INSTITUTE OF AERONAUTICAL ENGINEERING

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Dundigal, Hyderabad - 500 043, Telangana

ELECTRONICS AND COMMUNICATION ENGINEERING

QUESTION BANK

Course Name	:	**ANALOG COMMUNICATIONS**
Course Code	:	A50408
Class	:	III - B. Tech I -Sem
Branch	:	ECE
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Course Coordinator	:	Dr.P G Krishna Mohan
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OBJECTIVES

To meet the challenge of ensuring excellence in engineering education, the issue of quality needs to be addressed, debated and taken forward in a systematic manner. Accreditation is the principal means of quality assurance in higher education. The major emphasis of accreditation process is to measure the outcomes of the program that is being accredited.

In line with this, Faculty of Institute of Aeronautical Engineering, Hyderabad has taken a lead in incorporating philosophy of outcome based education in the process of problem solving and career development. So, all students of the institute should understand the depth and approach of course to be taught through this question bank, which will enhance learner's learning process.

1. Group - A (Short Answer Questions)

S. No	QUESTION	Blooms Taxonomy Level	Course Outcome
	UNIT-I AMPLITUDE MODULATION		
1	Define modulation. Why is modulation required?	Understand	a
2	Define is modulation index?	Understand	c
3	Describe the DSB-SC wave modulation with spectrum?	Understand	e
4	Describe the detection of AM wave using a)square law detector b)envelope detector	Remember	c
5	Compare Square law detector with envelope detector?	Analyze	c
6	Explain the detection of DSB-SC wave using a)synchronous detector b) costas loop	Remember	e
7	Why frequency translation is required?	Remember	a
8	Explain the generation of DSB-SC wave using a)balanced modulator b)ring modulator	Understand	e

S. No	QUESTION	Blooms Taxonomy Level	Course Outcome
9	What is envelope distortion?	Understand	c
10	List the various types of modulations?	Remember	b
2. Group - II (Long Answer Questions)			
1.	1. a) **Explain** necessary expressions, waveforms and spectrums, Explain 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%.	APPLY	a
2.	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 10-K 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.	APPLY	c
3.	a) **Sketch** the one cycle of AM wave and calculate the modulation index of it in terms of Vmax and Vmin 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.	APPLY	c
4.	a) **Plot** the one cycle of AM wave and calculate the modulation index of it in terms of Vmax and Vmin 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.	APPLY	c
5.	a) **Explain** the collector modulation method for generating AM wave with a neat circuit diagram and waveforms. 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? b) What is the side band power?	APPLY	c
6.	a) **Write** AM equation. Define modulation index, and percentage modulation. b) Define under-modulation and over-modulation. Explain why over modulation is undesirable.		
7.	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 reduced to 30%. What is the extent up to which the unmodulated carrier power can be increased to avoid over loading.		
8.	a) **Sketch** the one cycle of AM wave and calculate the modulation index of it in terms of Vmax and Vmin 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		

9.	a) **Define** communication. Explain with block diagram the basic 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.		
10.	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		
3. Group - III (Analytical Questions)			
1.	**Draw** the amplitude -frequency characteristic of vo(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 $Vo=2v^2$.	Apply	C
2.	**Determine** the antenna current when the depth of modulation changes to 0.8?The antenna current of an AM transmitter is 8A when only the carrier is sent, but it increases to 8.93A when the carrier is modulated by a sine wave .Find the percentage modulation.	Apply	C
3.	**What** is the total sideband power radiated? A 360W carrier is simultaneously simultaneously Amplitude modulated by two audio waves with modulation percentages of 55 and 65 respectively.	Apply	C
4.	**Determine** the total power radiated when modulated to 30%?A transmitter supplies 8kw to the antenna when unmodulated	Apply	C
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.	Apply	C
6.	**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.	Apply	c
7.	**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.	Apply	C
8.	**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.	Apply	c
UNIT-II SSB MODULATION			
1. Group - A (Short Answer Questions)			
1	What are the Advantages of SSB systems?	Remember	e
2	Compare different AM systems?	Understand	c, e ,f
3	List Application of different AM systems?	Remember	c, e, f
4	What is Hilbert Transform?	Remember	e
5	Draw the spectrum of SSB modulated signal?	Remember	e
6	Draw the spectrum of VSB modulated signal?	Remember	f
7	What are the methods for SSB generation?	Understand	f

8	What are the methods for SSB generation?	Remember	e
9	List Application of SSB?	Understand	e
10	Write the expression for SSB and VSB Waves.	Understand	e, f
2. Group - II (Long Answer Questions)			
1.	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.	Apply	e
2.	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[ωc t+]. c) Determine the recovered signal when the multiplying signal is cosωct.	Apply	e
3.	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.	Apply	f
4.	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.	understand	e
5.	a) Explain the Third method of generating SSB modulated waves. b) Explain the coherent detection of SSB signals.	understand	e
6.	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 % .	Apply	f
7.	Explain with block diagram, the phase discrimination method of generating SSB modulated wave	Apply	e
8.	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.	Apply	e
9.	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.	Apply	f
3. Group - III (Analytical Questions)			
1.	**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.	Apply	E
2.	**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.	Apply	E
3.	**Calculate** the power transmitted if it is transmitted as SSB for AM transmitter of 1KW power is fully modulated.	Apply	E
UNIT-III **ANGLE MODULATION**			
1. **Group - A (Short Answer Questions)**			

1	What is Angle modulation? What are different types of Angle modulation?	Remember	d
2	Define PM & FM? What is frequency deviation & phase deviation?	Understand	d
3	Compare AM and FM?	Remember	d
4	What are Advantages & Applications of FM?	Understand	d
5	Explain the Phasor diagram of FM signals?	Analyze	d
6	Plot FM wave taking modulating wave m(t) as a. Sine wave b. Square wave	Understand	d
7	Define is deviation ratio?	Remember	d
8	What is wideband FM & Narrowband FM?	Remember	d
9	State Carson's Rule?	Remember	d
10	Derive the equations for FM & PM waves?	Remember	d
2. Group - II (Long Answer Questions)			
1.	a) Describe generation of FM carrier by Transistor reactance modulator 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	Apply	d
2.	a) FM Give the procedure to determine the effective bandwidth of an signal. b) Which method of FM signal generation is the preferred choice, when the stability of the carrier frequency is of major concern? Discuss about the method in detail.	understand	d
3.	Determine the amplitude spectrum of the filter output for An FM wave with modulation index $\beta = 1$ 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..	Apply	d
4.	An angle modulated signal has the form $v(t) = 100 \cos(2\pi fct + 4 \sin 2000 \pi t)$ 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.	Apply	d
5.	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?	Apply	d
6.	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?	Apply	d
7.	a) Explain about FM generation using transistor reactance tube modulator. b) Explain balanced ratio detector for detecting FM signal.	understand	d
8.	a) Why are limiters and preemphasis filters used in FMradio. b) Classify radio transmitters based on the type of modulation and Service involved.	Understand	l

9.	a) Classify radio transmitters in detail. b) Compare low level modulation and high level modulation of radio transmitters.	Understand	g
10.	Draw the black diagram of FM stereo broadcast transmitters and explain its operation	understand	g

3. Group - III (Analytical Questions)

1.	**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.	Apply	d
2.	**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?	Apply	d
3.	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 =104Hz/volt.	Apply	d
4.	**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.	Apply	d
5.	**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.	Apply	d
6.	**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 $A c$.	Apply	d
7.	**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.	Apply	d
8.	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?	Apply	d
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.	Apply	d

10	**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.	Apply	d
1. Group - A (Short Answer Questions)			
	UNIT-IV NOISE IN ANALOG COMMUNICATION SYSTEMS		
1	Explain how noise affects performance of analog modulation systems?	Remember	l
2	Define figure of merit?	Understand	l
3	Discuss threshold effect	Remember	l
4	Explain threshold extension	Understand	l
5	Explain pre-emphasis &de-emphasis	Understand	l
6	Define Average noise figure.	Understand	l
7	Define Average Noise Temperature	Understand	l
8	List out various noise sources.	Remember	l
9	Define White noise and Shot noise.	Remember	l
2. Group - II (Long Answer Questions)			
1.	a) Find the output SNR in a PM system for tone modulation. b) A phase modulation (PM) system, with the modulated wave defined by S (t) = Ac Cos [2π fct + kpm(t)] where kp is a constant and m(t) is the message signal. The additive noise n(t) at the phase detector input is n(t) = nI(t) cos (2πfc t)−nQ (t) sin 2πfc t.Assuming that the carrier-to-noise ratio at the detector input is high compared with unity, determine i. the output signal-to-noise ratio and ii. the figure of merit of the system	Apply	1
2.	Explain how S/N ratio is a figure of merit in case of performance of a communication channel	Analyze	1
3.	Derive the expression for figure of merit of AM system for large case.	Understand	1
4.	Explain the noise performance of SSB - SC receiver and prove its S/N Ratio is unity.	Remember	1
5.	Compare noise performance of PM and FM system.	Apply	1
6.	a) Explain the equivalent model of a generalized communication system for noise calculation. b) Explain the noise performance of DSB -SC scheme with the help of block diagram	Apply	1
7.	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.	Apply	1

8.	a) Derive the expression for the S/N ratio of AM system. b) What is capture effect? Explain FM Threshold effect.	Apply	1
9.	Prove that narrow band FM offers no improvement in SNR over AM.	Understand	1
10.	Explain the noise performance of SSB - SC receiver and prove its S/N Ratio is unity.	Apply	1
3. Group - III (Analytical Questions)			
1.	**What** is the required transmitter power and channel bandwidth if the following modulation schemes are employed? a) DSB AM b)SSB AM c)Conventional AM with modulation	Apply	1
2.	**Calculate** the following .In a broadcasting communication system the transmitter power is 40KW, the channel attenuation is 80dB, and the noise power-spectral density is	Apply	1
3.	**Calculate** the following .The normalized message signal $m_n(t)$ has a bandwidth of 5000Hz and power of 0.1W,and the channel has a band width of 100KHz and attenuation of 80dB. The noise is white with power spectral density $0.5x10^{-}$	Apply	1
4.	**Find** the necessary transmitter power. a)SSB b)DSBSC c)Conventional AM with modulation index=0.5A certain communication channel is characterized by 90dB	Apply	1
5	**Prove** that the figure of merit of DSB - SC system is 1.	Apply	1
6	A Channel has a uniform noise power density spectrum a) What is the transfer function of this filter at the receiver. b) Find the S/N ratio of demodulator input and output. Find and sketch the noise power density spectrum at the demodulator output	Apply	1
1. Group - A (Short Answer Questions)			

UNIT-V RECEIVERS & PULSE MODULATION			
1	Define Sensitivity and Selectivity.	Understand	g
2	List the Classification of receivers.	Understand	g
3	Explain Super heterodyne working principle.	Understand	g
4	Define image frequency.	Remember	g
5	Define Image frequency rejection ratio.	Remember	g
6	Compare Continuous wave and pulse modulation technique.	Understand	h
7	State Sampling Theorem.	Remember	h
8	Write Merits and Demerits of PAM.	Understand	h
9	Compare PAM, PPM,PWM.	Understand	h
10	List out the applications of pulse modulation techniques.	Remember	h
2. Group - II (Long Answer Questions)			
1.	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	Understand	g

2.	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.	Analyze	g
3.	a) Explain the purpose and working of Tracking circuits. b) Explain the purpose of pre emphasis and de emphasis circuits and the working of these circuits.	Analyze	g
4.	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	g
5.	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	g
6.	a) Discuss about the alignment of Radio receiver with all details. b) Discuss about the need for limiter and de-emphasis circuits in FM receivers	Understand	g
7.	a) Describe the synchronization procedure for PAM, PWM and PPM signals. b) Discuss about the spectra of PWM and PDM signals.	Understand	h
8.	a) Describe the generation and demodulation of PPM with the help of block diagram and hence discuss its spectral characteristics. b) Define and distinguish between PTM and PAM schemes. Sketch and explain their waveform for a single tone sinusoidal input signal.	Understand	h
9.	a) How is PDM wave converted into PPM system? b) Explain why a single channel PPM of system requires the transmission of synchronization signal, where as a single channel PAM or PDM system does not it.	Understand	h
10.	a) Why is cross talk present in PTM system? Explain the generation and demodulation of PDM signals with suitable diagrams b) How a PPM signal can be generated from a PWM signal	Understand	h
3. Group - III (Analytical Questions)			
1	**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	Apply	g
2	**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.	Apply	g
3	**Find** the image frequency for a standard broadcast band AM receiver using a 455 kHz IF and tuned to a station at 640 kHz	Apply	g
4	**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,.	Apply	g

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