TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2079 Chaitra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEX	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

Subject: - Communication System I (*EX 652*)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. Define modulation. Draw the functional block diagram of analog communication system and briefly explain each block. [4+6]
2. Derive the equation for Single Side-Band modulated signal in terms of Hilbert Transformation of modulating signal m(t). Briefly discuss any one method of generating SSB signal. [6+4]
3. A message signal $m(t) = 10 \cos (2 \pi 4000 t)$, Volt is used to frequency modulate the carrier signal $c(t) = 80 \cos (2\pi 10^7 t)$, Volt. Assuming the frequency sensitivity of the frequency modulator to be 400 Hz/Volt, calculate: [4×2.5]
   a) Peak frequency deviation
   b) Modulation index
   c) Bandwidth of modulated signal for over 98% of FM power
   d) Total modulated signal power dissipated in unit impedance
4. Define energy spectrum and power spectrum density functions. Briefly explain the operation of analog spectrum analyzer. [4+6]
5. With functional block diagrams and spectral details explain the operation of stereo encoder and decoder. [5+5]
6. Define FDM. Explain FDM hierarchy used in telephony. [4+6]
7. Define unipolar, polar, bi-polar, unipolar RZ and Manchester line codes. [2×5]
8. Write short notes on: [2×5]
   a) Autocorrelation function and its properties
   b) Phase Locked Loop

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2077 Chaitra

Exam.	**Regular**		
Level	BE	**Full Marks**	80
Programme	BEX	**Pass Marks**	32
Year / Part	III / II	**Time**	3 hrs.

Subject: - Communication System I *(EX 652)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. List out the differences between analog source and digital source. What are the effects of atmospheric noise in analog communication system. Mention the advantages of analog communication over digital communication system? [2+2+4]
2. Define impulse response and transfer function of a system. Derive the transfer function for a system that provides distortionless transmission and draw its amplitude response as well. [2+6]
3. Define Parseval's theorem for power signal. Prove that in a LT1 system when a power signal x(t) is applied the PSD of its output is equal to the PSD of its input multiplied by the squared amplitude response of the system. [3+5]
4. Differentiate DSB-FC and DSB-SC amplitude modulation. Explain phase shift method for the generation of SSB modulated signal with necessary waveform, derivation and diagram. [2+6]
5. An AM wave is represented by $s(t) = 5[1 + 0.6\cos(3140t)].\cos(2\pi 10^3 t)$ volts, then find the followings; [2+2+2+2]
   a) Modulation percentage,
   b) Maximum and minimum amplitude of AM wave,
   c) Power dissipated across 1K ohm resistor and
   d) Frequency of USB and LSB.
6. Explain ISB modulation with necessary derivation. Differentiate between Amplitude modulated signal and Frequency modulated signal. [3+5]
7. What do you mean by coherent and non-coherent detections? Describe anyone of the carrier recovery methods. [2+6]
8. Differentiate between Narrow Band FM and Wide Band FM. Describe stereo FM broadcasting with its block diagram and spectral details. [2+6]
9. For a given Armsrong FM transmitter, the NBPM output has a frequency of 200KHz and frequency deviation of 25Hz. This signal is then frequency multiplied by 65 and passed through mixer of oscillation frequency 10.8 MHz. The resulting signal is then fed to a frequency multiplier with n=50. Calculate the maximum frequency deviation and the valid carrier frequency of the WBFM for commercial use. Draw the necessary diagram. [8]
10. Describe FMD in Telephony with its uses and structure. What are the uses of filters in FMD? [6+2]

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2076 Baisakh

Exam.	Back		
Level	BE	Full Marks	80
Programme	BEX	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

Subject: - Communication System I *(EX 652)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. Draw the block diagram of communication system and explain briefly. What are the needs for modulation? [6+2]
2. What is Hillbert transform; describe it with mathematical expression and frequency response. Mention the properties of Hilbert Transform. Explain distortionless transmission line with its frequency response. [2+2+4]
3. Define auto-correlation function. Write its properties for energy signal. Prove that for an energy signal x(t) the auto-correlation function and energy spectral density form Fourier transform pair. [1+3+4]
4. The signals $m(t)=10\cos 2\times10^{3}\pi t+15\cos 1\times10^{3}\pi t$, $c(t)=20\cos 3\times10^{6}\pi t$ are applied to AM. [2x4] Find
   a) The equation of the resulting signal.
   b) Modulation index
   c) Total power
   d) Draw spectrum
5. Explain about generation of Vestigial Side Band (VSB) AM with its frequency spectrum. Why is VSB suitable for television transmission? Write application areas of Single Side Band (SSB) communication. [4+2+2]
6. Explain the process of demodulation of AM wave using envelope detector. Does envelope detector demodulate DSB-SC AM wave? Explain. [6+2]
7. Define narrow band and wide band FM. Explain the process of generation of wide band FM wave using Armstrong method. [2+6]
8. Draw the block diagram of stereo FM encoder and decoder. Explain each block briefly. [8]
9. A sinusoidal modulating signal $m(t)=5\cos(18849.55t)$ is applied to an FM modulator that has frequency sensitivity of 9KHz/V. The amplitude of carrier is 25V and the carrier frequency is 88.7MHz. Compute a) modulation index b) Carrier frequency swing c) Bandwidth using Carson rule d) total power delivered to 10Ω resistor. [8]
10. Write short notes on : [4+4]
    a) FDM in telephony
    b) Super heterodyne Receiver

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2076 Bhadra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEX	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

Subject: - Communication System I *(EX 652)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. Define noise, distortion and interference in communication system. Describe the types and causes of internal and external noise that may affect the communication system. [2+5]
2. What is Hilbert Transform; describe it with mathematical expression and frequency response. Mention the properties of Hilbert Transform. Explain distortionless transmission line with its frequency response. [2+2+3]
3. Define energy and power signal. Find whether the signal $x(t) = A\cos 2\Pi ft$ is energy type or power type signal. [2+5]
4. What is modulation index of AM wave? Explain the process of generation of DSB-AM using square law modulator. [1+5]
5. An amplitude modulated signal is represented by [1+2+1+2+1]
   $S_{AM}(t) = 10(1 + 0.2\cos 2\Pi 10^3 t)\cos 2\Pi 10^6 t$.
   a) Identify which type of modulation.
   b) b) Find modulating frequency and carrier frequency
   c) c) Bandwidth of the signal
   d) Carrier power, total power, power in side bands
   e) Efficiency
6. Evaluate the effect of small phase error in the local oscillator on synchronous detection of DSB-SC AM. Propose one of practically synchronized receiving system for DSB-SC wave? [3+5]
7. Compare the performance of DSB-AM, DSB-SC, SSB-AM VSB. Describe the process of generation of SSB-AM wave using phase discrimination method. [2+6]
8. What are the properties of Bessel function? Show that a FM signal consists infinite number of cosine signal components centered at frequencies $f_c + n f_m$, where f_c = carrier frequency, f_m = message frequency and $n = 0, \pm 1, \pm 2, \pm 3, \ldots$. [2+6]
9. What is the role of amplitude limiter in limiter discriminator method? Explain FM demodulator using PLL. [2+4]
10. A sinusoidal modulating signal $m(t) = 5\text{Cos}(18849.55t)$ is applied to an FM modulator that has frequency sensitivity of 9KHz/V. The amplitude of carrier is 25V and the frequency is 88.7MHz. Compute: a) modulation index b) Carrier frequency swing c) Bandwidth using Carson rule d) total power delivered to 10Ω resistor. [2+2+2+2]
11. Write short notes on: [4+4]
    a) Envelope Detector
    b) FDM in telephony

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23 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2075 Bhadra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEX	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

Subject: - Communication System I *(EX652)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. Distinguish between external and internal nose. List out the sources of interferences. Write the needs of modulation in communication system. [2+2+4]
2. Define Hilbert transformation. Show that impulse response of an ideal low pass filter is non-causal. [2+6]
3. Define energy spectral density and power spectral density function of a signal and hence derive the auto correlation function of white noise utilizing power spectral density along with necessary diagrams. [4+4]
4. How does SSB differ from conventional AM and DSB-SC? Describe the process of generation of DSB-SC AM wave using Balance modulator. [3+5]
5. An Amplitude modulated wave is given by [3+2+2+1]

   $s(t) = 100\cos(2\pi * 10^6 t) + 30\cos(2\pi * 10^6 t)\cos(2\pi * 10^3 t) + 40\cos(2\pi * 10^6 t)\cos(4\pi * 10^2 t)\text{Volt}$

   a) Draw the frequency spectrum of modulated wave
   b) Net modulation index
   c) Total modulated power
   d) Efficiency
6. Describe any one method of demodulating DSB-FC AM signal. [8]
7. Derive the expression for single tone modulated FM signal in terms of Bessel coefficients. [8]
8. Describe the process of demodulation of FM using PLL. [8]
9. Why pre-emphasis and de-emphasis circuits are used in commercial FM broadcasting? Explain the functional block diagram of stereo encoder. [3+5]
10. What is frequency division multiplexing (FDM)? Describe the method of FDM in telephony. [2+6]

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35 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2075 Baisakh

Exam.	Back		
Level	BE	Full Marks	80
Programme	BEX	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

Subject: - Communication System I *(EX652)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. Distinguish between noise and interference? How their effects can be minimized? Also explain why modulation is needed in communication system. [4+2+2]
2. Define Hilbert Transform; describe it with mathematical expression and frequency response. Mention the properties of Hilbert Transform. Explain distortionless transmission channel with its frequency response. [3+2+3]
3. State and prove Rayleigh energy theorem for a given energy signal x(t). [2+6]
4. Find the time domain and frequency domain expressions for single tone DSB-FC AM modulated wave. Also, show the spectrum of the modulated signal. [3+3+3]
5. A cosine carrier of frequency 750 KHz is amplitude modulated by another cosine wave of frequency 325 Hz resulting in maximum and minimum carrier amplitudes of 110V and 90V respectively: [2+3+2]
   a) Draw the waveform of AM wave thus created.
   b) Write the expression of the resulting AM wave.
   c) Find the total power radiated and efficiency.
6. Explain the phase shift method of generation of SSB AM modulated wave. What are the pros and cons of this method? [6+2]
7. Explain the envelope detection method for the demodulation of AM wave with necessary conditions for time constants and waveforms. [4+2+2]
8. What is angle modulation? Find the time domain and frequency domain expression of single tone modulated FM signal. [2+3+3]
9. A 102.4 MHz carrier signal is frequency modulated by a 5 KHz sine wave. The resultant FM signal has frequency deviation of 75 KHz. Now, determine the followings: (a) carrier swing of FM signal, (b) the bandwidth occupied by FM signal and (c) modulation index. [3+3+3]
10. What is frequency division multiplexing (FDM)? Describe the FDM hierarchy in telephony. [2+5]

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35 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2074 Bhadra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEX	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

Subject: - Communication System I *(EX652)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ ***All** questions carry equal marks.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. Draw and explain block the diagram of analog communication system. [8]
2. What is impulse response? What are the conditions for distortionless transmission? Explain with necessary diagrams. [2+6]
3. Define energy spectral density and power spectral density function of a signal and hence derive the auto correlation function of white noise utilizing power spectral density. [4+4]
4. With waveforms and necessary derivation, explain Ring Modulator method of generating DSB-SC signal. [8]
5. An AM wave is represented by $s(t) = 5[1+ 0.6 \cos(6280t)] \cos(2\pi 10^4 t)$ volts, then find the followings: (a) Modulation Depth, (b) Maximum and Minimum Amplitude of AM wave, (c) Frequency components in modulated signal and their amplitudes, (d) Power dissipated across 1K Ohm resistor. [2+2+2+2]
6. What is QAM modulation, why is it necessary? Explain generation and detection of QAM wave. [3+4]
7. What are the essential components that constitute PLL? How can PLL be used to demodulate AM signal? [2+6]
8. Derive the time domain expression of single tone FM in terms of Bessel's function $J_n(\beta)$. Use the result to find the expression of average power of FM signal whose significant Bessel's coefficients are taken from ' - n' to ' + n'. [6+2]
9. An Armstrong FM modulator is required in order to transmit an audio signal of bandwidth 50 Hz to 15 KHz. The Narrow Band (NB) phase modulator used utilizes an oscillator providing carrier frequency f_{c1} = 0.2 MHz. The output of the NB phase modulator is multiplied by n_1 by multiplier and then passed to mixer with a local oscillator frequency f_{c2} = 10.925 MHz. The desired FM wave at the transmitter output has a carrier frequency f_c = 90 MHz and a frequency deviation Δf = 75 KHz, which is obtained by multiplying the mixer output frequency with n_2 by using another multiplier. Find n_1 and n_2. Assume that the NBFM signal at the output of NB phase modulator has modulation index, $\beta = 0.5$. [9]
10. Write short notes on following: (Any two) [4+4]
    a) FDMA in satellite communications
    b) Pre-emphasis and de-emphasis
    c) Superheterodyne radio Receiver

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35 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2073 Bhadra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEX	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

Subject: - Communication System I *(EX652)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. How does noise limit the performance of communication system? Describe the types and causes of any four types of internal noise that may affect the communication system. [2+8]
2. a) What do you understand by Impluse response and transfer functions of a system? Explain its significance. [4+2]
   b) Define Energy and Power Signal. Explain the meaning of bandwidth of a system along with necessary diagrams. [2+2]
3. Define power Spectral Density (PSD). Find expression for PSD and its relationship with autocorrelation function. [2+4+4]
4. Why is conventional AM wasteful of power and bandwidth? Explain the method of conventional AM generation by using switching modulator. [4+6]
5. An amplitude modulated wave is given by
   $s(t) = 50(1 + 0.3\cos 3141.60t + 0.2\cos 2513.28t)\cos 10^6 t$ [4+3+3]
   i) Draw the amplitude spectrum of s(t)
   ii) Determine the bandwidth of s(t)
   iii) Calculate the power efficiency
6. Draw the block diagram of Costas Loop detector and explain how it demodulates DSB-SC AM and corrects for phase error. [4+4+2]
7. Find the time domain expression for Narrowband FM signal. How NBFM can be used to generate Wideband FM signal? [6+4]
8. Write short notes on: (any two) [2×5]
   i) Frequency Division Multiplexing (FDM)
   ii) FDMA in Satellite Communication
   iii) Filter and Oscillator requirements in FDM

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35 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2073 Magh

Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BEX	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

Subject: - Communication System I *(EX652)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. What do you mean by channel in communication system? Classify the channel with example. [4+6]
2. Define Hilbert transform? How is it different from Fourier transform? State the properties of HT. [4+2+4]
3. Compare DSB-AM and SSB wave in terms of transmission power and bandwidth. Describe how ring modulator can be used to generate DSB-SC. [4+6]
4. What is power spectral density function (PSDF)? Derive an expression for PSDF of an arbitrary signal X(t). [4+6]
5. With block diagram and necessary mathematics, show that the Costas loop can be used as a practical synchronous receiving system suitable for use with the DSB-SC modulated wave. [10]
6. What is angle modulation? Explain with the help of equation and block diagram, the Armstrong method of generating FM signal. [4+6]
7. The angle modulated signal is given by $S(t) = 20\cos(6\times10^8 t + 7\sin 1250t)$ [2.5×4]

   Determine:

   i) The carrier and modulating frequency
   ii) The modulation index
   iii) Maximum frequency deviation
   iv) Power dissipated in 10 Ω resistor
8. Write short notes on: [5+5]

   i) Filter and oscillator requirements in FDM
   ii) Stereo FM encoder

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35 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2072 Ashwin

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEX	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

Subject: - Communication System I *(EX652)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. Draw the block diagram of analog communication system and digital communication system. Explain briefly about linear type and non-linear type distortion? [2+2+2]
2. What do you mean by the impulse response of a system? Why is the impulse response of a system quite useful in the design of communication systems? What is the impulse response of low-pass filter? [2+3+1]
3. Define power and energy spectral density function. Given a signal $x(t)=\cos(200\pi t)$, find the auto correlation of $x(t)$ at $\tau = \pi/4$ [2+3]
4. The signals $m(t) = 5\cos 2\times10^3\pi t + 10\cos 1\times10^3\pi t$, $c(t)=15\cos 2\times10^6\pi t$ are applied to AM. [2+2+3]
   i) Find modulation index
   ii) Find total power
   iii) Draw spectrum
5. Draw a neat diagram of amplitude-modulated wave and drive an expression for modulation index. Justify why AM transmitters are generally operated with the modulation index as close to 100% as possible. [6+2]
6. A certain AM transmitter radiates 10kW with the carrier unmodulated and 11.8 kW when the carrier is sinusoidally modulated. Calculate the modulation index. If another sine wave, corresponding to 30 percent modulation, is transmitted simultaneously, determine the total radiated power. [3+4]
7. Compare the basics of DSB-AM, DSB-SC and SSB modulations with their respective spectrum? Why DSB-SC detection is known as synchronous detection, explain with required details? [5+3]
8. Express angle modulated wave in terms of Bessel function $j_n(\beta)$ of first kind of order n and argument β. [6]
9. Show that a square-law modulator can be used to generate DSBAM signal with explanation of it's diagram and also sketch spectrum at the input of the Bpf. What is the basic characteristics of AM modulation? [5+3]
10. A carrier of frequency 10^6 Hz and amplitude 3 volts is frequency modulated by a sinusoidal modulating signal frequency 500 Hz and peak amplitude 1 volt. The frequency deviation is 1 kHz. The level of the modulating waveform is changed to 5V peak and the modulating frequency is changed to 2 kHz. Write the expression for the new modulated waveform. [6]
11. How AM can be demodulated using PLL circuit? Explain. [5]
12. Write short notes on: (any two) [2×4]
    i) FM radio receiver
    ii) Pre-emphases and de-emphases
    iii) Satellite communication system

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35 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2072 Magh

Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BEX	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

Subject: - Communication System I *(EX652)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. What is noise? Distinguish between internal and external noise. List various sources of external noise. [2+2+2]
2. Why modulation is necessary? Describe how channel can be modulated? [2+4]
3. Define signum signal. Explain the significance of distortionless transmission in communication system with its necessary derivation. [2+5]
4. Derive Rayleigh energy theorem. How can you calculate the power of a periodic signal when its Fourier-series coefficients C_n are known? [4+2]
5. Explain phase shift method of generating SSB signal. What is the main advantages and disadvantage of using this method? [5+3]
6. An audio signal given as $15\sin 2\pi$ (1500t) amplitude modulates a carrier given as 60 sin 2π (100, 000t) determine the following: [2+2+2+2]
   i) Construct the modulated wave
   ii) Determine the modulation index and percent modulation
   iii) What frequencies would present in a spectrum analysis of the modulated wave?
   iv) Sketch audio and carrier wave
7. Generate a FM signal with F_c = 50MHz and β = 1 from a NBFM signal with F_c = 1MHz, β = 0.1 and Fm = 10 KHz. [6]
8. Define lock range, capture range in PLL. Explain the demodulation of FM using PLL. [2+4]
9. What do you understand by FDMA? Explain the use of FDM in telephony hierarchy. [2+6]
10. Explain Carson's rule for determining the bandwidth of an FM wave. Under what condition the bandwidth of FM signal is same as that of AM? Explain. [2+4]
11. Write short notes on: (ant two) [2×4]
    i) AM radio receiver
    ii) Modulation index
    iii) Coherent detector
12. List the major differences between AM and FM superheterodyne receiver. Why are superheterodyne receivers provided with automatic gain control (AGC) mechanism? [3+2]

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35 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2071 Bhadra

Exam.	Regular / Back		
Level	BE	Full Marks	80
Programme	BEX	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

Subject: - Communication System I *(EX652)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. Define noise, interference and distortion? What will be their effects in communication? Explain briefly thermal and high frequency noise. [3+1+3]
2. Define LTI system. Find the expression (in time domain) for the output of a LTI. [2+5]
3. What do you understand by Energy Spectral Density (ESD)? Find ESD and total energy for sinc pulse defined by $g(t) = A \text{ sinc } (2Wt)$. [2+3+2]
4. a) What do you understand by modulation? Why modulation is needed? Find the frequency domain expression for standard AM wave for single tone message signal. [2+2+3]
   b) With the help of block diagram and expression explain the phase shift method for generation of SSB-AM wave. [6]
   c) An AM wave is represented by $S_{AM}(t) = 20(1 + 0.8 \cos 2\pi\ 1000\ t) \cos (9424777.96\ t)$ volts. Find [2×4]
      i) Amplitude of all frequency components
      ii) Modulation index
      iii) Maximum and minimum amplitude of AM wave
      iv) Frequency of USB and LSB
5. a) Draw the circuit diagram and the waveforms and describe how envelope detector can be used for demodulation of standard AM wave. [5]
   b) Describe the operation of PLL and show that it can be used to demodulate AM. [6]
6. a) Find the time domain expression for single tone FM modulated waves interms of Bessel coefficients. [6]
   b) Describe the limiter-discriminator method for demodulation of FM wave. [7]
   c) A modulating signal $m(t) = 5 \cos 18849.55\ t$ is applied to an FM modulator that has a frequency sensitivity of 9 KHz/V. Compute (i) peak frequency deviation, (ii) modulation index, (iii) frequency swing and (iv) Carson's bandwidth. [2×4]
7. Describe the principle of frequency division multiplexing (FDM). Briefly explain SCPC and DAMA types of FDMA. [2+4]

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35 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2071 Magh

Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BEX	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

Subject: - Communication System I *(EX652)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. Draw the block diagram of communication system and explain each component briefly. [6]
2. Define Hilbert transformation. State and explain the properties of LTI system. [2+4]
3. Define white noise. Establish relation between psdf and the AC function of a white noise. [3+3]
4. What are the advantages of SSB-AM over DSBFC-AM? Derive the expression for SSB signal. [2+4]
5. Explain the generation of DSB-FC AM using switching modulator with the help of diagrams and expressions. [8]
6. Show the effect of phase error in coherent detection of DSB-SC AM. Explain the demodulation of AM using PLL. [4+4]
7. Explain the operation of FM super heterodyne radio receiver. [8]
8. The equation of an angle modulation voltage is $E = 10 \sin (10^8 t + 3 \sin 10^4 t)$. Calculate the carrier and modulating frequency, modulating index and power dissipated in 100 Ω resistor. [2+2+2+2]
9. Explain demodulation of FM using limiter-discriminator method. Why pre-emphases is needed in FM during transmission? [6+2]
10. Define FDMA. Write about FDM in telephone hierarchy. [2+6]
11. Write short notes on: [4+4]
    a) Stereo encoder
    b) Distortion and interference

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35 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2070 Bhadra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEX	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

Subject: - Communication System I *(EX652)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt All questions.*
- ✓ *The figures in the margin indicate* ***Full Marks.***
- ✓ *Assume suitable data if necessary.*

1. Differentiate between noise and interference. What are the limitations posed by them in communication system? [3+3]
2. Define linear time invariant system. What is the significance of such system in communication engineering? [2+3]
3. List out any three the properties of autocorrelation function. Mention the autocorrelation function of white noise. [3+3]
4. How is SSB different from conventional full carrier AM? Describe how ring modulator can be used to generate DSB-SC. [2+5]
5. What is vestigial side band modulation? What is the motivation behind using VSB? Why is VSB suitable for television transmission? [2+2+2]
6. The amplitude modulated signal is given by $x(t) = 50\cos(2\pi \times 10^6 t) + 15\cos(2\pi \times 10^6 t)\cos(2\pi \times 10^3 t) + 20\cos(2\pi \times 10^6 t)\cos(4\pi \times 10^2 t)$. [3+2+2]
   a) Draw the spectrum.
   b) Find the total modulated power.
   c) Find the net modulation index.
7. Explain envelope detector. Include in your explanation how the values of capacitor and resistor be chosen so that the output of detector is the envelope of the signal as its input. [6]
8. How can synchronous demodulator be used to detect DSB-SC wave? Explain mathematically, the effects of phase error and frequency error in local oscillator while demodulating DSB-SC. [3+3]
9. How is the spectrum of Narrow band FM similar to and different from the spectrum of conventional AM? Explain how NBFM is generated by using Armstrong's method. [2+5]
10. Explain with necessary mathematical relations, the demodulation of FM wave using non-synchronous method. [6]
11. What are the requirements for a good radio receiver? Explain the operation of a superheterodyne receiver. [3+5]
12. Write short notes on: [5+5]
    a) FDM Telephone Hierarchy
    b) Distortionless Transmission

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35 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2070 Magh

Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BEX	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

Subject: - Communication System I *(EX652)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. a) Define modulation and explain the reasons for modulation. Compare noise, distortion and interference. [2+4]

   b) Differentiate between energy spectral density function and power spectral density function. Derive the expression of power spectral density function of a arbitrary signal z(t) [2+6]

2. a) Compare various types of AM systems in terms of transmission power and transmission bandwidth. Explain any one method generating DSB-FC AM. [2+4]

   b) Given the modulated wave, $u(t)=[20+2\cos 3000\pi t+10\cos 6000\pi t]\cos 2\pi f_c t$ where $f_c=10^5$Hz. [2×4]

      i) Sketch the spectrum of the signal
      ii) Find power contained in each frequency component
      iii) Calculate efficiency
      iv) Transmission bandwidth of the system

3. a) Derive the expression for SSB wave modulated by a low pass signal m(t). [6]

   b) What is the limitation of square law detector for DSB-AM detection? Explain the operation of envelope detector with required diagrams and conditions. [2+6]

4. a) Derive the expression for signal tone modulated FM signal interm of Bessel coefficients. [6]

   b) Explain the role of amplitude limiter used in limiter discriminator method. Prove that PLL can be used as FM demodulator. [2+6]

5. a) Why pre-emphasis and de-emphasis circuits are required in commercial FM broadcasting? Explain the functional block diagram of stereo encoder. [2+4]

   b) In an FM system a baseband signal band limited to 10 KHZ modulates 100 MHZ carrier wave so that the frequency deviation is 75 KHZ. [4+4]
   Find:
      i) Carrier frequency swing in the FM signal and modulation index
      ii) The practical bandwidth of the fm signal

6. Short notes on: (any two) [2×5]

   i) Distortionless Transmission
   ii) Frequency Division Multiplexing (FDM)
   iii) Superheterodyne Receiver

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34 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2069 Bhadra

Exam.	Regular (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BEX	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

Subject: - Communication System I *(EX652)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. What are the main components of analog communication system? Describe briefly about each component. Find the transfer function for distortionless system. [2+5+3]
2. Define energy and power spectral density functions. Find power spectral density and average power for the periodic signal defined by $g(t) = A\cos(2\pi f_c t+\theta)$. [4+6]
3. What do you understand by modulation? Why modulation is needed? Find the time and frequency domain expressions for standard AM wave for single tone message signal. [2+2+6]
4. An AM wave is represented by $S_{AM}(t) = 10\ (1+0.8\cos\ 25132.74t)\ \cos\ (9424777.96t)$ volts. [2×5]

   Find:

   i) Amplitude of all frequency components
   ii) Modulation index
   iii) Maximum and minimum amplitude of AM wave
   iv) Bandwidth of the signal
   v) Power spectrum of the modulated signal.
5. Describe how envelope detector can be used for demodulation of standard AM wave. Explain why DSB-SC and SSB cannot be demodulated using envelop detector. [6+4]
6. Find the time domain expression for signal tone FM modulated wave, in terms of Bessel coefficients. Derive the expression for estimating practical bandwith of a FM signal. [6+4]
7. A sinusoidal modulating signal $m(t) = 5\cos\ 18849.55t$ is applied to an FM modulator that has a frequency sensitivity of 9 KHz/V. The amplitude of the carrier is 25V and the frequency is 88.7Mhz. Compute: [2×5]

   i) Peak frequency deviation
   ii) Modulation index
   iii) Frequency swing
   iv) Carson's bandwidth and
   v) Total power delivered in 10Ω resistor.
8. Describe the principle of frequency division multiplexing (FDM) with its standard hierarchy in telephony system. [4+6]

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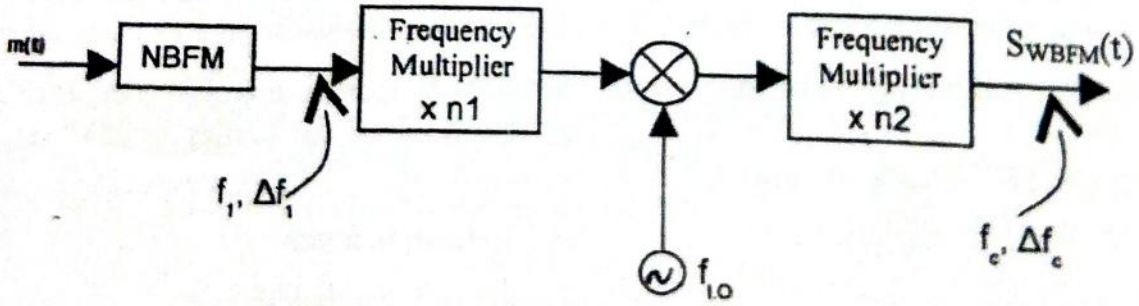
INSTITUTE OF ENGINEERING
Examination Control Division
2068 Bhadra

Exam.	Regular / Back		
Level	BE	Full Marks	80
Programme	BEX	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

Subject: - Communication System I

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. What major elements does a communication system contains? "Communication over long distance is impossible without modulation. Modulation is must to mitigate several constraints in transmission." Justify. [4+4]
2. Define Band pass signal and Band Limited signal with example. Write the properties of LTI system. [4+4]
3. Derive the expression for double side band full carrier amplitude wave where the massage contains a single tone frequency component. Also find the expression for modulation index. [6+2]
4. Determine the percentage power saving of SSB modulated wave for modulation depth equal to (i) 100%, and (ii) 50%. [4+4]
5. Explain the effect of phase and frequency error in local oscillator in demodulating DSB and SSB using PLL. [8]
6. Express the sinusoidal angle modulated wave interms of Bessel function, Jn(β) of first kind of order n and argument β. [8]
7. For the following Armstrong FM transmitter, compute maximum frequency deviation and the carrier frequency f_c if, $f_1 = 200kHz$, $f_{LO} = 10.8MHz$, $\Delta f_1 = 24Hz$, $n_1 = 65$ and $n_2 = 50$. [8]



8. Define white noise with PSDF and auto correlation function. State the properties of auto correlation function. [4+4]
9. Explain any one method of demodulating DPSK signal. [8]
10. Write short notes on: [2x4]
    a) Filter and oscillator requirement in FDM
    b) Satellite Communication

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