

JK LAKSHMIPAT UNIVERSITY, JAIPUR

INSTITUTE OF ENGINEERING AND TECHNOLOGY

End Term Examination (Regular/Backlog), Nov.-Dec. 2015

B. Tech in Electronics & Communication Engineering, Semester V

Roll No.....

ECE502: ANALOG COMMUNICATION

Time: 3 hours

Max. Marks: 100

Instructions to students:

1. Do not write anything other than your roll number on question paper.
2. Assume suitable data wherever required and mention it clearly.
3. Writing appropriate units, nomenclature, and drawing neat sketches/schematics/ flow chart wherever, required are an integral part of the answer.

Q.1A	Objective type multiple choice questions (10 questions @ 1 mark)	10
i.	Write the Hilbert transform of $\cos(\omega t)$.	
ii.	Shot noise is generated by a) Active components only b) Passive components only c) Both a) and b) d) None of these	
iii.	White noise has a) Spectral density varying as f b) Spectral density varies as $1/f$ c) Flat spectral density d) Rising spectral density	
iv.	Figure of merit is always unity in a) SSB-SC b) AM c) FM d) All of above	
v.	Aliasing occurs due to a) Over sampling b) Under sampling c) Attenuation or amplification of signals d) None of the above	
vi.	Theoretically the bandwidth required in FM is a) Zero b) Unity c) 100 d) Infinite	
vii.	If the modulation index of an AM wave is changed from 0 to 1, then the transmitted power is increased by _____ %.	
viii.	The message carrying capacity is best in a) FM b) AM	

	c) AM-SC d) Phase modulation	
ix.	Vestigial side band modulation is normally used for a) HF point to point communication b) Monaural broadcasting c) TV broadcasting d) Stereo broadcasting	
x.	Which of the following is a very popular form of multiplexing where multiple channels of digital data are transmitted in serial form? a) Frequency division multiplexing b) Phase shift multiplexing c) PAM multiplexing d) PCM multiplexing	

Q.2	Short answer type questions (4 questions @ 2.5 marks)	10
i.	1 μ F capacitor is shunted by a 1 k Ω maintained at temperature 300 K. What will be the rms noise voltage across capacitor over the entire frequency band?	
ii.	Calculate the Nyquist sampling rate for the signal $g(t) = 10\cos(50\pi t) \cos^2(150\pi t)$, where t is in second.	
iii.	An AM signal is detected using an envelope detector. The carrier frequency and modulating signal frequency are 1 MHz and 2 kHz respectively. Calculate the value of time constant of the envelope detector.	
iv.	The peak frequency deviation produced in a VHF carrier by a signal of 100 Hz is 50 kHz. What is the frequency modulation index?	

Q.3A	Explain the Foster Seeley Method of FM detection using suitable diagram and equations.	05
Q.3B	A commercial FM radio station alternated between music and talk show call in formats. The broadcasted CD music is bandlimited to 15 kHz, and based on convention. If the bandwidth for voice signal is $W = 5$ kHz, and the deviation ratio for both music and video is $D = 5$. Calculate the percentage of available transmission bandwidth during the talk show.	05

Q.4A	Explain the concept of pre-emphasis and de-emphasis using suitable diagrams.	05
Q.4B	Four signals each band limited to 5 kHz are sampled at twice the Nyquist rate. The resulting PAM samples are transmitted over a single channel after time division multiplexing. Calculate the theoretical minimum transmission bandwidth of the channel.	05

Q.5A	Two analog signals, having bandwidths 1200 Hz, 600 Hz are sampled at their respective Nyquist rates, encoded with 12 bit words, and time division multiplexed. What is the bit rate for the multiplex signal?	05
Q.5B	Explain the Pulse Width Modulation in detail using suitable equations.	05

Q.6A	An amplifier has a standard spot noise figure of $F_0 = 6.31$ (8 dB). The amplifier, that is used to amplify the output of an antenna have antenna temperature of $T_a = 180$ K.	05
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	i. Calculate the effective noise temperature of this amplifier. ii. Calculate the operating spot noise figure.	
Q.6B	In a superheterodyne receiver having no RF amplifier, the loaded Q of the antenna coupling circuit is 90. If the Intermediate frequency is 455KHz, Calculate the image frequency and its rejection ration at 10 MHz.	05
OR		
Q.6B	A singer's performance is to be recorded by sampling and storing the sample values. Assume that the highest frequency tone to be recorded is 15800 hertz. i. What is the minimum sampling frequency that can be used? ii. How many samples would be required to store a three minutes performance?	05

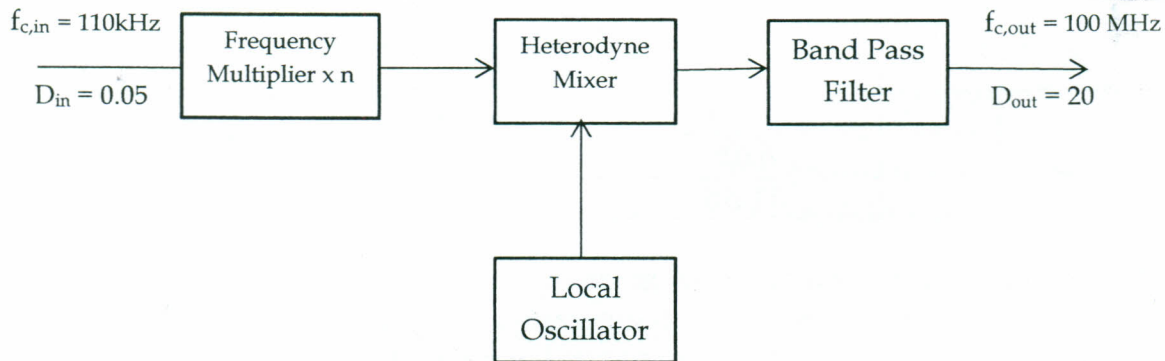
Q.7	Consider a cascade of three amplifiers having the specifications given in table below. <table border="1"> <thead> <tr> <th>Amplifier No.</th><th>Noise Figure (F)</th><th>Equivalent Temperature (Te)</th><th>Gain (G)</th></tr> </thead> <tbody> <tr> <td>1</td><td>-</td><td>300 K</td><td>10 dB</td></tr> <tr> <td>2</td><td>6 dB</td><td>-</td><td>30 dB</td></tr> <tr> <td>3</td><td>11 dB</td><td>-</td><td>30dB</td></tr> </tbody> </table> i. What is the equivalent noise figure of the cascade? ii. What is the equivalent noise temperature of the cascade? iii. If amplifiers 1 and 2 are interchanged, what will be the noise figure of the system?	Amplifier No.	Noise Figure (F)	Equivalent Temperature (Te)	Gain (G)	1	-	300 K	10 dB	2	6 dB	-	30 dB	3	11 dB	-	30dB	10
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Q.7	The block diagram of a receiver system with an antenna is shown below. The loss factor of the antenna lead in cable is $L = 1.5$ dB. The noise figure and gain of different stages are shown in the respective blocks. F_1, G_1 Lead in cable $F_2 = 7 \text{ dB}$ $G_2 = 20 \text{ dB}$ Pre amplifier $F_3 = 10 \text{ dB}$ $G_3 = 8 \text{ dB}$ Mixer $F_4 = 6 \text{ dB}$ $G_4 = 60 \text{ dB}$ IF i. What will be the overall noise figure of the system? ii. What is the overall noise temperature of the system? iii. If the lead-in cable and pre-amplifier are interchanged, calculate the overall noise figure of the system.	10																

Q.8A	An urn contains 4 white and 3 black balls. Two balls are drawn successively with X denoting the number of black balls. i. Find the probability function of X. ii. Draw the bar chart and histogram.	05
Q.8B	Show with the mathematical derivation that DSB-SC AM does not provide any SNR improvement over a simple baseband communication system.	10

OR

- Q.8B A message signal $m(t)$ has a bandwidth of 10 kHz, a power of 16 W and a maximum amplitude of 6 . It is desirable to transmit this message to a destination via a channel with 80 dB attenuation and AWGN with power spectral density $S_n(f) = N_0/2 = 10^{-12}$ W/Hz, and achieve a SNR at the modulator output of atleast 50 dB. What is the required transmitted power and channel bandwidth if the following modulation schemes are employed?
- SSB-AM
 - Conventional AM with modulation index equal to 0.8

- Q.9 A narrowband FM signal has a carrier frequency of 110 kHz and a deviation ration of 0.05. The modulation bandwidth is 10 kHz. This signal is used to generate a wideband FM signal with a deviation ratio of 20 and a carrier frequency of 100 MHz. The scheme utilized to accomplish this is shown in figure below.



- What is the required value of frequency multiplication n ?
- Calculate the permissible frequency for the local oscillator.
- Calculate the required center frequency and bandwidth of bandpass filter.