWR is given by,

$$S = SWR = \frac{1+|K|}{1-|K|} = \frac{1+0.3}{1-0.3} = \frac{1.3}{0.7} = 1.8571$$

2. At a frequency of 80 MHz, a lossless transmission line has a characteristic impedance of 300Ω and a wavelength of 2.5m. Find L and C. (2) **[AU-MAY2012]. (A)**

$$Z_o = R_o = \sqrt{\frac{L}{C}} = 300\Omega$$

$$\frac{L}{C} = 90000 \qquad (1)$$

$$\lambda = \frac{2\pi}{\beta} = \frac{2\pi}{\omega\sqrt{LC}} = \frac{2\pi}{2\pi f\sqrt{LC}}\frac{1}{f\sqrt{LC}} = 2.5$$

$$\sqrt{LC} = 5\times10^{-9}$$

   LC = $2.5\text{x}10^{-17}$ (2)

   solving (1) and (2) we get

   L=1.5μH and C=16.6667pF

3. A lossless transmission line has a shunt capacitance of 100pF/m and a series inductance of 4μH /m. Determine the characteristic impedance. (2) **[AU- NOV2013] [AU-NOV2015]. (A)**

   The characteristic impedance of a lossless line is given by,

$$Z_o = R_o = \sqrt{\frac{L}{C}} = \sqrt{\frac{4\times10^{-6}}{100\times10^{-12}}} = 200\Omega$$

4. An antenna as a load on a transmission line produces a standing wave ratio of 2.8 with a voltage minimum 0.12 A. from the antenna terminals. Find the antenna impedance, reflection factor and reflection loss at the antenna if Ro = 300 ohms for the line. (8) **[AU-NOV2006]. (A)**

5. A transmission line is terminated in Z_L. Measurements indicate that the standing wave minima are 102 cm apart and that the last minimum is 35 cm from the load end of the line. The value of standing wave ratio is 2.4 and R0 = 250 ohm. Determine wave length and load impedance. (8). **[AU-NOV2007]. (A)**
6. A 30m long lossless transmission line with Zo = 50Ω operating at 2 MHz is terminated with a load ZL =60+j40 Ω. If U=0.6C on the line, find (i) Reflection Coefficient (5), (ii) Standing wave ratio(5) (iii) Input impedance (6) **[AU-MAY2012]. (A)**
7. A lossless line in air having a characteristic impedance of 300Ω is terminated in unknown impedance. The first voltage minimum is located at 15cm from the load. The standing wave ratio is 3.3. Calculate the wavelength and terminated impedance. (6) **[AU-NOV2013] [AU-NOV2015] (A)**
8. A generator of 1V, 1 KHz supplies power to a 100Km open wire line terminated in 200 ohm resistance. The line parameter are R=10Ω / Km, L=3.8 mH/Km, G=$1x10^{-6}$ mho/Km, C = 0.0085 μf/Km. Calculate the impedance, reflection coefficient, power and transmission efficiency. (16) **[AU-MAY 2009] [AU-MAY 2011]. (A)**

ASSIGNMENT PROBLEMS

1. A low loss transmission line of 100 ohms characteristic impedance is connected to a load of 200 ohms. Calculate the voltage reflection co-efficient and the standing wave ratio. (6) **[AU-MAY 2012]. (A)**
2. A transmission line has the following per unit length parameters: L=0.1μ H, R=5Ω, C=300pF and G= 0.01mhos. Calculate the propagation constant and characteristic impedance at 600 MHz. **(A)**
3. The characteristic impedance of a uniform transmission line is 2309.6 ohms at a frequency of 800 Hz. At this frequency, the propagation constant is 0.054(0.0366+j0.99). Determine R and L, (6) **[AU-NOV 2010][AU-NOV 2013]. (A)**
4. Formulate the expression for the ratio of power delivered to the load.**(C)**

UNIT III IMPEDANCE MATCHING IN HIGH FREQUENCY LINES

PART - A

1. What is the use of eighth wave line? (R)

An eighth wave line is used to transform any resistance Z_R or R_R to impendence Z_{in} with a magnitude equal to the Characteristics impedance Z_O or R_O.

2. Give the input impendence of eighth wave line terminated in a pure resistance R_R. (R)

The input impendence of eighth wave line terminated in a pure resistance, R_R is given by

$$Zs = R_O \left[\frac{R_R + jR_O}{R_O + jR_R} \right]$$

From the above equation it is seen that Z_{in} is a complex quantity. Thus the magnitude of the input impedance is,

$$|Z_{in}| = R_O$$

3. Why is a quarter wave lines called as impendence inverter? (Or) Why a quarterwave line is considered as a impedance inverter? Justify [AU:May'15]. (R)

A quarter wave lines may be considered as an impendence inverter because it can transform a low impendence in to a high impendence and vice versa.

4. Mention the significance of Quarter wave line. [AU:MAY'12] [AU:Jan'16]. (U)

Quarter wave line can be used as impedance matching device between transmission line and resistive load such as an antenna.

Short circuited Quarter wave line can be used an insulator to support open wire or inner conductor of a coaxial line.

5. What is a Stub? Why it is used in between transmission line? [AU:May'15] (U)

A Stub is a small transmission line connected in parallel with main line at a certain distance from the load.

A Stub is used to match impedance between transmission line and load. It is used to cancel the reactive component in the main transmission line.

6. What is the application of the quarter wave matching section? (Or) What is the application of Quarter wave line?[AU:DEC'07][AU:MAY'11] [AU-NOV2007] [AU-NOV2015]. (U)

An important application of the quarter wave matching section is to a couple a transmission line to a resistive load such as an antenna.

If the antenna resistance is RA and the characteristic impendence of the line is Ro, then a quarter wave impedance matching section is designed such that its characteristic impendence is $Ro' = \sqrt{R_A.R_O}$

7. Why is the quarter wave line called as copper insulator? (2) [AU-NOV2008]. (U)

As quarter wave line is shorted at ground, its input impedance is very high. so, the signal on line passes to the receiving end, without any loss due to this mechanical support. thus the line acts as an insulator at this point. Hence such line is referred as copper insulator.

8. Bring out the significance of a half wavelength line. (U)

A half wavelength line may be considered as a one-to-one transformer. It has its greatest utility in connecting load to a source in cases where the load source cannot be made adjacent.

9. Give some of the impendence –matching devices. (R)

The quarter – wave line or transformer and the tapered line are some of the impendence –matching devices.

10. State the use of half wave line. (U)

The expression for the input impendence of the half wave line is given by, $Zs = Z_R$

Thus the line repeats is terminating impedance. Hence it is operated as one to one transformer.

Its application is to connect load to a source where they can not be made adjacent.

11. Name few applications of half-wave line. (2) [AU-MAY2007] (R)

Half-wave line repeats its terminating impedance. Hence it is operated as one to one transformer.

12. Explain impendence matching using stub. (R)

In the method of impendence matching using stub, an open or closed stub line of suitable length is used as a reactance shunted across the

transmission line at a designated distance from the load, to tune the length of the line and the load to resonance with an anti-resonant resistance equal to Ro.

13. Give reasons for preferring a short- circuited stub when compared to an open – circuited stub. (U)

A short circuited stub is preferred to an open circuited stub because of greater ease in constructions and because of the inability to maintain high enough insulation resistance at the open –circuit point to ensure that the stub is really open-circuited .A shorted stub also has a lower loss of energy due to radiation, since the short – circuit can be definitely established with a large metal plate, effectively stopping all field propagation.

14. What are the two independent measurements that must be made to find the location and length of the stub? (R)

The standing wave ratio S and the position of a voltage minimum are the independent measurements that must be made to find the location and length of the stub.

15. Give the formula to calculate the distance of the point from the load at which the stub is to be connected. (R)

The formula to calculate the distance of the point from the load at which the stub is to be connected is,

$$S_1 = \frac{\phi + \pi - \cos^{-1}(K)}{2\beta}$$

16. Give the formula to calculate the distance d from the voltage minimum to the point stub be connection. (R)

The formula to calculate the distance d from the voltage minimum to the point of stub be connection is,

$$d = \frac{\mathrm{Cos}^{-1}(K)}{2\beta}$$

17. Give the formula to calculate the length of the short circuited stub. (R)

The formula to calculate the length of the short circuited stub is,

$$L = \frac{\lambda}{2\pi}\tan^{-1}\left[\frac{\sqrt{1-K^2}}{2K}\right] \quad \text{or}$$

$$L = \frac{\lambda}{2\pi}\tan^{-1}\left[\frac{\sqrt{Z_R Z_O}}{(Z_R - Z_O)}\right]$$

This is the length of the short circuited stub to be placed d meters towards the load from a point at which a voltage minimum existed before attachment of the stub.

18. What is the nature and value of Z_o for the dissipationless line? [AU-MAY 2009] [AU-DEC 2003]. (R)

For the dissipationless line, Z_o is purely resistive and is given by,

$$Z_o = R_o = \sqrt{\frac{L}{C}}$$

19. Explain briefly properties of Smith chart. (U)

The properties of smith chart are,

1. It contains constant resistance and reactance circles.
2. Impedance chart can be converted to admittance chart by rotating the chart by 180°.
3. The distance around the chart is $\lambda/2$.
4. When r=0, it is Short circuited end.
   When r=∞, it is Open circuited end.
5. The RHS of smith chart denotes V_{SWR}, V_{max}, Z_{max}, I_{min}.
6. The LHS of smith chart denotes $1/V_{SWR}$, V_{min}, Z_{min}, I_{max}.
7. When smith chart is used as impedance chart, then upper part is +ve reactance (Inductance) and the lower part is known as –ve reactance (Capacitance).
8. When smith chart is used as admittance chart, then upper part is +ve susceptance and the lower part is known as –ve susceptance.

20. List the applications of the smith chart. [AU-MAY2015]. (U)

The applications of the smith chart are,

a. It is used to find the input impedance and input admittance of the line.
b. The smith chart may also be used for determining SWR, V_{max}, V_{min}, Z_{max}, Z_{min}, I_{max}, I_{min}, K.
c. The solution of the stub matching problem can be easily carried out using a smith chart.

21. Write the procedure to find the impedance from the given admittance using smith chart. (2) [AU-MAY2008] (U)

1. Find normalized admittance from the given admittance value and mark this value as A in the chart.

2. Draw S-Circle with OA as radius.
3. Draw a line joining A and O. Extend this line till it cuts the other side of S-Circle. Mark the intersection point of AO line with S-Circle as B.
4. The point B gives the normalized impedance value.
5. To get impedance value, multiply the normalized impedance value with Z_o.

22. What are the difficulties in single stub matching? (U)

The difficulties of the smith chart are,

i. Single stub impedance matching requires the stub to be located at a definite point on the line. This requirement frequently calls for placement of the stub at an undesirable place from a mechanical view point.

ii. For a coaxial line, it is not possible to determine the location of a voltage minimum without a slotted line section, so that placement of a stub at the exact required point is difficult.

iii. In the case of the single stub it was mentioned that two adjustments were required, these being location and length of the stub.

23. What is double stub matching? (R)

Double stub matching is another possible method of impedance matching which uses two stubs in which the locations of the stub are arbitrary, the two stub lengths furnishing the required adjustments. The spacing is frequently made $\lambda/4$. This is called double stub matching.

24. Give reason for an open line not frequently employed for impedance matching. (U)

An open line is rarely used for impedance matching because of radiation losses from the open end, and capacitance effects and the difficulty of a smooth adjustment of length.

25. Why Double stub matching is preferred over single stub matching? (U)

Double stub matching is preferred over single stub due to following disadvantages of single stub.

i. Single stub matching is useful for a fixed frequency. So as frequency changes the location of single stub will have to be changed.

ii. The single stub matching system is based on the measurement of voltage minimum .Hence for coaxial line it is very difficult to get such voltage minimum, without using slotted line section.

26. Distinguish between single and double stub matching [AU-MAY'08] [AU-NOV'15]. (AZ)

S.No	Single stub matching	Double stub matching
1	It has one stub to match the transmission line impedance	It requires two stub for impedance matching
2	Stub has to be placed at a definite place on a line	The location of the stub is arbitrary
3	Length and Location of the stub has to be altered for impedance matching	Only Length of the stub has to be altered for impedance matching

PART-B

1. Derive the expression for the input impedance of the dissipationless line and thus obtain the expression for the input impedance of a quarter-wave line. Also discuss the applications of quarter-wave line. (8) **[AU-NOV2006] [AU-MAY2015] (AZ)**
2. Discuss the application of Quarter-wave line in impedance matching and copper insulators. (6) **[AU-MAY2007]. (U)**
3. What is Quarter-wave line? Discuss its application. (6) **[AU-MAY2008] (R)**
4. Derive the input impedance of a quarter wave line and discuss its applications. (8) **[AU-MAY2009]. (AZ)**
5. Explain single stub matching on a transmission line and derive the expressions for the location and the length of the stub used for matching on a line. (10) **[AU-NOV2006]. (AZ)**
6. Obtain the expression for the length and location of a short circuited stub for impedance matching on a transmission line. (10) **[AU-MAY2009]. (AZ)**
7. Explain the procedure of double stub matching on a transmission line with an example. (8) **[AU-NOV2007]. (R)**
8. Discuss the following: (i) Impedance matching (8) (ii) Single and Double stub matching (8) **[AU-MAY2012]. (U)**
9. Discuss the principle of double stub matching with neat diagram and expressions. (8) **[AU-NOV2013] [AU-NOV2015]. (U)**
10. Explain double stub matching on a transmission line and derive the expression and the length of the stub used for matching on a line. (16) **[AU-MAY2015]. (AZ)**

PROBLEMS

1. Design a quarter wave transformer to match a load of 200Ω to a source resistance of 500Ω. The operating frequency is 200 MHz. (2) **[AU-NOV2006]. (C)**
2. A 75 ohm lossless transmission line is to be matched to a resistive load impedance of Z_L = 100 ohm via a quarter-wave section. Find the characteristic impedance of the quarter wave transformer. (4) **[AU-NOV2008]. (A)**
3. A 70 Ω lossless line is used at a frequency where wavelength (λ) equals 80cm terminated by a load of (140 + j91) Ω. Find the Reflection coefficient, VSWR and input admittance using SMITH chart. (10) **[AU-MAY2008]. (A)**
4. A 50 ohm lossless transmission line is terminated in load impedance of Z_L = (25+j50) ohm. Use the **SMITH** chart to find 1) Voltage reflection coefficient, 2) VSWR, 3) Input impedance of the line, iven that line is 3.3 λ long and 4) Input admittance of the line. (12) **[AU-NOV2008]. (A)**
5. Design a single stub match for a load of 150 + j 225 ohms for a 75 ohms line at 500 MHz using smith chart. (6) **[AU-NOV2006][AU-MAY2015]. (C)**
6. A 75 Ω lossless transmission line is to be matched with a 100-j80 Ω load using SINGLE stub. Calculate the stub length and its distance from the load corresponding to the frequency of 30 MHz using SMITH chart. (16) **[AU-MAY2008] [AU-NOV2015]. (A)**
7. A 50 ohm lossless feeder line is to be matched to an antenna with Z_L = (75-j20) ohm at 100MHz using single shorted stub. Calculate the stub length and distance between the antenna and stub using smith chart. (16) **[AU-NOV2008]. (A)**
8. A load (50-j100)Ω is connected across a 50Ω line. Design a short circuited stub to provided matching between the two at a signal frequency of 30 MHZ using Smith chart. (6) **[AU-MAY2009]. (C)**
9. A 300 Ω transmission line is connected to a load impedance of (450-j600) Ω at 10MHz. Find the position and length of a short circuited stub required to match the line using Smith Chart. (8) **[AU-NOV2013] [AU-NOV2015]. (A)**
10. A line having characteristic impedance of 50Ω is terminated in load impedance (75+j 75)Ω. Determine the reflection coefficient and voltage standing wave ratio. Mention the significance and application of Smith chart. (16) **[AU-NOV2014]. (A)**
11. An antenna as a load on a transmission line produces a standing wave ratio of 2.8 with a voltage minimum 0.12 A. from the antenna terminals. Find the antenna impedance, reflection factor and reflection loss at the antenna if Ro = 300 ohms for the line. (8) **(A)** **[AU-NOV2006]**

12. A transmission line is terminated in Z_L. Measurements indicate that the standing wave minima are 102 cm apart and that the last minimum is 35 cm from the load end of the line. The value of standing wave ratio is 2.4 and R0 = 250 ohm. Determine wave length and load impedance. (8). **[AU-NOV2007]. (A)**
13. A 75 ohm lossless transmission line is to be matched to a resistive load impedance of Z_L = 100 ohm via a quarter-wave section. Find the characteristic impedance of the quarter wave transformer. (4) **[AU-NOV2008]. (A)**
14. An ideal lossless quarter wave transmission line of characteristic impedance 60 ohm is terminated in a load impedance Z_L. Give the value of the imput impedance of the line when Z_L = 0, ∞ and 60 ohm. **[AU-MAY 2012]. (A)**
15. A 50 Ω transmission line is connected to a load impedance (Z_L) = 60 + j 80Ω. The operating frequency is 300MHz. A DOUBLE-stub tuner spaced an eighth of a wave length apart is used to match the load to the line. Find the required lengths of the short circuited stubs using SMITH chart. (16) **[AU-MAY2007]. (A)**
16. Design a single stub match for a load of 150 + j 225 ohms for a 75 ohms line at 500 MHz using smith chart. (6) **(C) [AU-NOV2006]**

ASSIGNMENT PROBLEMS

1. A 30 m long lossless transmission line with characteristic impedance (Zo) of 50 Ω is terminated by a load impedance (Z_L) = 60 + j40 Ω. The operating wavelength is 90m. Find the reflection coefficient, Standing Wave Ratio and input impedance using SMITH chart. (10) **(A) [AU-MAY2007]**
2. Determine the length and location of a single short circuited stub to produce an impedance match on a transmission line with R_o of 600 Ω and terminated in 1800Ω. (8) **(A) [AU-NOV2007] [AU-NOV2013]**
3. A 100 ohm, 200m long lossless transmission line operates at 10 MHz and is terminated into an impedance of 50-j200 ohm. The transit time of the line is 1 μs. Determine the length and location of a short circuited stub line. (8)**[AU-MAY 2012]. (A)**
4. A 30m long lossless transmission line with Z_o = 50 Ω operating at 2 MHz is terminated with a load ZL = 60+j40 Ω. If v=0.6C on the line, find the reflection coefficient, standing wave ratio and input impedance. (16) **[AU-MAY 2011]. (A)**
5. It is required to match a 200 ohms load to a 300 ohms transmission line to reduce the SWR along the line to 1. What must be the characteristic

impedance of the quarter wave transformer used for this purpose if it is directly connected to the load? (4) **(AZ)** **[AU-NOV 2010]**

6. A UHF transmission line working at 1 GHz is connected to an unmatched line producing a voltage reflection coefficient of 0.5(0.866+j0.5). Calculate the length and position of the stub to match the line. (8) **[AU-NOV 2010] (A)**
7. A 30m long lossless transmission line with Z_0 = 50Ω operating at 2 MHz is terminated with a load Z_L = 60+j40Ω. If U=0.6 C on the line, find Reflection coefficient (5) iii) Standing wave ratio (5) Input impedance (6) **[AU-NOV 2012][AU-MAY 2011]. (A)**
8. Assess the relation between standing wave ratio (S) and magnitude of relation co efficient.(6) **(E)**
9. Formulate the expression that permit easy measurement of power flow on a line of negligible losses. (8) **(C)**
10. A load 50+j100 ohms is connected across a 50 ohms line. Design a short circuited stub to provide matching between the two at a single frequency of 30MHz.(8) **(C)**
11. Design a single stub match for a load of 150 +j 225 ohms for a 75 ohms line at 500MHz using smith chart. **(C)**
12. Design a quarter wave transformer to match a load of 500 Ω to a source resistance of 800Ω. The operating frequency is 300 MHz. (2) **[AU-NOV2006]. (C)**

UNIT IV - FILTER

PART - A

1. What is a filter? (R)

An electric filter is a network which passes a specified band of frequencies and blocks or attenuates a signal of frequencies outside this band.

2. What is cut-off frequency? (R)

The frequency at which a network changes from pass band to stop band or vice versa is called as cutoff frequency.

3. Define Neper. (R)

Neper is defined as the natural logarithm of the ratio of input voltage (or current) to the output voltage (or current), provided that the network is properly terminated in its characteristic impedance 'Z_o'.

A Neper can also be expressed in terms of input power P_i and the output power P_o as $N=1/2 \log_e (P_i/P_o)$.

4. Define Decibel. (R)

Decibel is defined as ten times the common logarithms of the ratio of the input power to the output power.

Decibel $D=10 \log_{10} (P_i/P_o)$.

5. What is meant by characteristic impedance? (R)

Characteristic impedance is an important electrical property of a symmetrical network and it is defined as the input impedance measured at the input terminals when the output terminal is terminated in the impedance. It is represented by Zo.

6. Give the relation between neper and decibel. (R)

1 dB = 0.115 Neper

1 Neper = 8.686 dB

7. What are the characteristics of ideal filter? (R)

The ideal filter should have the following characteristics

1. Transmit pass band frequencies without any attenuation.
2. Suppress all frequencies in the attenuation band.
3. The transition region between the stop band and pass band should be very small.

8. What is a constant-k filter? Why it is called as prototype filter section? [AU-NOV2014]. (R)

A constant-k filter is a T or π network in which the series and shunt impedances Z_1 and Z_2 are connected by the relationship

$$Z_1Z_2 = R^2_k$$

where, R_k is a real constant. R_k is termed as design impedance or nominal impedance of the constant-k filter.

It is called as prototype filter section because other complex networks can be derived from it.

9. Define pass band, attenuation band and cut-off frequencies? (R)

Pass band: The range of frequencies in which the attenuation is zero. **Attenuation band:** The range of frequencies in which the attenuation is infinity by filter.

Cut-off frequencies: Frequencies which separates a pass and stop band.

10. What are the advantages of active filters over passive filters? (U)

- Active filters eliminate inductors, which are bulky and are very much expansive at lower frequencies.
- Active filters offer gain which may be variable.
- It is easy to tune active filters and can drive low impedance loads.

11. Give the Characteristics of filters? (U)

- Pass band
- Stop band
- Cut-off frequency
- Characteristic impedance

12. What are the uses of filters? (U)

The filters are used in

- Telephony and TV broadcasting
- AM detection
- Radio and TV receivers
- Audio amplifiers

13. What are the types of passive filters? (OR) Give the classification of filter according to frequency characteristic. (R)

1. Low pass filters

2. High pass filters
3. Band pass filters
4. Band elimination filters

14. What is low pass filter? (R)

The filter which passes frequencies without attenuation up to cut-off frequency f_c and attenuates all other frequencies greater than f_c are called as Low pass filter.

15. What is high pass filter? (R)

The filter which attenuates all frequencies below a designated cut-off frequency f_c, and passes all frequencies above f_c without attenuation are called as high pass filter.

16. What is band pass filter? (R)

The filter which passes frequencies between two designated cut-off frequencies and attenuates all other frequencies are called as band pass filter.

17. What is band stop filter? (R)

The filter which attenuates frequencies between two designated cut-off frequencies and passes all other frequencies are called as band stop filter. It is also known as band elimination filter.

18. What are the design equations of constant-K LPF? (R)

$$L = \frac{R_k}{\pi f_c}$$

$$C = \frac{1}{\pi R_k f_c}$$

$$f_c = \frac{1}{\pi\sqrt{LC}}$$

19. Write the expressions for attenuation (α) and phase shift (β) for constant-k LPF? (R)

Attenuation, $\alpha = 2\cosh^{-1}(f/f_c)$

Phase shift, $\beta = 2\sin^{-1}(f/f_c)$

20. What are design equations of constant-K HPF? (R)

$$L = \frac{R_k}{4\pi f_c}$$

$$C = \frac{1}{4\pi R_k f_c}$$

$$f_c = \frac{1}{4\pi\sqrt{LC}}$$

21. Write the expressions for attenuation (α) and phase shift (β) for constant-k HPF? (R)

Attenuation, $\alpha = 2\cosh^{-1}(f_c/f)$

Phase shift, $\beta = 2\sin^{-1}(f_c/f)$

22. What are the disadvantages of constant-k filters? [AU-Jan 2016] (Or) What are the major drawbacks of a constant-k filter? [AU-May 2015] (U)

1. Attenuation does not increase rapidly beyond f_c
2. Z_o varies widely in the transmission or pass band from the desired value
3. There is no sharp cut-off frequency.

23. What is m-derived filter? (R)

A m-derived filter is a T or π network which have the series impedance Z_1 and shunt impedance Z_2. this filter do not have the product $Z_1Z_2 = R^2_k$ but have the same characteristic impedance as constant-k filter.

24. Why do we go for m-derived filters? (U)

Since const-k filters have following disadvantages

1. Attenuation does not increase rapidly beyond f_c

2. Z_o varies widely in the transmission or pass band from the desired value

3. There is no sharp cut-off frequency. So, to overcome this and to improve attenuation const we go for m-derived filters.

25. What are the advantages of m-derived filters? [AU-NOV2013] [AU-NOV2015] (U)

1. Attenuation increases rapidly beyond f_c
2. Cut-off frequency is sharper than constant-k filter.
3. Characteristic impedance will be uniform within the pass band.

26. What are the drawbacks of m derived filters? (U)

In m derived filters stop band attenuation drastically reduces after f∞ in low pass section and before f∞ in high pass section. This drawback of m

derived filter can be overcome by connecting number of sections including prototype sections and m derived section with terminating half sections

27. What are composite filters? (R)

Composite filter is obtained by connecting number of section including prototype sections and m derived sections with terminating half sections

28. What is constant K section? (R)

A network, either T or π, is said to be of the constant-k type if Z_1 and Z_2 of the network satisfy the relation $Z_1 Z_2 = R_k$. Where Z_1 and Z_2 are impedances in the T or π secions.

29. Define identical networks. (R)

The networks are said to be identical if the electrical properties such as characteristic impedance and propagation constant of the networks are identical or same.

30. What do you mean by properly terminated symmetrical network? (R)

It is one which is terminated in both the input and output ports by its characteristic impedance .

31. What is a symmetrical network? (R)

When the electrical properties of the network remain unaffected even after interchanging the terminals of the network is called symmetrical network

32. What is an asymmetrical network? (R)

When the electrical properties of the network gets changed even after interchanging the terminals of the network is called asymmetrical network.

33. Why a composite filter is designed and what are the various sections of the composite filter? (U)

In prototype filter sections, the attenuation characteristic is not very sharp in the attenuation band as it is expected. This drawback can be overcome by using m-derived filter sections which are derived from respective prototype filter sections. But in stop band, it is observed that the attenuation drastically reduces after f_∞ in low pass section and before f_∞ in high pass section. This drawback of m-derived filter can be overcome by connecting number of sections including prototype sections and m-derived sections with terminating half sections. Such a combination of different sections is called as composite filter.

34. What are the advantages and disadvantages of Lattice filter? (U)

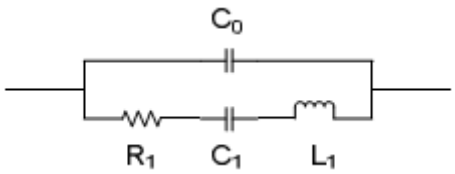
Advantage:

The advantage of lattice filter is that it is always physically realizable.

Disadvantage:

The disadvantage is that it requires more elements per section.

35. Draw the equivalent circuit for a piezoelectric crystal. (2) [AU-MAY2015] (R)



PART-B

1) Explain the properties and characteristic impedance of symmetrical networks. (6) **[AU-MAY2012]. (R)**
2) Derive the equations for the characteristic impedance of symmetrical T and Pi networks. (6) **[AU-NOV2015]. (AZ)**
3) iii) Discuss the properties of symmetrical network in terms of characteristic impedance and propagation constant. (6) **[AU-NOV2015]. (U)**
4) Derive and draw the m-derived T and π section for low pass and high pass filter. (16) **[AU-MAY2015]. (AZ)**
5) Derive characteristic impedance, inductance, capacitance and cut-off frequency for constant k low pass and constant high pass filter, also draw their reactance curves. (16) **[AU-MAY2015]. (AZ)**

PROBLEMS

1. A prototype LPF is to be designed which must have Ro = 600Ω, f_c = 1KHz. Find filter elements (L and C) (2) **[AU-NOV2014]. (A)**
2. Design T and π section low pass filter which has series inductance 80mH and shunt capacitance 0.022μf. Find the cutoff frequency and design impedance. (10) **[AU-MAY2012] [AU-DEC 2012]. (A)**
3. A constant-k, T section HPF has a cut off frequency of 10KHz and the design impedance is 600. Determine the value of shunt inductance L and series Capacitance C. (2) **[AU-NOV 2016]. (A)**

4. Determine the value of L required by a constant-k T section high pass filter with a cutoff frequency of 1 KHz and design impedance of 600Ω. (8)**[AU-NOV2013] [AU-NOV2015]. (A)**
5. Design a constant K band pass filter (both T and pi sections) having a design impedance of 600 Ω and cut off frequencies of 1 KHz and 4KHz. (8) **[AU-MAY2013] [AU-NOV2015]** . **(A)**
6. Design a constant-K T-section bandpass filter with cut-off frequencies of 1 KHz and 4KHz. The design impedance is 600 ohms. (8) **[AU-NOV 2010] [AU-NOV 2013]. (A)**
7. Explain the operation and design of constant-K T section band elimination filter with necessary equations and diagrams (8) **[AU-MAY2013] [AU-NOV2015] (AZ)**
8. Design a low pass filter with cut-off at 2600 Hz to match 350 ohm. One derives section with infinite attenuation at 2850 Hz. (8) **[AU-MAY 2011]. (A)**
9. Design an m-derived T-section low pass filter having cut-off frequency f_c =5000Hz and design impedance of 600 ohms. The frequency of infinite attenuation is 1.25f_c (16). **(A)** **[AU-NOV 2010]**
10. Design an m-derived T section filter (high-pass) will1 a cut-off frequency of 10 kHz, design impedance of 200 Ω and m= 0.4. **(A)** (10)**[AU-NOV 2003]**
11. Design a low pass composite filter for the following specifications. Cutoff frequency f_c = 2 kHz, Frequency of infinite attenuation f_∞ = 2050 Hz, Load impedance R_K = 500Ω. Use **T** section to develop the composite filter. (16) **[AU-MAY 2004]. (A)**
12. Design a composite high pass filter to operate into a load of 600Ω and have a cut off frequency of 1.2 KHz. The filter is to have one constant K section, one m-derived section with f=1.1 KHz and suitably terminated half section. Discuss the merits and demerits of m-derived filter and crystal filter. **[AU-NOV2014]. (A)**

ASSIGNMENT PROBLEMS

1) Find the characteristic impedance of the symmetrical T network if the series arm impedance is 10+ j30 and shunt arm impedance is 50 - j100. (8) **[AU-MAY 2004]. (A)**
2) Design a low pass filter (both π and T sections) having a cut-off frequency of 2 KHz to operate with a terminal load resistance of 500 Ω. (16) **[AU-NOV 2006]. (A)**
3) Each of the two series elements of a T-type low pass filter consists of an inductance of 30 mH having negligible resistance and a shunt element

having capacitance of 0.16μf**.** Calculate the value of cut-off frequency and determine the iterative impedance and the phase shift of the network at 2 KHz. (16) **[AU-NOV 2006]. (A)**

4) Design an m-derived T section low pass filter having cutoff frequency of 1KHz. Design impedance is 400Ω and the resonant frequency is 1100Hz. (6) **[AU-MAY2013] [AU-NOV2015]. (A)**
5) Design a constant K bandpass filter deriving expressions for the circuit components. A constant K high pass filter cuts off at a frequency of 2300HZ. The load resistance is 500Ω. Calculate the values of components used in the filter. (16)**[AU-NOV2014]. (A)**
6) What are the advantages of m derived filter? Design an m derived low pass filter (T and π section) having design resistance R_0=500Ω, cutoff frequency f_c=1500Hz and infinite attenuation frequency f_∞=2000Hz. (16) **[AU-MAY2012]. (A)**

UNIT V GUIDED WAVES BETWEEN PARALLEL PLANES

PART – A

1. What are guided waves? Give examples. (R)

The electromagnetic waves that are guided along or over conducting dielectric surface are called guided waves.

Examples: Parallel wire, transmission lines

2. What is a parallel plate wave guide? (R)

Parallel plate wave guide consists of two conducting sheets separated by a dielectric material.

3. What is TE wave or H wave? (R)

Transverse electric (TE) wave is a wave in which the electric field strength E is entirely transverse. It has a magnetic field strength H_z in the direction of propagation and no component of electric field strength E_z in the same direction.

4. What is TM wave or E wave? (R)

Transverse magnetic (TM) wave is a wave in which the magnetic field strength H is entirely transverse. It has electric field strength E_z in the direction of propagation and no component of magnetic field strength H_z in the same direction.

5. What is a TEM wave or principal wave? (Or)

What is Principal wave? (2) [AU-MAY2008] (Or)

Define TEM waves (2) [AU:NOV2013] (R)

TEM wave is a special type of TM wave in which an electric field E along the direction of propagation is also zero.

(Or)

The TEM waves are waves in which both electric and magnetic fields are transverse entirely but have no components of E_z and H_z. It is also referred as principal wave.

6. What is a dominant mode? (Or)

What is meant by dominant mode of the wave? (2) [AU-MAY2009] (R)

The modes that have the lowest cut off frequency is called the dominant mode

7. Give the dominant mode for TE and TM waves. (R)

Dominant mode: TE_{10} and TM_{10}

8. What is cut off frequency?(Or)

Define the cut-off frequency of a guide. (2) [AU-NOV2007]. (R)

The frequency at which the wave motion ceases is called cut-off frequency of the waveguide.

(Or)

The frequency at which the propagation ceases and attenuation begins is called cut-off frequency of the waveguide.

9. What is cut-off wavelength? (R)

It is the wavelength below which there is wave propagation and above which there is no wave propagation.

10. Write down the expression for cut off frequency when the wave is propagated in between two parallel plates. (R)

The cut-off frequency,

$$f_c = \frac{m}{2a\sqrt{\mu\varepsilon}}$$

11. Mention the characteristics of TEM waves. [AU:Jan'16] [AU:MAY'05](Or)

What are the characteristics of principal wave? (2) [AU-NOV2006] [AU-NOV2007] [AU-APR2009]

(Or) Enumerate the properties of TEM waves between parallel planes of perfect conductors. (2) [AU-NOV2008] (U)

a) It is a special type of TM wave.
b) It does not have either E_z or H_z component.
c) Its velocity is independent of frequency.
d) Its cut-off frequency is zero.

12. What is the cut-off frequency of TEM waves [AU-APR2007] (R)

Its cut-off frequency is zero.

13. Define attenuation factor. (R)

$$\text{Attenuation factor} = \frac{\text{Power lost/ unit length}}{2 \text{ x power transmitted}}$$

14. Give the relation between the attenuation factor for TE waves and TM waves. (U)

$$\alpha_{TE} = \left(\frac{f_c}{f}\right)^2 \alpha_{TM}$$

15. Define wave impedance. (R)

Wave impedance is defined as the ratio of electric to magnetic field strength,

$$Z^{+}_{xy} = \frac{E_x}{H_y} \text{ in the positive direction}$$

$$Z^{-}_{xy} = -\frac{E_x}{H_y} \text{ in the negative direction}$$

16. Write down the expression for cut-off wavelength of the wave which is propagated in between two parallel plates. (R)

The cut-off wavelength, $\lambda_c = \frac{2a}{m}$

17. Give the expression for the guide wavelength when the wave is transmitted in between two parallel plates. (R)

The guide wavelength, $\lambda g = \frac{2\pi}{\sqrt{\omega^2\mu\varepsilon - \left(\frac{m\pi}{a}\right)^2}}$

18. Write down the relation between guide wavelength and cut-off wavelength. (U)

$$\lambda g = \frac{\lambda_0}{\sqrt{1 - \left(\frac{\lambda_0}{\lambda_c}\right)^2}}$$

$$\lambda_0 = \frac{\lambda_c \lambda_g}{\sqrt{\lambda_c^{\,2} + \lambda_g^{\,2}}}$$

19. Give the expression for velocity of propagation of wave in between two parallel plates. (R)

$$v = \frac{\omega}{\sqrt{\omega^2\mu\varepsilon - \left(\frac{m\pi}{a}\right)^2}}$$

$$v = \frac{v_0}{\sqrt{1-\left(\frac{\omega_c}{\omega}\right)^2}}$$

20. Give the relation between phase velocity and group velocity (Or) Give the expression that relates phase velocity (Vp), group velocity (Vg) and free space velocity(C). (2) [AU-MAY2007]. (R)

$$v_p = \frac{v^2}{v_g} \qquad \text{Or} \qquad v_p v_g = C^2$$

21. Give the frequency of minimum attenuation for TM mode. (R)

The attenuation α_{TM} reaches a minimum value at a frequency equal to $\sqrt{3}$ times the cut-off frequency

$f = \sqrt{3}\, f_C$

22. Distinguish between TE and TM waves (Or) Compare TE and TM Mode [AU:MAY2012]. (AZ)

S.No	TE Waves	TM waves
1	Transverse electric (TE) wave is a wave in which the electric field strength E is entirely transverse.	Transverse magnetic (TM) wave is a wave in which the magnetic field strength H is entirely transverse.
2	It has a magnetic field strength H_z in the direction of propagation	It has electric field strength E_z in the direction of propagation
3	No component of electric field strength E_z in the direction of propagation.	No component of magnetic field strength H_z in the direction of propagation.

RECTANGULAR WAVEGUIDE

1. What is a waveguide? (R)

A waveguide is a hollow conducting metallic tube of uniform cross section used for UHF (Ultra High Frequency) transmission by continuous reflection from the inner walls of the guide.

2. Why rectangular waveguides are preferred over circular waveguide? (U)

Rectangular waveguides are preferred over circular waveguide because of the following reasons.

a) Rectangular waveguide is smaller in size than a circular waveguide for the same frequency.

b) The difference between the lowest frequency on a dominant mode and the next mode of a rectangular waveguide is higher than that in a circular waveguide.

3. What are the advantages of waveguide? (U)

The advantages of waveguides are,

a) In waveguides, no power is lost through radiation because the electric and magnetic fields are confined to the space with in the guides.

b) The dielectric loss is negligible.

c) Several modes of electromagnetic waves can be propagated with in a single waveguide.

d) Frequencies of the wave higher than 3 GHz can be easily transmitted.

4. What are the disadvantages of waveguide? (U)

The disadvantages of waveguide are,

a) The cost of the waveguide is very high.

b) The waveguide walls should be specially plated to reduce resistance to avoid skin effect and power loss.

5. Mention the applications of wave guides. (U)

The wave guides are employed for transmission of energy at very high frequencies where the attenuation caused by wave guide is smaller. Waveguides are used in microwave transmission. Circular waveguides are used as attenuators and phase shifters

6. What is an evanescent mode? (R)

When the operating frequency is lower than the cut-off frequency, the propagation constant becomes real i.e., $\gamma = a$. The wave cannot be propagated. This non- propagating mode is known as evanescent mode.

7. What are dominant mode and degenerate modes in a rectangular waveguide?[AU:NOV2006] [AU:APR'15] [AU:Jan'16]. (R)

The modes that have the lowest cut off frequency is called the **dominant mode.**

Some of the higher order modes having the same cutoff frequency are called as **degenerate modes**.

8. What is the dominant mode for the TE waves in the rectangular waveguide? (R)

The lowest mode for TE wave is TE_{10} (m=1, n=0)

9. What is the dominant mode for the TM waves in the rectangular waveguide? (R)

The lowest mode for TM wave is TM_{11} (m=1, n=1)

10. Define dominant mode. What is the dominant mode of rectangular waveguide? [AU:May'15]. (R)

The modes that have the lowest cut off frequency is called the dominant mode

The lowest mode for TE wave is TE_{10} (m=1, n=0) whereas the lowest mode for TM wave is TM_{11} (m=1, n=1). The TE_{10} wave has the lowest cut off frequency compared to the TM_{11} mode. Hence the TE_{10} (m=1, n=0) is the dominant mode of a rectangular waveguide.

11. Why the TE_{10} wave is called as dominant wave in rectangular wave guide? (2) [AU-MAY2007]. (U)

The TE_{10} (m=1, n=0) is the dominant mode of a rectangular waveguide. Because the TE_{10} mode has the lowest attenuation of all modes in a rectangular waveguide and its electric field is definitely polarized in one direction everywhere.

12. Which are the non-zero field components for the for the TE_{10} mode in a rectangular waveguide? (R)

H_x, H_z and E_y

13. Which are the non-zero field components for the for the TM_{11} mode in a rectangular waveguide? (R)

H_x, H_z, E_y and E_z

14. What is the cut-off wavelength and cut-off frequency of the TE_{10} mode in a rectangular waveguide? (R)

Cut-off wavelength, $\lambda_c = 2a$

Cut-off frequency, $f_c = \frac{C}{2a}$

15. What is the cut-off wavelength and cut-off frequency of the TM11 mode in a rectangular waveguide? (R)

Cut-off wavelength, $\lambda_c = \dfrac{2}{\sqrt{\left(\frac{1}{a}\right)^2 + \left(\frac{1}{b}\right)^2}}$

Cut-off frequency, $f_c = \dfrac{1}{2\sqrt{\mu\varepsilon}}\sqrt{\left(\frac{1}{a}\right)^2 + \left(\frac{1}{b}\right)^2}$

$$f_c = \frac{\nu}{2}\sqrt{\left(\frac{1}{a}\right)^2 + \left(\frac{1}{b}\right)^2}$$

16. What is the wave impedance for TE waves in a rectangular WG? (R)

$$Z_{TE} = \frac{\eta}{\sqrt{1 - \left(\frac{f_c}{f}\right)^2}} \text{ or } \frac{\omega\mu}{\beta}$$

17. What is the wave impedance for TM waves in a rectangular WG? (R)

$$Z_{TM} = \eta\sqrt{1 - \left(\frac{f_c}{f}\right)^2}$$

18. What is the wave impedance for TEM waves in a waveguide? (R)

$$Z_{TEM} = \eta = \sqrt{\frac{\mu}{\varepsilon}}$$

19. Write the expression for phase velocity in a waveguide. (R)

$$\nu = \frac{\omega}{\sqrt{\omega^2\mu\varepsilon - \left(\frac{m\pi}{a}\right)^2 - \left(\frac{n\pi}{b}\right)^2}}$$

20. Why TEM mode is not possible in rectangular waveguide? [AU:NOV2014]. (U)

Transverse electromagnetic (TEM) wave do not have axial component of either E or H so, it cannot propagate within a single conductor waveguide

21. Why TM_{01} and TM_{10} modes in a rectangular waveguide do not exist? (U)

For TM modes in rectangular waveguides, neither m nor n can be zero because all the field equations vanish (i.e., $E_z = E_y = H_x = H_y = 0$). If m=0, n=1 or m=1, n=0 no fields are present. Hence TM_{01} and TM_{10} modes in a rectangular waveguides do not exist.

22. Define characteristics impedance in a waveguide. (R)

For transmission lines the integrated characteristic impedance Z_0 can be defined as in terms of the voltage-current ratio or in terms of power transmitted for a given voltage or a given current.

$$Z_0 (V, I) = \frac{V}{I}$$

$$Z_0 (W, I) = \frac{2W}{I.I^*}$$

$$Z_0 (W, V) = \frac{V.V^*}{2W}$$

23. Define wave impedance and write the expression for wave impedance of TE waves in rectangular guide. (2) [AU-NOV2007]. (R)

The Wave impedance for the TE wave can be defined as the ratio of the strength of the electric field in one transverse direction to the propagation to the strength of the magnetic field in other transverse direction to the propagation.

$$Z_{TE} = \frac{\eta}{\sqrt{1-\left(\frac{f_c}{f}\right)^2}} \text{ or } \frac{\omega\mu}{\beta}$$

CIRCULAR WAVE GUIDES AND RESONATORS

1. What is Bessel equation? What is Bessel function? (R)

The analysis of field components within the hollow, perfectly conducting cylinder with uniform circular cross-section is carried out using the cylindrical co-ordinate system. The resulting differential equation is called as **Bessel's equation**. The solution of such equation is called as **Bessel's function**.

2. Mention the applications of circular waveguide. (R)

Circular waveguides are used as attenuators and phase-shifters.

3. Which mode in circular waveguides has attenuation effect decreasing with increase in frequency? (U)

TE_{01}.

4. Mention the dominant modes in rectangular and circular waveguides. (R)

For a rectangular waveguide, the dominant mode is TE_{01}.

For a Circular waveguide, the dominant mode is TE_{11}.

5. Write the expression for cut-off frequency in a circular waveguide. (R)

$$f_c = \frac{h_{nm}}{2\pi\sqrt{\mu\varepsilon}}, \text{ where } h_{nm} = \frac{(ha)_{nm}}{a}$$

6. Why is TM_{01} mode preferred to the TE_{01} mode in a circular waveguide? (U)

TM_{01} mode is preferred to the TE_{01} mode, since it requires a smaller diameter for the same cut-off wavelength.

7. Define Q of a waveguide. (R)

Quality factor Q is given by,

$$Q = \omega \frac{\text{energy stored / unit length}}{\text{energy lost / unit length / second}}$$

8. Give the relation between quality factor and attenuation factor of a waveguide. (R)

$$Q = \frac{\omega}{2v_g\alpha}$$

9. What are the performance parameters of microwave resonators? (R)

The performance parameters of microwave resonators are:

i. Resonant frequency,
ii. Quality factor
iii. Input impedance

10. What is resonant frequency of a microwave resonator? (R)

Resonant frequency of a microwave resonator is the frequency at which the energy in the resonator attains maximum value. ie., twice the electric energy or magnetic energy.

11. Define the quality factor of microwave resonator. (R)

The quality factor, Q is the measure of the frequency selectivity of the resonator. It is defined as,

Energy dissipated per cycle

$$Q = 2\pi \text{ x } \frac{\text{Maximum energy stored}}{\text{Energy dissipated per cycle}} = \omega\frac{W}{P}$$

Where, W is the maximum stored energy and
P is the average power loss.

12. Why transmission line resonator is not usually used as microwave resonator? (U)

At very high frequencies the transmission line resonator does not give very high quality factor, Q due to skin effect and radiation loss in braided cables. So, the transmission line resonator is not used as a microwave resonator

13. Why rectangular or circular cavities can be used as microwave resonator? (U)

Rectangular or circular cavities can be used as microwave resonators because they have natural resonant frequency and behave like a LCR circuit.

14. Name three basic configurations of coaxial resonators. (R)

The basic configurations of coaxial resonators are:

i. Quarter wave coaxial cavity
ii. Half wave coaxial cavity
iii. Capacitive end coaxial cavity

15. Write the expression for resonant frequency for a rectangular resonator. (R)

$$\text{The resonant frequency, } f_o = \frac{1}{2\sqrt{\mu\varepsilon}}\sqrt{\left(\frac{m}{a}\right)^2+\left(\frac{n}{b}\right)^2+\left(\frac{p}{d}\right)^2}$$

16. What is the dominant mode for a rectangular resonator? (R)

The dominant mode of a rectangular resonator depends on the dimension of the cavity. For b< a< d, the dominant mode is TE_{101} mode.

17. Write the resonant frequency of a circular resonator. (R)

The resonant frequency is,

$$\text{For TE, } f_o = \frac{1}{2\pi\sqrt{\mu\varepsilon}}\sqrt{\left(\frac{h'_{nm}}{a}\right)^2+\left(\frac{p\pi}{d}\right)^2};\ h'_{nm} = \frac{(ha)'_{nm}}{a}$$

$$\text{For TM, } f_o = \frac{1}{2\pi\sqrt{\mu\varepsilon}}\sqrt{\left(\frac{h_{nm}}{a}\right)^2+\left(\frac{p\pi}{d}\right)^2};\ h_{nm} = \frac{(ha)_{nm}}{a}$$

18. What is the dominant mode for a circular resonator? (R) (Or)
Which mode is called as dominant mode in the circular waveguide? (U) (2) [AU-MAY2008] (Or)
Which is the dominant mode in circular waveguide? (R) (2) [AU-MAY2009]

The dominant mode of a circular resonator will depend on the dimensions of the resonator.

For d< 2a, the dominant mode is TM_{010}.

For d≥ 2a, the dominant mode is TE_{111}.

19. What is the dominant mode for a semicircular resonator? (R)

The dominant mode of a semicircular resonator will depend on the dimensions of the resonator.

For d>a, the dominant mode is TE_{111}.

For d<a, the dominant mode is TM_{110}.

20. Write the resonant frequency of a semicircular resonator. (R)

The resonant frequency is,

For TE, $f_o = \frac{1}{2\pi\sqrt{\mu\varepsilon}}\sqrt{\left(\frac{h'_{nm}}{a}\right)^2 + \left(\frac{p\pi}{d}\right)^2}$

For TM, $f_o = \frac{1}{2\pi\sqrt{\mu\varepsilon}}\sqrt{\left(\frac{h_{nm}}{a}\right)^2 + \left(\frac{p\pi}{d}\right)^2}$

21. Write down the expression for the quality factor of a rectangular waveguide. (R)

The quality factor of a rectangular waveguide is

$$Q = \frac{\pi\eta b\left(a^2 + b^2\right)^{3/2}}{2R_s\left[2b\left(a^3 + b^3\right) + ad\left(a^2 + b^2\right)\right]}$$

Where, a, b and d are the sizes of rectangular cavity

η is the intrinsic impedance of the medium and

R_s is the surface resistance

22. What is the wave impedance for TE waves in a Circular WG? (R)

$$Z_{TE} = \frac{\eta}{\sqrt{1 - \left(\frac{f_c}{f}\right)^2}} \text{ or } \frac{\omega\mu}{\beta}$$

23. What is the wave impedance for TM waves in a Circular WG? (R)

$$Z_{TM} = \eta\sqrt{1 - \left(\frac{f_c}{f}\right)^2}$$

24. How a cavity resonator is formed. [AU:May'15] (U)

A cavity resonator is formed by shorting both the ends of a waveguide. The types of cavity resonator are i) Rectangular cavity resonator and ii) Circular cavity resonator.

25. What is cavity resonator? (2) [AU-MAY2007] (Or) what is meant by cavity resonator? (2) [AU-MAY2009] (R)

A metallic structure with all of its boundaries forming are enclosed set of conducting walls inside which EM waves are confined forming standing wave pattern is called cavity resonator.

26. Write the applications of cavity resonator. [AU:NOV'07] [AU:Jan'16] [AU-NOV2013] [AU-NOV2015] (Or)
Mention the applications of resonant cavities [AU-NOV2014] (R)

i. The cavity resonators are used in Klystron amplifier for amplifying the microwave signal.

ii. The cavity resonator plays important role in microwave signal generation when used in cavity magnetron.

iii. The cavity resonators are extensively used in the light house tube.

iv. The cavity resonators can be used in duplexers in the RADAR system as resonant cavity in Transmit-Receive (TR) tubes and Anti-Transmit-Receive (ATR) tubes.

v. The cavity resonators are most widely used for the measurement of the microwave signals with the help of cavity wavemeters.

27. Distinguish between wave guides and cavity resonator (2) [AU-NOV2008]. (AZ)

S.No	Waveguide	Cavity Resonator
1	A waveguide is a hollow metallic tube of uniform cross section through which EM waves can be transmitted	A cavity resonator is a metallic enclosure with all the sides are closed and conducting
2	It is used for transmitting an EM waves through it at microwave frequencies	Typically cavity resonator is used for storing energy

28. What is the maximum value of the quality factor of a rectangular cavity? (R)

$$Q_{max} = \frac{1.11\eta}{R_s\left[1+\frac{a}{2b}\right]}$$

PART-B

1. Derive the expression for the field strength for TE waves between parallel plates (parallel to xy plane) propagating in Z direction. (12) **[AU-NOV2006] (Or)** Obtain the solution of field components of TE waves between parallel plates, propagating in Z direction (10) **[AU-MAY2009] (Or) (AZ)**

   Derive the expression for the field strengths for Transverse Electric waves between a pair of parallel perfectly conducting planes of infinite extent in the 'Y' and 'Z' directions. The planes are separated in X direction by 'a' meter. (16) **[AU-MAY2008]. (AZ)**

2. Derive the components of Electric and Magnetic field strength between a pair of parallel perfectly conducting planes of infinite extent in the 'Y' and 'Z' directions. The planes are separated in X direction by "a" meter. (10) **[AU-MAY2007] [AU-NOV2008]. (AZ)**

3. Derive the expressions for the field components of TM waves between parallel plates, propagating in Z direction. (10) **[AU-NOV2007]. (AZ)**

4. Derive the field configuration, cut-off frequency and velocity of propagation for TM waves in rectangular waveguide. (16) **[AU-MAY2008]. (AZ)**
5. Discuss the characteristics of TE and TM waves and also derive the cut off frequency and phase velocity from the propagation constant. (8) **[AU-MAY2007]. (AZ)**
6. Discuss the characteristics of TE, TM and TEM waves between parallel conducting planes. And also derive the cut off frequency and phase velocity from the propagation constant. (10) **[AU-MAY2008] [AU-NOV2008]. (AZ)**
7. Describe the velocity of propagation of wave between a pair of perfectly conducting plates. (6) **[AU-NOV2008] (R)**
8. Derive the expressions for the field components of TEM waves between parallel conducting planes. Discuss the properties of TEM waves. (10) **[AU-MAY2009]. (AZ)**
9. Derive the expression for the attenuation constant of TE waves in between two parallel conducting planes. (8) **[AU-NOV2006]. (AZ)**
10. Discuss the attenuation of electromagnetic waves guided along rectangular waveguide. (8) **[AU-NOV2007]. (U)**
11. Derive the wave impedance for TE waves between parallel planes. (6) **[AU-MAY2007]. (AZ)**
12. Explain wave impedance and obtain the expressions of wave impedance for TE and TM waves guided along parallel planes, also sketch the variation of wave impedance with frequency. (10) **[AU-NOV2007]. (AZ)**
13. Derive the field configuration, cut off frequency and velocity of propagation for TM waves in rectangular wave guide. (16) **[AU-MAY2007]. (AZ)**
14. Obtain the solution of Electric and Magnetic fields of TM waves guided along rectangular wave guide. (10) **[AU-NOV2007]. (AZ)**
15. Deduce the expressions for the field components of TM waves guided along a rectangular waveguide. (16) **[AU-MAY2009] (Or)** Derive the field expression for TM wave propagation in rectangular waveguide stating the necessary assumptions. (16) **[AU-MAY2012]. (AZ)**
16. Determine the solution of electric and magnetic fields of TE waves guided along rectangular waveguide. (10) **[AU-NOV2006] (Or). (AZ)**

    Describe the propagation of TE waves in a rectangular waveguide with necessary expressions for the field components. (12) **[AU-NOV2013]. (AZ)**
17. Derive the field configuration, cut off frequency and velocity of propagation for TE waves in rectangular wave guide. (16) **[AU-NOV2008] (AZ)**
18. Explain wave impedance of a rectangular waveguide and derive the expression for the wave impedance of TE, TM and TEM waves. (8) **[AU-NOV2006] (AZ)**

19. Derive the expression of wave impedance for TE and TM waves guided along rectangular waveguide. (8) **[AU-MAY2009] (AZ)**
20. Derive the expressions for cut-off frequency, phase shift constant and velocity of propagation of waves in a circular waveguide. (6) **[AU-NOV 2006] (AZ)**
21. Sketch the electric and magnetic field configurations for TE_{01} mode in a circular waveguide. (4) **[AU-NOV2006] (R)**
22. Derive the TM wave components in circular wave guides using Bessel function. (12) **[AU-MAY2007] [AU-NOV2008] (Or)** Determine the solution of electric and magnetic fields of TM waves guided along circular waveguide. (10) **[AU-NOV2007] (AZ)**
23. Using the Bessel function derive the TE wave components in circular waveguides. (10) **[AU-MAY2008] (Or)** Derive the expressions for the field components of TE waves guided along circular waveguide. (10) **[AU-MAY2009] (AZ)**
24. Write a brief note on excitation of modes in circular wave guides. (6) **[AU-NOV2008] (R)**
25. What is meant by cavity resonator? Derive the expression for the resonant frequency of the rectangular cavity resonator. (8) **[AU-NOV2006] (AZ)**
26. Obtain the expression for resonant frequency of a rectangular cavity resonator. (8) **[AU-NOV2007] [AU-MAY2009] (AZ)**
27. Explain the concept of transmission of TM waves and TEM waves between parallel plates (16) **[AU-MAY2012] (R)**
28. Discuss the transmission of TM waves between parallel perfectly conducting planes with necessary expressions for the field components. Discuss briefly the manner how the wave travels and phase and group velocities between the two parallel planes. (16) **[AU-NOV2013] (AZ)**
29. i) Explain the concept of excitation of waveguides. (8) **(R)**

    ii) Discuss the structure, advantages and disadvantages of resonant cavities. (8) **[AU-MAY2012] (U)**
30. i) Discuss briefly the attenuation of TE and TM waves between parallel planes. (10) **(U)**

    ii) Give a brief note on the transmission of TEM waves between parallel planes. (6) **[AU-NOV2013] (U)**
31. Explain briefly the propagation of TM waves in a circular waveguide with necessary expressions for the field components. (10) **(U)**

    ii) Give a brief note on excitation of modes in rectangular waveguides. (6) **[AU-NOV2013] (R)**
32. Derive the expressions for transmission of TE waves between parallel planes (16) **[AU-NOV2014] (AZ)**

33. Explain the principles of the following: (i) Excitation of waveguides (ii) Guide termination and resonant cavities (16) **[AU-NOV2014] (R)**
34. Discuss the characteristics of TE and TM waves and also derive the cut off frequency and phase velocity from the propagation constant. **[AU-MAY2015] (AZ)**
35. (i) Derive field component of the wave propagation between parallel plates. **(AZ)**

    (ii) Derive the expression of wave impedance of TE, TM and TEM wave between a pair of perfectly conducting planes. **[AU-MAY2015] (AZ)**
36. Explain about excitation modes in rectangular wave guide. **(6) [AU-MAY2015] (R)**
37. Explain the propagation of electromagnetic waves in a cylindrical waveguide with suitable expressions. (16) **[AU-MAY2015]. (R)**

PROBLEMS

1. A parallel plane waveguide with plate separation of 20 cm with the TE_{10} mode excited at 1GHz. Find the propagation constant. (4) **[AU-NOV2006] (A)**
2. A wave is propagated in a parallel plane waveguide. The frequency is 6 GHz and the plane separation is 3cm. determine the group and phase velocities for the dominant mode. (2) **[AU-NOV2013]. (A)**
3. Pair of perfectly conducting planes is separated by 8 cm in air. For a frequency of 500 MHz with TM10mode excited, find cut-off frequency, phase shift, phase velocity and group velocity. (8) **[AU-NOV2006] (A)**
4. For a frequency of 10 GHz and plane separation of 5 cm in air, find the cutoff wavelength, phase velocity and group velocity of the wave. (6) **[AU-MAY2009] (A)**
5. A TEM wave at 1 MHz propagates in the region between conducting planes which is filled with dielectric material of $\mu_r = 1$ and $\varepsilon_r = 2$. Find the phase constant and characteristic wave impedance. (4) **[AU-NOV 2010] (A)**
6. An air filled rectangular waveguide with dimensions of a = 8.5 cm and b = 4.3 cm is fed by a 4 GHz carrier from co-axial cable. Determine the cut-off frequency, phase velocity and group velocity for TE_{11} mode. (6)**[AU-NOV2006] (A)**
7. The cut-off wavelengths of a rectangular waveguide are measured to be 8 cm and 4.8 cm for TE_{10} and TE_{11} mode respectively. Determine waveguide dimensions. (8) **[AU-NOV2006] (A)**
8. A TE_{10} wave at 10GHz propagates with the velocity of 2 x 10^8 m/sec in a brass σ_c = 1.57 X 10^7 s/m - rectangular wave guide with inner dimensions a

= 1.5 cm and b = 0.6 cm, which is filled with polyethylene ε_r = 2.25, μ_r = 1. Calculate the Phase constant, Guide wave length, Phase velocity, Wave impedance. Which signal among the two separate signals with frequency of 5 GHz and 15 GHz will be supported by the rectangular wave guide for propagation through it? (16) **[AU-MAY2007](E)**

9. What are the dimensions of a waveguide with the following specifications? (1) At a frequency of 9959.5 MHz, the guide wavelength for TE mode is 87.57% of the cut-off wavelength.(2) TE_{30} and TE_{12} mode have the same cut-off frequency. (8) **[AU-NOV2007] (A)**
10. A rectangular wave guide with dimensions a = 2.5 cm, b= 1 cm is to operate below 15 GHz. How many TE and TM modes can the waveguide transmit if the guide is filled with a medium characterized by α=0, ε = 4 ε_o, μ_r=1? Calculate the cutoff frequencies of the modes. **(A)**
11. A rectangular waveguide with dimensions a = 8.5 cm and b = 4.3cm is fed by 5 GHz carrier. Will a TE_{11} mode be propagated? (2) **[AU-NOV2007] (E)**
12. Calculate the cut-off wavelength of a rectangular wave guide whose inner dimensions are 'a' 2.3cm and 'b' = 1.03 cm operating at TE_{10} mode. (2) **[AU-MAY2008] (A)**
13. Calculate the cut-off frequency of a rectangular wave guide whose inner dimensions are 'a'=2.5cm and 'b' =1.5cm operating at TE_{10} mode. (2) **[AU-NOV2008] (A)**
14. A rectangular waveguide with dimension a=8.5 cm and b=4.3 cm. Determine the cut-off frequency for TM_{10} mode of propagation. (2) **[AU-MAY2009] (A)**
15. A rectangular waveguide has the following dimensions l=2.54cm, b=1.27 cm waveguide thickness=0.127 cm. Calculate the cut-off frequency for TE_{11} mode. (2) **[AU-NOV2006] [AU-MAY2015] (A)**
16. Given a circular waveguide of internal diameter 12 cm operating with a 8 GHz. Signal propagating $TM_{2,\ 2}$ mode. Calculate λ_1, λ_c, λ_g and η_g [(ha)2,2 =8.42]. (6) **[AU-NOV2006] (A)**
17. A circular waveguide has an internal diameter of 4 cm. For a 10 GHZ signal propagated in it in the TE_{11} mode, calculate cut-off wavelength, guide wavelength and characteristic impedance. [$(ha)^1_{11}$ = 1.84] (6)**[AU-NOV2007] (A)**
18. A 10 GHZ signal is to be transmitted inside a hollow circular conducting pipe. Determine the inside diameter of the pipe such that its lowest cut off frequency is 20% below this signal frequency. (6) **[AU-MAY 2012] (A)**
19. A rectangular cavity resonator excited by TE_{101} mode at 20 GHz, have the dimensions a = 2 cm and b = 1 cm. calculate the length of the cavity. (8) **[AU-NOV2006] (A)**

20. Calculate the resonant frequency of an air filled rectangular resonator of dimensions a = 3 cm, b = 2 cm and d = 4 cm operating in TE_{101}mode. (4) **[AU-MAY2007] [AU-MAY2015] [AU-NOV2007] (A)**

21. Find the resonant frequencies of first five lower modes of an air-filled rectangular cavity of dimensions 5cm x 2.5 cm. List them in ascending order. (8) **[AU-DEC 2011] (A)**

22. An air filled circular waveguide having an inner radius of 1 cm is excited in dominant mode at 10 GHz. Find cut-off frequency of dominant mode, guide wavelength, wave impedance and the bandwidth for operation in dominant mode only (Given X_{11} =1.84, X_{01} = 2.40)(8) **[AU-DEC 2011] (A)**

ASSIGNMENT PROBLEMS

1. Parallel perfectly conducting plates are separated by 7 cm in air and carry a signal with frequency (f) of 6GHz in TE_1 mode. Find The cut-off frequency (fc), Phase constant, Attenuation constant and Phase constant for f = 0.8 fc and Cut off wavelength. (8) **[AU-MAY2007] (A)**
2. For a frequency of 6 GHz and plane separation = 7 cm. Find the following for the TE_{10} mode find Cut-off frequency, Phase and group velocity. (6)**[AU-NOV2007] (A)**
3. For a frequency of 5 GHz and plane separation of 8 cm in air, find the following for TM mode (6)
   (1) Cut-off wave length
   (2) Characteristic impedance and
   (3) Phase constant**[AU-NOV2007] (A)**
4. A Pair of perfectly conducting plates is separated by 3cm in air and carries a 10GHz signal in TM_1 mode. Find the cut-off frequency, Phase constant, Cut-off wavelength. (6) **[AU-MAY2008] (A)**
5. Parallel perfectly conducting plates are separated by 5cm in air and carry a signal with frequency of 10GHz in TM_{11} mode. Find the cut-off frequency and cut-off wave length. (4) **[AU-NOV2008] (A)**
6. A pair of perfectly conducting planes is separated by 3.6 cm in air. For TM_{10} modes determine the cut-off frequency and cut-off wavelength if the operating frequency is 5 GHz. (6) **[AU-MAY2009] (A)**
7. A rectangular waveguide measures 3 x 4.5 cm internally and has a 10 GHz signal propagated in it. Calculate the cut-off wavelength, the guide wavelength and the characteristic wave impedance for the TE mode. (6) **[AU-NOV2007] (A)**
8. An X-band air filled rectangular waveguide has inner dimensions of 'a' = 2.3cm and 'b' = 1cm. Calculate the cut-off frequencies in the following modes: TE_{10}, TE_{20}, TM_{11}, TM_{12}. Also check which of the modes will propagate along the waveguide when the signal frequency is 10GHz. (8) **[AU-MAY2008] (A)**

9. An air filled rectangular waveguide of dimensions a=4.5cm and b=3cm operates in the TM11 mode. Find the cutoff wavelength and characteristic wave impedance at a frequency of 9 GHz. (4) **[AU-NOV2013] (A)**
10. A TE_{10} wave at 10GHz propagates in a X-band copper rectangular wave guide whose inner dimensions are 'a' = 2.3 cm and 'b' = 1 cm, which is filled with Teflon ε_r =2.1, μ_r =1. Calculate the cut-off frequency, velocity of propagation, phase velocity, phase constant, guide wave length and wave impedance. (16) **[AU-NOV2008] (A)**
11. A TE_{10} mode is propagated through a waveguide with a=10cm at a frequency of 2.5 GHz. Find cut-off wavelength, phase velocity, group velocity and wave impedance. (8 **[AU-MAY2009] (A)**
12. A rectangular waveguide with a=7cm and b=3.5cm is used to propagate TM10 at 3.5 GHz. Determine the guided wavelength. (2) **[AU-NOV2013] (A)**
13. A rectangular waveguide with a 5 cm x 2 cm cross is used to propagate TM_{11} mode at 10GHz. Determine the cut off wavelength. (2) **[AU-NOV2014] [AU-NOV2015] (A)**
14. A rectangular air filled copper waveguide with a=2.28 cm and b=1.01 cm cross section and l=30.48 cm is operated at 9.2 GHz with a dominant mode. Find the cut off frequency, guide wavelength, phase velocity and characteristic impedance. (16) **[AU-NOV2014] (A)**
15. A rectangular air-filled copper waveguide with dimension 0.9 inch x 0.4 inch cross section and 12 inch length is operated at 9.2 GHz with a dominant mode. Find cut-off frequency, guide wavelength, phase velocity, characteristics impedance and the loss. (16) **[AU-DEC 2011] [AU-NOV2015] (A)**
16. A rectangular waveguide measuring a = 4.5 cm and b = 3 cm internally has a 9 GHz signal propagated in it. Calculate the guide wavelength, phase and group velocities and characteristic impedance for the dominant mode.(6)**[AU-NOV2006] [AU-NOV 2013] (A)**
17. A circular waveguide has an internal diameter of 6cm. For a 9 GHz signal propagated in it in the TE_{11} mode, Calculate cut-off frequency and characteristic impedance [$(ha)^1_{11}$ = 1.84]. (6) **[AU-MAY2009] (A)**
18. Calculate the resonant frequency of an air filled rectangular resonator of dimensions a = 2cm, b = 4cm and d = 6cm operating in TE_{101} mode. (6) **[AU-MAY2008] [AU-NOV2015] (A)**
19. Calculate the lowest resonant frequency of a rectangular cavity resonator of dimension a = 2 cm, b = 1cm and d = 3cm. (8) **[AU-MAY2009] (A)**
20. Assess the features of TEM waves **(E)**
21. Formulate an expression for measuring quality factor of rectangular and circular waveguide. **(C)**

PANIMALAR ENGINEERING COLLEGE

DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

EC6504 MICROPROCESSOR AND MICROCONTROLLER

UNIT-I THE 8086 MICROPROCESSOR

Part-A

1. **Define microprocessor? (R)**

A microprocessor is a multipurpose, programmable, clock-driven, register – based electronic device that reads binary instructions from a storage device called memory . Accepts binary data as input and processes data according to instructions, and provides result as output.

2. **What are the basic units of a microprocessor ? (R)**

The basic units or blocks of a microprocessor are ALU, an array of registers and control unit.

3. **What are machine language and assembly language programs?(U)**

The software developed using 1's and 0's are called machine language programs. The software developed using mnemonics are called assembly language programs.

4. **What is the drawback in machine language and assembly language programs?(U)**

The machine language and assembly language programs are machine dependent. The programs developed using these languages for a particular machine cannot be directly run on another machine.

5. **What is assembly language? (R)**

The language in which the mnemonics (short -hand form of instructions) are used to write a program is called assembly language. The manufacturers of microprocessor give the mnemonics.

6. **Define bit, byte and word.(U)**

A digit of the binary number or code is called bit. Also, the bit is the fundamental storage unit of computer memory. The 8-bit (8-digit) binary number or code is called byte and 16-bit binary number or code is called word. (Some microprocessor manufactures refer the basic data size operated by the processor as word).

7. **What is a bus? (R)**

Bus is a group of conducting lines that carries data, address and control signals.

8. **Why data bus is bi-directional?(U)**

The microprocessor has to fetch (read) the data from memory or input device for processing and after processing, it has to store (write) the data to memory or output device. Hence the data bus is bi-directional.

9. Why address bus is unidirectional?(U)

The address is an identification number used by the microprocessor to identify or access a memory location or I / O device. It is an output signal from the processor. Hence the address bus is unidirectional.

10. Differentiate between Memory mapped I/O and I/O mapped I/O.(AZ)

S.NO	Memory mapped I/O	I/O mapped I/O
1.	It is treated as memory location	It is not treated as memory location
2.	No special instructions are needed to access the I/O devices	It requires special instructions like IN, OUT to access I/O devices
3.	Microprocessor can access 1 MByte memory locations or I/O ports	Microprocessor can access 64 KByte memory locations or I/O ports
4.	It requires 20 address lines	It requires 16 address lines
5.	MEMR, MEMW signals can be used to access I/O devices	IOR , IOW signals are used
6.	It is suitable for small system	It is suitable for large system

11. What is an interrupt? (R)

Interrupt is a signal send by an external device to the processor so as to request the processor to perform a particular task or work.

12. Define (a)Instruction Cycle (b) M/C Cycle (c) T-state. (R)

***Instruction cycle*:** Time required completing the execution of an instruction. One instruction cycle consists of 3 to 6 machine cycles.

***Machine cycle*:** Time required completing one operation of accessing memory or I/O device. One machine cycle consists of 3 to 6 T-states.

***T-State*:** The portion of the operation performed in one clock period.

13. Define machine cycle. (R)

Machine cycle is defined as the time required to complete one operation of accessing memory, I/O, or acknowledging an external request. This cycle may consist of three to six T-states.

14. Define T-State. (R)

T-State is defined as one subdivision of the operation performed in one clock period. These subdivisions are internal states synchronized with the system clock, and each T-State is precisely equal to one clock period.

15. What is the difference between Opcode and Operand?(AZ)

Opcode is the part of an instruction that identifies a specific operation. Operand is a part of an instruction that represents a value on which the instruction acts.

Example: MVI A ,18H MVI A is Opcode and 18 H is Operand.

16. What is Stack and Subroutine? (R)

Stack -It is a reserved area of the memory in the RAM , where temporary information may be stored. Subroutine-It is a group of instructions written from the main program to perform a function that occurs repeatedly in the main program

17. What are the difference between PUSH and POP instruction?(AZ)

S.NO	PUSH	POP
1.	Push register pack onto stack	Pop off stack to register pair
2.	The contents of the register pair designated in the operand are copied into the stack. The SP is decremented and the contents of the high order register are copied into that location.	The contents of memory location pointed out by the SP register are copied into the low order register of the operand.

18. What is meant by LATCH? (U)

Latch is a D- type flip-flop used as a temporary storage device controlled by a timing signal, which can store 0 or 1. The primary function of a Latch is data storage. It is used in output devices such as LED, to hold the data for display.

19. What is flag? (R)

Flag is a flip-flop used to store the information about the status of a processor and the status of the instruction executed most recently.

20. Why are the program counter and the stack pointer 16-bit registers? [NOV/DEC 2012](AZ)

Program Counter (PC) and Stack Pointer (SP) are basically used to hold 16-bit memory addresses. PC stores the 16-bit memory address of the next instruction to be fetched. SP can be used to temporarily store the 16-bit memory address as well as data. So PC & SP are 16-bit registers.

21. What are the modes in which 8086 can operate?(U)

The 8086 can operate in two modes and they are minimum (or uniprocessor) mode and maximum (or multiprocessor) mode.

22. What are the flags in 8086? (R)

- ✓ Carry flag
- ✓ Parity flag
- ✓ Auxiliary carry flag
- ✓ Zero flag
- ✓ Overflow flag
- ✓ Trap flag
- ✓ Interrupt flag
- ✓ Direction flag and
- ✓ Sign flag.

23. What are the various interrupts in 8086? (R)

Maskable interrupts, Non-Maskable interrupts.

24. What is meant by Maskable interrupts and Non-Maskable interrupts? (R)

An interrupt that can be turned off by the programmer is known as Maskable interrupt.
An interrupt which can be never be turned off (ie.disabled) is known as Non-Maskable interrupt.

25. What is meant by vectored interrupt? [MAY/JUNE 2014] (R)

A vectored interrupt is a processing technique in which the interrupting device directs the processor to the appropriate interrupt service routine. Vectored interrupts are achieved by assigning each interrupting device a unique code, typically four to eight bits in length.[1] When a device interrupts, it sends its unique code over the data bus to the processor, telling the processor which interrupt service routine to execute.

26. What are the different functional units in 8086? (R)

Bus Interface Unit and Execution unit are the two different functional units in 8086.

27. Which Segment is used to store interrupt and subroutine return address registers? (U)

Stack Segment in segment register is used to store interrupt and subroutine return address registers.

28. Which Flags can be set or reset by the programmer and also used to control the Operation of the processor? (U)

Trap Flag, Interrupt Flag, Direction Flag.

29. What does EU do?(U)

Execution Unit receives program instruction codes and data from BIU, executes these instructions and store the result in general registers.

30. What are the addressing modes of 8086? (R)

- Immediate addressing mode
- Direct addressing mode
- Register addressing mode
- Register indirect addressing mode
- Indexed addressing mode
- Register relative addressing mode
- Based indexed addressing mode
- Relative based indexed addressing mode
- Intra segment direct mode
- Intra segment indirect mode
- Inter segment direct mode
- Inter segment indirect mode

31. What are the types of instructions in instruction set of 8086? (R)

- Data copy / Transfer instructions
- Arithmetic and Logical instructions
- Branch instructions
- Machine control instructions
- Flag manipulation instructions
- String instructions

32. List some functions of BIU?(U)

- Sends address of the memory or I/O
- Fetches instructions from memory
- Reads data from port / memory
- Writes data into port / memory
- Supports instruction queuing
- Provides address relocation facility

33. Define assembler directives? (R)

There are some instructions in the assembly language program which are not a part of processor instruction set. These are instructions to assembler and are referred as pseudo operations or assembler directives.

34. List some features of 8086? (R)

- 16 bit microprocessor
- Has a 16 bit data bus, 20 bit address bus
- Can generate 16 bit I / O address
- Provides fourteen 16 bit registers
- Has multiplexed address and data bus
- Can operate in minimum and maximum mode

35. What is pipelining? (R)

In 8086, to speed up the execution of program, the instructions fetching and execution of instructions are overlapped each other. This technique is known as pipelining. In pipelining, when the n th instruction is executed, the n+1 th instruction is fetched and thus the processing speed is increased.

36. How many data lines and address lines are available in 8086? (R)

Address lines= 20 bit address bus
Data lines= 16 bit data bus

37. What is the use of Instruction Queue in 8086 microprocessor? (U)

The queue operates on the principle of first in first out(FIFO). So that the execution unit gets the instruction for execution in the order they fetched .Feature of fetching the next instruction while the current instruction is executing is called pipelining which will reduce the execution time.

38. Write the size of physical memory and virtual memory of 8086 microprocessor. (R)

Physical addresses are formed when the left shifted segment base address is added to the offset address. The combination of segment register base addresses and offset address is the logical address in memory.

Size of physical memory=220=1MB

Size of virtual memory=216=64 KB

39. List the advantages of using segment registers in 8086. (R)

- It allows the memory addressing capacity to be 1MB even though the address associated with individual instruction is only 16-bit.
- It facilitates use of separate memory areas for program , data and stack.
- It allows the program to be relocated which is very useful in multiprogramming.

40. What are the segment registers of 8086? (R)

CS- Code segment, DS-Data segment, ES-Extra segment, SS- Stack segment.

41. State the operation of minimum mode 8086 system? (R)

The 8086 microprocessor can be operated in minimum mode by connecting MN / MX pin to logic1. In this mode all control signals are given by the microprocessor chip itself. There is only a single microprocessor in minimum mode system.

42. What is pipelined architecture? (R)

In pipelined architecture the processor will have number of functional units and the execution time of functional units is overlapped. Each functional unit works independently most of the time.

43. What is the difference between segment register and general-purpose register? (AZ)

The segment registers are used to store 16-bit segment base address of the four memory segments. The general-purpose registers are used s the source or destination register during data transfer and computations, as pointers to memory and as counters.

44. What is the control bits used in IC 8086? (R)

The flags TF, IF and DF of 8086 are used to control the processor operation and so they are called control bits.

45. What is queue? How queue is implemented in 8086? (R)

A data structure, which can be accessed on the basis of first in first out, is called queue. The 8086 have six numbers of 8-bit FIFO registers, which is used for instruction queue.

46. What is the general purpose registers in 8086? (Nov/Dec 2011) (R)

The general purpose registers in 8086 are ax, bx, cx, dx, si, di, bp and sp. They are all 16 bit wide. Each of these has a special purpose in addition to their being of general purpose. For example, CX is used as a counter in conjunction.

47. Discuss the function of instruction queue in 8086? [APRIL / MAY 2016] (A)

In 8086, a 6-byte instruction queue is presented at the Bus Interface Unit (BIU). It is used to prefetch and store at the maximum of 6 bytes of instruction code from the memory. Due to this, overlapping instruction fetch with instruction execution increases the processing speed.

48. Give the importance of assembler directive EVEN. [NOV/DEC 2011]. (R)

The EVEN directive updates the location counter to the next even address, if the current location counter contents are not even, and assigns the following routine or variable or constant to that address.

```
EVEN
PROCEDURE       ROOT
                .
                .
ROOT            ENDP
```

49. List the pointer and index registers of 8086 architecture.[NOV/DEC 2010]. (R)

The pointers contain offset within the particular segment.
The pointer registers are
IP - Instruction Pointer
BP - Base Pointer
SP - Stack Pointer.
The index registers are used as general purpose registers as well as for offset storage.
SI - Source Index Register - used to store the offset of source data
DI - Destination Index Register - used to store the offset of destination data.

50. Identify the addressing modes involved in the following 8086 instructions:
MOV AX, 0005H; MOV AX, 50H [BX] [SI]. [NOV/DEC 2010]. (U)

MOV AX, 0005H - Immediate Addressing Mode
MOV AX, 50H [BX] [SI] - Relative Based Indexed Addressing Mode

51. What are assembler directives? Give examples. [APRIL / MAY 2011] (R)

Assembler directives help the assembler to correctly understand the assembly language programs to prepare the codes.
Examples: DB - Define Byte
DW - Define Word
END - End of Program
ENDP - End of Procedure.

52. What address in the interrupt vector table, are used for a Type-2 interrupt in 8086? [NOV/DEC 2012] ,[MAY/JUNE 2015 (R)

The address used in the interrupt vector table for a Type-2 interrupt is 0000:0008 to 0000:000A reserved for Non-Maskable Interrupt.

53. Why do we use macros?[NOV/DEC 2012] (R)

Suppose a number of instructions are appearing again and again in the main program, the program becomes lengthy. So, a label is assigned with the repeatedly appearing string of instructions is called macro. Macro reduces the time for execution.

54. What do you mean by addressing modes? [MAY/JUNE 2014] (R)

An addressing mode specifies how to calculate the effective memory address of an operand by using information held in registers and/or constants contained within a machine instruction or elsewhere.

Part – B & C

1. Draw the 8086 functional block diagram and explain its architectural features. **(May 07, May 10, May 12.Nov 08, Nov 11, Nov 2012,MAY 2016)(U)**
2. Draw and explain the pin configuration of 8086. **(May 12, May 07)(U)**
3. Explain in detail about the various addressing modes used in 8086 processor? Give Examples. **(May 08, Nov 08, Nov 10, May 11,May 2015)(U)**
4. Explain the string manipulation instructions, process control instructions, and program Execution transfer instruction, bit manipulation instructions and machine control Instructions of 8086 microprocessor with suitable examples.**(Nov 10, May 10) (U)**
5. Discuss in detail about the interrupts and Interrupt Service Routine (ISR) with interrupts Cycle of 8086.**(Nov 07, May 12, Nov 10, May 08, May 07, Nov 11, Nov 2012) (U)**
6. What are assembler directives? Explain ENDP, EQU, EXTERN, EVEN with example. **(May 10, May 12, May 07, May 2013) (R)**
7. Explain the BIOS function, procedures and Macros. **(Nov 08, May 06, May 12, Nov 10)(U)**
8. Develop an 8086 assembly language program for transferring block of data from one set of Memory location to other set of memory locations using suitable string instructions. **(Nov 07, May 08) (C)**
9. Give an example of 8086 instructions: AAA, CWD, JNBE, LAHF, MOVS, RCL, ROL and SAHF**. (Nov 2012) (R & U)**
10. Explain how to pass parameters to macros? **(May 2012)(U)**
11. How does one define and call macro parameters of 8086 microprocessor? **(May 10)(AZ)**
12. Draw and discuss the interrupt structure of 8086. **(May 2014)(U)**

UNIT - II 8086 SYSTEM BUS STRUCTURE

Part – A

1.What is the function of LOCK and RQ/GT Signals? [MAY/JUNE 2013] (R)

LOCK - this output pin indicates that other system bus masters will be prevented from gaining the system bus, while the LOCK signal is low.

RQ/GT - Request/Grant - these pins are used by other local bus masters to force the processor to release the local bus at the end of the processor's current bus cycle.

2. What is the minimum mode signals used in 8086? (R)

The minimum mode signals used in 8086 are DT/R, DEN, ALE, M/IO, WR, INTA, HOLD and HLDA.

3. Describe about the maximum mode 8086 system? (R &U)

In maximum mode, the 8086 is operated by connecting the MN / MX pin to ground. The processor drives the status signals S1, S2 and S3. Another chip called bus controller drives the control signals using the status information.

4. How clock signal is generated in 8086? What is the maximum internal clock frequency of 8086? (U)

The 8086 do not have on-chip clock generation circuit. Hence the clock generation chip, 8284 is connected to CLK pin of 8086.the clock signal supplied by 8284 is divided by three for internal use. The maximum internal clock frequency is 5MHz.

5. What are the signals used in 8086 maximum mode operation? (R)

Qs1, Qs0, s0, s1, s2, LOCK, RQ/GT1, and RQ/GT0 are the signals used in 8086 maximum mode operation.

6. What are the signals involved in memory bank selection in 8086 microprocessor? (R)

Entire memory is divided into two memory banks : bank0 and bank1. Bank0 is selected only when A0 is zero and Bank1 is selected only when BHE is zero. A0 is zero for all even addresses. So bank0 is usually referred as even addressed memory bank.BHE is used to access higher order memory bank , referred to as odd addressed memory bank.

7. What is the use of MN/MX signals in 8086? (R)

It is used to operate the microprocessor in two operating modes i.e. maximum and minimum mode. The minimum mode is used for small systems with a single processor and maximum mode is for medium size to large systems, which include two or more processors.

8. Differentiate between tightly coupled and loosely coupled configurations? (Apr/may 2010) (AZ)

- In a tightly coupled configuration, the 8089 shares the system bus and memory with the host CPU using the RQ / GT pins
- In a loosely coupled configuration, 8089 has its own local bus and communicate with the host using the bus arbiter and controller.

9. What are the three basic bus access control and arbitration scheme? (R)

- Daisy chaining
- Independent request
- Polling

10. List the advantages of loosely coupled systems over the tightly couples systems? (R)

- ✓ More number of CPUs can be added in a loosely coupled system to improve the system performance.
- ✓ System structure is modular and hence easy to maintain and trouble shoot.
- ✓ Fault in a single module does not lead to a complete system break down.
- ✓ It is more fault tolerant due to independent processing modules.
- ✓ More suitable to parallel applications due to its modular organization.

11. State the disadvantages of microprocessor based system design? (R)

- ✓ Overall system cost is high as compared to microcontroller based system.
- ✓ A large size PCB is required for assembling all the components, resulting in an enhanced cost of the system.
- ✓ Overall product design requires more time.
- ✓ Physical size of the product is big and it is not handy.

12. What is a co-processor? What is its use in a typical microprocessor based system. (Apr/may 2010) ? (Apr/may 2015) (R)

8087 NDP (numerical data processor) is also known as math co-processor which is used in parallel with the main processor for number crunching applications, which would otherwise require complex programming. It is also faster than 8086/8088 processor in performing mathematical computation. It has its own specialized instruction sets to handle mathematical programs. It is a processor which works in parallel with the main processor. It has its own set of specialized instructions. The number crunching part of the program is executed by 8087. Instruction for 8087 are written in the main program interspersed with the 8086 instructions. All the 8087 instruction codes have 11011 as the most significant bits of their first code byte.

13. What is bus contention? (U)

Bus contention, in computer design, is an undesirable state of the bus in which more than one device on the bus attempts to place values on the bus at the same time. Most bus architectures require their devices follow an arbitration protocol carefully designed to make the likelihood of contention negligible. However, when devices on the bus have logic errors, manufacturing defects or are driven beyond their design speeds, arbitration may break down and contention may result. Contention may also arise on systems which have a programmable memory mapping and when illegal values are written to the registers controlling the mapping.

14. Give the types of multiprocessor configuration. (R)

Types of multiprocessor configuration:

1. Coprocessor configuration

2. Closely coupled configuration
3. Loosely coupled configuration

15. Write a short note on data register in 8087. (R)

1. It has 8 data register.
2. Each register is 8 bit and accessed as a stack
3. A PUSH operation decrements the TOP of the stack by one and loads the value on The top register.
4. A POP register stores the value from the current TOP register and increments TOP by one.

16. Write a short note on status register in 8087. (R)

1. Status register is 16 bit register.
2. It indicates various errors, stores condition code for certain instruction and indicates the BUSY status.

17. Write a short note on TAG register in 8087. (R)

TAG register holds the status of the contents of the data register.

00 - Data valid
01 - Zero
10 - A special value
11 – Empty

18. List any four 8087 data formats.[MAY/JUNE 2012] ? (Apr/may 2016) (R)

- Word integer
- Short integer
- Long integer
- Packed BCD
- Short real
- Temporary real

19. Give the instruction set of 8087? (R)

1. Data Transfer Instructions
2. Arithmetic Instructions
3. Comparison Instructions.
4. Transcendental Operations.
5. Constant Operations.
6. Coprocessor Control Operations.

20. How does CPU differentiate the 8087 instructions from its own instructions? [MAY/JUNE 2013,NOV/DEC 2012,APRIL/MAY 2011] (U)

The CPU identifies the 8087 instructions by using ESCAPE code bits in them. Once the CPU recognizes the ESCAPE code, it triggers the execution of the numeric processor instruction in 8087.

21. Mention the need for co-processor in a microprocessor based system? [APRIL/MAY 2010] (U)

In a microprocessor based system, the co-processor is needed for achieving higher processing speed, capable of performing complicated calculations in less time.

22. What are the two internal sections of 8087 architecture? [NOV/DEC 2010] (R)

8087 is divided into two sections internally as

- control unit (CU)
- numeric extension unit (NEU)

23. What is meant by loosely coupled configuration? [MAY 2014] (R)

Loosely coupled system consists of different processor module, each processor has a set of input-output devices and a large local memory where it accesses most of the instructions and data, to which other processors do not have direct access. But, they can share system resources. The processor, its local memory and input-output interfaces together called computer module.

24. What are tightly coupled systems or closely coupled systems? (R)

In a tightly coupled systems the microprocessor (either coprocessor or independent processors may share a common clock and bus control logic.. The two processors in a closely coupled system may communicate using a common system bus or common memory.

25. What are loosely coupled systems?(Apr/May 2010) (R)

In loosely coupled systems each CPU may have its own bus control logic. The bus arbitration is handled by an external circuit, common to all processors. The loosely coupled system configuration like LAN & WAN can be spreaded over a large area.

26. Write some disadvantages of loosely coupled systems. (U)

- More complicated due to the required additional communication hardware.
- They are less portable and more expensive due to the additional hardware and the communication media requirement.

27. What are the multi microprocessor configuration methods.[apr/may 2009] (R)

- Tightly coupled systems or closely coupled systems
- Loosely coupled systems

28. What is meant by Daisy chaining method? (R)

It does not require any priority resolving network, rather the priorities of all the devices are essentially assumed to be in sequence. All the masters use a single bus request line for requesting the bus access. The controller sends a bus grant signal, in response to the request, if the busy signal is inactive when the bus is free. The bus grant pulse goes to each of the masters in the sequence till it reaches a requesting master .The master then receives the grant signal, activates the busy line and gains the control of the bus. The priority is decided by the position of the requesting master in the sequence.

29. What is independent bus request scheme? (R)

Each of the masters requires a pair of request and grant pins which are connected to the controlling logic. The busy line is common for all the masters. . f the controlling logic receives a request on a bus request line, it immediately grants the bus access using the corresponding bus grant signal, provided the BUSY line is inactive, and then grants the request. This is quite fast, because each of the masters can independently communicate with the controller.

30. What is meant by polling? (R)

In polling schemes, a set of address lines is driven by the controller to address each of the masters in sequence. When a bus request is received from a device by the controller, it generates the address on the address lines. If the generated address matches with that of the requesting masters, the controller activates the BUSY line.

PART B & C

1. Draw and explain the minimum mode configuration of 8086 with timing diagram. (AZ)
(Nov 11, Nov 05, May 06, Nov 10, Nov 08, May 2013,may 2015)

2. Draw and explain the maximum mode configuration of 8086 with timing diagram.(AZ)
(Nov 07, Nov 08, May 06, May 07, May 08, Nov 10, May 11, May 2013,May 2016)

3. Explain the multiprocessor configuration of 8086.**(Nov 07, May 07)** (U)

4. Explain the architecture of 8087 with neat block diagram.**(May07, May08, May10, May 12, Nov 11)** (U)

5. Explain the 8087 co-processor data format. **(May 10, May 21, Nov 10)** (U)

6. Explain in detail about closely coupled and loosely coupled configuration. What are the relative advantages and disadvantages? **(Nov 07, Nov 10, May 08, Nov 11)** (U)

7. Discuss the schemes used to solve bus arbitration problem in multiprocessors**. (Nov 11)(U)**

8. Explain the exception handling feature of 8087. **(Nov 10)(U)**

9. Explain the closely coupled configuration of multiprocessor configuration with suitable example. **(May 2014)(U)**

10. Explain the execution steps of 8087. **(May 2014)(U)**

UNIT – III I/O INTERFACING

Part – A

1. **What are the modes of operation of 8255? (R)**

   - BSR Mode
   - IO Mode
     - Mode 0
     - Mode 1
     - Mode 2

2. **List the steps in the general algorithm for ADC interfacing? (R)**

   - Ensure the stability of analog input applied to the ADC.
   - Issue start of conversion (SOC) pulse to ADC.
   - Read end of conversion (EOC) signal to mark the end of conversion process.
   - Read analog data output of the ADC as equivalent digital output.

3. **List the six modes of operation of 8253? (R)**

   - Mode 0 (Interrupt on terminal count)
   - Mode 1 (Programmable monoshot)
   - Mode 2 (Rate generator)
   - Mode 3 (Square wave generator)
   - Mode 4 (Software triggered strobe)
   - Mode 5 (Hardware triggered strobe)

4. **List the command words of 8259A. (R)**

   - Initialization command word &
   - Operation command word

5. **What are the operational modes of 8279? (R)**

   - Input (Keyboard) mode &
   - Output (Display) mode

6. **What are three modes of data transmission? (R)**

   - Simplex
   - Half duplex &
   - Full duplex

7. **List the transfer modes of 8237? [MAY/JUNE 2013] .(R)**
   - Single transfer mode
   - Block transfer mode
   - Demand transfer mode
   - Cascade mode
   - Memory to memory transfer

8. **List the commands that can be executed by 8237? (R)**

- Clear First / Last Flip flop
- Clear Mask Register
- Master Clear Command

9. List the salient features of Mode0 of 8255? (R)

- ✓ Two 8 bit ports (Port A and Port B) and two 4 bit ports (Port C upper and lower) are available. The two 4 bit ports can be combinedly used as third 8 bit port.
- ✓ Any port can be used as an input or output port.
- ✓ Output ports are latched. Input ports are not latched.
- ✓ A maximum of 4 ports are available so that overall 16 I / O configurations are possible.

10. State the features of 8255 in Mode1? (R)

- Group A and Group B are available for strobed data transfer.
- Each group contain one 8bit data I / O port and one 4 bit control / data port.
- 8bit data port can be either used as input or output port.
- Out of 8bit portC, PC0 – PC2 are used to generate control signals for port B, PC3 – Pc5 are used to generate control signals for port A. PC6, PC7 may be used as independent data lines.

11. State the salient features of Mode2 of 8255? (R)

- Single 8 bit port in group A is available
- 8bit port is bidirectional and a 5bit control port is available.
- 3 I / O ports are available at port C, PC2 – PC0
- Inputs and outputs are both latched.
- 5 control bits of portC (PC3 – PC7) is used for generating / accepting handshake signals for the 8bit data transfer on portA.

12. What is the disadvantage in keyboard interfacing using ports? (R)

The disadvantage in keyboard interfacing using ports is that most of the processor time is utilized in keyboard scanning and debouncing. As a result the computational speed of the processor will be reduced.

13.What is the advantage in using INTEL 8279 for keyboard and display interfacing? (R)

When 8279 is used for keyboard and display interfacing, it takes care of all the task involved in keyboard scanning and display refreshing. Hence the processor is relieved from the task of keyboard scanning, debouncing, keyboard generation and display refreshing and the processor time can be more effectively used for computing.

14. What is a programmable peripheral device? (R)

If the functions performed by a peripheral device can be altered or changed by a program instruction, then the peripheral device is called programmable device. Usually the programmable devices will have control registers. The device can be programmed by sending control word in the prescribed format to the control register.

15. What is synchronous data transfer scheme? (R)

In synchronous data transfer scheme, the processor does not check the readiness of the device after a command have been issued for read/write operation in this scheme the processor will request the device to get ready and then read/write to the device immediately after the request.

16. What is asynchronous data transfer scheme? (R)

In asynchronous data transfer scheme, first the processor sends a request to the device for read/write operation. Then the processor keeps on polling the status of the device. Once the device is ready, the processor execute a data transfer instruction to complete the process.

17. What are the operating modes of 8255? (R)

The port of 8255 can be programmed to work in any one of the following operating modes as input or output port.
Mode-0 : simple I/O port , Mode-1 :handshake I/O port , Mode-2:bi-directional I/O port

18. What are the functions performed by port-C of 8255? (R)

- the port-C pins are used for handshake signals.
- Port-C can be used as an 8-bit parallel I/O port in mode-0
- It can be used as two numbers of 4-bit parallel port in mode-0
- The individual pins of port-C can be set or reset for various control applications.

19. What is USART? (R)

The device which can be programmed to perform synchronous or asynchronous serial communication is called USART(Universal Synchronous Asynchronous Receiver Transmitter).The INTEL 8251 is an example of USART.

20. What are the functions performed by INTEL 8251? (U)

The INTEL 8251 is used for converting parallel data to serial or viceversa.the data transmission or reception can be either asynchronous or synchronous. The 8251 can be used to interface MODEM and or synchronously. The 8251 can be used to interface MODEM and establish serial communication through MODEM over telephone lines.

21. What are the control words of 8251 and what are its functions? (R)

The control words of 8251 are mode word and command word. The mode word informs 8251 about the baud rate, character length, parity and stop bits .The command word can be send to enable the data transmission and reception.

22. What is the information that can be obtained from the status word of 8251? (R)

The CPU to check the readiness of the transmitter or receiver and to check the character synchronization in synchronous reception can read the status word. It also provides information regarding various errors in the data received .The various error conditions that can be checked from the status word are the parity error, overrun error and framing error.

23. What is baud rate? (R)

The baud rate at which the serial data are transmitted. Baud rate is defined as 1/(the time for a bit cell).In some systems one bit cell has one data bit, then the baud rate and bits/sec are same.

24. What are the different types of data transfer scheme? (R)

The different types of data transfer transfer scheme are

- Synchronous u data transfer scheme.
- Asynchronous data transfer scheme
- Interrupt driven data transfer scheme.

25. What are the different types of DMA data transfer scheme? (R)

The different types of DMA data transfer scheme are

- Cycle stealing DMA
- Block or burst mode DMA
- Demand transfer mode DMA

26. What is the need for interrupt controller? (U)

The interrupt controller is employed to expand the interrupt inputs. It can handle the interrupt request from various devices and allow one by one to the processor.

27. List some of the features of INTEL 8259? (R)

- It manage eight interrupt request
- The interrupt vector addresses are programmable
- The priorities of interrupts are programmable.
- The interrupt can be masked or unmasked individually.

28. Write the various functional blocks of INTEL 8259? (R)

The various functional blocks of 8259 are control logic, read/write logic, data bus buffer, interrupt request register, in service register, interrupt mask register, priority resolver and cascade buffer.

29. How 8259 is programmed? (U)

The 8259 is programmed by sending initialization command words(ICW's) and operational command words(OCW's).

30. What are the features of 8259 that can be programmed using OCW's? (R)

The OCW's are used to program the following features of 8259

- masking of individual interrupts
- specific on nonspecific end of interrupt
- priority modes

31. What are the different scan modes of 8279? (R)

The different scan modes of 8279 are decoded scan and encoded scan and encoded scan. In decoded scan, the output of scan lines will be similar to a 2-to-4 decoder. In encoded scan mode, the output of scan lines will be binary count, and so an external decoder should be used to convert the binary count to decoded output.

32. What are the different programmed data transfer schemes used in microprocessor? (R)

The various data tranfer schemes are

- Synchronous data transfer
- Asynchronous data transfer(hand shaking)
- Interrupt driven data transfer

33. What are the two various modes of DMA transfer? (R)

- Burst mode
- Cycle stealing

34. What is meant by control word? (U)

The content of control register is called as control word or command word. It specifies the various mode of operations, I/O functions of the port etc.

35. What is handshake port ? Explain the working of a handshake input port and output port. (U)

In handshake port, signals are exchanged between I/O device and port or port and processor for checking or informing various condition of the device.
In handshake input operation, the input device will check whether the port is empty or not. If the port is empty then it will load data to port. When the port receives the data, it will inform the processor for read operation. Once the data have been read by the processor, the port will signal the input device that it is empty. Now the input device can load another data to port and the above process is repeated.

In handshake output operation, the processor will load a data to port. When the port receives the data, it will inform the output device to collect the data. Once the output device accepts the data, the port will inform the processor that it is empty. Now the processor can load another data to port and the above process is repeated.

36. What is debouncing ? (U)

When a key is, pressed it bounces for a short time. If a key code is generated immediately after sensing a key actuation, then the processor will generate the same keycode a number of times.(A key typically bounces for 10 to 20 msec). Hence the processor has to wait for the key bounces to settle before reading the keycode. This process is called keyboard debouncing.

37. What are the requirements to be met while interfacing memory or I/O devices to 8086 processor? [MAY/JUN 2013] [MAY/JUN 2016] (R)

The requirements to be met are:

- the microprocessor should be able to select the chip
- identify the register

- enable the appropriate buffer

38. What is DMA? [NOV/DEC 2011] [MAY/JUN 2015] (R)

DMA is direct memory access technique in which the bulk data is transferred directly to/from memory under the control of a DMA controller without any interference from the CPU.

39. State the use of cascading signals of 8259 programmable interrupt controller. [APRIL/MAY 2011]. (R)

CAS0-CAS2 Cascade lines - A single 8259 provides eight vectored interrupts. If more interrupts are required, 8259 is used in cascade mode. In cascade mode, a master 8259 along with eight slaves 8259 can provide upto 64 vectored interrupt lines. These three lines act as select lines for addressing the slaves 8259.

40. What are the advantages of Programmable Interval Timer / Counter IC? [MAY 2014] (R)

The Intel 8253 and 8254 are Programmable Interval Timers (PITs), which perform timing and counting functions. The timer has three counters, called channels. Each channel can be programmed to operate in one of six modes. Once programmed, the channels can perform their tasks independently. The timer is usually assigned to IRQ-0 (highest priority hardware interrupt) because of the critical function it performs and because so many devices depend on it.

PART B & C

1. Explain the block diagram of 8255 (PPI) in detail. **(Nov 08, Nov 05, Nov 06, May 12, May 08) (U)**
2. Explain the operating modes and control word format of 8255. **(Nov 12)(AZ)**
3. Explain the block diagram of 8251(serial Communication) in detail **(May 10, May 06, May 07) (U)**
4. Explain the control word format of 8251. **(May 10, May 06, May 12, Nov 11) (AZ)**
5. Explain the block diagram of 8253(timer) with control word and also explain the Operating modes with timing diagram. **(May 10, Nov 08, May 12, Nov 10, Nov 11) (AZ)**
6. Explain the block diagram of 8279(Keyboard/display) in detail. **(Nov 07, May 05, Nov 08, Nov 11, May 13,May15) (AZ)**
7. Explain the block diagram of 8259(PIC) in detail. **(May 10, May 06, May 12, Nov 10, May 08, May 07, Nov 11) (U)**
8. Explain the block diagram of 8237(DMA) in detail. **(Nov 07, May 06, Nov 10, May12, May 08, May 07, May 12) (U)**
9. Explain the (i) modes of operation of timer (ii) operation of interrupt controller. **(May 13) (U)**
10. Explain the parallel communication interface with the microprocessor. **(Nov 12) (U)**
11. Draw the functional block diagram and control word format of 8254 programmable Interval timer and its mode of operation and explain. **(May 10, May 12). (U)**
12. Explain in detail about 8237 DMA controller with a neat block diagram. **(May 11) (U)**
13. Explain the four modes of keyboard operation in 8279**. (Nov 10) (AZ)**
14. Explain the mode 0 operation of programmable peripheral interface. **(May 2014) (AZ)**
15. Explain the different modes of operation of a timer. **(May 2014,May 16) (AZ)**
16. Explain the internal architecture of 8237 Direct Memory Access controller. **(May 2014) (U)**

UNIT – IV MICROCONTROLLER

Part – A

1. What is Microcontroller?(R)

Microcontroller incorporates all the features that are found in microprocessor with the added features of in-built ROM, RAM, Parallel I/O, Serial I/O, counters and clock circuit to make a micro computer system on its own.

2. What are the alternate functions of Port 3 in 8051 microcontroller?(R)

P3.0-RXD
P3.1-TXD
P3.2-INT0
P3.3-INT1
P3.4-T0
P3.5-T1
P3.6-WR
P3.7-RD

3. What is the function of SM2 bit present in SCON register in 8051?(R)

- SM2 enables the multiprocessor communication feature in modes 2 and 3. If SM2 = 1, RI will not be activated if the received 9th data bit (RB8) is 0.
- In mode 1, if SM2 = 1, RI will not be activated if a valid stop bit was not received.
- In mode 0, SM2 should be 0.

4. If a 12 MHz crystal is connected with 8051, how much is the time taken for the count in timer 0 to get incremented by one?(R)

Baud rate = oscillator frequency/12
$= (12 \times 10^6) / 12$
$= 1 \times 10^6$ Hz
$T = 1/f$
$= 1 / (1 \times 10^6)$
$= 1\ \mu$ sec

5. What is the advantage of microcontroller over microprocessor?(R)

- The overall system cost is low, as the peripherals are integrated in a single chip.
- The size is very small
- The system is easy to troubleshoot and maintain.
- If required additional RAM, ROM and I/O ports may be interfaced.
- The system is more reliable.

6. What is the function of IP register in 8051?(R)

The IP register is used to set high priority to one or more interrupts in 8051.

-	-	-	PS	PT1	PX1	PT0	PX0

Setting a bit to 1 makes the corresponding interrupt to have high priority and setting a bit to 0 makes the corresponding interrupt to have low priority.

7. What is the importance of special function registers(SFR) in 8051? [MAY/JUN 2016] (R)

The 8051 operations that do not use the internal 128 byte RAM address from 00 H to 7F H are done by a group of special internal registers called SPFs(Special Function Registers) Which have address between 80 H and FF H.

8. Define baud rate. (R)

Baud rate is used to indicate the rate at which data is being transferred .
Baud rate = 1/Time for a bit cell.

9. Name any 4 additional hardware features available in 8051 when compared to microprocessor. (R)

ROM, RAM, Parallel I/O, Serial I/O, Counters, and a clock circuit are available.

10. What is the function of DPTR register? (R)

The data pointer register (DPTR) is the 16 bit address register that can be used to fetch any 8 bit data from the data memory space. When it is not being used for this purpose, it can be used as two eight bit registers, DPH and DPL.

11. What are the features of 8051 microcontroller? (R)

- 8 bit CPU with registers A and B
- 16 bit PC and DPTR
- 8 bit PSW
- Internal ROM of 4KB
- Internal RAM of 128 bytes
- Two 16 bit timers and counters: T0 and T1
- Two external and three internal interrupts
- 32 input / output pins arranged as four 8 bit ports: Port0, port1, port2 and port3.
- Control registers are: TMOD, TCON, SCON, PCON, IP and IE.

12. List any applications of microcontroller.(May 2015).(R)

- Industrial control (process control)
- Motor speed control(stepper motor control)
- Peripheral devices(printer)
- Stand alone devices(colour Xerox machine)
- Automobile applications(power steering)
- Home applications (washing machine)
- Length measurement
- Square wave generator

13. Explain the instruction: SWAP. (E)

SWAP instruction works only on the accumulator (SWAP A) . It swaps the lower nibble and higher nibble .The lower 4 bits are put into the higher 4 bits and the higher 4 bits are put into the lower 4 bits.

E.g. - SWAP A

	ACC
Before execution:	1111 0000
After execution:	0000 1111

15. Explain the PUSH and POP instruction in 8051?

PUSH direct: (sp) ← (SP) + 1
((SP))← (Direct)

The SP is incremented by 1. The content of the indicated register is then copied to the internal RAM location addressed by SP.

POP direct: (direct) ← ((SP))
(SP) ← (SP) – 1

The content of the internal RAM location addressed by SP is read , and SP is decremented by one . The value is then transferred to the directly addressed byte indicated.

16. How does 8051 differentiate between the external and internal program memory?(AZ)

S.NO	EXTERNAL PROGRAM MEMORY	INTERNAL PROGRAM MEMORY
1	EA pin is high	EA pin is grounded
2.	PSEN signal is activated	PSEN is grounded
3.	8051 can address up to 64 KB of External program memory	4KB of internal program memory is available
4.	Accessible by only direct and indirect addressing modes.	Accessible by all addressing modes

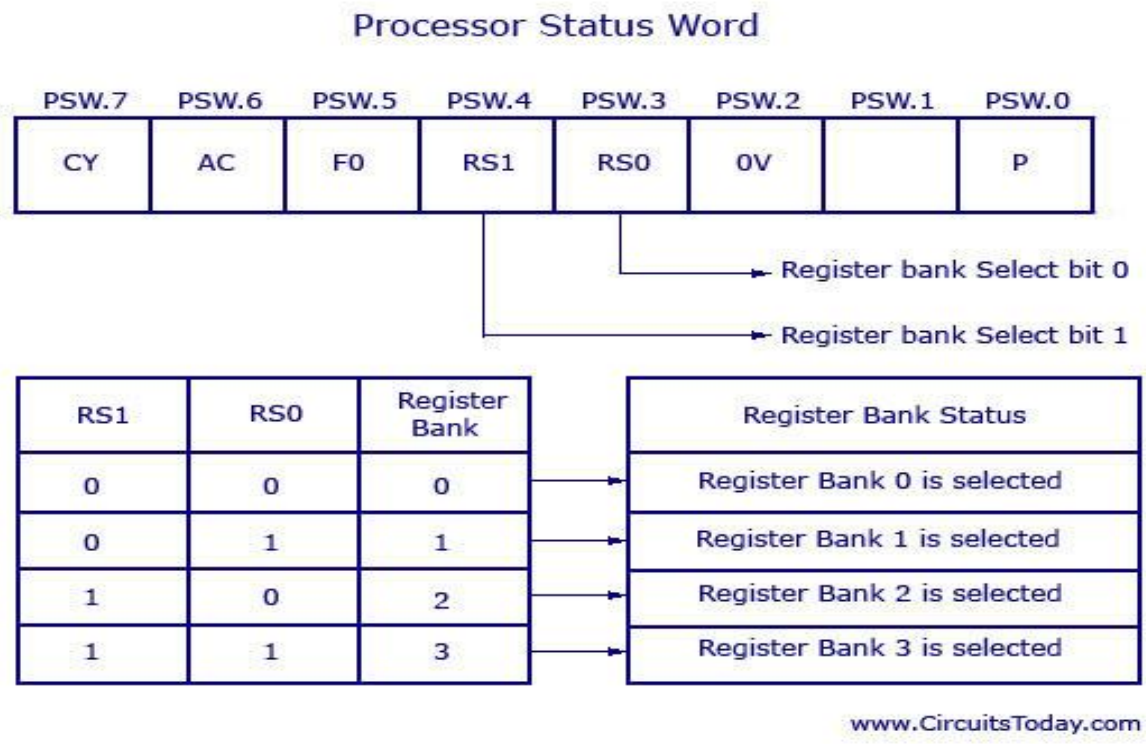
17. What is the maximum frequency of the clock signal that can be counted by 8051 counter? (R)

The maximum frequency of the clock signal is $1/12^{th}$ of the oscillator frequency.

18. What are the two memory address pointers in 8051 microcontroller? (R)

Program counter and Data Pointer are the two memory address pointers in 8051. The program instruction bytes are fetched from the locations in memory that are addressed by the PC. The DPTR register is made up of two 8 bit registers named DPH and DPL, which are used to furnish memory address for internal and external code access and external data access.

19. Give the PSW setting for register bank 2 as default bank in 8051 microcontroller. (Apr 2010, Apr 2013) (R)



20. What is the difference between timer and counter operation in 8051?(AZ)

The timer counts the internal clock pulses whose frequency is $1/12^{th}$ of oscillator frequency .The counter counts the internal clock pulses which are given through T0 pin (for counter 0) and T1 pin (for counter 1) of 8051.

21. What happens in power down mode of 8051 microcontroller? (R)

The memory locations of power down RAM can be maintained through a separate small battery backup supply so that the content of these RAM can be preserved during power failure conditions.

22. What are the difference between a microprocessor and microcontroller? (Nov/Dec 2011, May 2014) (AZ)

Sl.No	Microprocessor	Microcontroller
1	Microprocessor contains ALU,general purpose registers,stack pointer, program counter, clock timing circuit and interrupt circuit.	Microcontroller contains the circuitry of microprocessor and in addition it has built-in ROM, RAM, I/O devices, timers and counters.
2	It has many instructions to move data between memory and CPU.	It has one or two instructions to move data between memory and CPU.
3	It has one or two bit handling instructions.	It has many bit handling instructions.
4	Access times for memory and I/O devices are more.	Less access times for built-in memory and I/O devices.
5	Microprocessor based system requires more hardware.	Microcontroller based system requires less hardware reducing PCB size and increasing the reliability.

23. How does the status of EA pin affect the access to internal and external program memory? (R)

EA- Enable Interrupt bit. Cleared to 0 by program to disable all interrupts , set to 1 to permit individual interrupts to be enabled by their enabled bits . It is set to access data from external memory or else it is grounded for internal memory operations.

24. What are the register banks in 8051 microcontroller? (R)

The 32 **registers** are arranged as part of the internal RAM in 4 banks : bank 0 , bank 1, bank 2 and bank 3, each of eight registers.

25. State the function of RS1 and RS0 bits in the flag register of intel 8051 microcontroller? [MAY/JUNE 2013,nov/dec 2011] (R)

RS1, RS0 – Register bank select bits

RS1	RS0	Bank Selection
0	0	Bank 0
0	1	Bank 1
1	0	Bank 2
1	1	Bank 3

26. Give the alternate functions for the port pins of port3? (R)

$\overline{RD}$	$\overline{WR}$	T1	T0	$\overline{INT1}$	$\overline{INT0}$	TXD	RXD

$\overline{RD}$ – Read data control output.
$\overline{WR}$ – Write data control output.
T1 – Timer / Counter1 external input or test pin.
T0 – Timer / Counter0 external input or test pin.
$\overline{INT1}$- Interrupt 1 input pin.
$\overline{INT}$ 0 – Interrupt 0 input pin.
TXD – Transmit data pin for serial port in UART mode.
RXD - Receive data pin for serial port in UART mode.

27. Explain the function of the pins PSEN and EA of 8051. (U)

PSEN :

PSEN stands for program store enable. In 8051 based system in which an external ROM holds the program code, this pin is connected to the OE pin of the ROM.

EA :

EA stands for external access. When the EA pin is connected to Vcc, program fetched to addresses 0000H through 0FFFH are directed to the internal ROM and program fetches to addresses 1000H through FFFFH are directed to external ROM/EPROM. When the EA pin is grounded, all addresses fetched by program are directed to the external ROM/EPROM.

28. Explain the 16-bit registers DPTR and SP of 8051. (R)

DPTR:

DPTR stands for data pointer. DPTR consists of a high byte (DPH) and a low byte (DPL). Its function is to hold a 16-bit address. It may be manipulated as a 16-bit data register or

as two independent 8-bit registers. It serves as a base register in indirect jumps, lookup table instructions and external data transfer.

SP:

SP stands for stack pointer. SP is a 8- bit wide register. It is incremented before data is stored during PUSH and CALL instructions. The stack array can reside anywhere in on-chip RAM. The stack pointer is initialized to 07H after a reset. This causes the stack to begin at location 08H.

29. Name the special functions registers available in 8051. (R)

a. Accumulator
b. B Register
c. Program Status Word.
d. Stack Pointer.
e. Data Pointer.
f. Port 0
g. Port 1
h. Port 2
i. Port 3
j. Interrupt priority control register.
k. Interrupt enable control register.

30. List the register set of 8051? (R)

Accumulator, B, PSW, P0, P1, P2, P3, IP, IE, TCON and SCON.

31. List the addressing modes supported by 8051? (R)

- Direct addressing
- Indirect addressing
- Register instructions
- Register specific (Register implicit)
- Immediate mode
- Indexed addressing

32. Define direct addressing of 8051? (R)

The operands are specified using the 8bit address field in the instruction format.
Ex: MOV R0,89H
89H is the address of a special function register TMOD.

33. Discuss about the indirect addressing of 8051? (R)

The 8bit address of an operand is stored in a register and the register instead of the 8bit address is specified in the instruction. Ex: ADD A,@R0

34. Write about the register instructions of 8051? (R)

In this addressing mode, the operands are stored in the registers R0 – R7 of the selected register bank.
Ex: ADD A, R7

35. Write about the register specific instructions of 8051? (R)

In this type of instructions, the operand is implicitly specified using one of the registers. Some of the instructions always operate on a specific register.
Ex: RLA – Rotate left the accumulator

36. What are the types of register set available in 8051? (R)

- Bit addressable registers
- Byte addressable registers

37. List the registers available in 8051? (R)

8051 has twenty one 8bit, bit addressable registers.
Bit addressable registers – A, B, PSW, P0, P1, P2, P3, IP, IE, TCON & SCON
Byte addressable registers – SP, DPH, DPL, TMOD, TH0, TH1, TL0, TL1, SBUF, PCON.

38. What is the significance of EA line of 8051 microcontroller? [May 2014] (R)

The External Access (EA) line at pin 31 is used when the part is first powered up to determine whether the program will be executed from external code memory or from internal code memory.
If EA is tied high (connected to +5V) the microcontroller executes first the program from built-in ROM, then the program stored in external memory.
If EA is tied low (to ground) then the microcontroller completely ignores internal program memory and executes only the program stored in external memory.

39. List the I / O ports available in 8051? (R)

- Port0
- Port1
- Port2
- Port3

PART B & C

1. Explain the architecture of 8051 microcontroller with neat block diagram. (U) **(Nov 07,May 07,Nov 05,Nov 08,Nov 06,May 06, May 08,May 12,May15)**
2. Draw and explain the pin configuration of 8051. (R & U) **(May 08, Nov 11)**
3. Explain the I/O port structure of 8051. **(May 12,May 16) (U)**
4. How a program and data memory is interfaced with 8051?**(May 12)** (R)
5. Briefly explain about 8051 addressing modes. (R &U)
6. Explain about instruction set of 8051.(U)
7. Discuss about the Special Function Registers (SFRs) of 8051.(C)
8. Describe briefly various registers in 8051 microcontroller**. (May 11,Nov 11) (A)**
9. Explain the features of 8051 and compare it with 8086**. (May 11) (U)**
10. Discuss the functions of signals present in 8051. **(May 13) (C)**
11. Draw the pin diagram of 8051 microcontroller and explain the Input / Output lines in Detail. **(May 14) (R &U)**

UNIT – V INTERFACING MICROCONTROLLER

Part – A

1. Name the interrupts of 8051 microcontroller. (R)

External interrupt-0 , External interrupt-1,Timer-0 interrupt, Timer-1 interrupt, and serial port interrupt.

2. What is the job of the TMOD register? (R)

TMOD (timer mode) register is used to set the various timer operation modes . TMOD is dedicated to the two timers (Timer0 and Timer1) and can be considered to be two duplicate 4 bit registers, each of which controls the action of one of the timers

3. What are the bits available in TMOD register? (R)

GATE	C/T	M1	M0	GATE	C/T	M1	M0
TIMER 1				TIMER 0			

M1	M0	Mode
0	0	0 (13 bit Timer Mode)
0	1	1 (16 bit Timer Mode)
1	0	2 (8 bit auto reload)
1	1	3 (split Timer Mode)

GATE: Gating control when set

C/T : Timer or counter selection; 1= counter , 0= Timer.

4. What are the timers available in 8051? (R)

- Timer 0
- Timer 1

Each 16 bit timer is accessed as two separate 8 bit registers : Low byte register(TL) and High byte register (TH).

5. What are the external hardware interrupts in 8051? (R)

INT0 - External hardware interrupt 0

INT1 - External hardware interrupt 1

6. What is the interrupt priority in 8051 ? and write its vector address(May 2015)(R)

PRIORITY	SEQUENCE INTERRUPTS	ADDRESS
Highest priority	- External interrupt - 0 (INT 0)	- 0003 H
	Timer interrupt - 0 (TF 0)	- 000B H
	External interrupt - 1 (INT 1)	- 0013 H
	Timer interrupt - 1 (TF 1)	- 001B H
Lowest priority	- serial communication (RI,TI)	- 0023 H

7. When 8051 is reset, all interrupts are disabled. How to enable these interrupts? (R)

Each of the interrupts sources can be individually enabled or disabled by setting or clearing a bit in the Special Function Register IE . IE also has a global disable bit, which disables all interrupts at once.

8. What is nested interrupts? (R)

The 8051 is executing an ISR for servicing an interrupt and another interrupt occurs. If the new coming interrupt is high priority then only it can interrupt the previously occurred low priority interrupt. These are called nested interrupts.

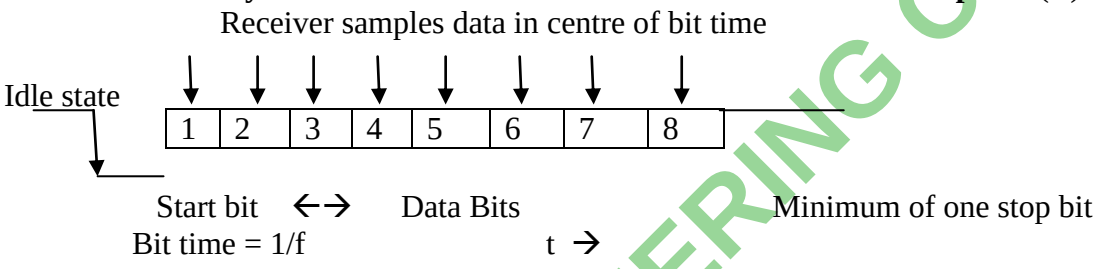
9. Give steps to program 8051 for serial data transfer. [MAY/JUN 2016] (R)

The 8051 has a serial data communication circuit that uses register SBUF to hold data. Register SCON controls data communication, register PCON controls data rates, and pins RXD (P3.0) and TXD (P3.1) connect to serial data network.

10. What is the significant of GATE in TMOD control register? (R)

It is OR gate enable bit which controls RUN/STOP of timer 1/0.
Timer/ Counter is enabled while TR 1/0 in TCON is set and signal on external interrupt INT1/0 pin is high. Cleared to 0 by program to enable timer to run, if bit TR1/0 in TCON is set.

11. What is the asynchronous data transmission format of 8051 serial port? (R)



12. Write down the different operating modes for serial communication of 8051. (R)

Serial communication of 8051 operates under four modes. They are mode 0 , mode 1, mode 2 and mode3 .SM0 and SM1 bits of SCON register specifies the mode.

Part – B & C

1. Explain the operating modes of timer/counter in 8051. (**May 12, May 08, 2010,2015) (R &U)**
2. Explain how the serial communication is performed in 8051. **(May 06) (R &U)**
3. Explain the Interrupt structure of 8051. **(Nov 08, Nov 06, Nov 10, May 12) (R &U)**
4. With a neat circuit diagram explain how a 4*4 Keyboard is interfaced with 8051 Microcontroller and write 8051 ALP for keyboard scanning. **(May 12) (R &U)**
5. Explain the interfacing of LCD display with 8051 in detail.**(May 12, May 10, Nov 12) (R &U)**
6. Explain the interfacing of ADC with 8051 with neat block diagram. **(May 10, Nov 10) (R &U)**
7. Explain the interfacing of DAC with 8051 with neat block diagram. **(May 11, May 13, May2016) (R &U)**
8. Develop an 8051 assembly language program to transfer the letter 'A' serially with 4800 Baud, 1stop bit continuously. (C)
10. Explain the on-chip timer modes of 8051**.** **(May 10) (R &U)**
11. How to transfer data between a PC and microcontroller using serial communication? Draw the necessary diagrams and explain**.** **(R &U)** **(Nov 12)**
12. What is timer/counter? Explain 16-bit timer mode and 8-bit auto reload mode of 8051. **(Nov 12) (R &U)**
13. Explain how LCD and keyboard is interfaced with 805**1. (May 13) (R &U)**
14. Describe about serial port interface of 8051. **(U)** **(May 13)**
15. Explain the different techniques to convert a digital quantity into its equivalent analog quantity. **(May 2014) (R &U)**

ASSIGNMENT QUESTIONS BASED ON BLOOM'S TAXONOMY LEVELS (BTL)

UNIT-I THE 8086 MICROPROCESSOR

ASSIGNMENT -I

Q. No	Question	BTL
	PART A	
1.	Write an ALP to generate a delay of 1 sec using a microprocessor running at 5 MHZ. Also show the delay calculations.	**U**
2.	To find the factorial of a number.	**C**
	PART B & C	
3.	Develop an ALP using 8086 instructions to convert upper case letter in to a lower case letter and lower case letter in to a upper case letter.	**C**

UNIT-II 8086 SYSTEM BUS STRUCTURE

ASSIGNMENT -II

Q. No	Question	BTL
	PART A	
1.	Bring out the differences between memory mapped I/O and I/O mapped I/O.	**AZ**
2.	Name the four different ways of passing parameters in 8086 microprocessor to a procedure in assembly language.	**R**
	PART B & C	
3.	Explain in detail the stack structure of 8086.Write a simple program to illustrate the concept of programming the stack.	**U**

UNIT-III I/O INTERFACING

ASSIGNMENT -III

Q. No	Question	BTL
	PART A	
1.	List the functions performed by 8279.	**R**
2.	What are the signals normally handled in ADC interfacing.	**R**
	PART B & C	
3.	Explain the interfacing of alphanumeric displays to microprocessors.	**U**

UNIT-IV MICROCONTROLLER

ASSIGNMENT -IV

Q. No	Question	BTL
	PART A	
1.	Multiply two 8 bit numbers.	**U**
2.	What are the functions of EA (low) and ALE.	**R**
	PART B & C	
3.	Explain about an interfacing of servomotor with 8051.	**U**

UNIT-V INTERFACING MICROCONTROLLER

ASSIGNMENT -V

Q. No	Question	BTL
	PART A	
1.	List any two applications of microcontroller.	**R**
2.	Mention the hardware requirement to interface an LCD using 8255.	**R**
	PART B & C	
3.	Develop a program to display “Engineer” on LCD on 8 X 1.	**AZ**

PANIMALAR ENGINEERING COLLEGE

DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

GE6351 ENVIRONMENTAL SCIENCE AND ENGINEERING

UNIT – I ENVIRONMENT, ECOSYSTEM & BIODIVERSITY

PART – A

1. Define ecology. (K)

- Ecology is the study of interactions among organisms or group with their environment. The environment consists of both biotic and abiotic components.

2. Define eco–system with an example. (K)

- A group of organisms interacting among them and with environment is known as eco system.
- Ex: animals cannot synthesis food directly but depend on the plants either directly or indirectly.

3. What are the structural components of an eco – system? (U)

- Abiotic (or) non – living components, Example: Air, Light, Temperature, etc.
- Biotic (or) living components, Example: Fish, lion, Human, etc.

4. What is ecological succession? (U) (Jun 05, Jun 09)

- The progressive replacement of one community by another till the development of stable community in a particular area is called ecological succession.

5. What are the hot spots of diversity? (U)

- The hot spots are the geographic areas which possess high endemic species and richness. Ex. Eastern Himalayas and Western Ghats.

6. India a mega diversity Nation. Justify. (C) (Dec 08, Dec 09)

- India is one among the 12 mega – diversity countries in the world. It has 89,450 animal species accounting for 7.31 % of the global faunal species and 47,000 plant species which accounts for 10.8% of world floral species.

7. Define endemism with an example. (K) (Dec 14)

- The species which are confined to a particular area are called endemic species. E.g. Sapria Himalayana, Indian Salamander.

8. Discuss about the characteristics of the followings (E)

Forest eco system:

- The forest maintains climate and rainfall.
- The forest support many wild animals and protect biodiversity.
- The soil rich in organic matter and nutrients, which support the growth of trees.

Grass land ecosystem:

- Grass land ecosystem is a plain land occupied by grasses.
- Soil is very rich in nutrients and organic matter.
- Since it has tall grass, it is ideal place for grazing animals.

Desert eco system:

- The desert air is dry and the climate is hot.
- Annual rainfall is less than 25 cm.
- The soil is very poor in nutrients an organic matter.

Aquatic eco system:

- It is temporary.
- It is stagnant fresh water body.

- They are polluted easily due to limited amount of water.

9. Define genetic diversity. (K)

- It is the diversity within species i.e., variation of genes within the species.
- Example: IR-20 Rice & IR- 8 Rice

10. Differentiate between biodiversity and ecosystem diversity. (C) (DEC '16)

- Bio diversity defined as "the variety and variability among all groups of living organisms and the ecosystem in which they occur".
- **Eco system biodiversity:** The diversity at the ecological or habitat is known as ecosystem diversity. A large region with different ecosystems can be considered as ecosystem diversity.

11. What are endangered species? (U) (Dec 06)

- A species is said to be endangered, when its number has been reduced to a critical level. Unless it is protected and conserved, it is immediate danger of extinction.
- E.g. Indian wolf, Santalum.

12. Bring few methods to conserve bio diversity. (E)

In situ conservation:

- It involves protection of fauna and flora within habitat, where the species normally occurs is called in – situ conservation.
- **Example:** Biosphere reserves, national parks, wild life sanctuaries, Gene sanctuary.

Ex – situ conservation:

- It involves protection of fauna and flora outside the natural habitats.
- **Example:** Botanical gardens, seed banks, museums, zoological gardens, etc.

13. What is ecosystem biodiversity? (U)

The diversity at the ecological or habitat level is known as ecological biodiversity.
Ex: River ecosystem

14. Bring out the bio geographical classification in India. (C)

- India is a mega diversity country having different types of climate and topography in different parts of the country.
- These variations have induced much variability in flora and fauna, India occupies 10^{th} position among the plant rich countries in the world.

15. Bring about the functional features of an eco – system. (AP)

- **Primary function:** The primary function of all plants is manufacture of starch
- **Secondary function:** The secondary function of all ecosystems is distributing energy in the form of food to all consumers.
- **Tertiary Function:** All living systems die at particular stage. These dead systems are decomposed to initiate the third function of ecosystems namely cycling.

16. Define Environmental studies. (K)

- The process of educating the people for quality environment

17. Write about physical hazard and its effects. / Chemical hazards. (June/ Dec16) (K)

Physical Hazards:

- UV radiation- Skin cancer
- Noise–Damages ear
- CFC-Cancer

Chemical Hazards:

- Combustion of fossil fuels – Asthma, Bronchititis
- Industrial effluent – Cancer and Death
- Pesticides (DDT) – Affects food chain

18. How do biological hazards enter into our body? (C)

- Through respiratory system
- Through body fluids of infected persons

19. How are hazards controlled? (C)

- Proper ventilation should be provided
- Use of gloves, masks.

20. Mention the scope and importance of Environmental studies. (E)

- To motivate the active participation in environmental protection and improvement.
- To develop skills for identifying and solving environmental problems.
- To know the necessity of conservation of natural resources.

Importance of Environmental Studies:

- Through EVS, people can gain the knowledge of different types of environment and the effects of different environmental hazards.
- EVS directs the relation to the quality of life we live.
- EVS develops a concern and respect for the environment

21. Mention two primary and secondary consumers in grassland ecosystem. (AP) (June 16)

- Primary consumers: Deer, sheep
- Secondary consumers: Snake, Lizard

PART – B

1. Briefly discuss the structure and functional components of an ecosystem. **(U) (Dec 14, Jun 08, Jun 16)**
2. Describe the types, characteristic features, structure and function of
   i) Forest ecosystem ii) Grassland ecosystem iii) desert ecosystem and
   iv) aquatic ecosystem. **(AP) (Dec 14, Dec 10, Jun 12)**
3. Explain the flow of energy through the various components of an ecosystem and material cycling**. (K) (Dec'16)**
4. Explain ecological succession processes./Stages using terms**. (C) (Dec'16)**
5. Explain the various values (productive use) and threats of biodiversity. **(K) (Jun 16)**
6. Explain in-situ and ex-situ conservation of biodiversity along with their merits and limitations. **(K) (Jun 10, Dec 12, Dec 14, Dec 16, Jun 16)**
7. Explain Nitrogen and Oxygen cycle in detail**. (K) (Jun 16)**
8. Justify India to be a mega biodiversity nation with the required data**. (AP) (DEC'16)**

PART -C

1. Identify and explain the present day major threats to the biodiversity of India. **(C)**
2. Mention a case study on: Man- wildlife conflicts and productive use of biodiversity. **(E) (Dec 16)**

ASSIGNMENT QUESTIONS

1. Values of biodiversity **(K)**
2. Aquatic ecosystem**. (K)**

UNIT – II ENVIRONNEMENTAL POLLUTION

PART – A

1. Defline pollution. (K)

- The unfavourable alteration of our surroundings is called pollution.

2. Name any three air pollutants, sources and effects. (AP) (Jun 05)

No	Pollutant	Sources	Effects
1.	Carbon monoxide	Cigarette smoking, fossils fuels	Coma brain cell damage
2.	Nitrogen dioxide	Burnings of fossils fuels	Acid rain, lung damage
3.	Sulphur dioxide	Coal burning	Breathing problem, acid rain

3. Define photochemical smog. (K) (Dec 06)

- The brownish smoke like appearance that frequently forms on clear, sunny days over large cities with significant amounts of automobile traffic.

4. Define soil pollution. (K) (May 08, Dec 10)

- The contamination of soil by human and living activities which may cause harmful effects on living beings.

5. How will you control air pollution? (C)

- Use only unleaded petrol.
- Encourage people to walk or use bicycles.
- Plant trees along busy streets because they remove particulates and absorb noise.

6 Give the major water pollutants with examples. (E) (Jun 06)

- Pesticides and biocides.
- Heavy metals, mercury, crude oil, plastics.
- Industrial and agricultural wastes.

7. What are points and non – point sources of water pollution? (U)

- **Point sources**: Point sources are discharged pollutants at specific locations through pipes, ditches or sewers into bodies of surface water.
- **Non – point sources:** They cannot be traced to any single site of discharge. They are usually large land areas or air sheds that pollute water by runoff, subsurface flow or deposition from the atmosphere.

8. What are the sources of soil pollution? (U) (Jan 06)

- Industrial wastes & Urban wastes.
- Agricultural wastes.
- Radioactive wastes & Biological wastes.

9. What are the sources & effects of marine pollution? (U)

- Dumping the wastes.
- Oil pollution of marine water.

Effects:

- Thinning of egg shell and tissues damage of egg in birds.
- Oil films are able to retard significantly the rate of oxygen uptake by water.

10. Give the sources of radioactivity. (C)

- **Natural sources:** The natural source is space, which emit cosmic rays. Soil, rocks, air, water, food, radioactive radon -222, etc, also contain one or more radioactive substance.
- **Man – made sources:** Man – made sources are nuclear power plants, X-rays, nuclear accidents, nuclear bombs, diagnostic kits etc., where radioactive substances are used.

11. What are the roles of an individual in reducing pollution? (U)

- Plant more trees &Use CFC free refrigerators.
- Reduce deforestation & Use renewable energy.

12. What are composting? (U)

- Bulk organic wastes are converted into fertilizing manure by biological action.

13. Define thermal pollution./Measures to control thermal pollution caused by industries. (K) (June/ Dec 16)

- It is defined as the presence of waste heat in the water which can cause undesirable changes in the natural environment.
- **Control Measures**: Methods adopted to control high temp. caused by thermal discharges are: Cooling Towers, Cooling Ponds, Spray Ponds, Artificial Lakes etc.,

14. Define hazards wastes. (K)

- The wastes that are generated in the nuclear generator i.e., in the by products in nuclear reactors are called as hazard wastes.

15. What are the control methods of noise pollution? (U)

- Reduction sources of noise such as heavy vehicles, old vehicles etc.,
- Use of sound absorbing filters & forestation.

16. How nuclear hazards can be disposed safely? (E)

- Nuclear power plants must be carefully done after studying long term and short term defects.
- Nuclear devices never be exploded in air.
- In nuclear mines, wet drilling may be employed along with underground drainage.

17. What are the roles of women in environment protection? (U)

- Reduce the dependency of fossil fuel especially coal or oil.
- Adopting and popularizing renewable energy sources.
- Using CFC free refrigerators.

18. What are BOD and COD? (U) (Jan 08)

- **BOD:** Biological oxygen demand is defined as the amount of dissolved oxygen required for aerobically decomposes biodegradable organic matter of a given volume of water.
- **COD:** chemical oxygen demand is the minimum level of oxygen in portable water by chemical oxidation of $K_2Cr_2O_7$ and $KMnO_4$.

19. What is marine pollution? (U) (Dec 14)

- In the sea the pollutants get dumped form the river, oil tankers, sewage sludge etc., to pollute the sea or ocean. This is termed as marine pollution.

20. Differentiate between pollution control and pollution prevention? (AP)

- Pollution prevention includes the pre steps taken to avoid the pollution before it occurs.
- It includes avoiding CFC fridges, fossil fuels etc. This is more effective than control.
- Pollution Control is controlling the occurred pollution and preventing its exposure.

21. What is PAN? Give its detrimental effect. (U) (June 16)

- PAN is Peroxy Acetyl Nitrates formed by the photochemical reaction between hydrocarbons, nitrogen oxides and light.

Effect:

- Damages plants and art
- Reacts explosively
- Plays a crucial role in photochemical smog

22. Explain acid rain and its effects. (C)

- The presence of excessive acids in rain water is known as acid rain
- The gases nitrous oxide, sulphur oxide due to burning of coal and oil, in the atmosphere, react with water to form acids. $SO_2 + H_2O \rightarrow H_2SO_4$

Effects:

- Acid rain corrodes houses, monuments, statues, bridges and fences.
- Acid rain causes corrosion of metals and the deterioration of paint and stone.

23. What are the causes and effects of ozone layer depletion? (U)

Causes:

- Presence of Chlorofluoro carbons, Hydrofluoro carbons & Bromo fluoro carbons

Effects:

- UV rays destroys the melamine pigment in human skin & affect the aquatic life
- It degrade paints, plastics and other polymeric materials

24. What are the water quality parameters? Give their importance. (U) (DEC'16)

- pH, acidity, alkalinity, fluorides, chlorides, colour, turbidity.

Importance:

- Acidity: Mineral acid causes more environmental health problems, undesirable to consume. Corrodes structure and collapses them.
- Turbidity causes objection in boilers and in cooling water systems. Interferes with water softening process.

25. Write any two methods of production of oxygen? (C)

- Photochemical dissociation.
- Photosynthesis.

26. Mention the control measures of acid rain. (E)

- Improvement in technologies and switching to clean combustion technologies are highly essential in order to monitor the air pollutants.
- Emissions of SO_2 and NO_2 from industries and power plants should be reduced by using pollution control equipments.
- Liming of lakes and soils should be done to correct the adverse effects of acid rain.

PART – B

1. What are the effects of improper municipal solid waste management? State the measures recommended for proper management of solid waste. (Flow Chart**) (AP) (Dec 10, Dec 13, DEC'16)**
2. Explain the various sources, effects and methods of control of
   (i) water (ii) air(iii) thermal (iv) marine (v) nuclear (vi) soil and (vii) noise pollutions.
(For Exam it will be asked separately) **(U) (Dec 14, Jun 16)**
3. Discuss the role of an individual in preventing pollution. **(C) (Dec 13)**
4. Explain the various chemical and photochemical reactions in the atmosphere**. (K) (Jun 16)**
5. Explain acid rain and ozone layer depletion. **(K)**
6. What are the methods adopted for the control of air pollutants? Explain each briefly**. (U) (Jun 16)**
7. How are water pollutant classified? Give examples of each type. **(E) (Jun 16)**

PART -C

1. All type of pollution related case study. (C) **(DEC 16)**

ASSIGNMENT QUESTIONS

1. Solid waste management**. (C)**
2. Role of an individual in preventing pollution**. (AP)**

UNIT – III NATURAL RESOURCES

PART – A

1. What is overgrazing? (U) (Dec 15)

- Process of eating away the vegetation without giving a chance to regenerate is called overgrazing.

2. How are the forests useful to mankind? (AP)

- They are habitats to millions of plants, animals and wildlife.
- They recycle rainwater and remove pollutants from air.
- They moderate temperature and weather and help to maintain humidity.

3. What is mining? Mention the methods of mining. (U)

- Mining is the process of extracting mineral resources and fossil fuels like coal form the earth.
- **Surface Mining:** it involves mining of minerals from the shallow deposits.
- **Underground mining**: It involves mining of minerals from deep deposits.

4. Enumerate the environmental effects of mining on the environment. (E) (Jun 05/16)

- During the mining operations the vibrations are developed , which leads to earthquake
- Large quantities of sediments are transported by water erosion.
- Noise pollution is the major problem from mining operations.

5. What are dams? How is it useful to human beings? (U) (Jan 07)

- Dams are the massive artificial structures built across the river in order to store water.
- Dams are built control floods and store flood water.
- Dams are used for drinking and agricultural purposes.
- Dams are built for generating electricity.

6. What are the up – stream impacts of construction of dams? (U) (Jan 06)

- Displacement of tribal people.
- Loss of forests flora and fauna.
- Landslides, sedimentation and siltation occur.

7. Discuss the problems of over – exploitation of ground water. (AP)

- Decrease of ground water.
- Ground subsidence.
- Earth quake and landslides.

8. Define under- nutrition and mal nutrition? (K)

- **Under – nutrition:** People who cannot buy enough food to meet their basic energy needs (carbohydrates) suffer from under nutrition. They receive < 90 % of these minimum dietary calories.
- **Mal Nutrition:** Besides the minimum calorie, we also need proteins, minerals, vitamins, iron and iodine. Deficiency or lack of nutrition leads to mal nutrition resulting in several diseases.

9. Differentiate renewable and non–renewable sources of energy. Give example. (Dec 09) (A)

S. No	Renewable energy	Non – Renewable energy
1.	It is regenerated continuously	Cannot be regenerated
2.	Inexhaustible	Exhausted
3.	Example : Solar , wind , Tidal	Example : Coal , Petroleum , Natural gas

10. What are the merits of renewable – energy resources. (U)

- Unlimited & Reliable supply.
- Provides energy security.
- Fits into sustainable development concept.

11. What is Geo Thermal energy? (U)

- The energy harnessed from the high temperature present inside the earth is called geo thermal energy.

12. What is soil erosion? (U)

- It is the process of removal of top layer of the soil from one place to another.
- Soil erosion also removes the soil components and surface liter.

13. Mention the advantages and disadvantages of modern agriculture? (A)

Advantages:

- It makes use of hybrid seeds of single crop variety, high tech equipments, lot of fertilizers, pesticides and water to produce large amount of single crops.

Disadvantages:

- Micronutrient imbalance, Nitrate pollution (Blue Baby syndrome)
- Eutrophication.
- Death of non – target species & Bio-magnification.

14. What are the super pests? (U)

- Some pest species usually survive even after the pesticide spray, which generates highly resistant generations.
- They are immune to all types of pesticides and are called super pests

15. Define Eutrophication. (K)

- A large amount of N, P and K fertilizers used in crop fields is washed off by the runoff water and reaches the water bodies causing over nourishment of the lakes.
- This process is known as Eutrophication.

16. What is bio magnification? (U)

- Many of the pesticides are non – biodegradable and keep on concentrating in the food chain. This process is called bio magnification.
- Example: DDT magnification in food chain.

17. What are the major causes of deforestation? (U)

- Developmental projects &Mining operations.
- Raw materials for industries.
- Shifting cultivation &Forest fires.

18. What is Bio gas? Mention its uses. (U) (DEC'16)

- Bio gas is the mixture of gases such as methane, CO_2, hydrogen sulphide etc;
- It contains about 65% of methane gas as a major constituent.

Uses: For cooking food, Heating water, to run engines, Used as an illuminant. Used in fuel cells for producing electricity.

19. What is nuclear energy? (U) (Dec 14)

- Nuclear and nuclear fusion reactions a large amount of energy is released through a chain reaction. This energy is called nuclear energy.

20. Define sustainable forestry? (K)

- Sustainable forestry is the optimum use of forest resources, which meet needs of the present without compromising the ability of future generations to meet their own needs.

21. State the environmental effects of extracting & using mineral resources? (C)

- Ground water contamination.
- Surface water pollution & Air pollution.
- Subsidence of land.

22. What is water logging? (U) (Dec 06)

- Water logging is the land where water stand for most of the year.

23. What is salinity? (U)

- The water not absorbed by the soil, undergoes evaporation leaving behind a thin layer of dissolved salts in the topsoil.
- This process of accumulation of salts is called salinity of the soil.

24. What is meant by bioconversion of pollutants? (U)

- Conversion of wastes or pollutants into a source of energy by the action of micro organisms.

25. What is environmental biochemistry? (U)

- It involves treating wastes using metabolic activities of micro organisms.

26. What is anaerobic digestion? (U)

- It is a series of biological process in which micro organisms break down biodegradable materials in the absence of oxygen.

27. What are the reasons for land degradation? (U) (June 16)

- Water logging,
- soil erosion,
- salination and
- contamination of soil with industrial wastes.

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PART – B

1. What is deforestation and explain its causes and impacts on the environment? **(U) (Dec 14, 16)**
2. Explain the effects of over utilization of surface and ground water? **(E) (Dec 16)**
3. Discuss the problems / effects of modern agriculture. **(A) (Dec 10, 14, 16, Jun 16)**
4. Discuss the environmental effects of extracting and using mineral resources. **(A)**
5. Illustrate any two methods of harnessing alternative sources of energy /Explain the various renewable and non – renewable energy sources / Advantages and disadvantages of harnessing non – renewable energy sources. **(E) (Dec 15, 16, Jun 16)**
6. What are the causes of soil erosion and methods of preventing it? **(U)**
7. Explain the role of an individual in conservation of natural resources. **(A)** (Jun 13)
8. Explain the stages in desertification**. (K) (Dec 16)**

9. Explain about any two methods of biodegradation/bioconversion of pollutants with example. **(A) (Dec 16)**

10. How is biogas produced? What are its advantages? **(C) (Jun16)**

11. Explain bioconversion of pollutants with examples. **(A) (Jun 16)**

PART –C

1. Environmental damages caused by mining last long after the mine has closed Explain. **(C) Dec 07**
2. Discuss the possible solution to improve the acceptability of dam projects in Indian condition. **(E) Dec 07**

ASSIGNMENT QUESTIONS

1. Role of an individual in conservation of natural resources**. (AP)**
2. Energy sources**. (C)**

UNIT IV

SOCIAL ISSUES AND ENVIRONMENT

PART – A

1. Define sustainable environment. / Lifestyle / Sustainability (Dec 09, June /Dec 16) (K)

♦ Sustainable environment is defined as "meeting the needs of the present without compromising the ability of future generations to meet their own needs"**.**

2. Bring out the important aspects of sustainable development. (AP)

♦ **Inter generational equity:** It states that we should hand over a safe, healthy and resourceful environment to our future generation.

♦ **Intra generational equity:** It states that the technological development of rich countries should support the economic growth of the poor countries and help in narrowing the wealth gap and lead to sustainability.

3. Write a note on Reduce, Reuse and Recycle principle.(K)

♦ It insists optimum use of natural resources, using it again and again instead of throwing it on the waste land or water and recycling the material into further products. It reduces pressure on our natural resources and reduces waste generation and pollution.

4. Define rainwater harvesting. (May 08) (K)

♦ Rainwater harvesting is a technique of capturing and storing of rainwater for further utilization.

5. What are the objectives of the rainwater harvesting? (U)

♦ To meet the increasing demands of water.

♦ To raise the water table by recharging the ground water.

♦ To reduce the surface runoff loss.

6. What is water shed? (K)

♦ Water shed is defined as the land area from which water drains under the influence of gravity into stream, lake, reservoir or other body of surface water.

7. What are the objectives of watershed management? (Dec 09) (C)

♦ To minimize the risks of floods, drought and landslides.

♦ To protect the soil from erosion by runoff.

♦ To raise the ground water level.

8. Write a note on agro forestry. (U)

♦ Afforestation and agroforestry help to prevent soil erosion and retention of moisture in watershed areas. **Example:** In high rainfall areas woody trees are grown in between crops to reduce the runoff and loss of nutrients of soil.

9.What is consumerism? How does it affects the environment?(Dec 16) (K)

♦ Consumerism refers to the consumption of resources by the people.
Effects: Dangerous to human life, degrades soil and making it unfit for irrigation and environmental pollution

10. Differentiate between Rehabilitation and Resettlement of people. (A)

♦ Resettlement is simple relocation or displacement of human population. This process does not focus on their future welfare.

♦ Rehabilitation involves making the system to work again by allowing the systems to function naturally. It includes replacing the lost economic assets, safeguard employment, provide safe land for buildings, restore social services, and repair damaged infrastructures.

11. Mention the objectives of Environment protection act? (Dec 14) (U)

♦ To protect and improvement of the environment.

♦ To prevent hazards to all living creatures and property.

♦ To maintain harmonious relationship between humans and their environment.

12. Enlist the objectives of Air protection act. (K)

- To prevent, control and abatement of air pollution.
- To maintain the quality of air.
- To establish a board for the prevention and control of air pollution.

13. Define environmental ethics. (K)

Environmental ethics refers to the issues, principles and guidelines relating to human interactions with their environment.

14. What is green chemistry? Give any four principles of green chemistry.(DEC'16) (C)

It involves designing and production of chemicals without polluting the environment. Prevention of waste, Less hazardous chemical synthesis, Designing Safer chemicals, safer solvents and auxiliaries.

15. What is Eco mark? (K)

Eco mark is a certification mark issued by the Bureau of Indian Standard (BIS) to the environmentally friendly product.

16. What are environmental audits? (Dec 08) (K)

- Environmental audit are intended to qualify environmental performance and environmental position. In this way they perform analogous function to financial audits.
- It also aims that to define what needs to be done to improve on indicators of such performance and position.

17. What is meant by ISO 14000? (Dec 08) (K)

- ISO14000 is the environmental management standards which exist to help organizations minimize how their operations negatively affect the environment and comply with applicable laws and regulations.

18. State few drawbacks of pollution acts. (Dec 08) (K)

- The penalties are very small when compared to the damage caused by the big industries.
- A person cannot directly file a petition in the court.
- For small unit it is very expensive to install effluent treatment – plant.

19. What are the objectives/benefits of environmental impact assessment (EIA)?(Dec 16) (AP)

- To identify the main issues and problem of the parties.
- To identify who is the party.
- To identify why are the problems arise.

20. Define holocaust. (K)

It means destruction of biodiversity by nuclear equipment's and nuclear bombs. In a holocaust, a large number of living beings are totally destroyed. Usually this kind of destructions is happened in a nuclear war.

21. State any two biomedical waste handling rules. (June 16) (K)

- Ministry of Environment and forest, 1998
- Biomedical wastes (Management and handling rules), 1998 Amended in 2000

Applied to hospitals, nursing homes and laboratories.

PART – B

1. Name the various Acts that have been framed for environmental protection and mention the objectives of each Act.**(Dec 14,16,Jun 16) (U)**
2. Discuss the recent approaches to achieve sustainable development.**(June 16) (AP)**
3. Explain disaster management:i) floodsii) earthquake, iii) cyclone and iv) landslides**.(Dec 16) (K)**
4. What is watershed management? What are the components of integrated watershed management? (K)

5. Bring out the various Wasteland Reclamation Practices. (C)
6. Explain rain water harvesting. **(Dec 14) (C)**
7. What is Eco-mark? Explain. **(Dec 16) (K)**
8. Explain bio-medical waste and their safe disposal.**(Dec 16) (A)**
9. Give a brief note on principles of green chemistry.**(Dec/Jun 16) (C)**
10. Discuss the various applications of green chemistry for achieving sustainable development**. (June 16) (AP)**

PART –C

1. Explain various emergency management tips to be under taken in case of any disaster.(Dec 09) (C)

2. What is meant by rain water harvesting? Why is it necessary now-a-days? (A)

ASSIGNMENT QUESTIONS

1. Sustainable development. **(A)**
2. Green chemistry. **(C)**

UNIT – V

HUMAN POPULATION AND THE ENVIRONMENT

PART – A

1. Define immigration and Emigration. (K)

- **Immigration**: It denotes the arrival of individuals from neighboring population.
- **Emigration**: It denotes the dispersal of individuals from the original population to new areas.

2. What are the objectives of the family welfare program? (Dec 09) (A)

- Slowing down the population explosion by reducing the fertility.
- Pressure on the environment, due to over exploitation of natural resources is reduced.

3. What is population explosion/ its causes? (Dec 09, June 16) (K)

The enormous increase in population

Causes

- Low death rate (mortality) and high birth rate (natality).
- Increase of life expectancy

4. What are the objectives of value education? (A)

- To improve integral growth of human being.
- To create attitudes towards sustainable lifestyle.

5. Differentiate between HIV and AIDS. (Dec 07) (U)

HIV	AIDS
Human immune deficiency virus It is a virus	Acquired immune deficiency syndrome It is disease

6. What is meant by NIMBY syndrome? (C)

- NIMBY means Not In My Back Yard, which describes the opposition of residents to the nearby location of something they consider undesirable, even if it clearly a benefit for many.

7. Define human rights.(K)

- Human rights are the fundamental rights, which are possessed by all human beings irrespective of their caste, nationality, sex and language.

8. Define doubling time. (Dec 08) (C)

- It is the time required for a population to double its size at a constant annual rate.
- It is calculated as follows.Td (Doubling Time) = 70/rWhere, r = annual growth rate
- If a nation has 2% annual growth, its population will double in next 35 years.

9. Define population density. (K)

- It is expressed as the number of individuals of the population per unit area (or) unit volume.

10. What are the effects of population explosion? (A)

- The increase in population will increase disease, economic inequity and communal war.
- Overcrowding of cities leads to development of slums.
- Lack of basic amenities like water supply and sanitation, education, health etc.,
- Unemployment and low living standard people.

11. What is Environmental Impact Assessment (EIA) (AP)

Process of predicting the environmental consequences of any developmental projects.

12. What are the objectives of women welfare systems? (Dec 16) (A)

- To provide education
- To improve the employment opportunity
- To aware problems of population
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13. Mention any two family welfare programs adopted in India. (June 16) (E)

Permanent method: Tubectomy and Vasectomy

PART – B

1. Write notes on the following in relation to human population and environment: i) Women and Child Welfare ii)Value Education.iii) Environment & human health. **(Dec14,16 Jun 16) (A)**
2. What is AIDS/HIV? How to prevent it? **(Jun 16) (K)**
3. Discuss the population growth variation among nations. **(Dec 14) (U)**
4. Discuss the role of Information Technology / GIS on Environment and Human health. **(Dec16)(AP)**
5. What is population explosion? Give the reasons behind it**. (Dec 16**) (A)
6. Explain a note on EIA. **(Jun16)** (K)
7. What are sparsely populated areas? Give examples and reasons for poor population in those areas. **(Jun 16) (E)**

PART –C

1. Deterioration of environment leads to deterioration of human health. Justify. (Jan06) (U)
2. .Briefly describe the various schemes launched for women and child welfare in India.(Dec08)(A)

ASSIGNMENT QUESTIONS

1. Role of Information Technology in the environment**.(Ap)**
2. Impacts of population explosion. **(E)**