BETCE Examination 2024
2nd Year 2nd Semester
Subject: Analog Communication Systems

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

Answer all questions under a particular CO in the same place.
Also, answer all sub-parts of a question serially in the same place.

CO-1 (Marks: 10)

(Answer the following question)

Q1.a) *Present* the channel model for multipath transmission of signals and *show* that such channel offers non-ideal characteristics in terms of both magnitude and phase responses. Also, *name* the type of distortion caused by this type of channel. [1+4+1]

b) *State*, what you mean by fading. *Explain* how that above channel causes frequency selective fading of transmitted signals. [1+3]

CO-2 (Marks: 15x2=30)

(Answer any two questions)

Q2. a) *Demonstrate* the modulation as well as demodulation operations of Double Side Band Suppressed Carrier (DSB-SC) technique using relevant block diagrams, mathematical expressions and corresponding spectra, considering an arbitrary signal g(t) and a sinusoidal carrier c(t). [10]

b) *Sketch* the phasor diagram of Amplitude Modulated (AM) as well as Narrow Band Frequency Modulated (NBFM) signal and *indicate* each component of the corresponding diagram. Also, *distinguish* between these two phasor diagrams. [3+2]

Q3. a) *Illustrate* the principle of operation of a Vestigial Side Band (VSB) transceiver. [7]

b) *Sketch* the Vestigial Side Band (VSB) spectrum of TV signal and *identify* its different parts. Also, *interpret* each part of the spectrum and *calculate* the corresponding bandwidth. [4+4]

Q4. a) *Find* the time domain expression of Wide Band FM signal. [8]

b) *Use* the above expression to *interpret* the spectral behavior of the Wide Band as well as Narrow Band FM signals. [3]

c) *Illustrate*, how, the total power in an FM signal remains constant i.e. remains independent of modulation index unlike an AM signal. [4]

CO-3 (Marks: 15x2=30)

(Answer any two questions)

Q5.a) *Describe* the working principle of a Single balanced Modulator with the help of necessary circuit diagram, assumptions and mathematical derivations. [8]

b) *Explain* the process of regenerating the carrier signal from the DSB-SC signal, $m(t)\cos\omega_c t$ in coherent manner. [7]

Q6.a) *Discuss* the principle of operation of a Phase Locked Loop (PLL) with proper block diagram. Hence develop its equivalent model. [8+2]

b) *Illustrate* how, you can use a PLL as FM demodulator. [5]

Q7.a) *Discuss* the major disadvantages of a Tuned Radio Frequency (TRF) receiver. [5]

b) *Identify* different sections of a Superheterodyne Receiver from its block diagram. [3]

c) *Describe* the function of each identified block. [7]

CO-4 (Marks: 10x2=20)

(Answer any two questions)

Q8. *Apply* the concept of Armstrong Indirect FM generation technique to design an FM carrier with a carrier frequency of 98.1 MHz and frequency deviation of 75 KHz. A Narrow Band FM generator with carrier frequency of 100 KHz and a frequency deviation of 10 Hz is available. For design purpose, you are also provided with an oscillator with adjustable frequency in the range of 10 to 11 MHz for the mixer, and sufficient numbers of frequency doublers (x2), triplers (x3) and quintuplers (x5).

Choose the proper frequency of the oscillator supplied with the mixer and *calculate* the frequency multiplication factors for the design. Also, *sketch* the overall design of the FM modulator *relating* the carrier frequency as well as frequency deviation at the input and output of every stage. [8+2]

Q9. a) *Develop* a DSB-SC modulator to generate a modulated signal $km(t)\cos\omega_c t$ with the carrier frequency $f_c = 300$ KHz. You are provided with the following equipments for the design:

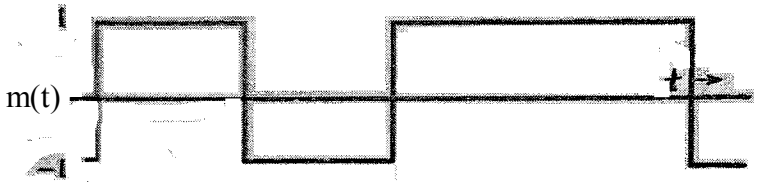
A signal generator of frequency 100 KHz, a ring modulator supplied with a periodic bipolar square pulse train as carrier and a band-pass filter tuned to 300 KHz.

i) *Show,* how you can generate the desired signal.

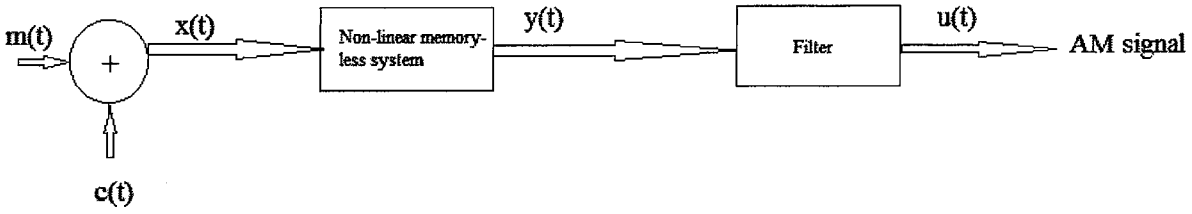
ii) *Sketch* the circuit for the required design.

iii) If the output of the modulator is $km(t)\cos\omega_c t$, *calculate* the value of 'k'. [3+2+1]

b) *Sketch* the waveform of Phase Modulated (PM) signal corresponding to the digital modulating signal m(t) shown below. Given, carrier frequency f_c = 100 MHz (sinusoidal carrier) and phase sensitivity $K_p = \pi/2$. [4]



Q10. a) The system shown below can be used to generate an AM signal. The carrier is described by $c(t) = \cos(2\pi f_0 t)$ and the modulating signal has zero mean and its maximum absolute value is given as $A_m = \max|m(t)|$. The non-linear device follows the relationship $y(t) = ax(t) + bx^2(t)$. [3+1+2]



i) *Find* the expression of y(t) in terms of m(t) and c(t).

ii) Specify the filter characteristics such that an AM signal is obtained at the output.

iii) *Calculate* the value of the modulation index.

b) A carrier is frequency modulated with a sinusoidal signal of 2 KHz, resulting in a maximum frequency deviation of 5 KHz. [2+2]

i) *Calculate* the bandwidth of the modulated signal.

ii) The amplitude of the modulating signal is increased by a factor of 3, and its frequency is lowered to 1 KHz. *Find* the maximum frequency deviation and the bandwidth of the new modulated signal.

CO-5 (Marks: 10x1=10)

(*Answer the following question*)

Q11. *Illustrate* the effect of the small amplitude interference signal in both Frequency Modulated (FM) and Phase Modulated (PM) system graphically (no derivation is required). Hence, *analyze* the effect of noise that gets introduced into the channel in an FM system. [2+8]