INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad - 500 043

ELECTRONICS AND COMMUNICATION ENGINEERING

TUTORIAL QUESTION BANK

Course Name	:	**ANALOG COMMUNICATIONS**
Course Code	:	**AEC005**
Class	:	**B. Tech-R16**
Semester		**IV Semester**
Branch	:	**ECE**
Academic Year	:	**2018– 2019**
Course Coordinator	:	**Dr.P.Munaswamy, Professor, ECE**
Course Faculty	:	**Dr.P.Munaswamy, Professor, ECE** **Mrs.G.Ajitha,Assistant Professor, ECE** **Mrs. L. Shruthi, Assistant Professor, ECE**

COURSE OBJECTIVES:

The course should enable the students to:

S. NO	DESCRIPTION
I	Develop skills for analyzing different types signals in terms of their properties such as energy, power, correlation and apply for analysis of linear time invariant systems.
II	Analyze various techniques of generation and detection of amplitude modulation (AM), frequency modulation (FM), and phase modulation (PM) signals.
III	Differentiate the performance of AM, FM, PM systems in terms of Power, Bandwidth and SNR (Signal-to-Noise Ratio).
IV	Evaluate Analog Communication system in terms of the complexity of the transmitters and receivers.

COURSE LEARNING OUTCOMES:

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

CAEC005.01	Understand the signal and analyze the Fourier Transform for different standard signals.
CAEC005.02	Understand and analyze the concept of convolution and correlation of signals.
CAEC005.03	Discuss about the system and their classifications based on properties and derive the transfer function of linear time variant and invariant system.
CAEC005.04	Discuss about the basic elements of communication system, importance of modulation and different types of modulation.
CAEC005.05	Understand the time domain, frequency domain description and power relations of amplitude modulation, various techniques of generation and detection of AM. Noise in AM.
CAEC005.06	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.
CAEC005.07	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.
CAEC005.08	Analyze the time domain, frequency domain description of Vestigial side band modulation, generation and detection of VSB.
CAEC005.09	Discuss the comparison of different amplitude modulation techniques and applications of various amplitude systems
CAEC005.10	Analyze the basic concepts of Frequency modulation like single tone , spectrum analysis of frequency modulated wave and transmission bandwidth of FM.
CAEC005.11	Understand the concepts of narrow band frequency modulation, wide band frequency modulation

	and pre emphasis and de emphasis circuits in FM
CAEC005.12	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.,
CAEC005.13	Discuss the concept of receivers in communication system and receiver types like tuned radio frequency receiver and super heterodyne receiver.
CAEC005.14	Analyze the characteristics of the receiver like sensitivity, selectivity, image frequency rejection ratio, choice of intermediate frequency and fidelity.
CAEC005.15	Understand the concept of sampling and its types, and analyze the graphical and analytical proof for band limited signals.
CAEC005.16	Apply the concept of analog communication to understand and analyze real time applications.
CAEC005.17	Acquire the knowledge and develop capability to succeed national and international level competitive examinations.

TUTORIAL QUESTION BANK

S. No	Questions	Blooms Taxonomy Level	Course learning Outcome
UNIT-I			
SIGNAL ANALYSIS AND LTI SYSTEMS			
PART-A (SHORT ANSWER QUESTIONS)			
1	Define Signal & System	Remember	CAEC005.01
2	What are the major classifications of a signal?	Understand	CAEC005.01
3	Define continuous time unit step and unit impulse.	Understand	CAEC005.01
4	State Convolution property of Fourier Transform.	Remember	CAEC005.01
5	What are the Conditions for a System to be a LTI System?	Understand	CAEC005.02
6	Define time variant and invariant systems.	Remember	CAEC005.02
7	Find the unit step response of the system, h (t)= 1/RC($e^{-t/RC}$) u(t)	Understand	CAEC005.02
8	What is the relationship between input and output of a LTI system?	Remember	CAEC005.02
9	Define impulse response of a linear time invariant system	Understand	CAEC005.02
10	What is the Fourier transform of unit step function?	Remember	CAEC005.03
11	Explain about Auto correlation?	Understand	CAEC005.03
12	State the Cross correlation?	Remember	CAEC005.03
13	Find the convolution of $x_1(t)$ and $x_2(t)$, $x_1(t)$= t u(t),$x_2(t)$=u(t)	Understand	CAEC005.03
14	What is transfer function of LTI system?	Remember	CAEC005.03
15	Explain signal bandwidth and system bandwidth.	Remember	CAEC005.03
PART-B (LONG ANSWER QUESTIONS			
1	Find the Fourier transform of the following a) real exponential, x(t)= e^{-at} u(t), a>0 b) x(t)= e^{-at} u(-t), a>0	Understand	CAEC005.01
2	a) The impulse response of the LTI-CT system is given as h(t) = e^{-t} u(t). Determine transfer function and check whether the system is causal and stable series? b) Write down the input-output relation of a LTI system in time and frequency domain.	Remember	CAEC005.02
3	a) State and prove the properties of auto correlation function. b) Prove that for a linear phase system, the impulse response h(t) is symmetrical about td, and it is non causal(non-zero for t<0).	Understand	CAEC005.03
4	a) Explain distortion less transmission through a system. b) Show that the relation between correlation and convolution.	Remember	CAEC005.03
5	a) Determine the convolution of two functions using graphical method i)x(t)= e^{-3t} ; ii)h(t)= u(t+3) b) Find the autocorrelation, power, RMS value and sketch the PSD for the	Understand	CAEC005.03

S. No	Questions	Blooms Taxonomy Level	Course learning Outcome
	signal x(t)=(A+ sin 100t) cos 200t		
6	i) Determine the auto and cross correlation and PSD and ESD of the following signal x(t)=A sin(wt+Ø). ii) find the convolution of signals using graphical method 	Remember	CAEC005.03
7	a) Write short notes on the following signals i)Unit step iii)Unit ramp ii)Unit impulse iv)Signum b) Define a system. How are systems classified? Define each one of them.	Understand	CAEC005.01
8	a) Explain the properties of cross correlation and auto correlation? b) Derive the fourier transform for signum function and rectangular pulse.	Understand	CAEC005.01
9	Determine the energy and power for the following signals and hence determine whether the signal is energy or power signal i) $x(t)=e^{-3t}$ ii) $x(t)=e^{-3\|t\|}$ iii) $x(t)= e^{-10t}\, u(t)$ iv) $x(t)=A\, e^{j2\pi at.}$	Remember	CAEC005.01
10	a) Explain the concepts of Convolution and correlation of signals based on properties. Mention the graphical representation of convolution and correlation. b) Explain the classification of signals with examples.	Understand	CAEC005.03
	PART-C (PROBLEM SOLVING AND CRITICAL THINKING QUESTIONS		
1	a) If x(t)=0, |t|>T1 and h(t)=0, |t|>T2 then x(t)*h(t)=0, |t|>T3 for some positive number T3. Express T3 in terms of T1 and T2 b) Consider a discrete-time LTI system with the property that if the input x[n]=0 for all n≥10, then the output y[n]=0 for all n≥15. What condition must h[n], the impulse response of the system, satisfy for this to be true?	Remember	CAEC005.02
2	The auto correlation function of signal is given below, i) $R(\tau)=e^{-\tau 2}/2\sigma^2$ ii)$R(\tau)=e^{-2a\tau}$ Determine the PSD and the normalized average power content of the signal.	Understand	CAEC005.03
3	Determine whether each of the following statements of a LTI systems is true or false and Justify your answers. a) if h(t) is the impulse response of a LTI system and h(t) is periodic and nonzero, the system is unstable. b) the inverse odd causal LTI system is always causal c) if $\|h[n]\| \leq K$ for each n, where K is a given number, then the LTI system with h[n] as its impulse response is stable.	Remember	CAEC005.02
4	A filter has an input $x(t)=e^{-t}\, u(t)$ and its impulse response $h(t)=e^{-3t}\, u(t)$. find the energy spectral density of the output.	Remember	CAEC005.01
5	Verify Parseval's theorm for the energy signal $x(t)= e^{-4t}\, u(t)$	Understand	CAEC005.01
6	Consider a causal LTI system with frequency response $H(\omega)=1/3+j\omega$ For a particular input x(t), the system is observed to produce the output, $y(t)=e^{-3t}\, u(t)-e^{-4t}\, u(t)$, find the input x(t)?	Understand	CAEC005.03
7	Find the Fourier transforms of a) cos wt u(t) b) sin wt u(t) c) cos (wt+Ø) d) e^{jwt}	Remember	CAEC005.01
8	Determine whether the following input-output equations are linear or non linear. a) $y(t)=x^2(t)$ b) $y(t)=x(t^2)$	Remember	CAEC005.02

S. No	Questions	Blooms Taxonomy Level	Course learning Outcome
	c) $y(t)=t^2 x(t-1)$ d) $y(t)=x(t)\cos 50\pi t$		
9	Find whether the following systems are causal or non-causal a) $y(t)=x(-t)$ b) $y(t)=x(t+10)+x(t)$ c) $y(t)=x(\sin(t))$ d) $y(t)=x(t)\sin(t+1)$	Understand	CAEC005.01
10	Determine whether the following systems are time-varying or time-invariant a) $y(t)=tx(t)$ b) $y(t)=t^2 x(t-1)$ c) $y(t)=a[x(t)]^2+bx(t)$ d) $y(t)=x(t)\cos 50\pi t$.	Understand	CAEC005.02
UNIT-II			
AMPLITUDE AND DOUBLE SIDE BAND SUPPRESSED CARRIER MODULATION			
PART-A(SHORT ANSWER QUESTIONS)			
1	Define modulation index	Remember	CAEC005.04
2	Define modulation. Why is modulation required ?	Understand	CAEC005.05
3	Describe the detection of AM wave using square law detector.	Remember	CAEC005.05
4	Define modulation efficiency.	Remember	CAEC005.04
5	List the various types of modulations?	Understand	CAEC005.04
6	Describe the DSB-SC wave modulation with spectrum?	Remember	CAEC005.06
7	Draw the frequency domain representation of AM wave.	Understand	CAEC005.05
8	What is synchronous detector?	Understand	CAEC005.06
9	What are the different methods of demodulation of DSB-SC signal?	Remember	CAEC005.06
10	What is envelope distortion?	Understand	CAEC005.05
11	Explain the noise in AM?	Understand	CAEC005.05
12	Explain the time domain description of AM?	Remember	CAEC005.05
13	List the generation methods of AM wave.	Remember	CAEC005.05
14	Write the power equation of AM.	Understand	CAEC005.05
15	Describe the noise in DSB-SC wave.	Remember	CAEC005.06
PART-B (LONG ANSWER QUESTIONS)			
1	a) Explain necessary expressions, waveforms and spectrums of AM for an arbitrary baseband signal m(t). b) The output power of an AM transmitter is 1KW when sinusoidally modulated to a depth of 100%. Calculate the power in each side band when the modulation depth is reduced to 50%.	Remember	CAEC005.05
2	a) Plot the one cycle of AM wave and calculate the modulation index of it in terms of V_{max} and V_{min} voltages b) The rms antenna current of an AM transmitter is 10 A when un-modulated and 12 A when sinusoidal modulated. Calculate the modulation index.	Remember	CAEC005.05
3	a) Explain the collector modulation method for generating AM wave with a neat circuit diagram and waveforms. b) An AM amplifier provides an output of 106 W at 100% modulation. The internal loss is 20 W i)What is un-modulated carrier power? ii) What is the side band power?	Understand	CAEC005.05
4	a) Write AM equation. Define modulation index, and percentage modulation. b) Define under-modulation and over-modulation. Explain why over modulation is undesirable.	Understand	CAEC005.05
5	a) Explain operation of square law detector with circuit diagram and waveforms. b) 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	Remember	CAEC005.05

S. No	Questions	Blooms Taxonomy Level	Course learning Outcome
	reduced to 30%. What is the extent up to which the un modulated carrier power can be increased to avoid over loading.		
6	a) Discuss the main objectives of a communication system design? What are the primary resources of any communication system? b) 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 modulation at a frequency of 10 KHz if diagonal peak clipping is to be avoided.	Understand	CAEC005.04
7	a) Sketch the one cycle of AM wave and calculate the modulation index of it in terms of V_{max} and V_{min} voltages. b) A modulating signal consists of a symmetrical triangular wave having zero dc component and peak to peak voltage of 12V. It is used to amplitude modulate a carrier of peak voltage 10V. Calculate the modulation index and the ratio of the side lengths L1/L2 of the corresponding trapezoidal pattern	Remember	CAEC005.05
8	a) Define communication. Explain with basic block diagram of a communication system. Write about modern communication system. b) A carrier wave of frequency 10 MHz and peak value of 10 V is amplitude modulated by a 5 KHz sine wave of amplitude 6 V. Determine the modulation index and draw the one sided spectrum of modulated wave.	Understand	CAEC005.04
9	a) Explain about the quadrature null effect of coherent detector. b) In DSB-SC, suppression of carrier so as to save transmitter power results in receiver complexity - Justify this statement	Remember	CAEC005.06
10	a) Explain how to obtain AM DSB signal in a balanced modulator circuit consider nonlinear device with characteristics $V_{out} = a_1 V_{in} + a_2 V_{in}^2$ b) A certain transmitter radiates 6KW 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	CAEC005.06
PART-C (PROBLEM SOLVING AND CRITICAL THINKING QUESTIONS)			
1	What is the total sideband power radiated? A 360W carrier is simultaneously Amplitude modulated by two audio waves with modulation percentages of 55 and 65 respectively.	Understand	CAEC005.05
2	Determine the total power radiated when modulated to 30%?A transmitter supplies 8kw to the antenna when unmodulated	Remember	CAEC005.05
3	Draw the amplitude -frequency characteristic of $V_o(t)$.The signal $v(t) = (1+ 0.1\cos\omega_1 t+0.1\cos 2\omega_2 t)\cos\omega_c t$ is detected by asquare law detector $V_o(t)=2v$	Understand	CAEC005.05
4	Find the value to which unmodulated carrier power may be increased without resulting in overloading if the maximum permitted modulation index is restricted to 40%?A Radio transmitter using AM has unmodulated carrier output power of 10kw and can be modulated to a maximum depth of 90% by a sinusoidal modulating voltage without causing overloading	Understand	CAEC005.05
5	Calculate the percentage modulation employed assuming no distortion. The rms value of the antenna current before modulation is 10A and after modulation is 12A.	Remember	CAEC005.05
6	Determine the depth of modulation for a Certain AM transmitter is coupled to an antenna. The input power to the antenna is measured although monitoring of the input current, when there is no modulation, t h e current is 10.8A.With modulation, the current rises to 12.5A.	Remember	CAEC005.05
7	Calculate the power of the modulated signal for a 1MHz carrier is amplitude modulated by a 400Hz modulating signal to a depth of 50%.The unmodulated carrier power is 1kw.	Remember	CAEC005.05

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8	Find the value to which unmodulated carrier power may be increased without resulting in overloading if the maximum permitted modulation index is restricted to 40%?A Radio transmitter using AM has unmodulated carrier output power of 10kw and can be modulated to a maximum depth of 90% by a sinusoidal modulating voltage without causing overloading	Understand	CAEC005.06
9	a) Prove that the figure of merit of AM system for single stone modulation with 100% modulation is 1/3. b) An AM system with envelope detection is operating at threshold. Determine the power gain indecibels needed at the transmitter to produce (S/N)o = 30dB for tone modulation with m = 1.	Understand	CAEC005.06
10	Find the necessary transmitter power. a) DSBSC b) Conventional AM with modulation index=0.5A certain communication channel is characterized by 90dB .	Understand	CAEC005.06
UNIT-III			
SINGLE SIDE BAND MODULATION AND VESTIGIAL SIDE BAND MODULATION			
PART-A(SHORT ANSWER QUESTIONS)			
1	What are the Advantages of SSB systems?	Remember	CAEC005.07
2	Compare different AM systems?	Remember	CAEC005.09
3	What are the methods for SSB generation?	Understand	CAEC005.07
4	List Application of different AM systems?	Understand	CAEC005.09
5	What are the advantages of SSB?	Remember	CAEC005.07
6	What is Hilbert Transform?	Understand	CAEC005.08
7	Draw the spectrum of SSB modulated signal?	Remember	CAEC005.07
8	List the Applications of SSB?	Remember	CAEC005.07
9	What are the methods for SSB degeneration?	Understand	CAEC005.07
10	What are the advantages of generating AMSSB using filter method	Remember	CAEC005.07
Syllabus for CIE-II			
1	Write the expression for SSB and VSB Waves.	Remember	CAEC005.08
2	What are the advantages of VSB?	Remember	CAEC005.08
3	Define VSB modulation.	Understand	CAEC005.07
4	Explain the time domain description of SSB & VSB?	Understand	CAEC005.08
5	Compare SSB Modulation &VSB Modulation?	Remember	CAEC005.08
6	Explain the frequency domain description of SSB & VSB?	Understand	CAEC005.08
7	Draw the spectrum of VSB modulated signal?	Remember	CAEC005.08
8	What is the difference between SSB and VSB.	Understand	CAEC005.08
9	A SSB transmitter radiates 5 kW when the modulation percentage is 50%. How much carrier power is required if we want to transmit the same message by an AM transmitter?	Understand	CAEC005.07
10	What are the drawbacks of SSB modulation?	Remember	CAEC005.07
11	Explain noise in SSB?		
PART-B(LONG ANSWER QUESTIONS)			
1	a) Prove that the modulating signal can be completely recovered if the cut-off frequency of the filter is fN < fo < 2fc. b) Determine the recovered signal when the multiplying signal is $\cos[\omega_c t]$. c) Determine the recovered signal when the multiplying signal is $\cos \omega_c t$.	Remember	CAEC005.04
2	a) Describe the time domain band-pass representation of SSB with necessary sketches. b) Find the percentage of power saved in SSB when compared with AM system.	Understand	CAEC005.07
3	Describe the single tone modulation of SSB. Assume both modulating and carrier signals are sinusoids. Write SSB equation and plot all the	Remember	CAEC005.07

S. No	Questions	Blooms Taxonomy Level	Course learning Outcome
	waveforms and spectrums.		
4	a) Explain the Third method of generating SSB modulated waves. b) Explain the coherent detection of SSB signals.	Remember	CAEC005.07
5	a) Explain the advantages and disadvantages of SSB modulation. b) With neat diagram, explain the phase discrimination method for generating SSB wave.	Remember	CAEC005.07
6	a) Explain Envelope detection of SSB signals? b) With respect to envelop detector derive the following i) Rate of Decay of Envelope ii) Rate of Discharge of capacitor	Understand	CAEC005.07
7	Consider a 2-stage SSB modulator with input signals consists of a voice signal in a frequency range of .3 to 3.4kHz. The two oscillators frequencies are f_1=100kHz and f_2 = 10MHz Specify 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	CAEC005.07
8	Explain the various generation techniques of SSB a)Filter method b)phase shift method	Remember	CAEC005.07
9	a) Tabulate the comparisons between AM and SSB modulation. b) With neat diagram, explain the frequency discrimination method for generating SSB wave.	Understand	CAEC005.07
10	a) Explain the differences between SSB and VSB. b) Calculate 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%	Remember	CAEC005.08
Syllabus for CIE-II			
1	a) Why VSB system is widely used for TV broadcasting -Explain? b) An AM transmitter of 1KW power is fully modulated. Calculate the power transmitted if it is transmitted as SSB.	Understand	CAEC005.08
2	a) Explain about Diagonal Clipping in a diode detector. How to avoid it? b) A 45Volts(rms) sinusoidal carrier is amplitude modulated by a 30Volts(rms) sinusoidal base band signal. Find the Modulation index of the resulting signal.	Understand	CAEC005.07
3	a) Explain the envelope detection of VSB wave plus carrier. b) Calculate the percentage power saving when the carrier and one of the sidebands are suppressed in an AM wave modulated to a depth of i.100 % ii. 50 % .	Remember	CAEC005.08
4	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	CAEC005.07
5	Explain with block diagram, the phase discrimination method of generating SSB modulated wave.	Understand	CAEC005.07
6	Explain the noise performance of SSB receiver and prove its Signal to Noise Ratio is unity.	Understand	CAEC005.07
7	For the balanced ring modulator, a carrier frequency fc= 400 kHz, and a modulating signal frequency range fm= 0 to 4kHz, determine, a) output frequency spectrum b) b) output frequency for a single frequency input fm= 2.8 kHz.	Remember	CAEC005.08
8	For a two-tone test signal of 1.5kHz and3kHz and a carrier frequency of 100kHz, determine for a single sideband suppressed carrier transmission 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	CAEC005.08

S. No	Questions	Blooms Taxonomy Level	Course learning Outcome
9	a) Comparison between SSB and VSB. b) Calculate 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)75 % (ii) 30%	Understand	CAEC005.08
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 f_1=10khz and f_2 = 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	Remember	CAEC005.07
PART-C (PROBLEM SOLVING AND CRITICAL THINKING QUESTIONS)			
1	Determine carrier power, modulating frequency, total power output and peak power output for the output voltage of a SSB transmitter is given by300(1 + 0.3 sin 5210t) sin 2.14 x 10^7t. This voltage is fed to a load of 500Ω resistance.	Remember	CAEC005.07
2	Calculate the power transmitted if it is transmitted as SSB for AM transmitter of 1KW power is fully modulated.	Understand	CAEC005.07
3	Find the various frequency components and their amplitude in the Voltage given below E=50(1+0.7cos5000t-0.3cos1000t) sin 5x10^6t.Draw the single sided spectrum. Also evaluate the modulated and sideband powers.	Understand	CAEC005.07
4	Find the necessary transmitter power of SSB with modulation index=0.5. A certain communication channel is characterized by 90dB.	Remember	CAEC005.07
5	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	CAEC005.07
6	Determine the following: VCO output frequency, multiplication factor, and second IF frequency for the multichannel pilot carrier SSB receiver, crystal oscillator frequency$f_{co} = 400kHz$, first IF frequency$f_{IF} = 4.4MHz$, RF input frequency$f_{RF} = 23.403MHz$, and modulating signal frequency$f_m = 3kHz$,.	Remember	CAEC005.07
7	Calculate 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.	Understand	CAEC005.07
8	Determine for a single sideband suppressed carrier transmission of a two-tone test signal of 1.5kHz and3kHz and a carrier frequency of 100kHz, a) Output frequency spectrum if only the upper side band is transmitted. b) For E1=E2=5v and a load resistance of 50 ohm, the PEP and average output power.	Understand	CAEC005.07
9	Determine a) output frequency spectrum b) output frequency for a single frequency input f_m= 2.8 kHz of the balanced ring modulator, a carrier frequency fc= 400 kHz, and a modulating signal frequency range fm= 0 to 4kHz.	Remember	CAEC005.07
10	Determine the message signal m(t) of a single sideband AM signal is given by $s(t) = \{1000sinc(1000\pi t)\}\cos(11000\pi t)$. the carrier signal is c(t)= cos (10000πt).	Remember	CAEC005.07
Syllabus for CIE-II			
1	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	CAEC005.08
2	Calculate the utilized power when the carrier and one of the side bands are	Remember	CAEC005.08

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	suppressed in an AM wave modulated to a depth of (i)100 % (ii) 50%		
3	Find the modulation index of multi tone amplitude modulation wave which is given by E=50(1+0.7cos5000t-0.3cos1000t) sin $5x10^6$t.	Understand	CAEC005.08
4	Obtain an expression for a VSB signal generated with $x(t) = cos2\pi f_x t$ and $H_{VSB}(f_c + f_x) = 0.5$+a, $H_{VSB}(f_c - f_x) = 0.5$-a. write the answer the envelope and phase form. Take a=0.25 and evaluate the distortion term.	Remember	CAEC005.08
5	Determine a) output frequency spectrum b) output frequency for a single frequency input f_m= 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	CAEC005.08
6	Determine the message signal m(t) of a single sideband AM signal is given by $s(t) = \{1000sinc(1000\pi t)\}\cos(11000\pi t)$. the carrier signal is c(t)= cos (10000πt).	Understand	CAEC005.08
7	Calculate the power transmitted if it is transmitted as SSB for AM transmitter of 10KW power is fully modulated.	Remember	CAEC005.07
8	Find the various frequency components and their amplitude in the Voltage given below E=50(1+0.7cos5000t-0.3cos1000t) sin $5x10^6$t.Draw the single sided spectrum. Also evaluate the modulated and sideband powers.	Understand	CAEC005.08
9	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	CAEC005.08
10	Calculate for a single sideband suppressed carrier transmission of a two-tone test signal of 1.5kHz and3kHz and a carrier frequency of 100kHz, a) Output frequency spectrum if only the upper side band is transmitted. b) For E1=E2=5v and a load resistance of 50 ohm, the PEP and average output power.	Understand	CAEC005.08
UNIT-IV			
ANGLE MODULATION			
PART-A (SHORT ANSWER QUESTIONS)			
1	What is Angle modulation? What are different types of Angle modulation?	Remember	CAEC005.10
2	Compare AM and FM?	Understand	CAEC005.10
3	What are Advantages & Applications of FM?	Remember	CAEC005.10
4	Define PM & FM. What is frequency deviation & phase deviation?	Understand	CAEC005.10
5	Plot FM wave for modulating wave m(t) as i) Sine wave ii) Square wave	Understand	CAEC005.10
6	Derive the equations for FM & PM waves?	Remember	CAEC005.10
7	Explain the Phasor diagram of FM signals?	Understand	CAEC005.10
8	State Carson's Rule?	Remember	CAEC005.10
9	What is the wideband FM ?	Understand	CAEC005.11
10	Define is deviation ratio?	Remember	CAEC005.11
11	What are the methods for FM generation?	Remember	CAEC005.12
12	Explain noise in Angle modulation system?	Understand	CAEC005.12
13	What is narrow band FM?	Remember	CAEC005.11
14	Define pre emphasis & de emphasis.	Understand	CAEC005.11
15	What are the methods for FM degeneration?	Understand	CAEC005.12
PART-B (LONG ANSWER QUESTIONS)			
1	a) Explain how FM can be generated from PM?. b) Which is best method for generation of FM signal , when the stability of the carrier frequency is of major concern? Discuss about the method in	Understand	CAEC005.10

S. No	Questions	Blooms Taxonomy Level	Course learning Outcome
	detail.		
2	Determine the amplitude spectrum of the filter output for a FM wave with modulation index β = 1 is transmitted through an ideal band pass filter with mid band frequency fc and bandwidth is 5fm, where fc is the carrier frequency and fm is the frequency of the sinusoidal modulating wave..	Remember	CAEC005.10
3	a) Describe generation of narrow band FM signal with necessary diagrams. b) Compare the phasor diagram of narrow band FM signal and AM signal and discuss about the similarities and differences of the two signals	Understand	CAEC005.11
4	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 is reduced to 15 kHz?	Remember	CAEC005.10
5	a) Explain about WBFM generation using indirect method or Armstrong method? b) Explain balanced ratio detector for detecting FM signal.	Understand	CAEC005.11
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	CAEC005.10
7	a) Explain the operation of limiter circuit in FM demodulation. 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 is reduced to 15 kHz?	Remember	CAEC005.12
8	Draw the black diagram of FM stereo broadcast transmitters and explain its operation.	Remember	CAEC005.12
9	a) Classify radio transmitters in detail. b) Compare low level modulation and high level modulation of radio transmitters.	Remember	CAEC005.11
10	a) Why are limiters and pre emphasis filters used in FM radio. b) Classify radio transmitters based on the type of modulation and Service involved.	Understand	CAEC005.11
PART-C (PROBLEM SOLVING AND CRITICAL THINKING QUESTIONS)			
1	a) Illustrate the relation between frequency and phase and hence show the inter conversion between FM and PM utilizing this concept. How is Narrow Band FM generated? b) 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	CAEC005.11
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	CAEC005.10
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 f_c and bandwidth is 5 f_m , where f_c is the carrier frequency and f_m is the frequency of the sinusoidal modulating wave.	Understand	CAEC005.10
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	Understand	CAEC005.10

S. No	Questions	Blooms Taxonomy Level	Course learning Outcome
	regulation.		
5	Determine the spectrum of the resulting phase modulated wave, assuming that the maximum phase deviation $\beta p = kpAm$ does not exceed 0.5 radians. The sinusoidal modulating wave $m(t)=A_m \cos(2\pi f_m t)$ is applied to a phase modulation with phase sensitivity K_p. The unmodulated carrier wave has frequency f_c and amplitude A_c.	Remember	CAEC005.10
6	An angle modulated signal has the form $V(t)=100(\cos 2\pi f_c t + 4\sin 2000\pi t)$ 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	CAEC005.11
7	Calculate for An angle-modulated signal has the form $u(t)=100\cos[2\pi f_c t+4\sin 2\pi f_m t]$ Where f_c=10MHz and f_m=1000Hz. a) Assuming that this is an FM signal, determine the modulation index and the transmitted signal bandwidth. b) Repeat part (a) if fm is doubled. c) 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	CAEC005.11
8	Determine the modulation index and bandwidth for FM and PM signals for a modulating signal 5 cos 30000 π t angle modulates a carrier A cos2π fct. Assume K_δ =Kp = 15 KHz/volt.	Remember	CAEC005.10
9	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. A single-tone modulating signal $\cos(15\pi 10^3 t)$ frequency modulates a carrier of 10MHz and produces a frequency deviation of 75kHz.	Understand	CAEC005.10
10	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	CAEC005.09
UNIT-V			
RECEIVERS AND SAMPLING THEORM			
PART-A(SHORT ANSWER QUESTIONS)			
1	Define Sensitivity and Selectivity.	Understand	CAEC005.14
2	State Sampling Theorem.	Understand	CAEC005.15
3	Define image frequency.	Understand	CAEC005.14
4	Explain Super heterodyne working principle.	Remember	CAEC005.13
5	Define Image frequency rejection ratio.	Remember	CAEC005.14
6	What are the types of sampling?	Understand	CAEC005.15
7	What is (AGC) automatic gain control?	Remember	CAEC005.14
8	What is the function of the mixer in radio receiver?	Understand	CAEC005.13
9	Define Fidelity?	Understand	CAEC005.14
10	What are the characteristics of the radio receiver?	Remember	CAEC005.14
11	What are the types of receivers?	Remember	CAEC005.13
12	How the Radio frequency (RF) signals are converted into intermediate frequency (IF) signals?	Understand	CAEC005.14
13	What is natural sampling and flat-top sampling?	Understand	CAEC005.15
14	Define the term aliasing?	Remember	CAEC005.15

S. No	Questions	Blooms Taxonomy Level	Course learning Outcome
15	Why is pre-filtering done before sampling?	Understand	CAEC005.15
	PART-B(LONG ANSWER QUESTIONS)		
1	a) Describe the circuit of an FET amplitude limiter, and with the aid of the transfer characteristic explain the operation of the circuit. b) What can be done to improve the overall limiting performance of an FM receiver? Explain the operation of the double limiter and also AGC in addition to a limier.	Remember	CAEC005.13
2	a) Explain of the block diagram TRF receiver. Also explain the basic super heterodyne principle. b) List out the advantages and disadvantages of TRF receiver	Remember	CAEC005.13
3	a) List and discuss the factors influencing the choice of the intermediate frequency for a radio receiver. b) What is simple automatic gain control? What are its functions?	Understand	CAEC005.14
4	a) What factors govern the choice of intermediate frequency? b) In a broadcast super heterodyne 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 1.1. kHz a station.	Apply	CAEC005.14
5	a) Draw and explain block diagram of AM superhetrodyne receiver. What do you mean by heterodyning process? b) How the Radio frequency (RF) signals are converted into intermediate frequency (IF) signals?	Remember	CAEC005.14
6	A flat-top sampling system samples s signal of maximum frequency 1kHz with 2.5 Hz sampling frequency. The duration of the pulse is 0.2s. Compute the amplitude distortion due to aperture effect at the highest signal frequency. Also determine the equalization characteristic.	Understand	CAEC005.15
7	a) State Sampling theorem. What are all the blocks are used to represent the CT signals by its samples? b) Mention the types of sampling. What is the Nyquist's Frequency for the signal x(t) =3 cos 50t +10 sin 300t – cos100t ?	Understand	CAEC005.15
8	Briefly explain the following receiver characteristics a)Sensitivity b) selectivity c)image frequency rejection ratio d)choice of intermediate frequency e) Fidelity.	Remember	CAEC005.15
9	Explian the different types of AGC with neat diagrams a) Simple AGC b) Delayed AGC	Understand	CAEC005.15
10	a) Distinguish between the Natural sampling and Flat Top sampling. What is the nature of the 'transform pair' in the above two cases. b) Briefly explain the graphical and analytical proof for samplings of band limited signals.	Remember	CAEC005.15
	PART-C (PROBLEM SOLVING AND CRITICAL THINKING QUESTIONS)		
1.	Determine the image frequency and its rejection ratio for tuning at 1.1. KHz for a station broadcast super heterodyne receiver having no RF amplifier, the loaded Q of the antenna coupling circuit is 100. If the IF frequency is 455 kHz,.	Remember	CAEC005.14
2	Determine the recovered baseband for a TRF receiver is turned to 1000 KHz AM radio broadcast signal by a variable tuned circuit with 1 KHz bandwidth. Find the bandwidth when receiver is returned to 1550 KHz and 550 KHz	Understand	CAEC005.13

S. No	Questions	Blooms Taxonomy Level	Course learning Outcome
3	What will be rejection ratio for the calculated image frequency, When a super heterodyne receiver is tuned to 555 KHz, its local oscillator provides the mixer with an input at 1010 KHz what is the image frequency? The antenna at receiver is connected to mixer via a tuned circuit whose loaded Q is 40.	Understand	CAEC005.14
4	Find the image frequency for a standard broadcast band AM receiver using a 455 kHz IF and tuned to a station at 640 kHz.	Remember	CAEC005.13
5	Determine the Nyquist's rate and interval corresponding to each of the following signals i) x(t)=sin 4000πt/πt ii) x(t) =1+cos 2000πt+sin 4000πt	Understand	CAEC005.15
6	The signal x(t)=cos 5πt+0.3 cos 10πt is instantaneously sampled. Determine the maximum interval of the sample.	Remember	CAEC005.15
7	For the analog signal x(t)=3 cos 100πt, a. Determine the minimum sampling rate to avoid aliasing b. Suppose that the signal is sampled at the rate, fs=200Hz, what is the discrete time signal obtained after sampling c. Suppose that the signal is sampled at the rate, fs=75Hz, what is the discrete time signal obtained after sampling d) What is the frequency 0<f< fs /2 of a sinusoid that yields samples identical to those obtained in (c) above.	Understand	CAEC005.15
8	Show that a band limited signal of finite energy which has no frequency components higher than fm Hz is completely described by specifying values of the signals at instants of time separated by 1/2 fm seconds. Also show that if the instantaneous values of the signal are separated at intervals larger than 1/2 fm seconds, they fail to describe the signal. A band pass signal has spectral range extending from 20kHz to 80kHz; find the acceptable range of sampling frequency fs .	Understand	CAEC005.15
9	The signal x(t)=cos 5πt+0.3 cos 10πt is instantaneously sampled. The interval between the samples is Ts, a) Find the maximum allowable value for Ts b) If the sampling signal is S(t)= , the sampled signal $v_s(t)$= v(t).S(t) consists of a train of impulses, each with a different strength vs , find I0, I1, I2 c) To reconstruct the signal vs(t) is passed through a rectangular LPF. Find the minimum filter bandwidth to reconstruct the signal without distortion.	Remember	CAEC005.15
10	What is the Nyquist's Frequency for the following signals a) x(t) =3 cos 100t +10 sin 30t – cos50t ? b) x(t) =3 cos 50t +10 sin 300t – cos100t ?	Understand	CAEC005.15

Prepared by,

Mrs. G. Ajitha, Assistant Professor, ECE

HOD, ECE