Ref. No.: Ex/ET/PC/B/T/223/2023

B.E. ELECTRONICS AND TELECOMMUNICATION ENGINEERING
SECOND YEAR SECOND SEMESTER EXAM 2023
ANALOG COMMUNICATION SYSTEMS

Time: 3 hours **Full Marks: 100**

Answer all the questions of a unit in the same place. Also, answer all the sub-parts of a question together

Unit - 1: Marks 10		**Marks**
1.	(a) Mention the elements of a communication system. List the basic functions of the radio transmitter and the receiver. (b) Explain the need for modulation in a communication system.	4 + 6

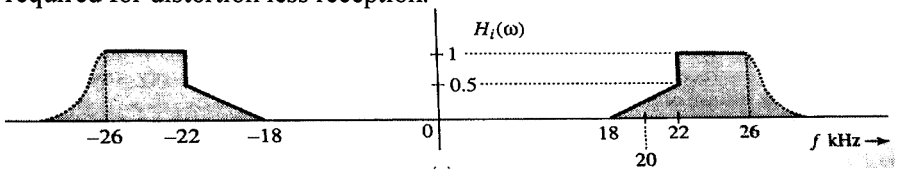
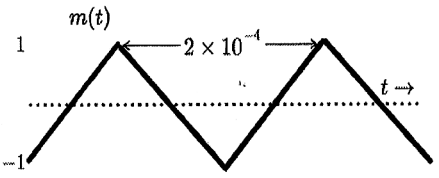
Unit - 2: Marks: 2 ×15 = 30 (Answer any two questions)		
2.	(a) Using a Pulse train generator, and by a proper choice of the sampling, how can we generate a PAM signal? (b) Comment on the principle of generation of PPM pulses from PWM signal. (c) Considering a sinusoidal baseband signal and a train of pulses as the carrier signal, draw the PPM and PWM waveforms.	6 + 5 + 4
3.	(a) Consider any arbitrary message signal g(t) and a sinusoidal carrier signal c(t). With necessary diagrams and mathematical expressions, how can you generate a Double Sideband Suppressed Carrier (DSB-SC) signal? (b) Derive the maximum power efficiency (η) of an AM modulator. Hence calculate the value of η for $\mu = 0.5$.	8 + (4+3)
4.	(a) Derive the time domain expression of Narrow Band Frequency Modulated (NBFM) Wave. (b) Draw the phasor diagrams of AM and NBFM and compare them.	7 + 8

Unit - 3: Marks: 2 ×15 = 30 (Answer any two questions)		
5.	(a) Draw the block diagram of the Phase Locked Loop (PLL) and mention its components. (b) Explain the different modes associated with the operation of the PLL in details.	5 + 10
6.	(a) Draw the block diagram of a superheterodyne receiver. (b) Explain how this type of receiver provides heterodyning function.	5 + 10
7.	(a) Explain the operation of the Foster-Seeley discriminator with the help of the circuit diagram and the necessary phasor diagrams. (b) A signal $x_c(t) = 5\,[1 + 2\cos\omega_c(t)]$ is to be demodulated. Check whether some of the following detectors can be used: (i) an envelope detector, (ii) a square-law detector, and (iii) a synchronous detector or coherent detector.	10 + 5

[Turn over

Ref. No.: Ex/ET/PC/B/T/223/2023

B.E. ELECTRONICS AND TELECOMMUNICATION ENGINEERING
SECOND YEAR SECOND SEMESTER EXAM 2023
ANALOG COMMUNICATION SYSTEMS

Unit - 4: Marks: 1×20 = 20 (Answer any one question)		
8.	(a) The carrier frequency of a certain VSB signal is $\omega_c = 20\ kHz$ and the baseband signal bandwidth is $6\ kHz$. The VSB shaping filter $H_i(\omega)$ at the input, which cuts off the lower sideband gradually over $2\ kHz$, is shown in the figure below. Find the output filter $H_o(\omega)$ required for distortion less reception.  (b) If all AM broadcasting stations handle audio frequencies of up to $5\ kHz$, how many AM broadcasting stations can be accommodated from $1\ MHz$ to $1.5\ MHz$ of the medium wave band? (c) An AM transmitter has an unmodulated carrier power of $10kW$. It can be modulated by a 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 without overloading? (d) When a superheterodyne receiver is tuned to $555\ kHz$, its local oscillator provides the mixer with an input at $1010kHz$. What is the image frequency? The antenna at the receiver is connected to the mixer via a tuned circuit whose loaded Q is 40. What will be the rejection ratio for the calculated image frequency?	6 + 4 + 6 + 4
9.	(a) Sketch FM and PM waves for the modulating signal $m(t)$ shown in the figure. The constants $k_f \& k_p$ are $2\pi \times 10^5 \& 10\pi$ respectively and the carrier frequency f_c is $100MHz$.  (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 $15\ kHz$? (c) An angle modulated signal with carrier frequency $\omega_c = 2\pi \times 10^5$ is described by the equation $\Phi_{EM}(t) = 10\cos(\omega_c t + 5\sin 3000t + 10\sin 2000\pi t)$. Find i) the power of the modulated signal, ii) the frequency deviation Δf, iii) the deviation ratio β, iv) the phase deviation $\Delta\phi$. Estimate the bandwidth of $\Phi_{EM}(t)$. (d) Compute the bandwidth requirement for the transmission of an FM signal having a frequency deviation of $75\ kHz$ and an audio bandwidth of $10kHz$.	7 + 4 + 6 + 3

Unit - 5: Marks: 1 ×10 = 10 (Answer any one question)		
10.	The use of pre-emphasis and de-emphasis filters in an FM system significantly reduce the effect of noise. Explain.	10
11.	Critically compare the noise performances of AM, DSB-SC and SSB-SC systems.	10