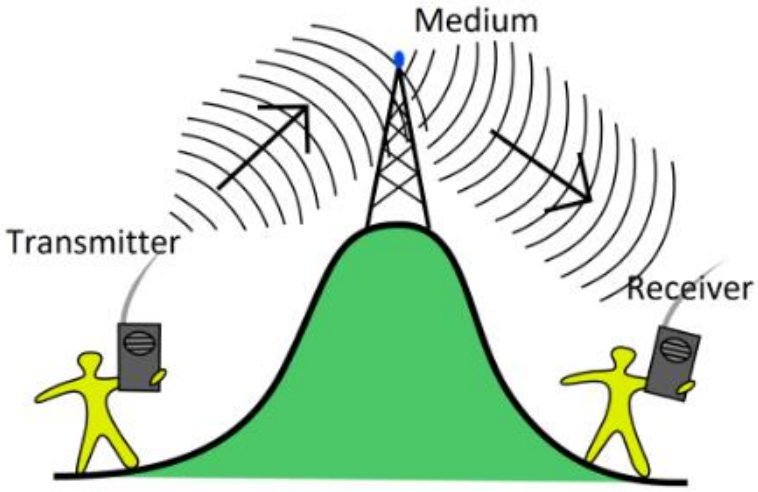
MUZAFFARPUR INSTITUTE OF TECHNOLOGY, Muzaffarpur

COURSE FILE

OF

Introduction to Communication System

(041x03)



Faculty Name:

Mr. MOHIT KUMAR

ASSISTANT PROFESSOR,

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

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VISION OF DEPARTMENT

The department is committed for high quality teaching and pursuit of excellence in research. We pledge to serve the nation and society by providing skilled and well developed human resource through brilliance in technical education and research.

MISSION OF DEPARTMENT

- To encourage innovation and research through projects and developmental activities with industries, institutions and government.
- To inculcate moral and ethical values with a sense of competitiveness, self-confidence and sincerity among the students to make them a good human and a good citizen.
- To produce excellent engineers, innovators, entrepreneurs and academicians for the growth of the society.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):

After successful completion of program, graduates will be able to

PEO1: Work in the infrastructure development projects.

PEO2: Pursue higher studies.

PEO3: Contribute in teaching, research and other developmental activities of electronics & communication engineering and its allied fields.

PEO4: Work in the multicultural and multidisciplinary groups for the sustainable development and growth of electronics and communication engineering projects and profession.

PROGRAMME OUTCOMES (PO)

PO1	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3	**Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4	**Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5	**Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO6	**The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7	**Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of and need for sustainable development.
PO8	**Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9	**Individual and teamwork:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11	**Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12	**Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

COURSE OBJECTIVE AND COURSE OUTCOMES:

Institute / College Name :	MUZAFFARPUR INSTITUTE OF TECHNOLOGY		
Program Name	**B.Tech. ECE**		
Course Code	041503		
Course Name	**INTRODUCTION TO COMMUNICATION SYSTEM**		
Lecture / Tutorial / Practical (per week):	3 – 0 - 3	**Course Credits**	5
Course Coordinator Name	Mr. MOHIT KUMAR		

Course objective:

This course provides the student with the fundamental skills to analyze and solve analog communication problems on a system level. It will build mathematical background for communication signal analysis. Students equipped with the knowledge and training provided in the course will be able to participate in design and development, installation and operation of a wide spectrum of applications in the area of communications.

Course outcomes (CO):

CO1: Perform the time and frequency domain analysis of the signals in an analog communication system.

CO2: Use of different modulation and demodulation techniques used in analog communication.

CO3: Analyze transmitter and receiver circuits.

CO4: Compare design issues, advantages, disadvantages and limitations of analog communication systems.

MAPPING OF COs AND POs

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1			2					3		3
CO2	2	3	1	2	1							2
CO3		3	3	2	3							3
CO4	1		2	2						3		2

Correlation level: 1- slight (Low) 2- moderate (Medium) 3-substantial (High)

COURSE SYLLABUS:

Topics	Number of Lectures	Weightage (%)
Periodic signals (Sinusoidal, rectangular, saw tooth and triangular wave) and its Fourier series expansion with single side representation in real frequency domain and with double side representation in rotating phasor domain.	3	**5**
Aperiodic signal A signal pulse event and its Fourier transform; impulse response of a linear time invariant system, convolution and response to arbitrary input.	3	6
Block diagram Communication system and comparative study of analog and digital communication	3	4
Modulation (Upward frequency translation) & demodulation (downward frequency translation) and the need for modulation: broad classification of modulation [linear (amplitude-AM) and exponential (frequency-FM and phase-PM)]	7	15
Generation Double side band (DSB) with carrier, double side band with suppressed carrier (DSBSC) and single side band with suppressed carrier: demodulation of double side band with carrier – incoherent detector or envelope detector, peak diode detector, coherent or synchronous detection of DSBSC and single side band with suppressed carrier.	8	20
Analog pulse, modulation PAM, PWM, PPM and demodulation; comparative study of various analog pulse modulation; comparison of incoherent and coherent detection.	3	5

Superhetrodyne Receivers Intermediate Frequency and its advantages, alignment and tracking, image rejection and IC version of the Receiver.	3	8
Frequency Multiplexing in carrier Telephony	1	5
Generation of FM signals (Direct and indirect methods) and demodulation.	3	10
Comparative study SNR in AM, FM and PM System and use of emphasis Circuit in FM for SNR optimization	2	7
Television Block diagram of the transmitter and receiver : description and working of video camera ;description working of B-W colour TV receiver ;description of the composite signal in B-W colour TV.	9	15

GATE SYLLABUS (Analog and Digital Communication):

Random processes: autocorrelation and power spectral density, properties of white noise, filtering of random signals through LTI systems; **Analog communications: amplitude modulation and demodulation, angle modulation and demodulation, spectra of AM and FM, Super-heterodyne receivers, circuits for analog communications**; Information theory: entropy, mutual information and channel capacity theorem; Digital communications: PCM, DPCM, digital modulation schemes, amplitude, phase and frequency shift keying (ASK, PSK, FSK), QAM, MAP and ML decoding, matched filter receiver, calculation of bandwidth, **SNR** and BER for digital modulation; Fundamentals of error correction, Hamming codes; Timing and frequency synchronization, inter-symbol interference and its mitigation; Basics of TDMA, FDMA and CDMA.

* Bold represents the matching part of the Course and Gate Syllabus

MUZAFFARPUR INSTITUTE OF TECHNOLOGY

B.Tech. 5th (Fifth) Semester TIME TABLE

WITH EFFECT FROM 10.07.2018

5th Semester Electronics and Communication Branch								
	09:00	10:00	11:00	12:00	R	2:00	3:00	4:00
	1	2	3	4	E	5	6	7
MON				CS				Weekly Test
TUES	CS				C			
WED		CS			E			
THUR								
FRI					S	--- CS LAB ---		
SAT					S			

MUZAFFARPUR INSTITUTE OF TECHNOLOGY

B.Tech. 5th (Fifth) Semester TIME TABLE

WITH EFFECT FROM 10.07.2018

5th Semester Information and Technology Branch								
	09:00	10:00	11:00	12:00	R	2:00	3:00	4:00
	1	2	3	4	E	5	6	7
MON							Weekly Test	
TUES		CS			C			
WED					E	--- CS LAB ---		
THUR								
FRI	CS				S			
SAT	CS				S			

STUDENT LIST:

5th Semester Electronics and Communication Branch		
S.No	**Roll No**	**Name of Students**
1	16EC01	ANKIT KUMAR
2	16EC09	UTSARG RANJAN
3	16EC10	AGHAZ JUNAID
4	16EC11	VIVEK KUMAR SONU
5	16EC12	SUGANDHA KUMARI
6	16EC13	SHREYA ANAND
7	16EC14	MD ARSHADULLAH
8	16EC16	NEHA PRAVEEN
9	16EC17	VISHAL KUMAR
10	16EC20	RAKESH KUMAR
11	16EC23	RAJU KUMAR
12	16EC24	PREM PRAKASH MANGLAM
13	16EC25	MD REHAN
14	16EC26	SUBHAM RAJ
15	16EC29	SANSKRITI SHREE
16	16EC30	VIMLA BHARTI
17	16EC31	PUJA KUMARI
18	16EC32	PRASHANT KUMAR
19	16EC33	PRANAY MOHAN
20	16EC34	OM PRAKASH
21	16EC35	MD SARVAR ALI
22	16EC36	NIDHI
23	16EC37	HIMANSHU RAJ
24	16EC38	NITISH KUMAR
25	16EC39	ANMOL SHRIVASTAVA
26	16EC40	KUNDAN KUMAR
27	16EC41	SHIKHA PURNIMA
28	16EC42	AYUSHMAN KUMAR
29	16EC43	SHIMPI KUMARI
30	16EC44	DEEPAK KUMAR GUPTA
31	16EC45	RAHUL RANJAN KAPRI
32	16EC46	SAKET RANA

33	16EC47	KISHAN KUMAR
34	16EC48	SRISTI SNEHA
35	16EC49	SHIVANI
36	16EC50	MAMTA KUMARI
37	16EC51	RAJ KUMAR
38	16EC52	ABHIMANYU KUMAR
39	16EC53	BRISHNI KANT PATHAK
40	17(LE)EC01	SHRUTI RAJNANDANI
41	17(LE)EC02	RAGINI KUMARI
42	17(LE)EC03	AKASH RAJ
43	17(LE)EC04	ANIL KUMAR
44	17(LE)EC05	JAY PRAKASH
45	17(LE)EC06	RITUL KUMARI
46	17(LE)EC07	MANOJ KUMAR

5th Semester Information & Technology Branch		
S.No	**Roll No**	**Name of Students**
1	15IT35	DOLLY KUMARI
2	16IT48	ISHITA SHREYA
3	16IT35	TANWEER HASAN
4	16IT33	APARNA KUMARI
5	16IT31	MEGHA SINHA
6	16IT38	SHWETA KUMARI
7	16IT09	ADITYA SINGH
8	16IT45	SHAGUFTA SHAHEEN
9	16IT16	AAKASH ROY
10	16IT42	VIVEK RAJ SINGH
11	16IT51	BEAUTY KUMARI
12	16IT26	RUBY KUMARI
13	16IT41	PRIYA BHARTI
14	16IT19	ANSHULI KUMARI
15	16IT37	SANJAY KUMAR
16	16IT40	MD NIZAMUDDIN
17	16IT47	VICKY KUMAR
18	16IT28	MD KAIFEE
19	16IT25	JANU KUMAR JHA
20	16IT18	AMAN KUMAR
21	16IT52	NISHI ANAND
22	16IT43	ANURAG KUMAR GUPTA
23	16IT46	KUMARI JAHANVI
24	16IT20	VIVEK KUMAR PASWAN
25	16IT50	SAURABH MISHRA
26	16IT39	DEEPA KUMARI
27	16IT49	NAVNEET KAUSHIK
28	16IT02	AMISHA
29	16IT14	AMAN KUMAR DWIVEDI
30	16IT29	RAIMA
31	16IT36	GAURAV KUMAR
32	16IT32	ADITYA RANJAN
33	16IT04	AYUSHMAN
34	16IT44	RASHMI KUMARI
35	16IT10	APOORVA RATHORE
36	16IT34	ARCHANA KUMARI
37	16IT30	SUNIL KUMAR
38	16IT27	MD SHAQUIB ULLAH
39	17(LE)IT01	KAJAL KUMARI

40	17(LE)IT02	MD ASIF EQUBAL
41	17(LE)IT03	TULSI KUMARI

TEXT BOOKS:

TB1: ‘Radio systems for Technicians’ by D.C.Green, Longman

TB2: ‘Communication System’ by Haykin, Wiley

REFERENCE BOOKS:

RB1: ‘Communication system ’ by Bruce carison. TMH

RB2: ‘Monochrome and colour television’ by R R Gulati

COURSE PLAN

Lecture Number	Topics	Web Links for video lectures	Text Book / Reference Book	Page numbers of Book
1-3	**Periodic signals**		RB 1	17 - 44
	(Sinusoidal, rectangular, saw tooth and triangular wave) and its Fourier series expansion with single side representation in real frequency domain and with double side representation in rotating phasor domain.	https://www.youtube.com/watch?v=VFbABtDcZDE&list=PLNEqvET0cb64T1v3SrANLP5zC8OQpjXBI		
4 - 6	**Aperiodic signal**		RB 1	44 - 66
	A signal pulse event and its Fourier transform; impulse response of a linear time invariant system, convolution and response to arbitrary input.	https://www.youtube.com/watch?v=hnn_EhRjPa8&list=PLq-Gm0yRYwTgX2FkPVcY6io003-tZd8Ru&index=5		
7 - 9	**Block diagram**		TB1	1 - 20
	Communication system and comparative study of analog and digital communication	https://www.youtube.com/watch?v=PygLdNMDr_E&list=PLNEqvET0cb64T1v3SrANLP5zC8OQpjXBI&index=1		
10-12	**Modulation**		TB2	39 -64
	(Upward frequency translation) & demodulation (downward frequency translation) and the need for modulation: broad classification of modulation [linear (amplitude-AM) and exponential (frequency-FM and phase-PM)]	https://www.youtube.com/watch?v=_YahdHyZLL4&index=10&list=PLq-Gm0yRYwTgX2FkPVcY6io003-tZd8Ru		
13-18	**Generation**		TB2	88 -103
	Double side band (DSB) with carrier, double side band with suppressed carrier (DSBSC) and single side band with suppressed carrier: demodulation of double side band with carrier – incoherent detector or envelope detector, peak diode detector, coherent or synchronous detection of DSBSC and single side band with suppressed carrier.	https://www.youtube.com/watch?v=6028j9VLlXA&list=PLq-Gm0yRYwTgX2FkPVcY6io003-tZd8Ru&index=14		

19- 25	**Analog pulse, modulation**		TB2	107 - 126
	PAM, PWM, PPM and demodulation; comparative study of various analog pulse modulation; comparison of incoherent and coherent detection.	https://www.youtube.com/watch?v=HCltbJapAf8&index=38&list=PLq-Gm0yRYwTgX2FkPVcY6io003-tZd8Ru		
26-28	**Superhetrodyne Receivers**		TB 2	128 -130
	Intermediate Frequency and its advantages, alignment and tracking, image rejection and IC version of the Receiver.	https://www.youtube.com/watch?v=b9AS6eP_N5A&index=48&list=PLq-Gm0yRYwTgX2FkPVcY6io003-tZd8Ru		
29	**Frequency Multiplexing**		RB 1	266 -277
	in carrier Telephony	https://www.youtube.com/watch?v=y2ZQkQZ7DWU&list=PLq-Gm0yRYwTgX2FkPVcY6io003-tZd8Ru&index=50		
30 - 32	**Generation of FM signals**		RB 1	208 - 212
	(Direct and indirect methods) and demodulation.	https://www.youtube.com/watch?v=WA4CTzCxJjE&index=31&list=PLq-Gm0yRYwTgX2FkPVcY6io003-tZd8Ru		
33 - 34	**Comparative study**		TB2	130 - 157
	SNR in AM, FM and PM System and use of emphasis Circuit in FM for SNR optimization	http://nptel.ac.in/courses/117102059/35		
35- 40	**Television**		RB 4	1 - 36
	Block diagram of the transmitter and receiver : description and working of video camera ;description working of B-W colour TV receiver ;description of the composite signal in B-W colour TV.	http://nptel.ac.in/courses/117102059/26		
41 - 43	**CCD Flat Panel Displays.**		RB 4	37 – 54

DETAILS OF ASSIGNMENTS:

S.No.	Assignment	Topic Name
1	Assignment 1	Periodic & Aperiodic Signal
2	Assignment 2	Block Diagram, Modulation & Generation
3	Assignment 3	Analog pulse modulation,
4	Assignment 4	Generation of FM signals, Super-Heterodyne receiver

ASSIGNMENT 1

(1) For a rectangular pulse f(t) defined as

$$f(t) = 1 \qquad -1 \le t \le 1$$
$$0 \qquad \textit{Otherwise}$$

Sketch f(t), f(2t), f(t/2), f (t-3), f (-t + 5)

(2) Evaluate the following Integrals:

(a) $\int_{-\infty}^{\infty} cos\ (t)\ \delta(t)\ dt$

(b) $\int_{-\infty}^{\infty} sin\ \left(t - \frac{\pi}{2}\right) \delta(t - \pi) dt$

(c) $\int_{-\infty}^{\infty} sin\ \left(t - \frac{\pi}{2}\right) \delta(3t - \pi) dt$

(d) $\int_{-\pi/6}^{\pi/6} sin\ \left(t - \frac{\pi}{2}\right) \delta(3t - \pi) dt$

(3) Find the even and odd part of following signals:

(a) Unit step

(b) $f(t) = \sin(t)\, u\ (t)$

(4) Find the time period of the following signals if they are periodic:

(a) $\sin(\pi t) + \sin(2\pi t)$

(b) $f(t) = 10 + 5\cos\left(\frac{\pi}{7}t + \frac{\pi}{3}\right) + \sin\left(\frac{5\pi}{6}t + \frac{\pi}{6}\right) + 0.1\cos\left(\frac{6\pi}{5}t + \frac{\pi}{4}\right)$

(5) Classify the following signals as Energy signal or Power Signal and find their corresponding Energy and Power.

(a) $f(t) = e^{-at}u(t)$

(b) $f(t) = 3 \qquad -2 \le t \le 2$
$0 \qquad \textit{Otherwise}$

(c) $f(t) = 5$

(d) $f(t) = 4sin(2\pi t)$

(e) $f(t) = e^{at}u(t)$

(f) $f(t) = t \qquad 0 \le t \le \infty$
$0 \qquad \textit{Otherwise}$

ASSIGNMENT 2

(1) Find the height of transmitting antenna required to convert electrical signal to EMT at a frequency of 15 KHz?

(2) An unmodulated AM transmitted power is given by 1000 watts. Find AM transmitted power with 100% of modulation?

(3) For an AM, total sideband power is 100W with $\mu = 0.5$. Find carrier power and total power?

(4) For an AM, each of the sideband power is given by 2KW and carrier power is given by 8KW. Find percentage of modulation?

(5) A carrier signal of 10 cos (2 x pi x 10^6 t) is amplitude modulated by a message signal of 4 cos (4 x pi x 10^3 t) with $\mu = 0.5$. Antenna resistance is given by 5 Ω.
   a. Find all the possible parameters of AM
   b. Plot AM spectrum and identify the spectral components.

(6) A carrier signal of 10 cos (4 x pi x 10^5 t) is amplitude modulated by a message signal of 6 cos (pi x 10^4 t).

   a. Find all the possible parameters of AM

   b. Find frequency components of resulting AM signal

(7) An AM signal is given by s(t) = 4 cos (3200x pi x t) + 10 cos (4 x pi x 10^3 t) + 4 cos (4800x pi x t)
   a. Find all the possible parameters of AM

   b. Find P_c / P_t

(8) An AM transmitted power is given by 100 W with $\mu = 0.707$.
   a. Find P_c and P_{USB} and P_{LSB}

   b. Find peak amplitude of carrier signal before and after modulation

(9) The peak amplitudes of AM signals are varying between 2V and 10V. Find μ, P_T and η.

(10) An unmodulated AM transmitted power is given by 10 KW. When the carrier is modulated by single sinusoidal message signal, AM transmitted power is increased to 13.5 KW. Find AM transmitted power if the carrier is simultaneously modulated by second messaged signal with 60% of modulation.

ASSIGNMENT 3

(1) An AM transmitter current is given by 10A corresponds to carrier is modulated by single sinusoidal message signal with 40% of modulation. When the carrier is simultaneously modulated by second message signal, AM transmitter current is increased to 10.5A. Find the percentage modulation due to second message signal.

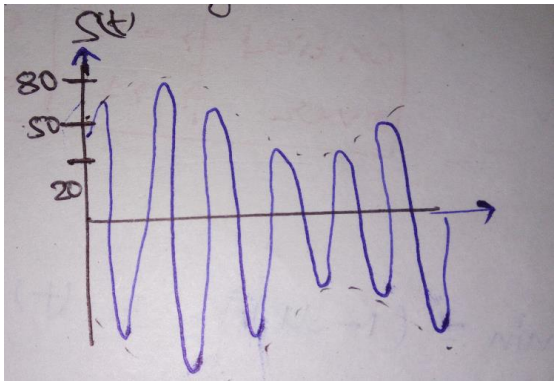
(2) An AM signal is given by

$s(t) = (20 + 12\cos(2\pi \times 10^4 t) + 16\cos(4\pi \times 10^4 t))\cos(2\pi \times 10^6 t)$

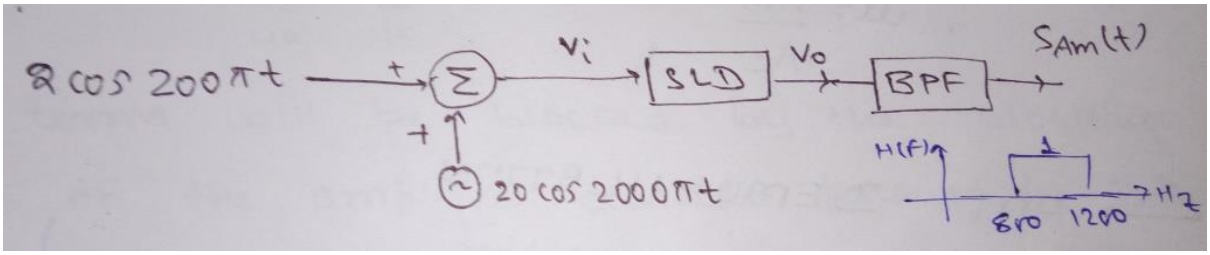
Find (1) All possible parameters of AM

(2) Find the frequency components of given AM signal.

(3) Find percentage of modulation of an AM signal with positive $A_{min} = 20$ &
Positive $A_{max} = 80$.



(4) For a square law modulator with square law device characterized by $V_0 = V_i + 0.1\,V_i^2$. IF the message signal is given by $2\cos(200\pi t)$ and carrier signal is given by $20\cos(2000\,\pi t)$ and pass band of BPF extends from (800-1200) Hz. Find all possible parameters of resulting AM signal?

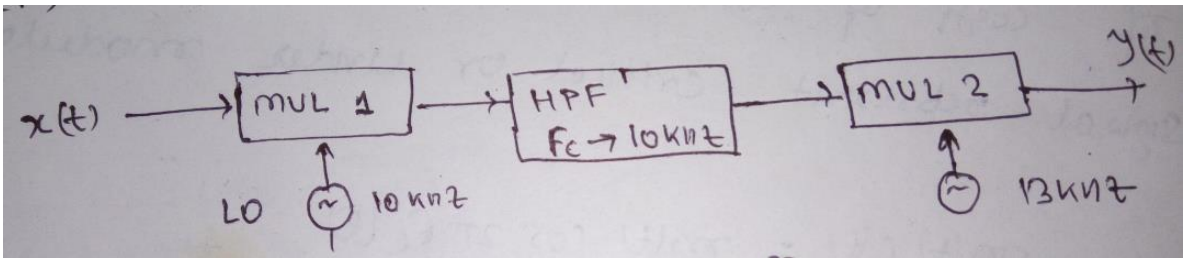


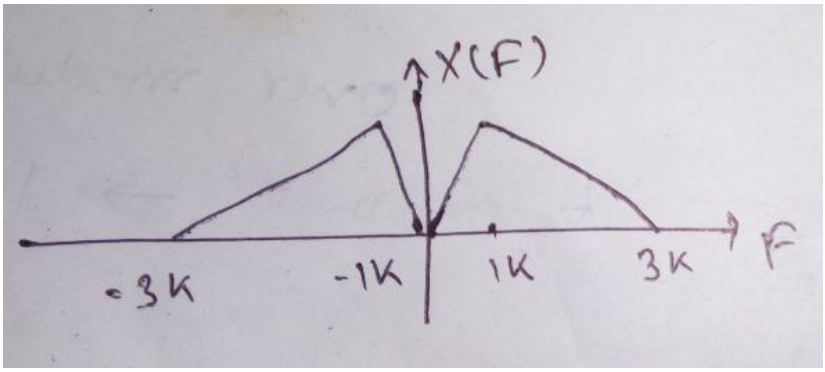
(5) A carrier signal of 1MHz is amplitude modulated by a message signal of 2Khz for proper Envelope detection RC should be

(a) $1\mu s$ (b) $0.5\mu s$ (c) $200\mu s$ (d) $500\mu s$

(6) For the following system find the positive frequencies for which spectral peaks will be observed in Y(f).

(a) 2K, 24K (b) 2k, 22k (c) 2k, 22k, 1k (d) None of these





(7) A carrier signal of $20\cos(2\pi\ 10^6 t)$ is DSB modulated by the message signal of

$$m(t) = \cos(2\pi\ 10^4 t) + 2\cos(4\pi\ 10^4 t) + 4\cos(6\pi\ 10^4 t)$$

(a) Find Bandwidth, P_T & η

(b) Which of the frequency component will not be present in the resulting DSB signal?

(1) 970 KHz (2) 980 KHz (3) 1000 KHz (4) 1010 KHz

(8) A Non-linear demodulator is characterized by $V_0 = \ a\,V_i + bV_i^3$ where, $V_i = m(t) + \cos(2\pi f t)$. By considering only DSB term from V_0 find "f" such that carrier frequency of the resulting DSB signal is 1MHz.

(9) A sinusoidal carrier signal of 1V, 100 KHz is product modulated by sinusoidal message signal of 1V, 1 KHz, the resulting signal is given to HPF having cut-off frequency of 100 KHz. Filter output is added with 1V,100KHz and 90-degree phase shift sinusoidal signal. Find the envelope or the resulting signal.

(10) An AM transmitted power is given by 500 W. Find the amount of power saved if carrier and one of the side band is suppressed with

(a) $\mu = 0.707$ (b) $\mu = 0.8$

ASSIGNMENT 4

(1) A receiver is tuned to 700 KHz station and corresponding image frequency is 1700 KHz. Find

(a) Local Oscillator frequency and Intermediate Frequency

(b) Find IRR if two tuned amplifiers having quality factor of 60 & 80 are cascaded.

(2) A receiver is tuned to 1MHz station. Intermediate Frequency is given by 455 KHz and quality factor = 100. Find

(a) IRR

(b) Find IRR if the receiver is tuned to 25 MHz station.

(3) A sinusoidal carrier signal of 20V, 2MHz is FM by a message signal of $10\cos(2\pi 10^4 t)$ $with$

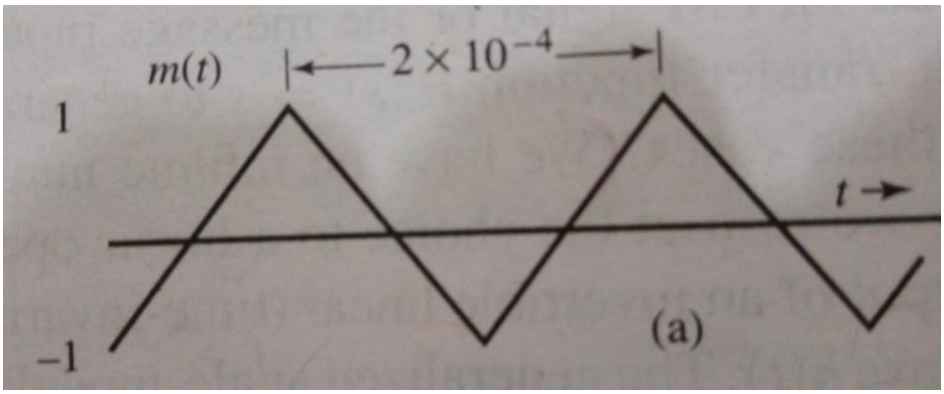
$k_f = 50\frac{KHz}{volt}$. Find Δf, f_{min} and f_{max}

(4) Given c(t) = 5 cos ($2\pi \times 10^6 t$) and m(t) = $4\cos(4\pi \times 10^3 t)$.

1. Both c(t) and m(t) are used to generate AM with $\mu = 0.707$. Find BW & Power.
2. Both c(t) and m(t) are used to generate FM such that $\Delta f = 4\ times\ AM\ BW$. Find coefficient of term cos ($2\pi \times 1018 \times 10^3 t$) in resulting FM expression

(5) Find $(f_i)_{min}$ &$(f_i)_{max}$ for the modulating signal m(t). The constant $(k_f) = 2\pi \times 10^5$ &

$(k_p) = 10\pi$ and carrier frequency $(f_c) = 100MHz$. Sketch the corresponding FM and PM.



QUESTION BANK:

Code : 041603

B.Tech 6th Semester Exam., 2014

INTRODUCTION TO COMMUNICATION SYSTEMS

Time : 3 hours

Full Marks : 70

Instructions :

(i) All questions carry equal marks.

(ii) There are ***NINE*** *questions in this paper.*

(iii) Attempt ***FIVE*** *questions in all.*

(iv) Question No. 1 is compulsory.

1. Answer any seven of the following :

(a) What is the basic purpose of an electronics communication system?

(b) What is meant by base band signal? Give an example.

(c) What are modulation and demodulation in simple terms?

(d) What happens if multiple messages are transmitted simultaneously without frequency translation or modulation?

(e) What is the function of a modem?

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(Turn Over)

(f) Give specific reasons to prefer digital technology over analog technology.

(g) Define the term EIRP. How is it related to transmitter power and transmitter antenna gain?

(h) List four different types of communication channel.

(i) What is meant by a Fourier series?

(j) How is 1 kHz sine wave represented in the frequency domain? What is its limitation?

2. (a) Describe periodic and aperiodic signals.

(b) Write down the trigonometric form of the Fourier series representation of a periodic signal. State the necessary and sufficient conditions for the existence of the Fourier series representation for a signal.

3. Define 'amplitude modulation'. Derive the relationship between the total transmitted power and carrier power in an AM system when several frequencies simultaneously modulate a carrier.

4. Describe the DSBSC wave generation process using balanced modulator.

5. (a) The antenna current of an AM transmitter is 8 amperes (8A) when only the carrier is sent, but it increases to 8·93 A when the carrier is modulated by a single sine wave. Find the percentage modulation. Also determine the antenna current when the percent of modulation changes to 0·8.

(b) Determine the modulation index for sinusoidal FM signal for which V_c (max) = 10 V, f_c = 20 kHz, V_m (max) = 3 V, f_m = 1 kHz and deviation constant, k_f = 2000 Hz/V. Also write the resulting expression for FM signal.

6. (a) Define the terms sensitivity, selectivity and image frequency.

(b) Draw the block diagram for an AM superheterodyne receiver and describe its operation and the primary function of each stage.

7. With the help of neat block diagram, explain PPM in detail. Compare among PAM, PWM and PPM.

8. Draw the block diagram of a monochrome TV transmitter and describe each block in brief.

9. Write notes on the following :

(a) FDM

(b) CCD flat panel displays

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6. (a) Explain the generation and detection of a PWM signal. 7

(b) Compare among PAM, PWM and PPM systems. 7

7. (a) Draw the block diagram of a super-heterodyne receiver and explain the function of each block. 7

(b) Define the following for a receiver : 7

(i) Sensitivity

(ii) Selectivity

(iii) Fidelity

(iv) Tracking

(v) Double spotting

(vi) Image frequency and its rejection

8. (a) Evaluate the noise performance of FM system. 7

(b) Evaluate the figure of merit of an AM receiver operating on single-tone AM. 7

9. (a) Sketch the composite video signal waveform for three lines and explain various components in brief. 7

(b) Draw the block diagram of a monochrome TV transmitter and describe each block in brief. 7

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B.Tech 6th Semester Exam., 2015

INTRODUCTION TO COMMUNICATION SYSTEMS

Full Marks : 70

Time : 3 hours

Instructions :

(i) The marks are indicated in the right-hand margin.

(ii) There are ***NINE*** *questions in this paper.*

(iii) Attempt ***FIVE*** *questions in all.*

(iv) Question No. ***1*** *is compulsory.*

1. Choose the correct option/Answer the following (any *seven*) : 2×7=14

(a) The highest modulating frequency used in AM broadcast system is

(i) 10 kHz

(ii) 15 kHz

(iii) 5 kHz

(iv) 2 MHz

(b) Radio signals are made up of

(i) voltages and currents

(ii) electric and magnetic fields

(iii) electrons and protons

(iv) noise and data

(c) The Fourier transform of convolution of signals in the time domain will be transformed into the —— of their Fourier transforms in the frequency domain.

(i) addition

(ii) subtraction

(iii) division

(iv) multiplication

(d) The trigonometric Fourier series of a periodic time function can have only —— term(s).

(i) d.c. and cosine

(ii) cosine

(iii) sine

(iv) sine and cosine

(e) In AM

(i) sideband power is always constant

(ii) total transmitted power is constant

(iii) carrier power is constant

(iv) bandwidth is infinite

(Continued)

(f) With increase in the modulation index of an FM wave, the number of sidebands having significant amplitude

(i) will increase

(ii) will decrease

(iii) remains constant

(g) The frequency deviation in PM is proportional to

(i) modulating voltage

(ii) modulating frequency

(iii) modulating frequency and voltage

(h) In FM, when the modulating frequency is 1000 Hz and AF voltage is 2 V, the deviation is 4 kHz. If the modulating voltage is increased to 3 V, the new deviation is given by

(i) 4 kHz

(ii) 2 kHz

(iii) 6 kHz

(iv) 10 kHz

(Turn Ov

(i) The noise immunity of PAM signal is

(i) better than PWM and PPM

(ii) better than PWM but worse than PPM

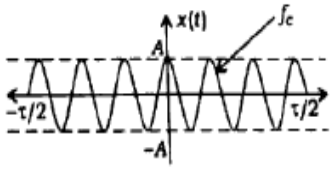
(iii) poorer than PWM as well as PPM

(j) Write the advantage of super-heterodyning.

2. (a) Write down the trigonometric form of the Fourier series representation of a periodic signal. State the necessary and sufficient conditions for the existence of the Fourier series representation for a signal. 7

(b) Find the PSD for $x(t) = A\cos(2\pi f_c t)$ and hence find the average power of the signal $x(t)$. 7

3. (a) Obtain the Fourier transform and amplitude spectrum of the RF pulse shown in the figure below : 7



RF pulse

(Continued)

(b) Define amplitude modulation. Derive the relationship between the total transmitted power and carrier power in an AM system when several frequencies simultaneously modulate a carrier. 7

4. (a) Show that if the output of a phase-shift modulator is an SSB signal, (i) the difference of the signals at the summing junction produces the upper-sideband SSB signal and (ii) the sum produces the lower-sideband SSB signal. That is

$$x_c(t) = x_{USB}(t) = m(t)\cos\omega_c t - \hat{m}(t)\sin\omega_c t$$

is an upper-sideband SSB signal and

$$x_c(t) = x_{LSB}(t) = m(t)\cos\omega_c t + \hat{m}(t)\sin\omega_c t$$

is a lower-sideband SSB signal. 7

(b) What is DSB-SC modulator? Explain how the ring modulator for generation of DSB-SC wave acts as a demodulator. 7

5. (a) Compare between wideband FM and narrowband FM. Use Carson's rule to compare the bandwidth that would be required to transmit a baseband signal with frequency range from 300 Hz to 3 kHz using (i) NBFM with maximum deviation of 5 kHz and (ii) WBFM with maximum deviation of 75 kHz. 7

(b) Draw the circuit diagram of balanced slope detector and explain it for demodulation of FM signal. 7

 Code : 041603

B.Tech 6th Semester Exam., 2016

INTRODUCTION TO COMMUNICATION SYSTEM

Time : 3 hours *Full Marks* : 70

Instructions :

(i) The marks are indicated in the right hand margin.

(ii) There are ***NINE*** *questions in this paper.*

(iii) Attempt ***FIVE*** *questions in all.*

(iv) Question No. ***1*** *is compulsory.*

1. Answer any *seven* of the following questions : 2×7=14

(a) In one period, the periodic signals will have

(i) finite number of maxima and zero minima

(ii) infinite number of maxima and finite number of minima

(iii) finite number of maxima and infinite number of minima

(iv) finite number of maxima and minima

(b) Fourier spectrum (transform) of non-periodic signal will have

(i) magnitude spectrum

(ii) phase spectrum

(iii) constant value

(iv) Both *(i)* and *(ii)*

(c) Fourier transform of a DC signal with unity strength is

(i) zero

(ii) 1

(iii) $2\pi\delta(\omega)$

(iv) 2π

(d) A message signal

$$m(t) = \frac{1}{3}\cos(\omega_1 t) - \frac{1}{2}\cos(\omega_2 t)$$

is amplitude modulated with a carrier of frequency ω_c to generate

$$s(t) = [1 + m(t)]\cos(\omega_c t)$$

The power efficiency achieved by this AM scheme is

(i) 8%

(ii) 12%

(iii) 16%

(iv) 25%

(e) An angle-modulated signal is given by

$s(t) = \cos[2\pi(2\times10^6 t) + 20\sin(200t) + 50\sin(250t)]$

The maximum frequency and phase deviations of $s(t)$ are

(i) 70, 15 kHz

(ii) 140π, 15 kHz

(iii) 70, 16·5 kHz

(iv) 140π, 16·5 kHz

(f) A message signal

$m(t) = \cos(2000\pi t) + 4\cos(4000\pi t)$

modulates the carrier $c(t) = \cos(2\pi f_c t)$, where $f_c = 1$MHz to produce an AM signal. For demodulating the generated AM signal using an envelope detector, the time constant RC of the detector circuit should satisfy

(i) $0\cdot5\,\text{ms} < RC < 1\,\text{ms}$

(ii) $1\,\mu\text{s} \ll RC < 0\cdot5\,\text{ms}$

(iii) $RC \ll 1\,\mu\text{s}$

(iv) $RC \gg 0\cdot5\,\text{ms}$

(g) Which of the following camera tubes has minimum lag?

(i) Vidicon

(ii) Saticon

(iii) Plumbicon

(iv) Iconoscope

(h) The camera signal output without sync is called

(i) black burst

(ii) composite video

(iii) generator lock video

(iv) non-composite video

(i) The signal $\cos(\omega_c t) + 0\cdot5\cos(\omega_m t)\sin(\omega_c t)$ is

(i) FM only

(ii) AM only

(iii) both AM and FM

(iv) neither AM nor FM

(j) Two sinusoidal signals of same amplitude and frequencies 10 kHz and 10·1 kHz are added together. The combined signal is given to an ideal frequency detector. The output of the detector is

(i) 0·1 kHz sinusoid

(ii) a constant

(iii) 200·9 Hz sinusoid

(iv) a linear function of time

Answer any *four* from the following :

2. *(a)* Determine the Fourier series expansion of the following signals : 8

(i) $x(t) = \cos(t) + \cos(2 \cdot 5t)$

(ii) $x(t) = \cos 2\pi f_0 t + |\cos 2\pi f_0 t|$

(b) Find the complex Fourier series for the following signal : 6

$$x(t) = \cos \omega_0 t + \sin^2 \omega_0 t$$

3. *(a)* A signal $m(t)$ is multiplied by a sinusoidal waveform of frequency f_c. The product signal $v(t) = m(t) \times \cos 2\pi f_c t$. If the Fourier transform of $m(t)$ is $M(f)$, find the Fourier transform of $v(t)$.

Further assume that $m(t)$ is a sinusoidal signal, i.e., $m(t) = m \times \cos 2\pi f_m t$, where m is a constant. Now, $v(t)$ is given by

$$v(t) = m \times \cos 2\pi f_m t \times \cos 2\pi f_c t$$

Find the Fourier transform of $v(t)$. 9

(b) Verify the duality property, that is

$$X(t) \leftrightarrow 2\pi x(-\omega)$$ 5

4. *(a)* With the help of suitable block diagram(s), discuss electronic communication system. 7

(b) Explain *(i)* limiter and *(ii)* discriminator in the context of FM receiving system. 7

(Turn Over)

5. *(a)* A modulating signal $m(t)$ is applied to a DSB-SC system modulator operating at $f_c = 50$ kHz. Determine and sketch the spectrum of the modulated signal if $m(t)$ is given by

$$m(t) = 2 \cos (4000\pi t) + 5 \cos (6000\ \pi t)$$

and the carrier signal is

$$c(t) = 100 \cos(2\pi f_c t)$$ 5

(b) With the help of suitable diagram(s), derive the expression for SSB-AM signals. 9

6. With the help of suitable diagram(s), explain the following methods for generating AM-modulated signals :

(a) Power-law AM modulator

(b) Switching modulator

Also, derive the expression for AM-modulated output(s) for these AM-modulators. 7+7=14

7. *(a)* Calculate signal to noise ratio (SNR) for the single sideband suppressed carrier (SSB-SC). 9

(b) Explain the need for frequency translation. 5

(Continued)

8. *(a)* An angle-modulated signal has the form

$x(t) = 100\cos[2\pi f_c t + 4\sin 2000\pi t]$

where $f_c = 10\,\text{MHz}$.

(i) Determine the average transmitted power.

(ii) Determine the peak-phase deviation.

(iii) Determine peak-frequency deviation.

(iv) Is this an FM or a PM signal? Explain. 7

(b) A superheterodyne FM receiver operates in the frequency range of 88–108 MHz. The IF and local oscillator frequencies are chosen such that $f_{IF} < f_{LO}$. We require that image frequency f_c' fall outside of the 88–108 MHz region. Determine the minimum required f_{IF} and the range of variation in f_{LO}. 7

9. *(a)* Explain the FM generation by Armstrong's indirect method. 7

(b) Show that DSB-SC amplitude modulation is linear, while phase modulation is not. 7

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B.Tech 5th Semester Exam., 2017

INTRODUCTION TO COMMUNICATION SYSTEM

Time : 3 hours *Full Marks* : 70

Instructions :

(i) The marks are indicated in the right-hand margin.

(ii) There are **NINE** *questions in this paper.*

(iii) Attempt **FIVE** *questions in all.*

(iv) Question No. **1** *is compulsory.*

1. Fill in the blanks/Choose the correct option of the following (any *seven*) : 2×7=14

(a) The input signal to a coherent detector is the DSB-SC and noise. At the detector output, the noise is ____

(b) Which of the following modulation (analog) schemes requires the minimal channel bandwidth?

(i) VSB

(ii) SSB ✓

(iii) DSB-SC

(iv) DSB-C

(c) Consider that an envelope detector is used to detect an AM signal. Let the carrier frequency and the message signal frequency are 1 MHz and 2 kHz respectively. The suitable value of the time constant of the envelope detector is

(i) 500 μs

(ii) 20 μs

(iii) 0·2 μs

(iv) 1000 μs

(d) Let a band limited signal is sampled at the Nyquist rate. This signal can be recovered by passing the sample through ____.

(e) Assume that a sinusoidal carrier signal with frequency 1 MHz is amplitude modulated by a symmetrical square wave with time period of 100 μs. Which of the following frequency components will not be present in the modulated signal?

(i) 990 kHz

(ii) 1030 kHz

(iii) 1080 kHz

(iv) 1010 kHz

(f) The PAM signals can be detected by using ____.

(g) PLL can be used to demodulate ____ signals.

(h) The image channel selectivity of a superheterodyne communication receiver is determined by ____.

(i) The signal

$$\cos 2\pi f_c t + \frac{1}{2}\cos 2\pi f_m t \cos 2\pi f_c t$$

is basically

(i) AM signal

(ii) FM signal

(iii) both AM signal and FM signal

(iv) None of the above

(j) A Hilbert transformer is belonging to which of the following systems?

(i) Linear system

(ii) Non-causal system

(iii) Time-varying system

(iv) Low-pass system

2. (a) Let $x(f) = 0{\cdot}1 \sin C(3f)$. Find $x(t)$. 7

(b) Obtain the complex Fourier series for

$$x(t) = \cos \omega_c t + \sin^2 \omega_c t$$ 7

3. (a) Explain the method for frequency translation. 6

(b) Using suitable diagram, explain the working of power-law modulator and mention for what kind of AM it can be used. 8

4. (a) Explain the relation between the frequency and phase modulation. Use the necessary diagrams. 7

(b) Using suitable diagram, explain frequency division multiplexing of multiple signals. 7

5. (a) Using the varactor diode, explain the direct method for FM generation. 7

(b) Explain the method for FM demodulation with some suitable examples of FM demodulators. 7

6. (a) Determine the instantaneous frequency (in Hz) of each of the following signals : 6

(i) $50\cos\left(300\pi t + \frac{\pi}{4}\right)$

(ii) $20\cos(50\pi t + \pi t^2)$

(iii) $\cos[200\pi t - 5\sin 2\pi t]$

(b) Show that for angle modulation, the modulated carrier can be represented by

$$x(t) = A_c \sum_{n=-\infty}^{\infty} J_n(\beta)\cos(\omega_c + n\omega_m)t$$

where, $J_n(\beta)$ = Bessel function of first kind of order n and β = modulation index. 8

7. (a) Using the suitable diagrams/ expressions, discuss the concept of multiplexing luminance and chrominance signals in context of compatible Color Television. 7

(b) Discuss the preemphasis and deemphasis in an FM system. 7

8. (a) With the help of suitable block diagrams, explain briefly the basic monochrome TV-transmitter and receiver. 9

(b) Describe the working principle of a non-linear DSB-SC modulator. 5

9. (a) Calculate the SNR for SSB-SC signal. 7

(b) With the help of necessary block diagram(s), explain the working principle of a superheterodyne receiver for FM radio system. 7

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Code : 041603

B.Tech 6th Semester Exam., 2018

INTRODUCTION TO COMMUNICATION SYSTEM

Time : 3 hours *Full Marks* : 70

Instructions :

(i) The marks are indicated in the right-hand margin.

(ii) There are ***NINE*** *questions in this paper.*

(iii) Attempt ***FIVE*** *questions in all.*

(iv) Question No. 1 is compulsory.

1. Answer any *seven* of the following : 2×7=14

(a) What is aliasing effect?

(b) What are the applications of FM?

(c) What is white noise?

(d) What are the applications of AM?

(e) What is the difference between SSB and DSB?

(f) Draw pre/de-emphasis response.

(g) What is sensitivity in communication receiver?

(h) What is the main purpose of using source encoder in a communication system?

2. (a) Determine the Fourier series of periodic impulse train defined by

$$x(t) = \sum_{k=-\infty}^{\infty} \delta(t - kT_0)$$ 5

(b) Explain any four properties of Fourier series expansion of a continuous and a periodic signal. 4

(c) State and prove time scaling property of Fourier series. 5

3. (a) Draw the block diagram of a superheterodyne receiver and explain its functioning. How and why constant IF is achieved in this receiver? What is the criteria for IF selection? Why is the rejection of image frequency so important in superheterodyne receiver? 5

(b) Explain the filtering method of SSB generation. 4

(c) With a neat block diagram, explain Armstrong's method of FM generation. 5

4. (a) Discuss the bandwidth requirements for the wideband FM system in detail. 5

(b) An angle-modulated signal is described by $S(t) = 10\cos[2\pi(10^6)t + 0{\cdot}1\sin(10^3)t]$. Find the message signal $m(t)$ considering $S(t)$ in FM with $k_f = 5$. 4

(c) Explain the difference between wide-band FM and narrowband FM. 5

5. (a) In a broadcast AM receiver, having an RF amplifier, loaded Q of antenna coil at the input of the mixer is 200. If the IF frequency is 455 kHz, find the image frequency and its image rejection ratio at 1000 kHz. 6

(b) What are the desirable features of a communication receiver? Explain its any two features in detail. A superheterodyne receiver with $f_{IF} = 500$ kHz and $3{\cdot}5 < f_{LO} < 4{\cdot}0$ MHz has a tuning dial calibrated to receive signals from 3 MHz to 3·5 MHz. It is set to receive a 3·0 MHz signal. The receiver has a broadcast RF amplifier, and it has been found that the local oscillator (LO) has a significant third harmonic output. If a signal is heard, what are all its possible carrier frequencies? 8

6. (a) Give examples of balanced modulator circuit. Explain the operation of ring modulator circuit used for DSB-SC generation. 8

(b) Given the following SSB signal with a carrier (SSB + C) :

$$x(t) = A_c\cos(2\pi f_c t) + m(t)\cos(2\pi f_c t) - m_h(t)\sin(2\pi f_c t)$$

Can it be demodulated using envelope detector? Find the condition for which the envelope detector would produce a good approximation of message signal $m(t)$. 6

7. (a) The signal

$$\phi_{AM}(t) = 2(1 + 0{\cdot}4\cos 6000\pi t)\cos 10^6\pi t$$

is applied to a square-law device having a transfer characteristics $y = (x+4)^2$. The output of the square-law device is filtered by an ideal LPF with a cut-off frequency of 8000 Hz. Sketch the amplitude spectrum of the filter output. 6

(b) Explain the basic principle of frequency discriminator and prove that it works as an FM demodulator. Show that balance slope detector works as an FM demodulator. 8

8. (a) Draw and explain each block of communication system. 8

(b) In an envelope detector, the input is an AM signal which is expressed as

$$\phi_{AM}(t) = A(1 + m\cos\omega_m t)\cos\omega_c t$$

Show that if the detector output is to follow the envelope at all times, it is required that

$$\frac{1}{RC} \geq \left(\frac{m\omega_m}{\sqrt{1-m^2}}\right)$$ 6

9. (a) The single-tone modulating signal $m(t) = A_m \cos(2\pi f_m t)$ is used to generate the VSB signal

$$s(t) = 0{\cdot}5\,aA_m A_c \cos[2\pi(f_c + f_m)t] + 0{\cdot}5A_m A_c(1-a)\cos[2\pi(f_c - f_m)t]$$

where a is a constant, less than unity, representing the attenuation of the upperside frequency.

(i) Find the quadrature component of the VSB signal $s(t)$.

(ii) The VSB signal, plus the carrier $A_c\cos(2\pi f_c t)$, is passed through an envelope detector. Determine the distortion produced by the quadrature component.

(iii) What is the value of constant a for which this distortion reaches its worst-possible condition? 8

(b) What is the difference between SSB and VSB modulations? 6

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LIST OF THE EXPERIMENT

1. AM modulation and demodulation.
2. DSB-SC modulation and demodulation.
3. FM modulation and demodulation.
4. PAM, PPM & PWM modulation and demodulation.
5. TDM multiplexer & demultiplexer.
6. Pre-emphasis and de-emphasis in FM.
7. Pulse code modulation and demodulation.
8. Delta modulation and demodulation.
9. Sampling and reconstruction of analog signals.
10. Simulation of signal constellation of BPSK, QPSK and QAM.
11. ASK, PSK and FSK modulation and demodulation