JEPPIAAR ENGINEERING COLLEGE

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

EC8392– Communication Engineering

Question Bank

II YEAR A & B / BATCH : 2017 -2021

Vision of Institution

To build Jeppiaar Engineering College as an Institution of Academic Excellence in Technical education and Management education and to become a World Class University.

Mission of Institution

M1	To excel in teaching and **learning, research and innovation** by promoting the principles of scientific analysis and creative thinking
M2	To participate in the production, **development and dissemination of knowledge** and interact with **national and international communities**
M3	To equip students with **values, ethics and life skills** needed to enrich their lives and enable them to meaningfully contribute to the **progress of society**
M4	To prepare students **for higher studies and lifelong learning**, enrich them with the **practical and entrepreneurial skills** necessary to excel as future professionals and contribute to **Nation's economy**

Program Outcomes (POs)

PO1	**Engineering Knowledge**: Apply the Knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2	**Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3	**Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations
PO4	**Conduct investigations of complex problems**: Use research-based Knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5	**Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO6	**The engineer and society**: Apply reasoning informed by the contextual Knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7	**Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the Knowledge of, and need for sustainable development.
PO8	**Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9	**Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10	**Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11	**Project management and finance**: Demonstrate Knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12	**Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Vision of Department

To emerge as a globally prominent department, developing ethical computer professionals, innovators and entrepreneurs with academic excellence through quality education and research.

Mission of Department

M1	To create **computer professionals** with an ability to identify and **formulate the engineering problems** and also to provide **innovative solutions** through **effective teaching learning process.**
M2	To **strengthen the core-competence** in computer science and engineering and to create an ability to **interact** effectively with industries.
M3	To produce engineers with good professional sKills, **ethical values** and life skills for the **betterment of the society.**
M4	To encourage students towards **continuous and higher level learning** on technological advancements and provide a platform for **employment and self-employment.**

Program Educational Objectives (PEOs)

PEO1	**To address the real time complex engineering problems using innovative approach with strong core computing skills.**
PEO2	**To apply core-analytical Knowledge and appropriate techniques and provide solutions to real time challenges of national and global society**
PEO3	**Apply ethical Knowledge for professional excellence and leadership for the betterment of the society.**
PEO4	**Develop life-long learning skills needed for better employment and entrepreneurship**

SYLLABUS

UNIT I ANALOG MODULATION 9

Amplitude Modulation – AM, DSBSC, SSBSC, VSB – PSD, modulators and demodulators – Angle modulation – PM and FM – PSD, modulators and demodulators – Superheterodyne receivers

UNITII PULSE MODULATION 9

Low pass sampling theorem – Quantization – PAM – Line coding – PCM, DPCM, DM, and ADPCM And ADM, Channel Vocoder - Time Division Multiplexing, Frequency Division Multiplexing.

UNIT III DIGITAL MODULATION AND TRANSMISSION 9

Phase shift keying – BPSK, DPSK, QPSK – Principles of M-ary signaling M-ary PSK & QAM Comparison, ISI – Pulse shaping – Duo binary encoding – Cosine filters – Eye pattern, equalizers

UNIT IV INFORMATION THEORY AND CODING 9

Measure of information – Entropy – Source coding theorem – Shannon–Fano coding, Huffman Coding, LZ Coding – Channel capacity – Shannon-Hartley law – Shannon's limit – Error control codes – Cyclic codes, Syndrome calculation – Convolution Coding, Sequential and Viterbi decoding

UNIT V SPREAD SPECTRUM AND MULTIPLE ACCESS 9

PN sequences – properties – m-sequence – DSSS – Processing gain, Jamming – FHSS – Synchronisation and tracking – Multiple Access – FDMA, TDMA, CDMA,

TOTAL: 45 PERIODS

OUTCOMES:

At the end of the course, the student should be able to:

- Ability to comprehend and appreciate the significance and role of this course in the present contemporary world
- Apply analog and digital communication techniques.
- Use data and pulse communication techniques.
- Analyze Source and Error control coding.

TEXT BOOKS:

1. H Taub, D L Schilling, G Saha, “Principles of Communication Systems” 3/e, TMH 2007
2. S. Haykin “Digital Communications” John Wiley 2005

REFERENCES:

1. B.P.Lathi, "Modern Digital and Analog Communication Systems", 3rd edition, Oxford University Press, 2007
2. H P Hsu, Schaum Outline Series – "Analog and Digital Communications" TMH 2006
3. B.Sklar, Digital Communications Fundamentals and Applications" 2/e Pearson Education 2007.

Course Outcomes (COs)

BLOOM TAXANOMY LEVELS

BTL6: Creating
BTL 5: Evaluating
BTL 4: Analyzing
BTL 3: Applying
BTL 2: Understanding
BTL 1: Remembering

INDEX

UNIT NO	TEXT/ REFERENCE BOOK	PAGE NO
UNIT -I	1. H Taub, D L Schilling, G Saha, "Principles of Communication Systems" 3/e, TMH 2007	**113-173**
UNIT -II	1. H Taub, D L Schilling, G Saha, "Principles of Communication Systems" 3/e, TMH 2007	**183-240**
UNIT -III	1. H Taub, D L Schilling, G Saha, "Principles of Communication Systems" 3/e, TMH 2007	**249-310**

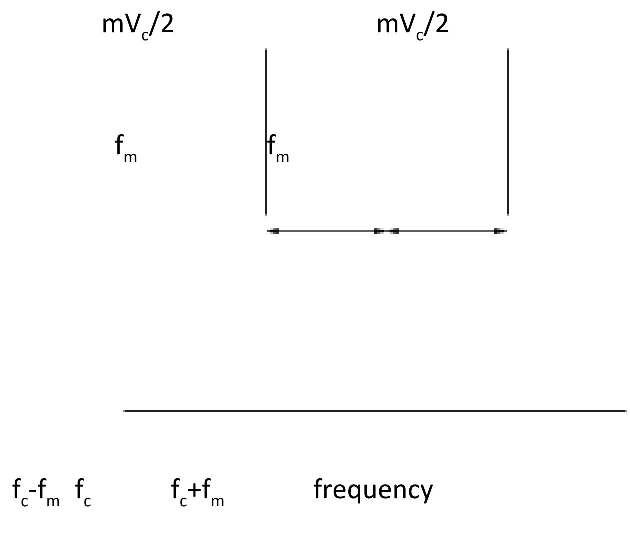
UNIT -IV	1. H Taub, D L Schilling, G Saha, “Principles of Communication Systems” 3/e, TMH 2007	**511-564**
UNIT -V	1. H Taub, D L Schilling, G Saha, “Principles of Communication Systems” 3/e, TMH 2007 2. S. Haykin “Digital Communications” John Wiley 2005	**720-745** **310-343**

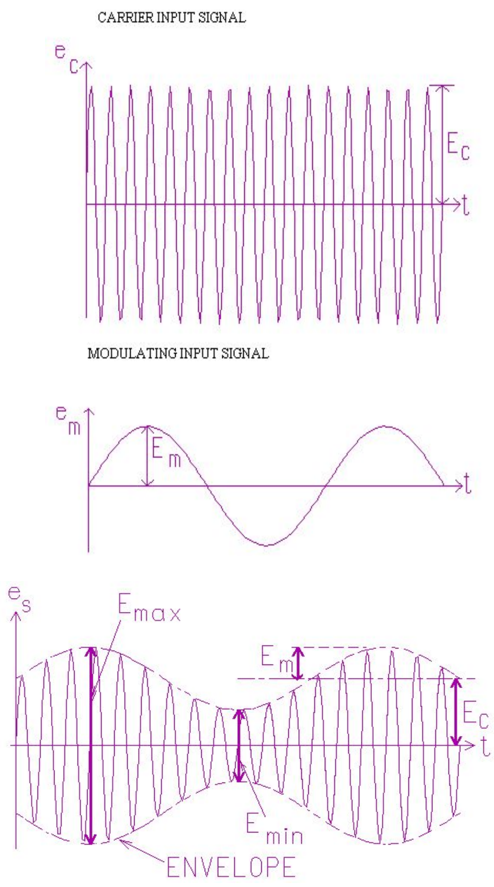
UNIT I

I ANALOG MODULATION

Amplitude Modulation – AM, DSBSC, SSBSC, VSB – PSD, modulators and demodulators – Angle modulation – PM and FM – PSD, modulators and demodulators – Superheterodyne receivers

S. No.	Question	Course Outcome	Blooms Taxanomy Level
1	**Define Amplitude modulation.<u>NOV/DEC 2011</u>** Amplitude Modulation is the process of changing the amplitude of a relatively high frequency carrier signal in proportion with the instantaneous value of the modulating signal.		BTL1
2	**What is modulation index and percentage modulation in AM? <u>NOV/DEC 2011</u>** Modulation index is a term used to describe the amount of amplitude change present in an AM waveform .It is also called as coefficient of modulation. Mathematically modulation index is $\mathbf{m = E_m / E_c}$ Where m = Modulation coefficient E_m = Peak change in the amplitude of the output waveform voltage.		BTL 1

	E_c = Peak amplitude of the unmodulated carrier voltage. Percent modulation gives the percentage change in the amplitude of the output wave when the carrier is acted on by a modulating signal.		
3	**In a Amplitude modulation system, the carrier frequency is Fc= 100KHz. The maximum frequency of the signal is 5 KHz. Determine the lower and upper side bands and the band width of AM signal. <u>APRIL?MAY 2010,</u> <u>NOV/DEC 2010</u>** $B=2f_{m(max)}=2(5khz)=10khz$ $f_{usf}=fc+fm=100khz+5khz=105khz$ $fl_{sf}=fc-fm=100khz-5khz=95khz$		BTL 1
4	**The maximum frequency deviation in an FM is 10 KHz and signal frequency is 10 KHz. Find out the bandwidth using Carson's rule and the modulation index <u>APRIL?MAY 2010</u>** m=10khz/10khz=1 Bandwidth using carson's rule B=2(f+fm) B=2(10khz+10khz)=40khz.		BTL 1
5	**Draw the frequency spectrum and mention the bandwidth of AM signal. . <u>APRIL?MAY 2011</u> <u>MAY/JUNE 2013,APRIL/MAY 2015</u>**  		BTL 2
6	**In an AM transmitter, the carrier power is 10 kW and the modulation index is 0.5. Calculate the total RF power delivered. <u>APRIL?MAY 2011</u>** Pt=pc(1+m 2/2)		BTL 1

	Pt=10kw(1+0.25/2) Pt=11.25watts m=0.5 pc=10kw		
7	**.State Carson’s rule.** Carson rule states that the bandwidth required to transmit an angle modulated wave as twice the sum of the peak frequency deviation and the highest modulating signal frequency. Mathematically Carson’s rule is $\mathbf{B=2(\Delta f + f_m)}$ **Hz**		BTL 2
8	**Draw the waveforms of AM signal <u>NOV/DEC 2009</u>.** 		BTL 1

9	**What is the required bandwidth for FM signal, in terms of frequency deviation? NOV/DEC 2009** *For high index modulation ,the minimum bandwidth is approximated by* $B=2\Delta f$ hz		BTL 1
10	**A broadcast radio transmitter radiates 5 KW power when the modulation percentage is 60% How much is the carrier power?** P_t = 5kW,m=0.6 or 60% $P_{total} = P_c [1 + m^2 / 2]$ $P_c = P_{total} / [1 + m^2 / 2] = 5 * 10^2 / [1+ (.6)^2 / 2]$ = **4.24 kW**		BTL 1
11	**What is modulation?** Modulation is the process of changing any one parameter (amplitude, frequency or phase) of a relatively high frequency carrier signal in proportion with the instantaneous value of the modulating signal or message signal		BTL 1
12	**Define image frequency rejection ratio.** The image frequency rejection ratio is the measure of the ability of preselector to reject the image frequency. Mathematically, IFRR is **IFRR** $=(1+Q^2\rho^2)^{1/2}$ Where $\rho = (f_{im}/f_{RF})-(f_{RF}/f_{im})$ Q – quality factor of preselector f_{im}-image frequency f_{RF}- RF frequency		BTL 1
13	**Define Deviation ratio** viation ratio is the worst-case modulation index and is equal to the maximum peak frequency deviation divided by the maximum modulating signal frequency. Mathematically, the deviation ratio is $$DR= \Delta f_{(max)} / f_{m(max)}$$		BTL 1
14	**Write down the comparison of frequency and amplitude modulation**		BTL 1

	AM . Noise interference is more. Amplitude Modulation is the process of changing the amplitude of a relatively high frequency carrier signal in proportion with the instantaneous value of the modulating signal. **FM** Noise interference is less Frequency Modulation is the process of changing the frequency of a relatively high frequency carrier signal in proportion with the instantaneous value of the modulating signal.		
15	**If a modulated wave with an average voltage of 20Vp changes in amplitude ±5V, determine the maximum and minimum envelope amplitudes and the modulation coefficients.** $V_m = 20Vp$ $V_c = 5$ V $m = V_{max} – V_{min} / V_{max} + V_{min}$ $V_{max} = V_m + V_c = 20+5= 25V$ $V_{min} = V_m - V_c = 20-5= 15V$ $m= V_{max} – V_{min} / V_{max} + V_{min}$ =25-15 /25+15 = **0.25**		BTL 1
16	**An FM transmitter has a rest frequency f_c =96MHz and a deviation sensitivity K_1 = 4 KHz/V. Determine the frequency deviation for a modulating signal $V_m(t)$ = 8sin(2π 2000t). Determine the modulation index.** V_m=8V, f_m =2000Hz and K_1 =4 kHz /V Frequency deviation = δ = K_1V_m = 4 kHz/v * 8V = **32kHz** Modulation index = m = δ/ f_m = 32 kHz/2000Hz = **16**		BTL 1

17	**For an FM receiver with an input frequency deviation Δf=4 kHz and a transfer ratio K= 0.01 V/k Hz, determine V_{out}.** V_{out} = K * Δf =0.01* 40 =0.4V		BTL 1
18	**Define bandwidth efficiency <u>NOV/DEC 2012.</u>** Bandwidth efficiency(B.E)=Transmission bitrate(bps)/minimum bandwidth(hz) B.E=bits/cycle		BTL 1
19	**Distinguish between FM and PM <u>NOV/DEC 2012.,</u> . <u>NOV/DEC 2016</u>** FM- Frequency is varied directly but Phase is indirectly varied with respect to modulating signal. PM- Frequency is varied indirectly but Phase is directly varied with respect to modulating signal.		BTL 2
20	**What is the bandwidth of the FM signal if the frequency sensitivity of the modulator is** **25 Khz per volt? <u>APRIL/MAY 2015</u>**		BTL 2
21	**Define Phase modulation.** Phase of a constant amplitude carrier is varied directly proportional to the amplitude of the modulating signal at a rate equal to the frequency of the modulating signal		BTL 1
22	**What are the advantages of angle modulation and also list its disadvantages.** vantages: i. Noise reduction. ii. Improved system fidelity. iii. more efficient use of power. Disadvantages: i. wider Bandwidth. ii.uses more complex circuit in receiver and		BTL 1

	transmitter		
23	**Give the expression for bandwidth of angle-modulated wave in terms of Bessel's table.** B= 2(n*f_m) n=no. of significant sidebands for m found using Bessel's table		BTL 1
24	**Define deviation sensitivity for FM and PM and give its units.** **FM:** Change in output frequency occurs when amplitude changes in input signal. **Unit** K_1=(rad/s)/V. **PM:** Change in output phase occurs when amplitude changes in input signal. **Unit** K =(rad)/V.		BTL 1
25	**Define instantaneous frequency deviation.** The instantaneous frequency deviation is the instantaneous change in the frequency of the carrier and is defined as the first derivative of the instantaneous phase deviation		BTL 1
26	**Define instantaneous frequency deviation.** The instantaneous frequency deviation is the instantaneous change in the frequency of the carrier and is defined as the first derivative of the instantaneous phase deviation.		BTL 1
27	**Define frequency deviation.** Frequency deviation is the change in frequency that occurs in the carrier when it is acted on by a modulating signal frequency. Frequency deviation is typically given as a peak frequency shift in Hertz (Δf). The peak-to-peak frequency deviation (2 Δf) is sometimes called carrier swing. The peak frequency deviation is simply the product of the deviation sensitivity and the peak modulating signal voltage and is expressed mathematically as **$\Delta f = K_1 V_m$ Hz.**		BTL 1
28	**State Carson rule.** Carson rule states that the bandwidth required to transmit an angle modulated wave as twice the sum of the peak frequency deviation and the highest modulating signal frequency. Mathematically Carson's rule is **$B=2(\Delta f + f_m)$ Hz**		BTL 5

29	**Define Heterodyning.** Heterodyne means to mix two frequencies together in a nonlinear device or to translate one frequency to another, using nonlinear mixing		BTL 5
30	**Define direct frequency modulation.** direct frequency modulation, frequency of a constant amplitude carrier signal is directly proportional to the amplitude of the modulating signal at a rate equal to the frequency of the modulating signal.		BTL 5
31	**st the sourses of internal and external noise. <u>NOV/DEC 2016</u>** ernal noise Partion noise Low frequency or flicker noise High Frequency or transit time noise Shot noise Thermal noise .		BTL 5
32	mpare AM with DSB-SC and SSB-SC. Nov/Dec 2015. nplitude Modulation - carrier frequency and upper and lower sidebands. -carries message oublesideband suppressd carrier – upper and lower sidebands with carrier- carries message gle sideband suppressed carrier-Either lowersideband or uppersideband-carries message		BTL 5
	PART-B		
1	**Explain the principles of amplitude modulation its generation and detection.. (8) <u>NOV/DEC 2011, APRIL?MAY2011, NOV/DEC 2010,NOV/DEC 2009</u>** Refer Page No120 . H Taub, D L Schilling, G Saha, “Principles of Communication Systems” 3/e, TMH 2007		BTL 2

2	**Write a note on frequency spectrum analysis of angle modulated waves. (8)** <u>NOV/DEC 2011</u> Refer Page No282 in . H Taub, D L Schilling, G Saha, "Principles of Communication Systems" 3/e, TMH 2007		BTL 5
3	**Explain the band width requirements of angle modulated waves. (8) <u>NOV/DEC 2011, APRIL?MAY 2011</u>** Refer Page No286 . H Taub, D L Schilling, G Saha, "Principles of Communication Systems" 3/e, TMH 2007		BTL 5
4	**Compare FM and PM. (8) <u>NOV/DEC 2011, APRIL?MAY 2010, APRIL?MAY 2011 APRIL/MAY 2015</u>** Refer Page No 286 in. H Taub, D L Schilling, G Saha, "Principles of Communication Systems" 3/e, TMH 2007		BTL 2
5	**Derive the relationship between the voltage amplitudes of the side band frequencies and the carrier and draw the frequency spectrum. (8 Marks) <u>APRIL?MAY 2010</u>** Refer Page No139 in. H Taub, D L Schilling, G Saha, "Principles of Communication Systems" 3/e, TMH 2007		BTL 2
6	**. Discuss about the sets of side bands produced when a carrier is frequency modulated by a single frequency sinusoid. (8 Marks) <u>APRIL?MAY 2010</u>** Refer Page No282 in. H Taub, D L Schilling, G Saha, "Principles of Communication Systems" 3/e, TMH 2007		BTL 2
7	***.In an AM modulator, 500 KHz carrier of amplitude 20 V is modulated by 10 KHz modulating signal which causes a change in the output wave of +_ 7.5 V. Determine:*** ***(1) Upper and lower side band frequencies*** ***(2) Modulation Index*** ***(3) Peak amplitude of upper and lower side frequency*** ***(4) Maximum and minimum amplitudes of envelope. (8 Marks) <u>APRIL?MAY 2010</u>*** *Refer Page No153 in H Taub, D L Schilling, G Saha, "Principles o 3/e, TMH 2007*		BTL 1
8	***Obtain a relationship between carrier and side band powers in an AM DSBFC wave and explain how power distribution takes place in AM DSB FC system.<u>NOV/DEC 2010 NOV/DEC 2012</u>*** *Refer Page No149 in H Taub, D L Schilling, G Saha, "Principles*		BTL2

9	**10.Define FM and PM modulation. Write down their equations. Descr produce PM from FM modulator** **<u>NOV/DEC 2009.</u>** Refer Page No277 H Taub, D L Schilling, G Saha, "Principles of Communication Systems" 3/e, TMH 2007		BTL 5
10	**Explain the difference between phase modulation and frequency odulation.** **<u>APRIL/MAY 2015.</u>** Refer Page No 281 in H Taub, D L Schilling, G Saha, "Principles of Communication Systems" 3/e, TMH 2007		BTL 5
11	**Explain the difference between phase modulation and frequency odulation.** **<u>APRIL/MAY 2015.</u>** Refer Page No 281 H Taub, D L Schilling, G Saha, "Principles Communication Systems" 3/e, TMH 2007		BTL 5
12	**the help of neat block diagram explain about the generation of SSBSC wave and demodulation.** **<u>NOV/DEC 2015, Nov/Dec 2016.</u>** Refer Page291 H Taub, D L Schilling, G Saha, "Principles of ommunication Systems" 3/e, TMH 2007		BTL 5
13	**ceiver connected to an antenna resistance is 50 ohms has an equivalent noise resistance of 30 ohms. Calculate the receivers noise figure and its equivalent noise temperature.** **<u>Nov/Dec 2016.</u>** **<u>Notes</u>**		BTL 5
14	**0 khz carrier is simultaneously modulated with 300 khz 800khz and 2 Khz audio sine waves. Find the frequencies present in the output.** **<u>Nov/Dec 2016</u>** **300=1300khz USF** **00=700khz LSF** **800=1800khz USF** **00=200khz LSF** **2=1002khz USF** **2=998khz LSF** **25 MHZ carrier is modulated by a 400 Khz audio sine wave. If the carrier voltage is 4V and the maximum frequency deviation is 10 khz and phase deviation is 25 radiance. Write the equations for**		BTL 5

	modulated wave for FM and PM. If the modulating frequency os now changed to 2khz all else remaining constant. Write a new equation for FM and PM. ec 2016. notes		
15	25 MHZ carrier is modulated by a 400 Khz audio sine wave. If the carrier voltage is 4V and the maximum frequency deviation is 10 khz and phase deviation is 25 radiance. Write the equations for modulated wave for FM and PM. If the modulating frequency os now changed to 2khz all else remaining constant. Write a new equation for FM and PM. ec 2016. Refer notes		BTL 5
16	carrier is amplitude modulated to a depth of 100 %. Calculate the total power in case of AM and DSBSC techniques.How much power saving is achieved in DSBSC?. If the depth of modulation is changed to 75% then how much power in Watts is required for transmitting DSBSC wave? Compare the power required for DSBSC in both cases and comment on the reason for change in power levels. Nov/Dec 2016 Notes.		BTL 5

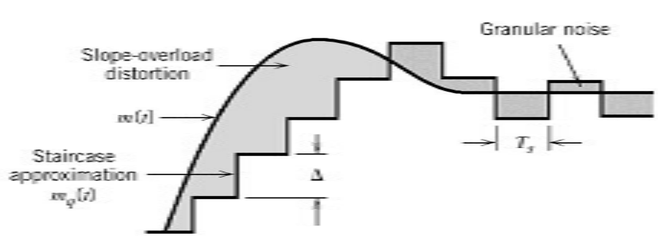
UNIT II

PULSE MODULATION

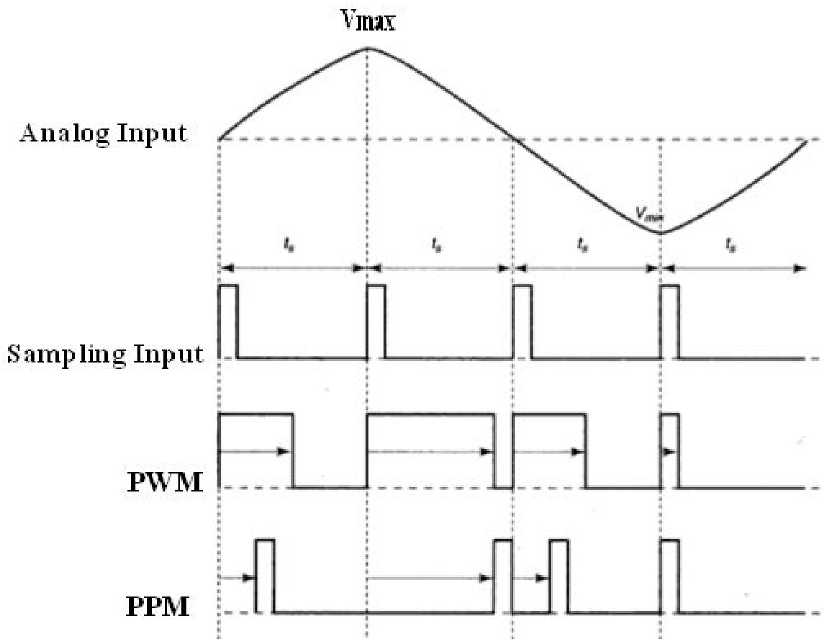
Low pass sampling theorem – Quantization – PAM – Line coding – PCM, DPCM, DM, and ADPCM And ADM, Channel Vocoder - Time Division Multiplexing,Frequency Division Multiplexing

.

S. No.	Question	Course Outcome	Blooms Taxanomy Level
1	**What is the need for sampling?** NOV/DEC 2011 To convert analog signals to digital signals sampling is needed**.**		BTL 1
2	**Define Nyquist sampling theorem. APRIL/MAY 2010, APRIL?MAY 2011** **If a finite energy signal g(t) contains no frequency higher than W Hz, it is completely determined by specifying its ordinates at a sequence of points spaced 1/2W seconds apart. fs>2fa** **where . fs= sampling frequency** **fa=analog frequency**		BTL 1
3	**For the signal m(t)= 3 cos 500^t + 4 sin 1000^t, Determine the Nyquist sampling rate.** APRIL/MAY 2010 **.Refer notes** **4.What is meant by differential pulse code modulation? APRIL?MAY 2011** With DPCM the difference in the amplitude of two successive samples is transmitted rather than the actual sample. Because the range of sample differences is typically less than the range of individual samples fewer bits are required for DPCM than conventional PCM.		BTL 5
4	**Define companding** NOV/DEC 2010 Companding is the process of compression and then expanding. Higher amplitude signals are compressed prior to transmission and then expanded in the receiver. Companding is the means of improving dynamic range of communication systems		BTL 1
5	**What are the advantages of digital transmission?** NOV/DEC 2010		BTL 1

	i. The transmission of digitally encoded analog signals requires significantly more bandwidth than simply transmitting the original analog signal. Analog signal must be converted to digital codes prior to transmission and converted back to analog form at the receiver, thus necessitating additional encoding and decoding circuitry		
6	**Draw PWM and PPM waveforms. <u>NOV/DEC 2009</u>**		BTL 1
7	**Compare slope overload and granular noise.** **Slope overload noise** Slope of analog signal is greater than delta modulator can maintain Caused when step- size is small. **Granular noise** Original input signal has relatively constant amplitude and the reconstructed signal has variation the were not present in the original signal Caused when step -size is large.		BTL 1
8	**. What do you mean by slope overload distortion in delta modulation?** Slope of analog signal is greater than delta modulator can maintain. Caused when the step size is small. 		BTL 5

9	**Define and state the causes of fold over distortion** The minimum sampling rate (f_s) is equal to twice the highest audio input frequency (f_a). If fs is less than two times f_a, distortion will result. The distortion is called aliasing or fold over distortion. The side frequencies from one harmonic fold over into the sideband of another harmonic. The frequency that folds over is an alias of the input signal hence, the names "aliasing" or "fold over distortion		BTL 1
10	**Define overload distortion.** If the magnitude of sample exceeds exceeds the highest quantization interval, overload distortion occurs		BTL 1
11	**What is the need for sampling? NOV/DEC 2011** To convert analog signals to digital signals sampling is needed**.**		BTL 5
12	**Define Nyquest sampling theorem. APRIL/MAY 2010, APRIL?MAY 2011** If a finite energy signal g(t) contains no frequency higher than W Hz, it is copletely determined by specifying its ordinates at a sequence of points spaced 1/2W seconds apart. $f_s>2f_a$ where . $f_{s=}$ sampling frequency $f_{a=analog\ frequency}$		BTL 1
13	**For the signal m(t)= 3 cos 500^t + 4 sin 1000^t, Determine the Nyquist sampling rate. APRIL/MAY 2010** Refer notes		BTL 1
14	**Define companding and state the need for companding in a PCM system. NOV/DEC 2010, APRIL/MAY 2015** Companding is the process of compression and then expanding. Higher amplitude signals are compressed prior to transmission and then expanded in the receiver. Companding is the means of improving dynamic range of communication systems		BTL 1
15	**. What are the advantages of digital transmission? NOV/DEC 2010** The transmission of digitally encoded analog signals requires significantly more bandwidth than simply transmitting the original analog signal.		BTL 1

	Analog signal must be converted to digital codes prior to transmission and converted back to analog form at the receiver, thus necessitating additional encoding and decoding circuitry		
16	**Draw PWM and PPM waveforms.** **NOV/DEC 2009**  		BTL 5
17	**.Mention how PPM is derived from PWM.** **APRIL/MAY 2015.** Pulse-position modulation may be obtained very simply from PWM. Considering PMW and its generation again, it is seen that each pulse has a leading edge and a trailing edge. However, in this case the repetition rate of the leading edge is fixed. where as that of the trailing edges is not. Their position depends on pulse width, which is determined by the signal amplitude at that instant. Thus, it may be said that the trailing edges of PWM pulses are in fact, position modulated.		BTL 1
18	**What are the disadvantages of digital transmission?** The transmission of digitally encoded analog signals requires significantly more bandwidth than simply transmitting the original analog signal. Analog signal must be converted to digital codes prior to transmission and converted back to analog form at the receiver, thus necessitating additional encoding and decoding circuitry		BTL 1

19	**Define pulse code modulation.** In pulse code modulation, analog signal is sampled and converted to fixed length, serial binary number for transmission. The binary number varies according to the amplitude of the analog signal.		BTL 1
20	**What is the purpose of the sample and hold circuit?** The sample and hold circuit periodically samples the analog input signal and converts those samples to a multilevel PAM signal		BTL 1
21	**.What is the Nyquest sampling rate?** Nyquest sampling rate states that, the minimum sampling rate is equal to twice the highest audio input frequency.		BTL4
22	**What is the principle of pulse modulation?** Pulse modulation consists essentially of sampling analog information signal and then converting those discrete pulses and transporting the pulses from a source to a destination over a physical transmission medium.		BTL5
23	**List the four predominant methods of pulse modulation.** i. Pulse width modulation (PWM) ii. Pulse position modulation (PPM) iii. Pulse amplitude modulation (PAM) iv. Pulse duration modulation (PDM)		BTL5
24	**What is codec?** An integrated circuit that performs the PCM encoding and decoding functions is called a Codec (coder/decoder).		BTL1
25	**Define quantization.** Quantization is a process of approximation or rounding off. Assigning PCM codes to absolute magnitudes is called quantizing		BTL1
26	**Define dynamic range.** Dynamic range is the ratio of the largest possible magnitude to the smallest possible magnitude. Mathematically, dynamic range is $DR = V_{max} / V_{min}$		BTL5
27	**What is PAM?**		BTL1

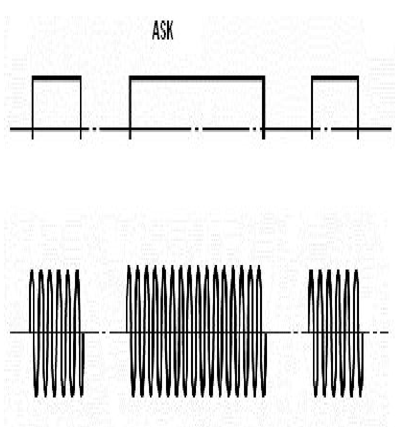
	PAM is the pulse amplitude modulation. In pulse amplitude modulation, the amplitude of a carrier consisting of a periodic train of rectangular pulses is varied in proportion to sample values of a message signal.		
28	**List the four predominant methods of pulse modulation.** i. Pulse width modulation (PWM) ii. Pulse position modulation (PPM) iii. Pulse amplitude modulation (PAM) iv. Pulse duration modulation (PDM)		BTL3
29	**What is PWM?** PWM is the pulse width modulation. In pulse width modulation, the width of a carrier consisting of a periodic train of rectangular pulses is varied in proportion to sample values of a message signal.		BTL1
30	**What is PPM?** PAM is the pulse position modulation. In pulse position modulation, the position of carrier r consisting of a periodic train of rectangular pulses is varied in proportion to sample values of a message signal.		BTL1
PART-B			
1	**Describe the basic principles of PCM system.and PCM transmitter. NOV/DEC 2011, NOV/DEC 2010** Refer Page No425 in H Taub, D L Schilling, G Saha, “Principles of Communication Systems” 3/e, TMH 2007		BTL5
2	**What is companding ? Explain in detail. (8) NOV/DEC 2011, APRIL/MAY 2010,NOV/DEC2009** Refer Page No442 H Taub, D L Schilling, G Saha, “Principles of Communication Systems” 3/e, TMH 2007		BTL5
3	**Describe in detail the adaptive delta modulation system. (8) NOV/DEC 2011** Refer Page No457 in H Taub, D L Schilling, G Saha, “Principles of Communication Systems” 3/e, TMH 2007		BTL5
4	**. What is signal to quantization noise? Explain. (8) NOV/DEC 2011, APRIL?MAY 2011**		BTL5

	Refer Page No439 H Taub, D L Schilling, G Saha, "Principles of Communication Systems" 3/e, TMH 2007		
5	**Discuss about the causes of ISI. (8 Marks)** **APRIL?MAY 2010, . APRIL?MAY 2011** Refer Page No463 H Taub, D L Schilling, G Saha, "Principles of Communication Systems" 3/e, TMH 2007		BTL5
6	**6 Explain in detail the Delta modulation transmitter and Receiver. (10 Marks) APRIL?MAY 2010,NOV/DEC2009** Refer Page No 455 in H Taub, D L Schilling, G Saha, "Principles of Communication Systems" 3/e, TMH 2007		BTL2
7	**Discuss the draw backs of delta modulation and explain the significance of adaptive delta modulator. (6 Marks) APRIL?MAY 2011** Refer Page No 455 in H Taub, D L Schilling, G Saha, "Principles of Communication Systems" 3/e, TMH 2007		BTL2
8	**What are the types of sampling? Explain the operation of the sample and hold circuit. NOV/DEC 2010** Refer Page No 429 in H Taub, D L Schilling, G Saha, "Principles of Communication Systems" 3/e, TMH 2007		BTL2
9	**9..Compare DM and PCM APRIL?MAY 2011. NOV/DEC 2010. Refer Notes**		BTL5
10	**11.Compare analog and digital modulation.** **APRIL?MAY 2011** Refer Notes		BTL2

UNIT III

DIGITAL MODULATION AND TRANSMISSION

Phase shift keying – BPSK, DPSK, QPSK – Principles of M-ary signaling M-ary PSK & QAM Comparison, ISI – Pulse shaping – Duo binary encoding – Cosine filters – Eye pattern, equalizers

S. No.	Question	Course Outcome	Blooms Taxanomy Level
1	**What is Shannon limit for information capacity? <u>NOV/DEC 2011 NOV/DEC 2012</u>** $I = B \log_2 [1 + S/N]$ Where, I= information capacity (bps) B= bandwidth **S/N=signal to noise power ratio (unit less)**		BTL1
2	**What is binary phase shift keying? <u>NOV/DEC 2011 NOV/DEC 2012</u>** With Binary phase shift keying two phases are possible for the carrier. One phase represents a logic 1 and the other phase represents a logic 0 As the input digital signal changes state (from 1to180		BTL1
3	**What are the advantages of QPSK? <u>APRIL?MAY 2010,</u>** <u>APRIL?MAY 2011 NOV/DEC 2012</u> a.All signal points placed on circumference of circle b.Circuit is simple c.Noise immunity is high. d.Error probability is less then AQSK		BTL1
4	**Draw ASK and PSK waveforms for a data stream 1010101. <u>APRIL?MAY 2011, APRIL?MAY 2010 NOV/DEC2015</u>** 1. **Sketch the waveform representation of ASK, FSK, PSK for NRZ coded binary sequence and represent also each case mathematically.**  		BTL2

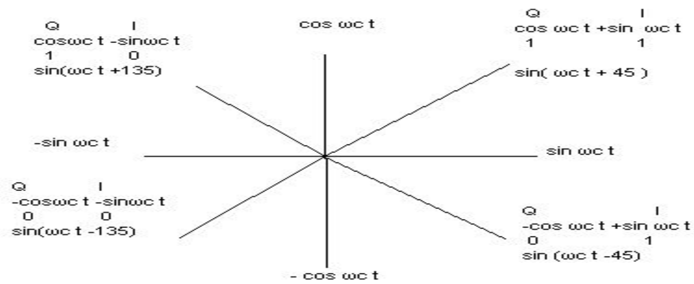
5 **Define information capacity. <u>NOV/DEC 2010,,NOV/DEC2009</u>** — BTL1

It is the number of independent symbols that can be carried through a system in a given unit

6 **What is the relation between bit rate and baud for a FSK system? <u>NOV/DEC 2010</u>** — BTL2

In digital modulation, the rate of change at the input to the modulator is called the bit rate (f_b) and has the unit of bits per second (bps).

7 **Draw the phasor diagram of QPSK <u>NOV/DEC 2009</u>** — BTL1



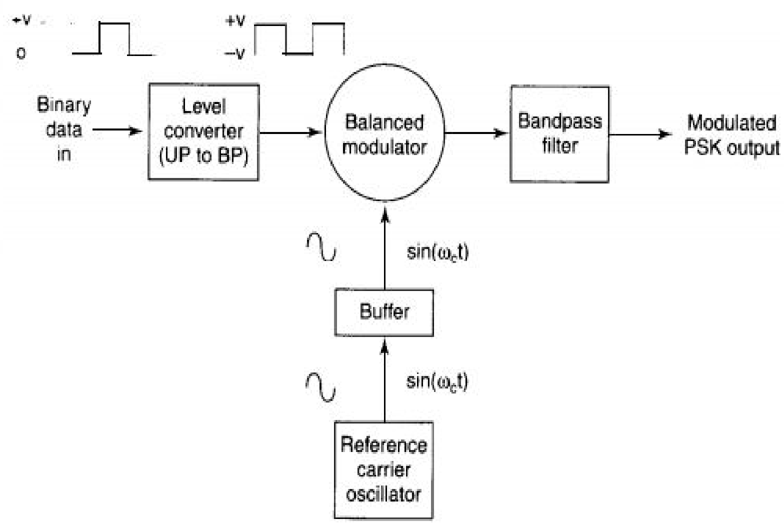
8 **Compare binary PSK with QPSK.** — BTL1

BPSK	QPSK
1. One bit forms a symbol.	Two bits form a symbol.
2. Two possible symbols	Four possible symbols.
3. Minimum bandwidth is twice of f_b	Minimum bandwidth is equal to f_b.
4. Symbol duration = Tb.	Symbol duration = 2Tb.

9 **. Bring out the difference between DPSK and BPSK.** — BTL1

DPSK	BPSK
1. It does not need a carrier at its receiver	It needs a carrier at receiver

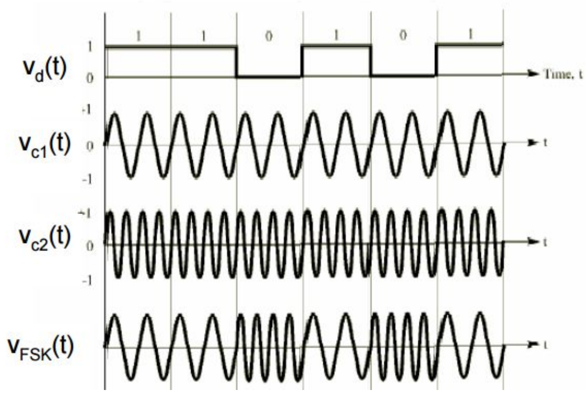
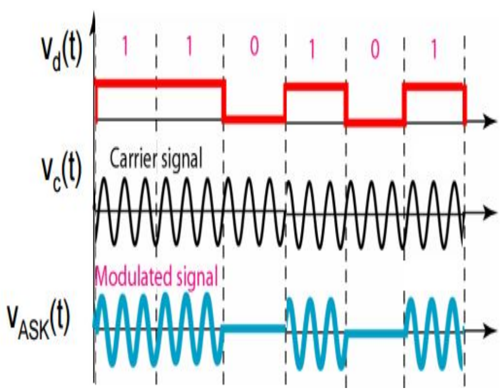
	<table><tr><td>2. Bandwidth reduced compared to BPSK</td><td>More bandwidth.</td></tr><tr><td>3.Probability of error or bit error rate more than BPSK</td><td>Comparatively low</td></tr><tr><td>4. Error propagation more, since it uses two bits for its reception</td><td>Comparatively low, since it uses only single bit</td></tr><tr><td>5. Noise interference more</td><td>Comparatively low</td></tr></table>		
10	**Define carrier recovery.** s the process of extracting a phase-coherent reference carrier from a receiver signal. It is also called as phase referencing		BTL1
11	**Mention any four advantage of digital modulation over analog modulation.** i. Maximum data rate ii. Minimum probability of symbol error iii. Minimum transmitted power. iv. Minimum channel bandwidth. v. Minimum circuit complexity vi. Maximum resistance to interfering signals		BTL1
12	**What are the advantages of M-ary signaling scheme?** i. M-ary signaling schemes transmit bits at a time. Bandwidth requirement of M-ary signaling schemes is reduced		BTL1
13	**. Draw the block diagram of BPSK transmitter <u>NOV/DEC 2012</u>**		BTL1

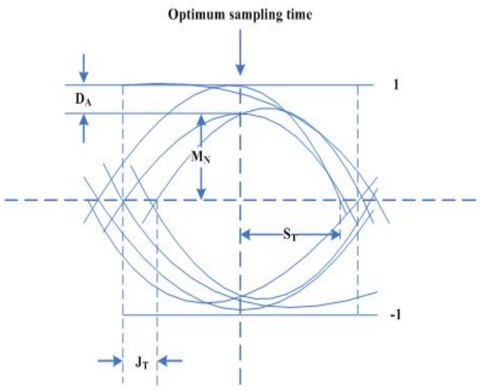
	BPSK transmitter 		
14	**Sketch the QPSK signal for the binary sequence 11001100. APRIL/MAY 2015**		BTL1
15	**Compare QPSK and16 PSK signal in terms of bandwidth. APRIL/MAY 2015** **QPSK Bandwidth $f_N=f_{b/}2$.** **16PSK Bandwidth $f_N=f_{b\,/}4$**		BTL1
16	**What is digital modulation?** When the information signal is digital and any one of the parameters (amplitude, phase or frequency) of the analog carrier is varied proportional to the information signal is called digital modulation.		BTL1
17	**What is information capacity?**		BTL1

	It is the number of independent symbols that can be carried through a system in a given unit of time .		
18	**Give the expression for Shannon limit for information capacity.** $I = B \log_2 [1 + S/N]$ Where, I= information capacity (bps) B= bandwidth **S/N=signal to noise power ratio (unit less)**		BTL1
19	**Give the Nyquist formulation for channel capacity.** $f_b = 2B \log_2 M$ Where, f_b –channel capacity (bps) B-minimum Nyquist bandwidth (Hz) M- number of discrete level or voltage levels		BTL2
20	**What are Antipodal signals?** In BPSK, the two symbols are transmitted with the help of following signals Symbol '1' => $s_1(t) = \sqrt{2P} \cos(2\pi f_0 t)$ Symbol '0' => $s_2(t) = \sqrt{2P} \cos(2\pi f_0 t + \pi)$ Here observe that above two signals differ only in a relative phase shift of 180^0. Such signals are called antipodal signals.		BTL5
21	**Define minimum shift keying. . <u>NOV/DEC 2016</u>** Minimum shift keying uses two orthogonal signal to transmit '0' and '1' in such a way the difference between these two frequencies is minimum. Hence, there is no abrupt change in the amplitude and the modulated signal is continuous and smooth		BTL1
22	**Give the difference between standard FSK and MSK.** **FSK** / **MSK**		BTL1

	<table><tr><td>1. The two frequencies are integer multiple of base band frequency and at the same time orthogonal.</td><td>Difference between two frequencies minimum and at the same time they are orthogonal.</td></tr><tr><td>2. Bandwidth (BW) = $4f_b$</td><td>BW = $f_b/2$</td></tr><tr><td>3. Has discontinuities when phase changes from 0 to 1 or 1 to 0.</td><td>Phase discontinuities are removed by smooth phase transition.</td></tr></table>		
23	**What are the advantages of M-ary signaling scheme?** i. M-ary signaling schemes transmit bits at a time. Bandwidth requirement of M-ary signaling schemes is reduced		BTL1
24	**Differentiate coherent and noncoherent methods.** **Coherent (synchronous) detection:** In coherent detection, the local carrier generated at the receiver is phase locked with the carrier at the transmitter. The detection is done by correlating received noisy signal and locally generated carrier. The coherent detection is a synchronous detection. **Non- coherent (envelope) detection:** This type of detection does not need receiver carrier to be phase locked with transmitter carrier. The advantage of such a system is that the system becomes simple, but the drawback is that error probability increases.		BTL1
25	**Define Baud rate.** The rate of change at the output of the modulator is called baud rate. Baud= $1/t_s$, where, t_s- time of one signaling element (seconds		BTL2
26	**.Compare binary PSK with QPSK.** <table><tr><th>BPSK</th><th>QPSK</th></tr><tr><td>1. One bit forms a symbol.</td><td>Two bits form a symbol.</td></tr><tr><td>2. Two possible symbols</td><td>Four possible symbols.</td></tr><tr><td>3. Minimum bandwidth is twice of f_b</td><td>Minimum bandwidth is equal to f_b.</td></tr><tr><td>4. Symbol duration = Tb.</td><td>Symbol duration = 2Tb.</td></tr></table>		BTL1

27	**Define peak frequency deviation for FSK.** Peak frequency deviation (Δf) is the half the difference between either the mark and space frequency. **(Δf)=|fm-fs|/2.**		BTL1
28	**Define bit rate.** In digital modulation, the rate of change at the input to the modulator is called the bit rate (f_b) and has the unit of bits per second (bps)		BTL1
29	**Define QAM.** Quadrature amplitude modulation is a form of digital modulation where the digital information is contained in both the amplitude and phase of the transmitted carrier.		BTL1
30	**What do you mean by ASK?** ASK (Amplitude Shift Keying) is a modulation technique which converts digital data to analog signal. In ASK, the two binary values(0,1) are represented by two different amplitudes of the carrier signal. S(t) = Acos2πft binary 1 0 binary 0		BTL1
31	**Why is FSK and PSK signals are preferred over ASK signals.NOV/DEC2015**. ASK is very susceptible to noise interference – noise usually (only) affects the amplitude, therefore ASK is the modulation technique most affected by noise		
32	**For a 8 PSK system operating with an information bit rate of 24 Kbps. Determine bandwidth efficiency? . <u>NOV/DEC 2016</u>** Bandwidth efficiency=fb/3=24/3=8 Bandwidth efficiency=8		
33	**. Sketch the digitally modulated waveforms for the binary data 110101 using ASK ,FSK** **NOV/DEC2015**		

	[FSK]  **[ASK]**  		
34	**Define inter symbol interference (ISI).** **<u>NOV/DEC 2011</u>** The ringing tails of several pulses have overlapped, thus interfering with major pulse lobe. This interference is commonly called as intersymbol interference or ISI. The four primary causes of ISI are i. Timing inaccuracies ii. Insufficient bandwidth iii. Amplitude distortion iv. Phase distortion		
35	**Draw the Eye pattern and indicate how ISI is measured from it.** **<u>NOV/DEC 2009</u>**		

			
36	**What is an eye pattern?** The performance of a digital transmission system can be measured by displaying the received signal on an oscilloscope and triggering the time base at data rate. Thus, all waveform combinations are superimposed over adjacent signaling intervals. Such a display is called eye pattern or eye diagram		
PART-B			
1	**s the principle of operation of FSK transmitter. (8) NOV/DEC 2011 APRIL/MAY 2013, NOV/DEC 2015, Nov/Dec 2016** Refer Page No373 in H Taub, D L Schilling, G Saha, "Principles of Communication Systems" 3/e, TMH 2007		BTL5
2	**Write a note on QPSK.modulator&demodulator. Draw its phasor and constellation diagram .Explain bandwidth consideration of QPSK.NOV/DEC 2011, APRIL?MAY 2011, NOV/DEC 2010,NOV/DEC 2009, APRIL/MAY2015,NOV/DEC2015** Refer Page No381 H Taub, D L Schilling, G Saha, "Principles of Communication Systems" 3/e, TMH 2007		BTL5
3	**s the principle of operation of FSK receiver. (8) NOV/DEC 2011, NOV/DEC 2015 Nov/Dec 2016** Refer Page No374 H Taub, D L Schilling, G Saha, "Principles of Communication Systems" 3/e, TMH 2007		BTL5
4	**Write a note on DPSK. (8) NOV/DEC 2011 APRIL/MAY 2013** Refer Page No407 in H Taub, D L Schilling, G Saha, "Principles of Communication Systems" 3/e, TMH 2007		BTL5
5	**What is known as Binary phase shift keying? Discuss in detail the BPSK transmitter and Receiver and also obtain the minimum double sided Nyquist bandwidth. (16 Marks) APRIL?MAY 2010, APRIL?MAY 2011**		BTL5

	Refer Page No376 in H Taub, D L Schilling, G Saha, "Principles of Communication Systems" 3/e, TMH 2007		
6	**Illustrate the concept of 8 QAM transmitter with the truth table. (8 Marks) APRIL?MAY 2010, APRIL?MAY 2011, APRIL/MAY2015** Refer Page No395 in H Taub, D L Schilling, G Saha, "Principles of Communication Systems" 3/e, TMH 2007		BTL5
7	**What is the need for carrier Recovery? Explain the Costas loop and squaring loop method of carrier recovery. (8 Marks) APRIL/MAY 2010, APRIL?MAY 2011, NOV/DEC 2010** Refer Page No404 in H Taub, D L Schilling, G Saha, "Principles of Communication Systems" 3/e, TMH 2007		BTL2
8	**. Find the peak frequency deviation (ii) minimum bandwidth (iii) baud for FSK signal with a mark frequency of 49 kHz, space frequency of 51 kHz,and input bit rate of 2 kbps. NOV/DEC 2009.** Ref page No. 371 in H Taub, D L Schilling, G Saha, "Principles of Communication Systems" 3/e, TMH 2007		BTL5
9	**are various digital modulation schemes. NOV/DEC 2015. Nov/Dec 2016** **ěr Notes**		BTL6
10	**igital message input data rate is 8 Kbps and average energy per bit is 0.01 unit. Find the bandwidth required for transmission of the message through BPSK,QPSK,BFSK,MSK,16 PSK. Nov/Dec 2016** **notes.**		

UNIT IV

INFORMATION THEORY AND CODING 9

Measure of information – Entropy – Source coding theorem – Shannon–Fano coding, Huffman Coding, LZ Coding – Channel capacity – Shannon-Hartley law –

Shannon's limit – Error control codes – Cyclic codes, Syndrome calculation – Convolution Coding, Sequential and Viterbi decoding .

S. No.	Question	Course Outcome	Blooms Taxanomy Level
1	**What is hamming distance?** 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		BTL1
2	**Define code efficiency.** 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.		BTL1
3	**What is meant by systematic and non-systematic codes?** In a Systematic block code, message bits appear first and then check bits. In a non-systematic code, message and check bits cannot be identified in the code vector.		BTL1
4	**What is meant by linear code?** 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.		BTL1
5	**What are the error detection and correction capabilities of hamming codes?** 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.		BTL1
6	**What is meant by cyclic codes? When a binary code is said to be cyclic codes.?Nov/Dec 2016** Cyclic codes are the subclasses of linear block codes. They have the property that a cyclic shift of one codeword produces another code word. A binary code is said to be a cyclic codes it it exhibits two fundamental properties.		BTL2

	1. linearity property : the sum of any two code words iin the code is also a code word. 2.cyclic property: Any cyclic shift of a codeword in the code is also a codeword.		
7	**How syndrome is calculated in Hamming codes and cyclic codes?** In hamming codes the syndrome is calculated as, S=YHT Here Y is the received vector and HT.is the e transpose of parity check matrix		BTL1
8	**What is difference between block codes and convolutional codes?** Block codes takes k number of bits simultaneously form n-bit code vector. This code vector is also called block. Convoluotional 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.		BTL1
9	**Define constraint length in convolutional code?** Constraint length is the number of shift over which the single message bit influence the encoder output. It is expressed in terms of message bits		BTL1
10	**Define free distance and coding gain.** 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= (Eb /No)encoded (Eb /No)coded For convolutional coding, the coding gain is given as, A = rdf/2 Here r is the code rate and df is the free distance		BTL1
11	**What is convolution code?** Fixed number of input bits is stored in the shift register & they are combined with the help of mod 2 adders. This operation is equivalent to binary convolution coding		BTL1
12	**What is meant by syndrome of linear block code?** The non zero output of the produce YHT is called syndrome & it is used to detect error in y. Syndrome is denoted by S & given as, S=YHT		BTL1
13	**are the advantages & Disadvantages of convolutional codes?** **Advantages:**		BTL1

	The decoding delay is small in convolutional codes since they operate o smaller blocks of data. The storage hardware required by convolutional decoder is less since the block sizes are smaller. **Disadvantages:** ·Convolutional codes are difficult to analyze since their analysis is complex. ·Convolutional codes are not developed much as compared to block codes		
14	**Define sates of encoder?** The constraint length of the given convolutional encoder is K=2. Its rate is1/2 means for single message bit input, two bits x1 and x2 are encoded at the output. S1 represents the input message bit and S2 stores the previous message bit. Since only one previous message bit is stored, this encoder can have states depending upon this stored message bit. Let S represent, S2= 0 state a and S2= 1 state b		BTL1
15	. **Define constraint length in convolutional codes?** Constraint length is the number of shifts over which the single message bit can influence the encoder output. This is expressed in terms of message bits.		BTL1
16	**An event has six possible outcomes with probabilities ½,1/4,1/8,1/16,1/32,1/32.Find the entrophy of the system APRIL/MAY 2015**		BTL1
17	**What is mutual information? APRIL/MAY 2015** It measures the amount of information that can be obtained about one random variable by observing another. It is important in communication where it can be used to maximize the amount of information shared between sent and received signals.		BTL1
18	**Define code redundancy.** It is the measure of redundancy of bits in the encoded message sequence.		BTL1

19	**Define rate of information transmission across the channel.** Dt = [H(X) – H(X/Y)]r bits/sec		BTL1
20	**Define bandwidth efficiency.** The ratio of channel capacity to bandwidth is called bandwidth efficiency		BTL1
21	**What is the capacity of the channel having infinite bandwidth?** $C = 1.44\ (S/N_0)$		BTL1
22	23.**Define a discrete memoryless channel.** For the discrete memoryless channels, input and output, both are discrete random variables. The current output depends only upon current input for such channel		BTL1
23	**Find entropy of a source emitting symb ls x, y, z with probabilities of 1/5, 1/2, 1/3 respectively.** p1 = 1/5, p2 = 1/2, p3 = 1/3. = 1.497 bits/symbol		
24	**An alph bet set contains 3 letters A,B, C transmitted with probabilities of 1/3, ¼, 1/4. Find entro py**		Band widt h (B)
25	**Write the properties of information** If there is more uncertainty about the message, information carried is also more. If receiver knows the message being transmitted, the amount of information carried is zero. If I_1 is the information carried by message m_1, and I_2 is the information carried by m_2, then amount of information carried compontely due to m_1 and m_2 is I_1+I_2		BTL1
26	Define channel capacity of discrete memoryless channel **NOV/DEC2015** The channel capacity of a discrete memoryless channel is C = max X I(X; Y), (1) where X is the random variable describing input distribution, Y		BTL1

	describes the output distribution and the maximum is taken over all possible input distributions X.		
27	**Find the entropy of the sourse alphapet { s0,s1,s2} with respective probabilities {1/4,1/4,1/2}. . <u>NOV/DEC 2016.</u>**		BTL1
28	**Calculate the amount of information if p_k = ¼** Amount of information : $I_k = \log_2 (1/p_k)$ $= \dfrac{\log_{10} 4}{\text{Log}_{10} 2}$ = 2 bits		BTL5
29	**Define code variance** Variance is the measure of variability in codeword lengths. It should be as small as possible		BTL1
30	**Properties of entropy:** Entropy is zero if the event is sure or it is impossible When p_k = 1/M for all the „M" symbols, then the symbols are equal.		BTL1
	PART-B		
1	**Explain Huffman coding with example** Refer Page No 578 in H Taub, D L Schilling, G Saha, "Principles of Communication Systems" 3/e, TMH 2007		BTL2
2	**Explain Shanon Fano coding.** H Taub, D L Schilling, G Saha, "Principles of Communication Systems" 3/e, TMH 2007		BTL5
3	**Explain Linear block codes with example** Refer Page No 632 in H Taub, D L Schilling, G Saha, "Principles of Communication Systems" 3/e, TMH 2007		BTL5
4	**Explain cyclic codes with example** Refer Page No 641 in H Taub, D L Schilling, G Saha, "Principles of Communication Systems" 3/e, TMH 2007		BTL5
5	**Explain convolutional coding.** Refer Page No 654 in H Taub, D L Schilling, G Saha, "Principles of Communication Systems" 3/e, TMH 2007		BTL2

6	**Explain how viterbi decoding procedure is used for decoding convolutional codes.** **<u>APRIL/MAY2015</u>** Refer Page No 668 in H Taub, D L Schilling, G Saha, "Principles of Communication Systems" 3/e, TMH 2007		BTL5
7	**Derive the expression for channel capacity of a continuous channel. Comment on the trade off between SNR and capacity.** **<u>APRIL/MAY2015.</u>** H Taub, D L Schilling, G Saha, "Principles of Communication Systems" 3/e, TMH 2007		BTL5
8	**Five sourse messages are probable to appear as m1=0.4, 0.15, 0.15,0.15,0.15 .Find coding efficiency using Shannons Fano coding and Huffman coding and also Compare the efficiency.** **<u>Nov/Dec 2016</u>** **Refer notes.**		BTL5
9	**Explain the concept of code generation and decoding of correlation codes.** **<u>Nov/Dec 2016</u>** **Refer Notes.**		BTL5
10	**The generator polynomial of (15,11) Hamming code is given by 1+X+X2. Determine encoder and syndrome calculator for this code using systametic codes.** **<u>Nov/Dec 2016.</u>** **Refer Notes**		BTL2
11	**A data bit sequence consists of the following strings of bits 10 11 10 10 .Analyze and draw the nature of waveform transmitted by BPSK transmitter.** **<u>Nov/Dec 2016</u>** **Notes.**		BTL5

UNIT V

SPREAD SPECTRUM AND MULTIPLE ACCESS

PN sequences – properties – m-sequence – DSSS – Processing gain, Jamming – FHSS – Synchronisation and tracking – Multiple Access – FDMA, TDMA, CDMA,

S. No.	Question	Course Outcome	Blooms Taxanomy Level

1	**List the spread spectrum techniques.** **NOV/DEC 2011** Direct sequence spread spectrum with coherent Binary phase shift keying Frequency hop spread spectrum		BTL1
2	**What is CDMA?** **NOV/DEC 2011** In code division multiple access ,each subscriber is assigned a distinct spreading code(PN sequence),thereby permitting the subscriber full access to the channel all of the time.		BTL2
3	**What are the applications of spread spectrum modulation? APRIL/MAY 2010, APRIL?MAY 2011** 1.Millitary applications. 2.secured communication		BTL1
4	**Define processing gain in spread spectrum modulation. APRIL/MAY 2010, APRIL?MAY 2011** Processing gain is defined as the gain in Signal to noise Ratio obtained by the use of spread spectrum . It is defined as the gain achieved by the processing a spread spectrum signal over an unspread signal.		BTL1
5	**. Define effective jamming power and processing.** **NOV/DEC 2009** $(\text{Jamming margin})_{db} = (\text{processing gain})_{db} - 10\log_{10}(E_b/N_o)_{min}$ Where $(E_b/N_o)_{min}$ minimum value needed to support a prescribed average probability of error.		BTL1
6	**What is the principle of frequency hopping spread spectrum? NOV/DEC 2009** The type of spread spectrum in which the carrier hops randomly from one frequency to another is called frequency hop spread spectrum		BTL1
7	**Compare slow and fast frequency hopping.** (see table below)		BTL1

Slow Frequency Hopping	Fast Frequency Hopping
1.More than one symbols are transmitted per frequency hop.	More than one frequency hops are required to transmit one symbol.
2.Chip rate is equal to symbol rate.	Chip rate is equal to hop rate.
3. Symbol rate higher than hop rate.	Hop rate higher than symbol rate.

8	**What are the two different techniques used in speech coding for wireless communication?** i. Multi-pulse excited Linear Predictive Coding (LPC). ii. Code-excited LPC		BTL1
9	**What are the two function of fast frequency hopping?** 1. Spread Jammer over the entire measure of the spectrum of transmitted signal.2. Retuning the Jamming signal over the frequency band of transmitted signal		BTL1
10	**What are the features of code Division multiple Accesses?** 1. It does not require external synchronization networks. 2. CDMA offers gradual degradation in performance when the no. of users is increased But it is easy to add new user to the system.		BTL1
11	**Write some features of TDMA?** *In TDMA , no. of time slots depends upon modulation technique ,available bandwidth *Data transmission occurs in bursts It uses different time slots for transmission and reception, then duplexers are not required *Adaptive equalization is necessary *Guard time should be minimized		BTL1
12	**Write some features of CDMA?** *In CDMA system, many users share the same frequency either TDD or FDD may be used *Channel data rate is high *Multipath fading may be substantially reduced *CDMA uses co –channel cells, it can use macroscopic spatial diversity to provide soft hand Off.		BTL5
13	**What is near far effect in a CDMA system**? **APRIL/MAY 2015**		BTL1

	The near-far problem is a condition in which a receiver captures a strong signal and thereby makes it impossible for the receiver to detect a weaker signal.[1] The near-far problem is particularly difficult in CDMA systems, where transmitters share transmission frequencies and transmission time.		
14	**What are Walsh codes.** Walsh codes are orthogonal codes obtained from Hadamard matrices They are used in CDMA to separate the users		BTL5
15	**<u>on the three most commonly used multiple access techniques.</u>** **<u>Nov/Dec 2016</u>** : division multiple access uency division multiple access e division multiple access.		BTL4
16	vill you generate PNsequence. feedback shiftregister PN sequences are generated.		BTL1
17	**Write some advantages of TDMA?** Data transmission occurs in bursts It uses different time slots for transmission and reception, then duplexers are not		BTL5
18	**Write some advantages of of CDMA** Multipath fading may be substantially reduced *CDMA uses co –channel cells, it can use macroscopic spatial diversity to provide soft hand Off.		BTL4
19	**What is frequency hopping spread spectrum?** The type of spread spectrum in which the carrier hops randomly from one frequency to another is called frequency hop spread spectrum		BTL1
20	**What is the important applications of Spread spectrum?** **Millitary applications**		BTL5
21	**What are spread spectrum techniques**		BTL4

	Direct sequence spread spectrum with coherent Binary phase shift keying Frequency hop spread spectrum		
22	**Define code division multipleaccess.** In code division multiple access ,each subscriber is assigned a distinct spreading code(PN sequence),thereby permitting the subscriber full access to the channel all of the time.		BTL1
23	**What is processing gain?** Processing gain is defined as the gain in Signal to noise Ratio obtained by the use of spread spectrum . It is defined as the gain achieved by the processing a spread spectrum signal over an unspread signal.		BTL5
24	**What is effective jamming power .** Jamming margin)$_{db}$= (processing gain)$_{db}$-10log$_{10}$(E_b/N_o)$_{min}$		BTL4
25	**Which oscillator is used in DS spread spectrum?** **Voltage controlled oscillator(VCO) is used**		BTL2
1	**PART B** **Explain the principle of DS spread spectrum technique.with coherent binaryPSK. (8) NOV/DEC 2011, APRIL/MAY 2010, APRIL?MAY 2011, NOV/DEC 2010, NOV/DEC 2009** Refer Page No310 in S. Haykin "Digital Communications" John Wiley 2005		BTL2
2	**Explain the salient features of wireless communication. (8) NOV/DEC 2011** Page no 312 in S. Haykin "Digital Communications" John Wiley 2005		BTL5
3	**Describe the frequency hopping spread spectrum technique in detail. (8) NOV/DEC 2011, NOV/DEC 2009** Refer Page No318 S. Haykin "Digital Communications" John Wiley 2005		BTL5

4	**Explain the basic principle of TDMA. (8) <u>NOV/DEC 2011</u>** Refer Page No320 in S. Haykin "Digital Communications" John Wiley 2005		BTL5
5	**What is a Pseudo noise sequence?How it is generated? What are the properties of Pseudo noise sequence? (8 Marks) <u>APRIL/MAY 2010, APRIL?MAY2011,NOV/DEC2010</u>** Refer Page No322 in S. Haykin "Digital Communications" John Wiley 2005		BTL5
6	**. Describe the application of CDMA in wireless communication systemList the advantages of TDMA over CDMA.. <u>APRIL/MAY2010</u>,NOV/DEC2010, <u>APRIL?MAY 2011</u>** Refer Page No301 in S. Haykin "Digital Communications" John Wiley 2005		BTL5
7	**Explain the near- far problem in spread spectrum modulation? (6 Marks) <u>APRIL/MAY 2010</u>7.** Page No 315 in S. Haykin "Digital Communications" John Wiley 2005		BTL2
8	**8..Write note on coding of speech for wireless communication. <u>APF</u> <u>2011</u> (6)** Refer Page No325 S. Haykin "Digital Communications" John Wiley 2005		BTL5