INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)
Dundigal, Hyderabad - 500 043

ELECTRONICS AND COMMUNICATION ENGINEERING

TUTORIAL QUESTION BANK

Course Title	**ANALOG COMMUNICATIONS**				
Course Code	AECB12				
Programme	B.Tech				
Semester	IV	ECE			
Course Type	Core				
Regulation	IARE - R18				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	3	1	4	3	1.5
Chief Coordinator	Mrs. G Ajitha, Assistant Professor				
Course Faculty	Dr.P.Munisamy, Professor Mrs.P.Saritha, Assistant Professor Mr.G.Kiran Kumar, Assistant Professor				

COURSE OBJECTIVES

The course should enable the students to:	
I	Introduce he communication system and need of modulation.
II	Understand the concepts of Amplitude Modulation and its types (DSB-SC, SSB and VSB).
III	Understand the concepts of Angular Modulation, FM and types of FM.
IV	Describe the behavior of analog communications in the presence of noise and also the basics of analog pulse modulation techniques.
V	Classify and discuss the different types of transmitters and receivers.

COURSE OUTCOMES (COs):

CO 1	Understand the basic concepts of the communication systems and illustrate different amplitude modulation techniques
CO 2	Analyze the time domain and frequency domain description of SSB and VSBSC and compare various amplitude modulation schemes.
CO 3	Analyze generation and detection of FM signal and comparison between amplitude and angle modulation schemes.
CO 4	Gain the knowledge of different noise sources and evaluate the performance of the communication system in the presence of noise
CO 5	Interpret with different types of receivers and study different pulse modulation and demodulation techniques.

COURSE LEARNING OUTCOMES (CLOs):

Students, who complete the course, will have demonstrated the ability to do the following:

AECB12.01	Discuss about the basic elements of communication system, importance of modulation and different types of modulation.
AECB12.02	Understand the time domain, frequency domain description and power relations of amplitude modulation, various techniques of generation and detection of AM.
AECB12.03	Analyze the time domain, frequency domain description of Double Side Band Suppressed Carrier (DSB SC), various generation techniques and detection techniques of DSB SC, Noise in DSB SC.
AECB12.04	Understand the time domain, frequency domain description of amplitude modulation single side band modulated wave, various techniques of generation and detection of SSB, Noise in SSB SC.
AECB12.05	Analyze the time domain, frequency domain description of Vestigial side band modulation, generation and detection of VSB.
AECB12.06	Discuss the comparison of different amplitude modulation techniques and applications of various amplitude systems.
AECB12.07	Analyze the basic concepts of Frequency modulation like single tone , spectrum analysis of frequency modulated wave and transmission bandwidth of FM.
AECB12.08	Understand the concepts of narrow band frequency modulation, wide band frequency modulation and pre emphasis and de emphasis circuits in FM.
AECB12.09	Discuss the generation of frequency modulation waves by direct method and indirect method and detection methods like balanced frequency discriminator, foster seeley discriminator, phase locked loop etc.
AECB12.10	Discuss the different types of Noises and noise source, Narrowband Noise In phase and quadrature phase components and its Properties.
AECB12.11	Analyze the Noise in DSB and SSB System, Noise in AM System, Noise in Angle Modulation System, Pre-emphasis and de-emphasis circuits.
AECB12.12	Discuss the concept of receivers in communication system and receiver types like tuned radio frequency receiver and super heterodyne receiver.
AECB12.13	Analyze the characteristics of the receiver like sensitivity, selectivity, image frequency rejection ratio, choice of intermediate frequency and fidelity.
AECB12.14	Understand the different Pulse analog modulation techniques.
AECB12.15	Acquire the knowledge and develop capability to succeed national and international level competitive examinations.

TUTORIAL QUESTION BANK

S.No	QUESTION	Blooms Taxonomy Level	Course Outcomes	Course Learning Outcomes
	MODULE-I AMPLITUDE MODULATION			
	Part - A(Short Answer Questions)			
1	State modulation index.	Remember	CO 1	AECB12.01
2	State modulation.	Understand	CO 1	AECB12.01
3	Describe the detection of AM wave using square law detector.	Remember	CO 1	AECB12.01
4	What is modulation efficiency.	Remember	CO 1	AECB12.01
5	List the various types of modulations?	Understand	CO 1	AECB12.01
6	Describe the DSB-SC wave modulation with spectrum?	Remember	CO 1	AECB12.01
7	Plot the frequency domain representation of AM wave.	Understand	CO 1	AECB12.02
8	What is synchronous detector?	Understand	CO 1	AECB12.02
9	What are the different methods of demodulation of DSB-SC signal?	Remember	CO 1	AECB12.02
10	What is envelope distortion?	Understand	CO 1	AECB12.03
11	Plot the Amplitude Modulation waveforms with modulation index (m) =1, m>1, m<1.	Understand	CO 1	AECB12.03
12	Describe the time domain representation of AM?	Remember	CO 1	AECB12.03
13	List the generation methods of AM wave.	Remember	CO 1	AECB12.03
14	State the power equation of AM.	Understand	CO 1	AECB12.03
15	List out the methods for detecting AM waves?	Remember	CO 1	AECB12.02
16	What are the advantages of ring modulator	Remember	CO 1	AECB12.03
17	What is the difference between coherence detection and non coherent detection?	Understand	CO 1	AECB12.03
18	Obtain the expression for amplitude modulated wave	Remember	CO 1	AECB12.03
19	Interpret Modulating Signal, Carrier and Modulated Signals.	Remember	CO 1	AECB12.02
20	Obtain the time domain expression for DSBSC	Understand	CO 1	AECB12.03
	Part - B (Long Answer Questions)			
1	Describe the necessary expressions, waveforms and spectrums of AM for an arbitrary baseband signal m (t).	Remember	CO 1	AECB12.01
2	Plot the one cycle of AM wave and calculate the modulation index of it in terms of V_{max} and V_{min} voltages.	Remember	CO 1	AECB12.01
3	Describe modulation and explain the need of modulation.	Understand	CO 1	AECB12.01
4	State AM equation. Define modulation index, and percentage modulation.	Understand	CO 1	AECB12.01
5	Demonstrate operation of square law detector with circuit diagram and waveforms.	Remember	CO 1	AECB12.01
6	Obtain the following i)Current relations in AM wave ii)Voltage relations in AM wave iii)Modulation index in terms of current and voltages	Understand	CO 1	AECB12.01
7	Illustrate the generation of AM signals using switching modulator.	Remember	CO 1	AECB12.02
8	State communication. Explain with basic block diagram of a communication system. Describe about modern communication system.	Understand	CO 1	AECB12.02
9	Describe about the quadrature null effect of coherent detector. In DSB-SC, suppression of carrier so as to save transmitter power results in receiver complexity - Justify this statement	Remember	CO 1	AECB12.02
10	Develop the equation of a single tone modulation of AM system and Also power relations.	Remember	CO 1	AECB12.03
11	Prove the relation between the output power of an AM transmission and the depth of modulation.	Remember	CO 1	AECB12.03
12	Demonstrate the coherent detection of DSB-SC modulated	Remember	CO 1	AECB12.03

S.No	QUESTION	Blooms Taxonomy Level	Course Outcomes	Course Learning Outcomes
	wave with a block diagram of detector and Explain. a block diagram of detector and Explain.			
13	Evaluate total power and total modulation index expressions for multitone AM	Understand	CO 1	AECB12.03
14	An AM transmitter has un-modulated carrier power of 10 KW. It can be modulated by sinusoidal modulating voltage to a maximum depth of 40%, without overloading. If the maximum modulation index is reduced to 30%. What is the extent up to which the un modulated carrier power can be increased to avoid over loading.	Understand	CO 1	AECB12.03
15	Analyze envelope detector with neat block diagram. Describe when negative peak clipping takes place in envelope detector.	Remember	CO 1	AECB12.02
16	Illustrate the detection of DSB-SC wave using Costas loop.	Remember	CO 1	AECB12.03
17	Demonstrate the generation of Double Side Band Suppressed Carrier (DSBSC) wave using balanced modulator with necessary block diagram, waveforms and mathematical expressions.	Remember	CO 1	AECB12.03
18	With the help of the block diagram describe the operation of ring modulator for DSBSC wave generation.	Understand	CO 1	AECB12.03
19	State the principle of amplitude modulation. Obtain expression for the AM wave and draw its spectrum.	Understand	CO 1	AECB12.02
20	Describe the generation of AM signals using square law modulator.	Remember	CO 1	AECB12.03
	Part - C (Analytical Questions)			
1	Consider an AM signal m (t) = (1+ A cos ω_m t) cos ω_c t, where the message signal frequency ω_m = 5 KHz and the carrier frequency, ω_c = 100 KHz. The constant A = 15. Can this signal be demodulated by an envelope detector? What will be the output of the envelope detector? Find the frequency spectrum of the envelope detector output.	Remember	CO 1	AECB12.01
2	For an Am DSBFC wave with peak un modulated carrier voltage V_c=10Vp, a load resistance RL= 10 Ω and a modulation co efficient m = 1. Determine a) Power of carrier, upper and lower side band b) Total power of modulate wave c) Total sideband power d) Draw the power spectrum.	Understand	CO 1	AECB12.01
3	A distorted form of a sinusoidal wave cos3ωct is available. To obtain DSB – SC signal, a modulating signal f(t) is multiplied by this distorted carrier waveform. Find and sketch of the product f(t) cos3ωct. How can the desired modulated signal f(t) cos ωct be obtained from this product.	Understand	CO 1	AECB12.01
4	A certain transmitter radiates 6 KW with carrier unmodulated, and 9 kW when the carrier is sinusoidally modulated. Calculate modulation index. If another sine wave is simultaneously transmitted with modulation index of 0.5,determine the total radiated power	Remember	CO 1	AECB12.01
5	An audio frequency signal m(t)= 10Sin(2π500t) is used to amplitude modulate a carrier of c(t)= 50sin(5π105t). Calculate i. Modulation index ii. Side band frequencies iii. BW required iv. Total power delivered to the load of 600Ω.	Remember	CO 1	AECB12.01
6	A modulating signal is a multi-tone signal given by m(t) = A1cosw1t+A2cosw2t+A3cosw3t. The signal m (t) modulates a carrier Accosw$_c$t. Plot the signal sided spectrum and find the bandwidth of the modulating signal. Assume that w3>w2>w3 and A3>A2>A1.	Remember	CO 1	AECB12.01
7	The RC load for a diode envelope detector consists of a 1000 pF capacitor in parallel with a 10K resistor. Calculate the maximum modulation depth that can be handled for sinusoidal	Understand	CO 1	AECB12.02

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	modulation at a frequency of 10 KHz if diagonal peak clipping is to be avoided.			
8	The rms antenna current of an AM transmitter is 10 A when un-modulated and 12 A when sinusoidal modulated. Calculate the modulation index.	Understand	CO 1	AECB12.02
9	An AM modulator has an output given by x(t)=Acos400πt+Bcos380πt+Bcos420πt.Then unmodulated carrier power is 100 watts and the Transmission efficiency of the AM signal is 40%. Find A and B.	Remember	CO 1	AECB12.02
10	A carrier with amplitude modulated to a depth of 50% by a sinusoidal, produces side band frequencies of 5.005 MHz and 4.995MHz. The amplitude of each side frequency is 40V. Find the frequency and amplitude of the carrier signal.	Understand	CO 1	AECB12.03
11	A message signal given by m (t) = (1 /2) cosw1t − (1/ 2) sinw2t is amplitude modulated with a carrier of frequency ωc to generate s(t) = [1 + m(t)] cosωct What is the power efficiency achieved by this modulation scheme?	Remember	CO 1	AECB12.02
12	A message signal m(t) = cos2000πt + 4cos4000πt modulates the carriers $c(t)$ = cos2πfct where fc = 1MHz to produce an AM signal. For demodulating the generated AM signal using an envelope detector, the time constant RC of the detector circuit should satisfy.	Understand	CO 1	AECB12.03
MODULE - II SSB MODULATION				
Part – A (Short Answer Questions)				
1	List out the Advantages of SSB systems?	Remember	CO 2	AECB12.04
2	Compare different AM systems?	Remember	CO 2	AECB12.04
3	Enlist the methods for SSB generation?	Understand	CO 2	AECB12.04
4	List out Applications of different AM systems?	Understand	CO 2	AECB12.05
5	Highlight the advantages of SSB?	Remember	CO 2	AECB12.05
6	State Hilbert Transform?	Understand	CO 2	AECB12.05
7	Plot the spectrum of SSB modulated signal?	Remember	CO 2	AECB12.06
8	List the Applications of SSB?	Remember	CO 2	AECB12.06
9	State the methods for SSB degeneration?	Understand	CO 2	AECB12.06
10	What are the advantages of generating AMSSB using filter method	Remember	CO 2	AECB12.06
11	Describe the expression for SSB and VSB Waves.	Remember	CO 2	AECB12.06
12	What are the advantages of VSB?	Remember	CO 2	AECB12.06
13	State VSB modulation.	Understand	CO 2	AECB12.06
14	Obtain the time domain description of SSB & VSB?	Understand	CO 2	AECB12.06
15	Compare SSB Modulation &VSB Modulation?	Remember	CO 2	AECB12.06
16	Plot the frequency domain description of SSB & VSB?	Understand	CO 2	AECB12.05
17	Plot the spectrum of VSB modulated signal?	Remember	CO 2	AECB12.05
18	What are the drawbacks of SSB modulation?	Remember	CO 2	AECB12.06
Part - B (Long Answer Questions)				
1	Describe the coherent detection of SSBSC signal with necessary mathematical expressions.	Remember	CO 2	AECB12.05
2	Explore the time domain band-pass representation of SSB with necessary sketches.	Understand	CO 2	AECB12.05
3	Describe the single tone modulation of SSB. Assume both modulating and carrier signals are sinusoids. Write SSB equation and plot all the waveforms and spectrums.	Remember	CO 2	AECB12.05
4	Illustrate the Third method of generating SSB modulated waves.	Remember	CO 2	AECB12.06
5	With neat diagram, describe the phase discrimination method	Remember	CO 2	AECB12.06

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	for generating SSB wave.			
6	Analyze Envelope detection of SSB signals.	Understand	CO 2	AECB12.06
7	Prove that in coherent detection there is a phase error in the output if carrier is cos[ωc*t*+ϕ]	Understand	CO 2	AECB12.06
8	State Hilbert transform. Prove the properties of Hilbert transform.	Remember	CO 2	AECB12.06
9	Explain the advantages and disadvantages of SSB modulation. With neat diagram, describe the filter method for generating SSB wave.	Understand	CO 2	AECB12.06
10	Find the percentage of power saved in SSB when compared with AM system.	Remember	CO 2	AECB12.05
11	Why VSB system is widely used for TV broadcasting - Explain? An AM transmitter of 1KW power is fully modulated. Calculate the power transmitted if it is transmitted as SSB.	Understand	CO 2	AECB12.05
12	Describe the generation technique of VSBSC	Understand	CO 2	AECB12.06
13	Describe the envelope detection of VSB wave plus carrier.	Remember	CO 2	AECB12.06
14	Calculate the filter requirement to convert DSB signal to SSB Signal, given that the two side bands are separated by 200HZ. The suppressed carrier is 29MHZ.	Remember	CO 2	AECB12.06
15	Explain with block diagram, the phase discrimination method of generating SSB modulated wave.	Understand	CO 2	AECB12.05
16	Plot the spectrum of SSBSC with necessary equations.	Understand	CO 2	AECB12.05
17	Analyze coherent detection of VSBSC with block diagram.	Remember	CO 2	AECB12.05
18	Plot the spectrum of VSBSC with necessary equations.	Understand	CO 2	AECB12.06
19	Compare the modulation techniques SSB and VSB in terms of generation and detection.	Understand	CO 2	AECB12.06
20	Distinguish various AM modulation techniques in terms of power ,bandwidth and transmission efficiency.	Remember	CO 2	AECB12.06
	Part - C (Analytical Questions)			
1	Calculate the power transmitted if it is transmitted as SSB for AM transmitter of 1KW power is fully modulated.	Understand	CO 2	AECB12.05
2	Find the necessary transmitter power of SSB with modulation index=0.5. A certain communication channel is characterized by 90dB.	Remember	CO 2	AECB12.06
3	Calculate the total power in case of SSB technique. A 500 W carrier is amplitude modulated to a depth of 75%.. How much power is achieved for SSB compared to AM and DSBSC?	Understand	CO 2	AECB12.06
4	Determine for a single sideband suppressed carrier transmission of a two-tone test signal of 1.5kHz and3kHz and a carrier frequency of 100kHz, Output frequency spectrum if only the upper side band is transmitted. For E1=E2=5v and a load resistance of 50 ohm, the PEP and average output power.	Understand	CO 2	AECB12.06
5	Find the percentage power saving when the carrier and one of the side bands are suppressed in an AM wave modulated to a depth of,(i)100 % (ii) 50%	Understand	CO 2	AECB12.06
6	Calculate the power transmitted if it is transmitted as SSB for AM transmitter of 10KW power is fully modulated.	Remember	CO 2	AECB12.06
7	Find the various frequency components and their amplitude in the Voltage given below E=50(1+0.7cos5000t-0.3cos1000t) sin 5x106t.Draw the single sided spectrum. Also evaluate the modulated and sideband powers.	Understand	CO 2	AECB12.06

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8	Find the IF and BFO frequencies for the SSB receiver, a RF input frequency of 35.602 MHz, a RF local oscillator frequency of 25MHz and a 2 kHz modulating frequency.	Remember	CO 2	AECB12.05
9	Determine a) SSBSC output frequency spectrum b) output frequency for a single frequency input fm= 5.6 kHz of the balanced ring modulator, a carrier frequency fc= 400 kHz, and a modulating signal frequency range fm= 0 to 8kHz.	Understand	CO 2	AECB12.05
10	Consider a 2-stage SSB modulator with input signals consists of a voice signal in a frequency range of .3 to 4khz. The two oscillators frequencies are f1=10khz and f2 = 100Khz. Evaluate the following 1) Side bands of DSBSC wave modulated. 2) Side bands of SSB wave modulated waves at outputs of two BPFs. 3)The pas bands and guard bands of two BPFs	Understand	CO 2	AECB12.05
MODULE -III ANGLE MODULATION				
Part - A (Short Answer Questions)				
1	Summarize angle modulation? What are different types of Angle modulation?	Remember	CO 3	AECB12.07
2	Compare amplitude and frequency modulation?	Understand	CO 3	AECB12.07
3	List out the Advantages & Applications of FM?	Remember	CO 3	AECB12.09
4	State PM & FM. What is frequency deviation & phase deviation?	Understand	CO 3	AECB12.08
5	Plot FM wave for modulating wave m(t) as i) Sine wave ii) Square wave	Understand	CO 3	AECB12.08
6	Write the equations for FM & PM waves?	Remember	CO 3	AECB12.09
7	Plot the phasor diagram of frequency modulated signals?	Understand	CO 3	AECB12.07
8	State Carson's Rule?	Remember	CO 3	AECB12.07
9	What is the wideband FM ?	Understand	CO 3	AECB12.09
10	Describe is deviation ratio?	Remember	CO 3	AECB12.08
CIE-II				
1	List out the methods for FM generation?	Remember	CO 3	AECB12.07
2	State modulation index of FM?	Understand	CO 3	AECB12.07
3	What is narrow band FM?	Remember	CO 3	AECB12.09
4	Describe pre emphasis.	Understand	CO 3	AECB12.08
5	Classify the methods for FM demodulation?	Understand	CO 3	AECB12.08
6	What are the drawbacks of direct method for FM modulation	Remember	CO 3	AECB12.09
7	Categorize FM demodulators.	Understand	CO 3	AECB12.07
8	Enlist the advantages of balanced slope detector.	Understand	CO 3	AECB12.07
9	Describe de emphasis.	Understand	CO 3	AECB12.09
10	Summarize voltage controlled oscillator.	Understand	CO 3	AECB12.08
Part - B (Long Answer Questions)				
1	Illustrate how FM can be generated from PM?	Understand	CO 3	AECB12.09
2	Calculate an expression for single tone frequency modulated wave.	Remember	CO 3	AECB12.07
3	Describe generation of narrow band FM signal with necessary diagrams.	Understand	CO 3	AECB12.07
4	Discuss frequency deviation and mention the applications of angle modulation.	Understand	CO 3	AECB12.09
5	Compare the phasor diagram of narrow band FM signal and AM signal and discuss about the similarities and differences of the two signals	Remember	CO 3	AECB12.07
6	Describe the generation of narrow band frequency modulation with necessary circuit diagram.	Understand	CO 3	AECB12.07
7	Distinguish narrow band frequency modulation with wide band	Remember	CO 3	AECB12.09

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	frequency modulation			
8	Solve frequency deviation for phase modulated wave and compare with FM wave.	Remember	CO 3	AECB12.08
9	Derive an expression for single tone for narrow band frequency modulated wave.	Remember	CO 3	AECB12.08
10	Compare frequency modulation with amplitude modulation.	Remember	CO 3	AECB12.07
	CIE-II			
1	Describe balanced slope detector for detecting FM signal with circuit diagram.	Understand	CO 3	AECB12.08
2	Discuss about WBFM generation using indirect method or Armstrong method?	Understand	CO 3	AECB12.07
3	Illustrate varactor diode method for FM generation using neat circuit diagram.	Understand	CO 3	AECB12.09
4	Discuss the operation of phase discriminator using phasor diagrams.	Remember	CO 3	AECB12.09
5	Analyze Ratio detector for FM demodulation and also mention the applications.	Understand	CO 3	AECB12.08
6	Describe pre emphasis and de emphasis using block diagrams.	Remember	CO 3	AECB12.08
7	Discuss the operation of phase locked loop for FM demodulation briefly.	Remember	CO 3	AECB12.09
8	Discuss the performance comparison of all frequency modulators.	Remember	CO 3	AECB12.07
9	Describe zero crossing detector using block diagram.	Understand	CO 3	AECB12.07
10	Discuss simple slope detector and mention it's advantages and disadvantages.	Understand	CO 3	AECB12.07
	Part - C (Analytical Questions)			
1	An FM signal is given by s(t) = 2 cos 20000π t+ cos 2000π t + 3 cos 40000π t. Determine the bandwidth and β assuming K f =104 Hz/volt.	Remember	CO 3	AECB12.09
2	Calculate the maximum deviation. What is the modulation index when the modulating frequency is reduced to 250 Hz and the modulating voltage is simultaneously raised to 3.2v.When the modulating frequencies in an FM system is 400Hz and the modulating voltage is 2.4v the modulation index is 60.	Remember	CO 3	AECB12.08
3	Determine the amplitude spectrum of the filter output for FM wave with modulation index β=1 is transmitted through an ideal band pass filter with mid band frequency fc and bandwidth is 5 fm , where fc is the carrier frequency and fm is the frequency of the sinusoidal modulating wave.	Understand	CO 3	AECB12.08
4	Find the significant sidebands and the bandwidth of the FM signal as a result of these sidebands for an FM broadcast signal which has been modulated by a single-tone modulating signal of frequency fm=15kHz. The frequency deviation is the same as allowed by the international regulation.	Understand	CO 3	AECB12.09
5	Determine the spectrum of the resulting phase modulated wave, assuming that the maximum phase deviation βp=kpAm does not exceed 0.5 radians. The sinusoidal modulating wave m(t)=Amcos (2π fm t)is applied to a phase modulation with phase sensitivity K p . The un modulated carrier wave has frequency f c and amplitude A c .	Remember	CO 3	AECB12.07
6	a) Compute the bandwidth requirement for the transmission of FM signal having a frequency deviation 75 KHz and an audio bandwidth of 10 KHz. b) An FM radio link has a frequency deviation of 30 kHz. The modulating frequency is 3 kHz. Calculate the bandwidth needed for the link. What will be the bandwidth if the deviation	Remember	CO 3	AECB12.09

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	is reduced to 15 kHz?			
	CIE-II			
1	An angle modulated signal has the form V(t)=100(cos 2πfct +4 sin2000πt)when f_c = 10 MHz. (a)Determine the average transmitted power. (b) Determine the peak phase deviation. (c) Determine the peak frequency deviation. (d) Is this an FM or a PM signal?	Understand	CO 3	AECB12.07
2	Calculate for An angle-modulated signal has the form u(t)=100cos[$2\pi f_c t$+4sin$2\pi f_m t$] Where fc=10MHz and fm=1000Hz. Assuming that this is an FM signal, determine the modulation index and the transmitted signal bandwidth. Repeat part (a) if fm is doubled. Assuming that this is an PM signal, determine the modulation index and the transmitted signal bandwidth. d) Repeat part (c) if fm is doubled.	Remember	CO 3	AECB12.07
3	Determine the modulation index and bandwidth for FM and PM signals for a modulating signal 5cos30000πt angle modulates a carrier Acos2πfct. Assume K_f =Kp = 15 KHz/volt.	Remember	CO 3	AECB12.09
4	Find, i) The modulation index ii) Phase deviation produced in the FM wave iii) If another modulating signal produces a modulation index of 100 while maintaining the same deviation, find the frequency and amplitude of the modulating signal, assuming K_f=15kHz per volt.Asingle-tone modulating signal cos($15\pi 10^3$t) frequency modulates a carrier of 10MHz and produces a frequency deviation of 75kHz.	Understand	CO 3	AECB12.08
5	Determine the bandwidth when modulating signals amplitude is doubled? The maximum frequency deviation allowed in an FM broadcast system is 75 kHz. If the modulating signal is a single-tone sinusoid of 10 kHz, find the bandwidth of the FM signal. What will be the change in the bandwidth, if modulating frequency is doubled?	Remember	CO 3	AECB12.08
6	An angle modulated signal has the form v(t) = 100 cos (2πfct+4 sin 2000 πt) when fc =10 MHz. i. Determine average transmitted power. ii. Determine peak phase deviation. iii. Determine the peak frequency deviation. iv. Is this an FM or a PM signal? Explain.	Understand	CO 3	AECB12.07
	MODULE -IV **NOISE IN ANALOG COMMUNICATION SYSTEM**			
	Part - A (Short Answer Questions)			
1	Classify of noise sources.	Understand	CO 4	AECB12.10
2	State shot noise.	Understand	CO 4	AECB12.10
3	Describe Thermal noise.	Remember	CO 4	AECB12.10
4	Discuss available noise power.	Remember	CO 4	AECB12.11
5	Describe flicker noise and white noise.	Understand	CO 4	AECB12.11
6	Obtain the frequency domain representation of Noise.	Remember	CO 4	AECB12.11
7	Compare the different noise sources available in communication receiver.	Understand	CO 4	AECB12.11
8	Describe the term Average noise figure in detail.	Understand	CO 4	AECB12.10
9	State the term noise figure.	Remember	CO 4	AECB12.10
10	Analyze how noise can be calculated in a communication system.	Remember	CO 4	AECB12.10
11	Describe pre-emphasis and de-emphasis.	Understand	CO 4	AECB12.11

S.No	QUESTION	Blooms Taxonomy Level	Course Outcomes	Course Learning Outcomes
12	Discuss FM threshold effect.	Understand	CO 4	AECB12.11
13	Obtain the expression for term noise equivalent temperature.	Remember	CO 4	AECB12.11
14	The Signal to Noise of Fm at modulation index = 5. calculate of S/N of AM.	Remember	CO 4	AECB12.10
15	Write Friss formulae.	Understand	CO 4	AECB12.10
16	State the Figure of Merit of FM	Remember	CO 4	AECB12.10
17	Discribe Figure of Merit	Understand	CO 4	AECB12.10
18	Compare the noise performance of DSB-SC systems and SSB-SC systems	Understand	CO 4	AECB12.10
19	List the characteristics of shot noise?	Remember	CO 4	AECB12.11
20	State signal-to-noise ratio?	Remember	CO 4	AECB12.11
Part – B (Long Answer Questions)				
1	Describe thermal noise. Derive equivalent noise source for thermal noise.	Remember	CO 4	AECB12.10
2	Discuss noise equivalent bandwidth. Derive the expression for noise bandwidth.	Understand	CO 4	AECB12.10
3	Describe noise figure. Derive average noise figure of cascaded network.	Remember	CO 4	AECB12.10
4	Obtain the relation between equivalent noise temperature and noise factor. Find the noise temperature of cascaded network.	Remember	CO 4	AECB12.11
5	Compare the performance of AM and FM in the presence of noise.	Understand	CO 4	AECB12.11
6	Plot the AM receiver model and determine the signal to noise ratio of AM system	Remember	CO 4	AECB12.10
7	Discuss about noise equivalent temperature.	Understand	CO 4	AECB12.12
8	Obtain the equation for noise figure of FM receiver	Understand	CO 4	AECB12.10
9	With a neat block diagram explain the pre-emphasis and de-emphasis in FM	Remember	CO 4	AECB12.10
10	Analyze the following: a) Resistive noise source. b) Shot noise. c) In phase and quadrature phase components and its properties. d) Noise Figure.	Remember	CO 4	AECB12.10
11	Illustrate Quadrature representation of narrowband noise	Understand	CO 4	AECB12.10
12	Calculate the power spectral density of Noise in case of SSB-SC and also calculate Figure of merit.	Understand	CO 4	AECB12.11
13	Compare the noise performance in frequency modulated system and amplitude modulated system.	Remember	CO 4	AECB12.11
14	Describe white noise and plot autocorrelation function which has power spectral density N0/2	Remember	CO 4	AECB12.11
15	What is the purpose of pre-emphasis and de-emphasis filtering? Explain the filtering process with suitable sketches.	Understand	CO 4	AECB12.10
16	Estimate the power spectral density of Noise in case of DSB-SC and also calculate Figure of merit.	Remember	CO 4	AECB12.10
17	Obtain the equivalent model of a generalized communication system for noise calculation.	Understand	CO 4	AECB12.10
18	Prove that narrow band FM offers no improvement in SNR over AM	Understand	CO 4	AECB12.10
19	What is FM threshold effect? How threshold reduction is achieved in FM receiver in detail.	Remember	CO 4	AECB12.10
20	Discuss in detail the following (i) thermal noise (ii) shot noise (iii) noise figure (iv) equivalent noise temperature	Remember	CO 4	AECB12.11
Part - C (Analytical Questions)				
1	At a room temperature of 300K, calculate the thermal noise generated by two resistors of 10KΩ and 20 KΩ when the bandwidth is 10 KHz.	Understand	CO 4	AECB12.10
2	The noise figure of a receiver is 20dB and it is fed by a low noise amplifier which has again of 40dB and noise temperature	Understand	CO 4	AECB12.10

S.No	QUESTION	Blooms Taxonomy Level	Course Outcomes	Course Learning Outcomes
	of 800K.Calculate the overall noise temperature of the receiving system and the noise temperature of the receiver			
3	A 1mW video signal having a bandwidth of 100 MHz is transmitted to a receiver through a cable that has 40 dB loss. If the effective one-sided noise spectral density at the receiver is 10-20 Watt/Hz, then find the signal-to noise ratio at the receiver.	Remember	CO 4	AECB12.10
4	The signal power and noise power measured at the input of an amplifier are 150µw and 1.5 µw respectively. If the signal power at the output 1.5w and noise power is 40mw.calculate the amplifier noise factor and noise figure.	Remember	CO 4	AECB12.11
5	An AM system with envelope detection is operating at threshold. Determine the power gain in decibels needed at the transmitter to produce (S/N) = 30dB for tone modulation with m = 1.	Understand	CO 4	AECB12.11
6	Evaluate thermal noise voltage developed across a resistor of 700Ω.The bandwidth of measuring instrument is 7MHz and ambient temperature is 27^{o} C.	Remember	CO 4	AECB12.10
7	Calculate equivalent input noise of an amplifier having noise figure of 13dB and has a bandwidth of 2MHz	Understand	CO 4	AECB12.11
8	A cable has a power loss of 3 dB is connected to the input of an amplifier, which has a noise temperature of 100K. Calculate the overall noise temperature referred to the cable input.	Understand	CO 4	AECB12.10
9	For a three stage cascade amplifier, calculate the overall noise figure when each stage has a gain of 12 DB and noise figure of 8dB.	Remember	CO 4	AECB12.10
10	For a two stage amplifier, first amplifier has Voltage gain = 20, Input Resistance Rin1=700Ω, equivalent Resistance Req1=1800Ω and Output Resistor Ro1 = 30KΩ. The corresponding values of second amplifier are: 25, 80 KΩ, 12 KΩ, 1.2 MΩ respectively. What is the value of equivalent input noise resistance of the given two stage amplifier?	Remember	CO 4	AECB12.10
	MODULE -V RECEIVERS			
	Part - A (Short Answer Questions)			
1	Describe Sensitivity and Selectivity.	Understand	CO 5	AECB12.12
2	State image frequency.	Understand	CO 5	AECB12.12
3	What are the advantages of the super heterodyne receiver	Remember	CO 5	AECB12.12
4	Describe Image frequency rejection ratio.	Remember	CO 5	AECB12.13
5	What is (AGC) automatic gain control?	Understand	CO 5	AECB12.14
6	What is the function of the mixer in radio receiver?	Remember	CO 5	AECB12.13
7	Describe Fidelity?	Understand	CO 5	AECB12.13
8	List characteristics of the radio receiver?	Understand	CO 5	AECB12.13
9	Classify types of receivers?	Remember	CO 5	AECB12.14
10	List the disadvantages of TRF receiver?	Remember	CO 5	AECB12.14
11	What is Pulse Modulation and what are the types of pulse modulations.	Remember	CO 5	AECB12.12
12	List out the advantages and disadvantages of PAM	Understand	CO 5	AECB12.12
13	State the advantages and disadvantages of PWM	Remember	CO 5	AECB12.12
14	List the advantages and disadvantages of PPM	Understand	CO 5	AECB12.13
15	What is analog multiplexing and de multiplexing?	Understand	CO 5	AECB12.14
16	Discuss Double spotting.	Remember	CO 5	AECB12.13
17	Classify different types of receivers?	Remember	CO 5	AECB12.13
18	What is synchronous time division multiplexing?	Remember	CO 5	AECB12.13
19	List the types of tracking in super heterodyne receiver	Remember	CO 5	AECB12.14
20	Sketch three variations of PWM pulses.	Understand	CO 5	AECB12.14

S.No	QUESTION	Blooms Taxonomy Level	Course Outcomes	Course Learning Outcomes
Part - B (Long Answer Questions)				
1	Discuss the block diagram tuned radio frequency receiver.	Remember	CO 5	AECB12.12
2	Describe the basic principle of super heterodyne receiver.	Remember	CO 5	AECB12.12
3	List and discuss the factors influencing the choice of the intermediate frequency for a radio receiver.	Understand	CO 5	AECB12.12
4	Analyze a simple automatic gain control circuit and list its functions?	Remember	CO 5	AECB12.13
5	Interpret how the Radio frequency (RF) signals are converted into intermediate frequency (IF) signals?	Understand	CO 5	AECB12.14
6	Plot the spectrum of SSBSC with necessary equations. types of AGC explain in detail?	Understand	CO 5	AECB12.13
7	Discuss time division multiplexing with neat block diagram.	Remember	CO 5	AECB12.13
8	Describe a) Sensitivity b)Selectivity c)Image frequency rejection ratio d)Fidelity	Remember	CO 5	AECB12.13
9	Discuss the generation and demodulation of the pulse amplitude modulation (PAM) with block diagrams?	Remember	CO 5	AECB12.14
10	Discuss the generation and demodulation of the pulse width modulation (PWM) with block diagrams?	Understand	CO 5	AECB12.14
11	Describe the generation and demodulation of the pulse position modulation (PPM) with block diagrams?	Remember	CO 5	AECB12.12
12	Compare different pulse modulation methods PAM, PWM and PPM.	Remember	CO 5	AECB12.12
13	Describe single polarity and double polarity pulse amplitude signals.	Understand	CO 5	AECB12.12
14	What are the major requirements of a receiver and explain RF mixing.	Remember	CO 5	AECB12.13
15	Discuss the block diagram AM receiver with neat diagram.	Understand	CO 5	AECB12.14
16	Illustrate the block diagram Amplitude Limiter circuit.	Understand	CO 5	AECB12.12
17	Discuss frequency changing and tracking.	Remember	CO 5	AECB12.12
18	Distinguish different receiver Characteristics in detail.	Remember	CO 5	AECB12.12
19	Describe the spectral representation of PDM and PPM waves	Remember	CO 5	AECB12.13
20	Differentiate AM receiver and FM receiver.	Understand	CO 5	AECB12.14
Part - C (Analytical Questions)				
1	For a PAM transmission of voice signal with W=3kHZ. Calculate BT if fs = 8Khz and $\tau = 0.1T_s$.	Understand	CO 5	AECB12.12
2	In a super heterodyne receiver, the IF is 455 kHz. If it is tuned to 1200 kHz. Calculate image frequency.	Remember	CO 5	AECB12.12
3	An AM Superhetrodyne receiver is tuned to 600kHz.If the Q of its tank circuit is 60 and the IF is 450kHz, determine the image rejection of the receiver in dB. What will be the image rejection in case of 2-stage RF amplifier	Understand	CO 5	AECB12.12
4	When a super heterodyne receiver is tuned to 555kHz, its local oscillator provides the mixer with an input at 1001kHz. What is the image frequency? If the receiver is connected to a tune circuit with Q as 40 then calculate rejection ratio.	Remember	CO 5	AECB12.13
5	For a five low pass message signals, each of bandwidth 2kHz are to be sampled at 5kHz and PAM/TDM using pulses of width 20μs.What is the guard time available?	Remember	CO 5	AECB12.14
6	In a broadcast Superhetrodyne receiver having no RF amplifier the loaded Q of the antenna coupling circuit is 100. If the IF frequency is 455 KHz determine the image frequency and its rejection ratio for tuning at 1.1KHz. the image frequency and its rejection ratio for tuning at 25MHz.	Understand	CO 5	AECB12.13

S.No	QUESTION	Blooms Taxonomy Level	Course Outcomes	Course Learning Outcomes
7	For a 24 different message signals, each band limited to 4kHz are to be multiplexed and transmitted. What is the minimum bandwidth required for each signal?	Understand	CO 5	AECB12.14

Prepared by:

Mrs. G Ajitha, Assistant Professor, ECE

HOD, ECE