Department of Electronics and Communication Engineering

Course File

ANALOG AND DIGITAL COMMUNICATIONS

(Course Code: EC403PC)

II B.Tech II Semester

2023-24

Mr. G. Ravi kumar
Assistant Professor

Ananthagiri, Kodad, Telangana 508 206, India.

Department of Electronics and Communication Engineering

ANALOG AND DIGITAL COMMUNICATIONS

Check List

Department of Electronics and Communication Engineering

ANALOG AND DIGITAL COMMUNICATIONS

Course Code:EC403PC **L/T/P/C:3/0/0/3**
II Year II Semester

Prerequisite: Probability theory and Stochastic Processes, Signal and system

Course Objectives:

1. To develop ability to analyze system requirements of Analog and digital communication systems.
2. To understand the generation, detection of various Analog and digital Modulation techniques.
3. To acquire the vertical knowledge of each block in AM, FM transmitters and Receivers.
4. To understand the concepts of baseband transmissions.

UNIT - I

Amplitude Modulation: Need for modulation, Amplitude Modulation - Time and frequency domain description, single tone modulation, power relations in AM waves, Generation of AM waves - Switching modulator, Detection of AM Waves - Envelope detector, DSBSC modulation - time and frequency domain description, Generation of DSBSC Waves - Balanced Modulators, Coherent detection of DSB-SC Modulated waves, COSTAS Loop, SSB modulation - time and frequency domain description, frequency discrimination and Phase discrimination methods for generating SSB, Demodulation of SSB Waves, principle of Vestigial side band modulation.

UNIT - II

Angle Modulation: Basic concepts of Phase Modulation, Frequency Modulation: Single tone frequency modulation, Spectrum Analysis of Sinusoidal FM Wave using Bessel functions, Narrow band FM, Wide band FM, Constant Average Power, Transmission bandwidth of FM Wave - Generation of FM Signal- Armstrong Method, Detection of FM Signal: Balanced slope detector, Phase locked loop, Comparison of FM and AM., Concept of Pre-emphasis and de-emphasis.

UNIT - III

Transmitters: Classification of Transmitters, AM Transmitters, FM Transmitters Receivers: Radio Receiver - Receiver Types - Tuned radio frequency receiver, Super heterodyne receiver, RF section and Characteristics - Frequency changing and tracking, Intermediate frequency, Image frequency, AGC, Amplitude limiting, FM Receiver, Comparison of AM and FM Receivers.

UNIT - IV

Pulse Modulation: Types of Pulse modulation- PAM, PWM and PPM. Comparison of FDM and TDM. Pulse Code Modulation: PCM Generation and Reconstruction, Quantization Noise, Non-Uniform Quantization and Companding, DPCM, Adaptive DPCM, DM and Adaptive DM, Noise in PCM and DM.

Department of Electronics and Communication Engineering

UNIT - V

Digital Modulation Techniques: ASK- Modulator, Coherent ASK Detector, FSK- Modulator, Non-Coherent FSK Detector, BPSK- Modulator, Coherent BPSK Detection. Principles of QPSK, Differential PSK and QAM. Baseband Transmission and Optimal Reception of Digital Signal: A Baseband Signal Receiver, Probability of Error, Optimum Receiver, Coherent Reception, ISI, Eye Diagrams.

TEXT BOOKS

1. Simon Haykin -Analog and Digital Communications, John Wiley, 2005.
2. Wayne Tomasi - Electronics Communication Systems-Fundamentals through Advanced, 5th Ed., PHI, 2009.

REFERENCE BOOKS

1. Herbert Taub, Donald L Schilling,Goutam Saha -Principles of Communication Systems, 3rd Ed., McGraw-Hill, 2008.
2. Dennis Roddy and John Coolean - Electronic Communications, 4th Ed., PEA, 2004
3. George Kennedy and Bernard Davis - Electronics & Communication System, TMH, 2004
4. K. Sam Shanmugam - Analog and Digital Communication, Willey, 2005

Course Outcomes: Upon completing this course, the student able to

1. Design and analyze various Analog Modulation and Demodulation techniques.
2. Model the noise present in continuous wave Modulation techniques.
3. Implement the Super heterodyne Receiver concept and Pulse Modulation Techniques invarious applications
4. Design Various Pulse Modulation Techniques in Various Applications
5. Design and analyze various Digital Modulation and Demodulation techniques

CO-PO-PSO Mapping:

CO's/ PO's	PO 1	PO2	PO 3	PO 4	PO5	PO6	PO7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	H	H	H	L	-	H	M	-	-	-	-	L	M	M	
CO2	H	H	H	L	-	M	M	-	-	-	-	L	M	M	
CO3	H	H	H	L	-	M	M	-	-	-	-	L	M	M	
CO4	H	H	H	L	-	H	M	-	-	-	-	L	M	M	
CO5	H	H	H	L	-	H	M	-	-	-	-	L	M	M	

Anurag ENGINEERING COLLEGE (An Autonomous Institution)

Department of Electronics and Communication Engineering

Time Table: B. Tech II Year II Semester (A Sec)

FACULTY NAME: Mr.G. Ravikumar **w.e.f: 05.02.2024**

DAY	9:30-10:20	10:20-11:10	11:20-12:10	12:10-1:00	1:00 - 1:40	1:40-2:25	2:25-3:10	3:15-4:00
MON	PTSP	EMTL	ADC	LDICA	LUNCH	ADC / ECA LAB		
TUE	ECA	LDICA	PTSP	ADC		LDICA / ADC LAB		
WED	LDICA	ADC	ECA	HVPE		LDICA / ECA LAB		
THU	EMTL	PTSP	LDICA	ECA		ADC	EMTL	HVPE
FRI	ECA	LDICA	PTSP	ADC		EMTL	REAL TIME PROJECT	
SAT	ADC	EMTL	PTSP	ECA		LDICA	TEDX/VLS	LIB / SPORTS

S.No	Course Code	Course Name	Faculty Name
1	EC401PC	Probability Theory and Stochastic Processes	Mr. V. David
2	EC402PC	Electromagnetic Fields and Transmission Lines	Mr. Ramu
3	EC403PC	Analog and Digital Communications	Mr. G. Ravikumar (AC)
4	EC404PC	Linear and Digital IC Applications	Mr. B. Narasimha Rao
5	EC405PC	Electronic Circuit Analysis	Mrs. B. Swetha
6	EC406PC	Analog and Digital Communications Laboratory	Mr. G. Ravikumar
7	EC407PC	Linear and Digital IC Applications Laboratory	Mr. B. Narasimha Rao
8	EC408PC	Electronic Circuit Analysis Laboratory	Mrs. B. Swetha
9	EC409PW	Real Time Project/ Field Based Project	Mrs.V. Kalyani
10	HS410MC	Human Values and Professional Ethics	Mrs. V. Kalyani
11		Video Lecture Session (TEDX/VLS)	Mr. D. Rajeev Naik

II B.Tech. II Semester Academic Calendar		
I Spell Instruction	05.02.2024	30.03.2024
I Mid Examinations	01.04.2024	03.04.2024
II Spell Instruction	04.04.2024	22.05.2024
Summer Vacation	23.05.2024	05.06.2024
II Spell Instruction Continuation	06.06.2024	12.06.2024
II Mid Examinations	13.06.2024	15.06.2024
Preparation Holidays	18.06.2024	24.06.2024
Semester End Examinations (Theory & Practical's)	25.06.2024	20.07.2024

Academic Counselor	**Mr. G. Ravikumar** (7396685191)
CR's	**THUNKOJU AKHIL**
	SHAIK KHATIJA

Department of Electronics and Communication Engineering

Time Table: B. Tech II Year II Semester (B Sec)

DAY	9:30-10:20	10:20-11:10	11:20-12:10	12:10-1:00	1:00 - 1:40	1:40-2:25	2:25-3:10	3:15-4:00
MON	ADC	LDICA	ECA	PTSP	LUNCH	EMTL	LDICA	HVPE
TUE	PTSP	EMTL	LDICA	ECA		ADC	PTSP	HVPE
WED	ECA	LDICA / ECA LAB				PTSP	REAL TIME PROJECT	
THU	LDICA	PTSP	ADC	EMTL		ADC / LDICA LAB		
FRI	EMTL	ADC	ECA	LDICA		ADC / ECA LAB		
SAT	PTSP	ADC	ECA	EMTL		ECA	TEDX/VLS	LIB / SPORTS

S.No	Course Code	Course Name	Faculty Name
1	EC401PC	Probability Theory and Stochastic Processes	Mr. V. David(AC)
2	EC402PC	Electromagnetic Fields and Transmission Lines	Mr. T. Ramu
3	EC403PC	Analog and Digital Communications	Mr. G. Ravikumar
4	EC404PC	Linear and Digital IC Applications	Mr. B. Narasimha Rao
5	EC405PC	Electronic Circuit Analysis	Mrs. B. Swetha
6	EC406PC	Analog and Digital Communications Laboratory	Mr. V. David
7	EC407PC	Linear and Digital IC Applications Laboratory	Mr. B. Narasimha Rao
8	EC408PC	Electronic Circuit Analysis Laboratory	Mrs. B. Swetha
9	EC409PW	Real Time Project/ Field Based Project	Mr. T. Narasimha Rao
10	HS410MC	Human Values and Professional Ethics	Mr.Fareed
11		Video Lecture Session (TEDX/VLS)	Mr. D. Rajeev Naik

II B.Tech. II Semester Academic Calendar		
I Spell Instruction	05.02.2024	30.03.2024
I Mid Examinations	01.04.2024	03.04.2024
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Summer Vacation	23.05.2024	05.06.2024
II Spell Instruction Continuation	06.06.2024	12.06.2024
II Mid Examinations	13.06.2024	15.06.2024
Preparation Holidays	18.06.2024	24.06.2024
Semester End Examinations (Theory & Practical's)	25.06.2024	20.07.2024

Academic Counselor	**Mr. V.David** (9346255810)
CR's	**SHARATH**
	SINDHU

Department of Electronics and Communication Engineering

Individual Time table- II ECE(A&B)

Subject: Analog and Digital Communications (EC403PC)

DAY	9:30-10:20	10:20-11:10	11:20-12:10	12:10-1:00	1:00-1:40	1:40-2:25	2:25-3:10	3:15-4:00
MON	ADC-B		ADC-A		LUNCH	ADC LAB-A		
TUE				ADC-A		ADC-B		
WED		ADC-A						
THU			ADC-B			ADC-A		
FRI		ADC-B		ADC-A		ADC LAB-A		
SAT	ADC-A	ADC-B						

Department of Electronics and Communication Engineering

Vision of the Institute

To be a premier Institute in the country and region for the study of Engineering, Technology and Management by maintaining high academic standards which promotes the analytical thinking and independent judgment among the prime stakeholders, enabling them to function responsibly in the globalized society.

Mission of the Institute

To be a world-class Institute, achieving excellence in teaching, research and consultancy in cutting-edge Technologies and be in the service of society in promoting continued education in Engineering, Technology and Management.

Quality Policy

To ensure high standards in imparting professional education by providing world-class infrastructure, top-quality-faculty and decent work culture to sculpt the students into Socially Responsible Professionals through creative team-work, innovation and research

Vision of the Department

Our vision is to develop the department into a full-fledged centre of learning in various fields of Electronics & Communication Engineering keeping in view the latest development.

Mission of the Department

The Mission of the department is to turn out full-fledged Engineers in the field of Electronics & Communication Engineering with an overall back-ground suitable for making a successful career either in industry/research or higher education in India and abroad. To inculcate professional behavior, strong ethical values, innovative research capabilities and leadership abilities in the young minds so as to work with a commitment to the progress of the nation.

Department of Electronics and Communication Engineering

Program Educational Objectives (B.Tech. ECE)
Graduates will be able to

PEO 1	**:**	Excel in professional career & higher education, by acquiring knowledge in related fields of Electronics & Communication Engineering.
PEO 2	**:**	Exhibit leadership in their profession, through technological ability and contemporary knowledge for solving real life problems appropriately that are technically sound, economically feasible &socially acceptable.
PEO 3	**:**	Adapt to the emerging technologies for sustenance by exhibiting professionalism, ethical attitude & communication skills in their relevant areas of interest by engaging in lifelong learning.

Department of Electronics and Communication Engineering

Program Outcomes (B.Tech. – ECE)

At the end of the Program, a graduate will have the ability to

PO 1 : An ability to apply knowledge of mathematics, science, fundamentals of engineering to solve electronics and communication engineering problems.

PO 2 : An ability to identify, formulate and analyze and solve complex electronics and communication Engineering using the first principles of mathematics and engineering sciences.

PO 3 : An ability to develop solutions to electronics and communication systems to meet the specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations.

PO 4 : An ability to design and perform experiments of electronic circuits and systems, analyze and interpret data to provide valid conclusions.

PO 5 : An ability to learn, select and apply appropriate techniques, resources and modern engineering tools including prediction and modelling, to complex electronics and communication systems.

PO 6 : An ability to assess the knowledge of contemporary issues to the societal responsibilities relevant to the professional practice.

PO 7 : An ability to understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate knowledge for the need of sustainable development.

PO 8 : An ability to demonstrate the understanding of professional, ethical responsibilities and norms of engineering practice.

PO 9 : An ability to function effectively as an individual and as a member or leader in diverse teams and in multidisciplinary settings.

PO 10 : An ability to communicate effectively with the engineering community and withsociety at large.

PO 11 : An ability to demonstrate knowledge and understanding of engineering and management principles and apply these to manage projects.

PO 12 : An ability to recognize the need for, and engage in lifelong learning in the broadest context of technological change.

Department of Electronics and Communication Engineering

COURSE OBJECTIVES

On completion of this Subject/Course the student shall be able to:

S.No	Objectives
1	To develop ability to analyze system requirements of Analog and digital communication systems.
2	To understand the generation, detection of various Analog and digital Modulation techniques.
3	To acquire the vertical knowledge of each block in AM, FM transmitters and Receivers.
4	To understand the concepts of baseband transmissions.

COURSE OUTCOMES

The expected outcomes of the Course/Subject are:

S.No	Outcomes
1.	Design and analyze various Analog Modulation and Demodulation techniques.
2.	Model the noise present in continuous wave Modulation techniques
3.	Implement the Super heterodyne Receiver concept and Pulse Modulation Techniques in various applications
4.	Design Various Pulse Modulation Techniques in Various Applications
5.	Design and analyze various Digital Modulation and Demodulation techniques

Signature of HOD **Signature of faculty**

Date: **Date:**

Department of Electronics and Communication Engineering

GUIDELINES TO STUDY THE COURSE / SUBJECT

Course Design and Delivery System (CDD):

- The Course syllabus is written into number of learning objectives and outcomes.
- Every student will be given an assessment plan, criteria for assessment, scheme of evaluation and grading method.
- The Learning Process will be carried out through assessments of Knowledge, Skills and Attitude by various methods and the students will be given guidance to refer to the text books, reference books, journals, etc.

The faculty be able to –

- Understand the principles of Learning
- Understand the psychology of students
- Develop instructional objectives for a given topic
- Prepare course, unit and lesson plans
- Understand different methods of teaching and learning
- Use appropriate teaching and learning aids
- Plan and deliver lectures effectively
- Provide feedback to students using various methods of Assessments and tools of Evaluation
- Act as a guide, advisor, counselor, facilitator, motivator and not just as a teacher alone

Signature of HOD **Signature of faculty**

Date: **Date:**

Department of Electronics and Communication Engineering

COURSE SCHEDULE

The Schedule for the whole Course / Subject is:

S. No.	Description	Duration (Date)		Total No. of Periods
		From	To	
1.	**UNIT - I** Amplitude Modulation: Need for modulation, Amplitude Modulation - Time and frequency domain description, single tone modulation, power relations in AM waves, Generation of AM waves - Switching modulator, Detection of AM Waves - Envelope detector, DSBSC modulation - time and frequency domain description, Generation of DSBSC Waves - Balanced Modulators, Coherent detection of DSB-SC Modulated waves, COSTAS Loop, SSB modulation - time and frequency domain description, frequency discrimination and Phase discrimination methods for generating SSB, Demodulation of SSB Waves, principle of Vestigial side band modulation.	05.02.2024	20.02.2024	15
2.	**UNIT - II** Angle Modulation: Basic concepts of Phase Modulation, Frequency Modulation: Single tone frequency modulation, Spectrum Analysis of Sinusoidal FM Wave using Bessel functions, Narrow band FM, Wide band FM, Constant Average Power, Transmission bandwidth of FM Wave - Generation of FM Signal- Armstrong Method, Detection of FM Signal: Balanced slope detector, Phase locked loop, Comparison of FM and AM., Concept of Pre-emphasis and de-emphasis.	21.02.2024	06.03.2024	12
3.	**UNIT - III** Transmitters: Classification of Transmitters, AM Transmitters, FM Transmitters Receivers: Radio Receiver - Receiver Types - Tuned radio frequency receiver, Super heterodyne receiver, RF section and Characteristics - Frequency changing and tracking, Intermediate frequency, Image frequency, AGC, Amplitude limiting, FM Receiver, Comparison of AM and FM Receivers.	07.03.2024	23.03.2024	11
4.	**UNIT - IV** Pulse Modulation: Types of Pulse modulation- PAM, PWM and PPM. Comparison of FDM and TDM. Pulse Code Modulation: PCM Generation and Reconstruction, Quantization Noise, Non-Uniform Quantization and Companding, DPCM, Adaptive DPCM, DM and Adaptive DM, Noise in PCM and DM.	26.03.2024	06.05.2024	13

5.	**UNIT - V** Digital Modulation Techniques: ASK- Modulator, Coherent ASK Detector, FSK- Modulator, Non- Coherent FSK Detector, BPSK- Modulator, Coherent BPSK Detection. Principles of QPSK, Differential PSK and QAM. Baseband Transmission and Optimal Reception of Digital Signal: A Baseband Signal Receiver, Probability of Error, Optimum Receiver, Coherent Reception, ISI, Eye Diagrams.	07.05.2024	11.06.2024	12

Total No. of Instructional periods available for the course: 63 Hours

Signature of HOD **Signature of faculty**

Date: **Date:**

Department of Electronics and Communication Engineering

SCHEDULE OF INSTRUCTIONS - COURSE PLAN

Unit No.	Lesson No.	Date	No. of Periods	Topics / Sub-Topics	Objectives & Outcomes Nos.	References (Textbook, Journal)
1.	1	05.02.2024	1	**UNIT - I:** Introduction to Communication system	1 1	Herbert Taub, Donald L Schilling, Goutam Saha -Principles of Communication Systems, 3rd Ed., McGraw-Hill, 2008.
	2	06.02.2.24	1	Classification of Communication system	1 1	Herbert Taub, Donald L Schilling, Goutam Saha -Principles of Communication Systems, 3rd Ed., McGraw-Hill, 2008.
	3	08.02.2024	1	Modulation	1 1	Herbert Taub, Donald L Schilling, Goutam Saha -Principles of Communication Systems, 3rd Ed., McGraw-Hill, 2008.
	4	09.02.2024 & 12.02.2024	2	Amplitude Modulation	1 1	Herbert Taub, Donald L Schilling, Goutam Saha -Principles of Communication Systems, 3rd Ed., McGraw-Hill, 2008.
	5	13.02.2024	1	Power relations in AM	1 1	Herbert Taub, Donald L Schilling, Goutam Saha -Principles of Communication Systems, 3rd Ed., McGraw-Hill, 2008.
	6	15.02.2024 & 16.02.2024	2	Generation and Detection of AM	1 1	Herbert Taub, Donald L Schilling, Goutam Saha -Principles of Communication Systems, 3rd Ed., McGraw-Hill, 2008.
	7	17.02.2024 & 19.02.2024	2	Generation and Detection of DSB-SC	1 1	Herbert Taub, Donald L Schilling, Goutam Saha -Principles of Communication Systems, 3rd Ed.,
	8	20.02.2024	1	Costas loop	1 1	Herbert Taub, Donald L Schilling, Goutam Saha -Principles of Communication Systems, 3rd Ed., McGraw-Hill, 2008.
	9	22.02.2024 & 23.02.2024	2	Generation and Detection of SSB-SC	1 1	Herbert Taub, Donald L Schilling, Goutam Saha -Principles of Communication Systems, 3rd Ed., McGraw-Hill, 2008.
	10	24.02.2024	1	VSB Modulation	1 1	Herbert Taub, Donald L Schilling, Goutam Saha - Communication Systems.

	11	24.02.2024	1	Problems on AM	1 1	Communication Systems, 3rd Ed., McGraw-Hill, 2008.
	1	26.02.2024	1	**Unit-II**: Introduction to Angle Modulation	2 2	Herbert Taub, Donald L Schilling, Goutam Saha -Principles of Communication Systems, 3rd Ed., McGraw-Hill, 2008.
	2	29.02.2024	2	FM and PM	2 2	Herbert Taub, Donald L Schilling, Goutam Saha -Principles of Communication Systems, 3rd Ed., McGraw-Hill, 2008.
	3	01.03.2024 & 04.03.2024	2	Frequency Modulation	2 2	Herbert Taub, Donald L Schilling, Goutam Saha -Principles of Communication Systems, 3rd Ed., McGraw-Hill, 2008.
2	4	05.03.2024	1	B.W of Frequency Modulation	2 2	Herbert Taub, Donald L Schilling, Goutam Saha -Principles of Communication Systems, 3rd Ed., McGraw-Hill, 2008.
	5	07.03.2024	2	Generation and Detection of FM	2 2	Herbert Taub, Donald L Schilling, Goutam Saha -Principles of Communication Systems, 3rd Ed., McGraw-Hill, 2008.
	6	11.03.2024	1	PLL	2 2	Herbert Taub, Donald L Schilling, Goutam Saha -Principles of Communication Systems, 3rd Ed., McGraw-Hill, 2008.
	7	12.03.2024	2	Pre emphasis and De-emphasis	2 2	Herbert Taub, Donald L Schilling, Goutam Saha -Principles of Communication Systems, 3rd Ed., McGraw-Hill, 2008.
	8	14.03.2024	1	Problems on AM and FM	2 2	Herbert Taub, Donald L Schilling, Goutam Saha -Principles of Communication Systems, 3rd Ed., McGraw-Hill, 2008.
	1	15.03.2024	1	**UNIT-III:** Classification of Transmitters	3 3	Herbert Taub, Donald L Schilling, Goutam Saha -Principles of Communication Systems, 3rd Ed., McGraw-Hill, 2008.
3.	2	16.03.2024 & 19.03.2024	2	AM and FM Transmitters	3 3	Herbert Taub, Donald L Schilling, Goutam Saha -Principles of Communication Systems, 3rd Ed.,

	3	22.03.2024	2	Radio Receivers-TRF	3 3	Herbert Taub, Donald L Schilling, Goutam Saha -Principles of Communication Systems, 3rd Ed., McGraw-Hill, 2008.
	4	23.03.2024	2	Superheterodyne Receiver	3 3	Herbert Taub, Donald L Schilling, Goutam Saha -Principles of Communication Systems, 3rd Ed., McGraw-Hill, 2008.
	5	26.03.2024	2	Simple AGC	3 3	Herbert Taub, Donald L Schilling, Goutam Saha -Principles of Communication Systems, 3rd Ed., McGraw-Hill, 2008.
	6	15.04.2024	1	Amplitude limiting	3 3	Herbert Taub, Donald L Schilling, Goutam Saha -Principles of Communication Systems, 3rd Ed., McGraw-Hill, 2008.
	7	16.04.2024	1	Comparison of AM &FM	3 3	Herbert Taub, Donald L Schilling, Goutam Saha -Principles of Communication Systems, 3rd Ed., McGraw-Hill, 2008.
4	1	18.04.2024	1	**UNIT-IV:** Introduction to Pulse Modulation	4 4	Herbert Taub, Donald L Schilling, Goutam Saha -Principles of Communication Systems, 3rd Ed., McGraw-Hill, 2008.
	2	19.04.2024	1	Types of Pulse Modulation	4 4	Herbert Taub, Donald L Schilling, Goutam Saha -Principles of Communication Systems, 3rd Ed., McGraw-Hill, 2008.
	3	20.04.2024 & 22.04.2024	2	PAM and PWM and PPM	4 4	Herbert Taub, Donald L Schilling, Goutam Saha -Principles of Communication Systems, 3rd Ed., McGraw-Hill, 2008.
	4	23.04.2024	1	Comparison of FDM &TDM	4 4	Herbert Taub, Donald L Schilling, Goutam Saha -Principles of Communication Systems, 3rd Ed., McGraw-Hill, 2008.
	5	24.04.2024 & 25.04.2024	2	PCM Generation and Demodulation	4 4	Herbert Taub, Donald L Schilling, Goutam Saha -Principles of Communication Systems, 3rd Ed., McGraw-Hill, 2008.
	6	26.04.2024	1	Quantization	4 4	Herbert Taub, Donald L Schilling, Goutam Saha -Principles of Communication Systems, 3rd Ed., McGraw-Hill, 2008.

	7	27.04.2024	1	Companding techniques	4 4	Herbert Taub, Donald L Schilling, Goutam Saha -Principles of Communication Systems, 3rd Ed., McGraw-Hill, 2008.
	8	29.04.2024 & 30.04.2024	2	DPCM and Adaptive DPCM	4 4	Herbert Taub, Donald L Schilling, Goutam Saha -Principles of Communication Systems, 3rd Ed., McGraw-Hill, 2008.
	9	01.05.2024	1	DM and Adaptive DM	4 4	Herbert Taub, Donald L Schilling, Goutam Saha -Principles of Communication Systems, 3rd Ed., McGraw-Hill, 2008.
	10	03.05.2024	1	Noise in PCM and DM	4 4	Herbert Taub, Donald L Schilling, Goutam Saha -Principles of Communication Systems, 3rd Ed., McGraw-Hill, 2008.
5	1	06.05.2024	1	**UNIT – V**: Introduction to Digital Modulation Techniques	5 5	Herbert Taub, Donald L Schilling, Goutam Saha -Principles of Communication Systems, 3rd Ed., McGraw-Hill, 2008.
	2	07.05.2024 & 08.05.2024	2	ASK and FSK	5 5	Herbert Taub, Donald L Schilling, Goutam Saha -Principles of Communication Systems, 3rd Ed., McGraw-Hill, 2008.
	3	03.06.2024	1	BPSK	5 5	Herbert Taub, Donald L Schilling, Goutam Saha -Principles of Communication Systems, 3rd Ed., McGraw-Hill, 2008.
	4	04.05.2024 & 05.05.2024	2	QPSK and DPSK	5 5	Herbert Taub, Donald L Schilling, Goutam Saha -Principles of Communication Systems, 3rd Ed., McGraw-Hill, 2008.
	5	05.05.2024	1	QAM	5 5	Herbert Taub, Donald L Schilling, Goutam Saha -Principles of Communication Systems, 3rd Ed., McGraw-Hill, 2008.
	6	08.06.2024	2	Optimum reception and error of ASK	5 5	Herbert Taub, Donald L Schilling, Goutam Saha -Principles of Communication Systems, 3rd Ed., McGraw-Hill, 2008.
	7	10.06.2024	1	Probability error of FSK	5 5	Herbert Taub, Donald L Schilling, Goutam Saha -Principles of Communication Systems, 3rd Ed.,

	8	11.06.2024	1	Coherent Reception	5 5	Herbert Taub, Donald L Schilling, Goutam Saha -Principles of Communication Systems, 3rd Ed., McGraw-Hill, 2008.
	9	10.06.2024 & 11.06.2024	1	ISI and EYE Diagrams	5 5	Herbert Taub, Donald L Schilling, Goutam Saha -Principles of Communication Systems, 3rd Ed., McGraw-Hill, 2008.

Signature of HOD **Signature of faculty**

Date: **Date:**

.

Department of Electronics and Communication Engineering

LESSON PLAN (U-I)

Lesson No: 03, 04 Duration of Lesson: 1hr 40 min

Lesson Title: Amplitude Modulation

Instructional / Lesson Objectives:

- To make students understand Modulation
- To understand need for Modulation
- To understand students the concept Amplitude Modulation and Types of AM

Teaching AIDS : PPTs, Digital Board
Time Management of Class :

5 mins for taking attendance 80 min for the lecture delivery 15 min for doubts session

Assignment / Questions:

1 . (a) Define Modulation and what is the need for Modulation(obj:1,out:1)

(b)Explain the generation of AM signals using Square Law Modulator (obj:1,out:1)

Refer Assignment-1&Tutorial-1.

Signature of faculty

Department of Electronics and Communication Engineering

LESSON PLAN (U-II)

Lesson No: 02, 03 Duration of Lesson: 1hr 40min

Lesson Title: Frequency Modulation and Phase Modulation

Instructional / Lesson Objectives:

- To make students understand concept of Angle Modulation
- To make students understand FM
- To make students understand PM

Teaching AIDS : PPTs, Digital Board
Time Management of Class :

5 mins for taking attendance 10 for revision of previous class 75 min for lecture delivery 10 min for doubts session

Assignment / Questions:

1 . Explain about Indirect method of generation of FM ? (obj:2,out:2)

Refer Assignment-2&Tutorial-2.

Signature of faculty

Department of Electronics and Communication Engineering

LESSON PLAN (U-III)

Lesson No: 03, 04 Duration of Lesson: 1hr 40min

Lesson Title: TRF and Superheterodyne Receiver

Instructional / Lesson Objectives:

- To make students understand the concept Receiver.
- To familiarize students on Different Receivers ,
- To make students understand Concept of TRF and Superheterodyne Receiver

Teaching AIDS : PPTs, Digital Board
Time Management of Class :

5 mins for taking attendance 10 for revision of previous class 75 min for lecture delivery 10min for doubts session

Assignment / Questions:

1.Explain about TRF Receiver and give its Drawbacks? ? (obj:3,out:3)
2. Explain about Superheterodyne Receiver in detail? ? (obj:3,out:3)

Refer assignment-III & tutorial-III sheets.

Signature of faculty

Department of Electronics and Communication Engineering

LESSON PLAN (U-IV)

Lesson No: 05, 06 Duration of Lesson: 1hr 40min

Lesson Title: Pulse Digital Modulation Techniques –PCM & Concept of Quantization Process

Instructional / Lesson Objectives:

- To make students understand the conversion of Analog to Digital Signals
- To make students understand the PCM Generation
- To make students understand the Concept of Quantization Process

Teaching AIDS : PPTs, Digital Board
Time Management of Class :

5 mins for taking attendance 10 for revision of previous class 75 min for lecture delivery 10min for doubts session

Assignment / Questions:
1.Explain about generation of PCM with the help of block diagram(obj:4,out:4)

Refer assignment-IV & tutorial-IV sheets.

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LESSON PLAN (U-V)

Lesson No: 02, 03 Duration of Lesson: 1hr 40min

Lesson Title: ASK,FSK and BPSK

Instructional / Lesson Objectives:

- To make students understand the concept of Digital Modulation Techniques
- To familiarize students on ASK,FSK and BPSK.

Teaching AIDS : PPTs, Digital Board
Time Management of Class :

5 mins for taking attendance 10 for revision of previous class 75 min for lecture delivery 10min for doubts session

Assignment / Questions:
1.Explain the operation of the binary FSK modulator and demodulator with its constellation diagram?
2. Compare ASK and FSK?

Refer assignment-V& tutorial-V sheets.

Signature of faculty

Department of Electronics and Communication Engineering

ASSIGNMENT – 1

This Assignment corresponds to Unit No. 1

Question No.	Question	Objective No.	Outcome No.
1	a) Define Modulation and what is the need for Modulation (b)Explain the generation of AM signals using Square Law Modulator.	1	1
2	(a) Compare AM with DSB-SC and SSB-SC? (b)Explain the coherent detection of DSB-SC modulated wave with a neat block diagram ?	1	1

Signature of HOD **Signature of faculty**

Date: **Date:**

Department of Electronics and Communication Engineering

ASSIGNMENT – 2

This Assignment corresponds to Unit No. 2

Question No.	Question	Objective No.	Outcome No.
1	(a)Define FM and PM ? (b)Explain about Indirect method of generation of FM ?	2	2
2	(a)Compare AM and FM ? (b)Explain the operation of PLL as FM Demodulator ?	2	2

Signature of HOD **Signature of faculty**

Date: **Date:**

Department of Electronics and Communication Engineering

ASSIGNMENT – 3

This Assignment corresponds to Unit No. 3

Question No.	Question	Objective No.	Outcome No.
1	(a)Define Receiver? (b)Explain about TRF Receiver and give its Drawbacks?	3	3
2	(a)Explain about Superheterodyne Receiver in detail? (b)Give the Characteristics of Radio Receivers?	3	3

Signature of HOD **Signature of faculty**

Date: **Date:**

Department of Electronics and Communication Engineering

ASSIGNMENT – 4

This Assignment corresponds to Unit No. 4

Question No.	Question	Objective No.	Outcome No.
1	(a) Define Pulse Modulation and list out types of Pulse Modulation Methods ? (b) Explain about Pulse Amplitude Modulation ?	4	4
2	(a) Explain about generation of PCM with the help of block diagram ? (b)Compare FSK and QPSK , BPSK ?	4	4

Signature of HOD **Signature of faculty**

Date: **Date:**

Department of Electronics and Communication Engineering

ASSIGNMENT – 5

This Assignment corresponds to Unit No. 5

Question No.	Question	Objective No.	Outcome No.
1	(a) What are the advantages of QPSK? (b) Explain the operation of the binary FSK modulator and demodulator with its constellation diagram?	4	4
2	(a) Compare ASK and FSK? (b) Discuss in detail the operation of QPSK modulator and demodulator with its phasor diagram?	4	4

Signature of HOD **Signature of faculty**

Date: **Date:**

Department of Electronics and Communication Engineering

TUTORIAL – 1

This tutorial corresponds to Unit No. 1 (Objective Nos.: 1, Outcome Nos.: 1)

Q1. In which technique data is transmitted using continuous signals?

a) Analog communication b) Digital communication
c) Both a and b d) None of the above

Q2. The amplitude modulation is the process in which amplitude of the carrier signal changes with respect to ----signal

a) Modulating signal b) Carrier signal
c)Suppressed carrier d) modulating signal Noise

Q3. The advantages of the modulation are _____

a) High energy of carrier b) Noise can be reduced
c)Multiplexing is possible d) All of the above

Q4. The envelope detector is _____

a) Effective for detection of narrow band AM signal b) Simple
c) Both a and b d) None of the above

Q5. In __modulation the frequency of the carrier signal is modulated by the message Signal

a) Pulse modulation b) Phase modulation
c) Amplitude modulation d) Frequency modulation

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Date: **Date:**

Department of Electronics and Communication Engineering

TUTORIAL – 2

This tutorial corresponds to Unit No. 2 (Objective Nos.: 2, Outcome Nos.: 2)

Q1. **In a frequency modulation system, maximum frequency deviation allowed is 1000and modulating frequency is 1 kHz. Determine the modulation index β.**

a)2000 b)2
c)1 d)1000

Q2. **Which of the following is not a component of PLL?**

a) Frequency multiplier b) Phase detector
c)VCO d) Loop filter

Q3. **In TV transmission, the modulation schemes for Video and Audio are,respectively**

a) FM and AM b) FM and FM
c) AM and FM d) AM and AM

Q4. In phase modulation, the frequency deviation is

a) independent of the modulating signal frequency

b) increasingly proportional to the modulating signal

c) frequencydirectly proportional to the modulating signal

d) frequency inversely proportional to the square root of the modulating signal

Q5. Which one of the following statement is not correct?

a) FM has an infinite number of side-bands

b) Modulation index for FM is always greater than one

c) As modulation depth increases the BW increases

d) As modulation depth increases the sideband power increases

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Date: **Date:**

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TUTORIAL SHEET – 3

This tutorial corresponds to Unit No. 3 (Objective Nos.: 3, Outcome Nos.: 3)

Q1. **The selectivity of most receivers is determined largely by ……**

a) sensitivity b) characteristics of IF section
c)antenna direction d) all of the above

Q2. **Most popular IF for receivers tuning to 540 to 1650 kHz is**

a) 433 kHz b) 455 kHz
c) 545 kHz d) 555 kHz

Q3. **The function of an AM detector circuit is to**

a) rectify the input signal b) discard the carrier
c)provide audio signal d) all of the above

Q4. **Which of the following is same in AM and FM receivers?**

a) Demodulator b) AGC
c) IF amplifier d) All of the above

Q5. **In superheterodyne receivers, the local oscillator is used to**

a) detect the modulating signal
b) amplify the received modulated carrier
c)shift the frequency of the received modulated carrier to the IF band
d)none of the above

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Date: **Date:**

Department of Electronics and Communication Engineering

TUTORIAL – 4

This tutorial corresponds to Unit No. 4 (Objective Nos.: 3, Outcome Nos.: 3)

Q1. **PAM signals can be demodulated by using a**

a) Band Pass Filter b)Low Pass Filter
c)High Pass Filter d)Band reject Filter

Q2. **The correct sequence of PCM Modulation**

a) quantizing, Sampling, encoding b) Sampling, quantizing, encoding
c)quantizing, encoding, Sampling d) encoding, Sampling, quantizing

Q3. **which of the following system is analog**

a) PCM b) DM
c)DPCM d) PAM

Q4.**A PWM signal can be generated by**

a) an unstable Multivibrator b) Integrating a PPM signal
c) A Monostable Multivibrator d) Differentiating a PPM signal

Q5.**PTM includes**

a) Pulse Width Modulation b) Pulse Amplitude Modulation
c) Pulse Position Modulation d)BOTH A and C

Signature of HOD **Signature of faculty**

Date: **Date:**

Department of Electronics and Communication Engineering

TUTORIAL SHEET – 5

This tutorial corresponds to Unit No. 5 (Objective Nos.: 5, Outcome Nos.: 5)

Q1. **The source used in digital communication is discrete in terms of parameter?**

a) Amplitude b) Time
c) Frequency d) Both a and b

Q2. **Which of the following is the application of FSK?**

a) Modems b) Telemetry systems
c) Radiosondes d) All the above

Q3. **FSK reception uses**

a) Correlation receiver b) PLL
c) Correlation receiver & PLL d) None of the mentioned

Q4. **Which of the following are the components of ASK coherent detection block?**

a) LPF b) Multiplier
c) Sample and Hold Circuit d) All the above

Q5. **Which is called as on-off keying?**

a) Amplitude shift keying b) Uni-polar PAM
c) Amplitude shift keying & Uni-polar PAM d) None of the mentioned

Signature of HOD **Signature of faculty**

Date: **Date:**

Department of Electronics and Communication Engineering

EVALUATION STRATEGY

Target (s)

a. Percentage of Pass : 95%

Assessment Method (s) (Maximum Marks for evaluation are defined in the Academic Regulations)

a. Daily Attendance
b. Assignments
c. Online Quiz (or) Seminars
d. Continuous Internal Assessment
e. Semester / End Examination

List out any new topic(s) or any innovation you would like to introduce in teaching the subjects in this semester

Case Study of any one existing application

Signature of HOD **Signature of faculty**

Date: **Date:**

Department of Electronics and Communication Engineering

COURSE COMPLETION STATUS

Actual Date of Completion & Remarks if any

Units	Remarks	Objective No. Achieved	Outcome No. Achieved
Unit 1	completed on 20.02.2024	1	1
Unit 2	completed on 06.03.2024	2	2
Unit 3	completed on 23.03.2024	3	3
Unit 4	completed on 06.05.2024	4	4
Unit 5	completed on 11.06.2024	5	5

Signature of HOD

Date:

Signature of faculty

Date:

Department of Electronics and Communication Engineering

Mappings

1. Course Objectives-Course Outcomes Relationship Matrix

Course-Outcomes / Course-Objectives	1	2	3	4	5
1	H	M			
2		H			
3			H		
4				H	M
5				M	H

2. Course Outcomes-Program Outcomes (POs) & PSOs Relationship Matrix

P-Outcomes / C-Outcomes	PO1	PO2	PO 3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO12	PSO 1	PSO 2	PSO 3
1	H	H	H	L	-	H	M	-	-	-	-	L	M	M	
2	H	H	H	L	-	M	M	-	-	-	-	L	M	M	
3	H	H	H	L	-	M	M	-	-	-	-	L	M	M	
4	H	H	H	L	-	H	M	-	-	-	-	L	M	M	
5	H	H	H	L	-	H	M	-	-	-	-	L	M	M	

H-HIGH **M-MEDIUM** **L-LOW**

Department of Electronics and Communication Engineering

Rubric for Evaluation

Performance Criteria	Unsatisfactory	Developing	Satisfactory	Exemplary
	1	2	3	4
Research & Gather Information	Does not collect any information that relates to the topic	Collects very little information some relates to the topic	Collects some basic Information most relates to the topic	Collects a great deal of Information all relates to the topic
Fulfill team role's duty	Does not perform any duties of assigned team role.	Performs very little duties.	Performs nearly all duties.	Performs all duties of assigned team role.
Share Equally	Always relies on others to do the work.	Rarely does the assigned work - often needs reminding.	Usually does the assigned work - rarely needs reminding.	Always does the assigned work without having to be reminded
Listen to other team mates	Is always talking—never allows anyone else to speak.	Usually doing most of the talking-- rarely allows others to speak.	Listens, but sometimes talks too much.	Listens and speaks a fair amount.

Department of Electronics and Communication Engineering

(53)

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II B.TECH IV SEMESTER I MID EXAMINATIONS - APRIL 2024

Branch : B.Tech. (ECE) **Max. Marks 30M**
Date : 02 - Apr - 2024 **Time : 120**
Subject : Analog and Digital Communications,EC403PC

PART - A

ANSWER ALL QUESTIONS 10 X 1M = 0M

Q.No	Question		CO	BTL
1.	Bandwidth of DSB-SC Signal (A). 2Wm (B). Wm (C). <Wm (D). 3Wm	( )	CO1	1
2.	The VSB signals detected by (A). LPF (B). HPF (C). Synchronous Detector (D). none	( )	CO1	2
3.	Define Modulation Index of an AM wave ?	( )	CO1	1
4.	VSB is most commonly used in (A). Radio transmission (B). Television transmission (C). Telephony (D). Radar	( )	CO1	1
5.	The carrier is suppressed in (A). a mixer (B). a Frequency Multiplier (C). a transducer (D). a balance modulator	( )	CO2	2
6.	Carsons rule is used to calculate (A). Signal to noise ratio (B). BW of FM Signal (C). Modulation index (D). Noise figure	( )	CO2	2
7.	Which of the following is not a component of PLL (A). Phase Detector (B). VCO (C). Schmitt Trigger (D). Filter	( )	CO2	1
8.	Following is not advantage of FM over AM (A). Noise Immunity (B). Fidelity (C). Capture effect (D). Sputtering effect	( )	CO2	2
9.	Most popular IF for receivers tuning to 540 to 1650kHZ is (A). 433KHZ (B). 455KHZ (C). 545KHZ (D). 535KHZ	( )	CO3	2
10.	Write the main functions of a radio Receiver	( )	CO3	2

PART - B

ANSWER ANY FOUR 4 X 5M = 0M

Q.No	Question	CO	BTL
11.	Define Modulation and what is the need for Modulation ?	CO1	2
12.	Derive an expression for the power content and Transmission efficiency of single tone Amplitude Modulated signal.	CO1	3
13.	Explain the operation of PLL as FM Demodulator	CO2	3
14.	Compare AM,FM and PM	CO2	2
15.	Write short notes on Receiver Characteristics	CO3	2
16.	Define Receiver and explain about TRF Receiver	CO3	2

Department of Electronics and Communication Engineering

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II B.TECH IV SEMESTER II MID EXAMINATIONS - JUNE 2024

Branch : B.Tech. (ECE) **Max. Marks : 30M**
Date : 19-Jun-2024 **Session : Morning** **Time : 120 Min**
Subject : Analog and Digital Communications,EC403PC

PART - A

ANSWER ALL THE QUESTIONS **10 X 1M = 10M**

Q.No	Question		CO	BTL
1.	In a Radio receiver,noise is generally developed at (A). IF Stage (B). Receiver (C). RF Stage (D). None of the mentioned	( )	CO3	1
2.	Which of the following is same in AM and FM receivers? (A). Demodulator (B). AGC (C). IF amplifier (D). All of the above	( )	CO3	1
3.	A PWM signal can be generated by (A). an unstable Multivibrator (B). Integrating a PPM signal (C). A Monostable Multivibrator (D). Differentiating a PPM signal	( )	CO4	1
4.	The correct sequence of PCM Modulation is (A). quantizing, Sampling, encoding (B). Sampling, quantizing, encoding (C). quantizing, encoding, Sampling (D). encoding, Sampling, quantizing	( )	CO4	1
5.	PTM includes (A). Pulse Width Modulation (B). Pulse Amplitude Modulation (C). Pulse Position Modulation (D). both A and C	( )	CO4	1
6.	Quantizing noise occurs in (A). PCM (B). TDM (C). FDM (D). PPM	( )	CO4	2
7.	Which system uses QAM? (A). Digital microwave relay (B). Dial up modem (C). Digital microwave relay & Dial up modem (D). Digital Ammeter	( )	CO5	1
8.	Which is called as on-off keying? (A). Amplitude shift keying (B). Uni-polar PAM (C). Amplitude shift keying & Uni-polar PAM (D). None of the mentioned	( )	CO5	1
9.	The source used in digital communication is discrete in terms of_____ parameter? (A). Amplitude (B). Time (C). Frequency (D). Both a and b	( )	CO5	1
10.	The process of reconstructing back the original signal is called ____? (A). Modulation (B). Demodulation (C). Phasing (D). Modifying	( )	CO5	1

PART - B

ANSWER ANY FOUR **4 X 5M = 20M**

Q.No	Question	CO	BTL
11.	Draw a neat block diagram of an AM transmitter and explain each block	CO3	2
12.	Explain the principle of working of AGC in detail	CO3	3
13.	Write in detail about Types of Quantization Process used in Digital Modulation Techniques	CO4	2
14.	Explain the generation and demodulation of PAM signals	CO4	2
15.	Write in detail about DPSK Used in Digital Modulation Methods	CO5	3
16.	Explain generation of Amplitude shift Keying with the help of block diagram	CO5	3

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Department of Electronics and Communication Engineering

II ECE-'A' SECTION MARK SHEETS:

S.No.	H.T.No.	Name of the Student	Mid - I Marks (30)	Mid- II Marks (30)	Avg of Mid-I & Mid-II (A)	Assignment - I (5)	Assignment - II (5)	Avg of Assg.-I & Assg.-II (B)	Viva Voce (5) (C)	Total (A+B+C)
1	22C11A0401	Vanka Adarsh Reddy	22	13	18	5	5	5	5	28
2	22C11A0402	Pillalamarri Ajay	12	8	10	5	5	5	5	20
3	22C11A0404	Thunkoju Akhil	25	23	24	5	5	5	5	34
4	22C11A0405	Gaddam Akhila	17	14	16	5	5	5	5	26
5	22C11A0407	Aithagani Anusha	27	25	26	5	5	5	5	36
6	22C11A0408	Karisha Ashok	20	14	17	5	5	5	5	27
7	22C11A0409	Kilaru BhaswanthKumar	18	17	18	5	5	5	5	28
8	22C11A0410	Erla Bhavana	21	23	22	5	5	5	5	32
9	22C11A0411	Banothu Chandra Shekar	22	17	20	5	5	5	5	30
10	22C11A0413	Gugulothu Divya	27	25	26	5	5	5	5	36
11	22C11A0414	Kothapalli Divya Jyothi	20	21	21	5	5	5	5	31
12	22C11A0415	Thalla Gayathri	26	26	26	5	5	5	5	36
13	22C11A0416	Godhumala Gopichand	25	26	26	5	5	5	5	36
14	22C11A0417	Bhukya Harshitha	19	25	22	5	5	5	5	32
15	22C11A0418	Reddymalla Janaki Ram Reddy	12	9	11	5	5	5	5	21
16	22C11A0419	Shaik Jasmine	25	21	23	5	5	5	5	33

17	22C11A0420	Janapati Jyoshna	20	17	19	5	5	5	5	29
18	22C11A0421	Dharavath Karthik	13	14	14	5	5	5	5	24
19	22C11A0422	Jonnalagadda Kavya	17	17	17	5	5	5	5	27
20	22C11A0423	Jonnalagadda Kavya Sree	16	19	18	5	5	5	5	28
21	22C11A0424	Shaik Khatija	27	29	28	5	5	5	5	38
22	22C11A0425	Kondru Lakshmi	AB	18	9	5	5	5	5	19
23	22C11A0426	Boda Likhitha	22	21	22	5	5	5	5	32
24	22C11A0427	Kunduru Likhitha Reddy	26	24	25	5	5	5	5	35
25	22C11A0428	Chinthakuntla Lokesh Reddy	23	24	24	5	5	5	5	34
26	22C11A0429	KolluriMadhu	11	18	15	5	5	5	5	25
27	22C11A0430	Gujjula Mamatha	AB	AB	0	0	0	0	0	0
28	22C11A0431	Madasu Mamatha	AB	AB	0	0	0	0	0	0
29	22C11A0432	Chinnam Manasa	11	16	14	5	5	5	5	24
30	22C11A0433	Nanneboina Meghana	25	29	27	5	5	5	5	37
31	22C11A0434	Bhukya Mokshagna	27	28	28	5	5	5	5	38
32	22C11A0435	Gundla Nandini	26	27	27	5	5	5	5	37
33	22C11A0436	Akula Naresh	23	27	25	5	5	5	5	35
34	22C11A0437	Kodi Naveen	13	21	17	5	5	5	5	27
35	22C11A0438	Poloju Naveen	24	14	19	5	5	5	5	29
36	22C11A0439	Varra NaveenReddy	15	16	16	5	5	5	5	26

37	22C11A0440	MallelaNavya	24	23	24	5	5	5	5	34
38	22C11A0441	PagadalaNavya	25	28	27	5	5	5	5	37
39	22C11A0442	Madduri Nichitha	22	18	20	5	5	5	5	30
40	22C11A0443	Kovvuri Nikhil	05	8	7	5	5	5	5	17
41	22C11A0444	Gudipati Nikhil SaiKumar	21	17	19	5	5	5	5	29
42	22C11A0445	Nagireddy NiranjanReddy	24	22	23	5	5	5	5	33
43	22C11A0446	Enugurthi Nithin	21	6	14	5	5	5	5	24
44	22C11A0447	Banala Nithin Vamshi	24	22	23	5	5	5	5	33
45	22C11A0448	Udari NithishKumar	15	14	15	5	5	5	5	25
46	22C11A0449	Akarapu Poojitha	15	18	17	5	5	5	5	27
47	22C11A0450	Bollaka Poojitha	27	27	27	5	5	5	5	37
48	22C11A0451	Yaragani Prajval	15	14	15	5	5	5	5	25
49	22C11A0453	Mamidi Priyanka	16	19	18	5	5	5	5	28
50	22C11A0454	Thokala PurushothAm	12	10	11	5	5	5	5	21
51	22C11A0455	Mohammad Rafi	04	20	12	5	5	5	5	22
52	22C11A0456	Nukala Rajagopal Reddy	27	25	26	5	5	5	5	36
53	22C11A0457	K Raju	28	24	26	5	5	5	5	36
54	22C11A0458	Pangoth Ram Kumar	18	23	21	5	5	5	5	31
55	22C11A0459	Sheelam Ramakanth	17	15	16	5	5	5	5	26
56	22C11A0460	Banothu Ravi	23	12	18	5	5	5	5	28

Department of Electronics and Communication Engineering

II ECE-'B' SECTION MARK SHEETS:

S.No.	H.T.No.	Name of the Student	Mid- I Marks (30)	Mid- II Marks (30)	Av g of Mi d-I & Mi d-II (A)	Assign ment - I (5)	Assign ment - II (5)	Avg of Assg -I & Assg .-II (B)	Viva Voce (5) (C)	Total (A+B+C)
1	22C11A0461	Kotika Ravi Kiran	28	24	26	5	5	5	5	36
2	22C11A0462	Shaik Reshma	27	22	25	5	5	5	5	35
3	22C11A0463	Badeti Sai	12	20	16	5	5	5	5	26
4	22C11A0464	Sampatharao Sai Kumar	25	21	23	5	5	5	5	33
5	22C11A0465	Kalla Sai Manojkumar	26	19	23	5	5	5	5	33
6	22C11A0466	Kandula Saikiran	12	15	14	5	5	5	5	24
7	22C11A0467	Shaik Sameer	14	19	17	5	5	5	5	27
8	22C11A0469	Anantharapu Sanjan	14	21	18	5	5	5	5	28
9	22C11A0470	Pally Santhosh Reddy	11	12	12	5	5	5	5	22
10	22C11A0471	Shaik Shafiq	28	23	26	5	5	5	5	36
11	22C11A0472	N Sharath Chandra	27	28	28	5	5	5	5	38
12	22C11A0473	Battula Sharath Gopal	8	12	10	5	5	5	5	20
13	22C11A0474	Kumbham Shirisha	24	21	23	5	5	5	5	33
14	22C11A0475	Panugoth Shiva	26	25	26	5	5	5	5	36
15	22C11A0476	Bolisetty Shiva Shankar	9	15	12	5	5	5	5	22
16	22C11A0477	Chennakeshav A Shreya	26	19	23	5	5	5	5	33
17	22C11A0478	Bhukya Siddu Naik	18	21	20	5	5	5	5	30
18	22C11A0479	Mekala Sindhu	23	23	23	5	5	5	5	33
19	22C11A0480	Lavori Sravani	27	21	24	5	5	5	5	34
20	22C11A0481	Lingam Sravani	25	19	22	5	5	5	5	32

21	22C11A0482	Boddu Sreeja	26	18	22	5	5	5	5	32
22	22C11A0483	Eatukuri Sri Lakshmi	28	25	27	5	5	5	5	37
23	22C11A0484	Kavuri Srichandana	23	22	23	5	5	5	5	33
24	22C11A0485	Kukkala Srujan	25	22	24	5	5	5	5	34
25	22C11A0486	Ravella Surya	12	12	12	5	5	5	5	22
26	22C11A0487	Kunchala Triveni	26	23	25	5	5	5	5	35
27	22C11A0488	Pedanati Uday Sainadh	11	AB	6	5	0	3	0	9
28	22C11A0489	Siram Setti Umamahesh	26	21	24	5	5	5	5	34
29	22C11A0490	Banothu Usha	24	21	23	5	5	5	5	33
30	22C11A0491	Dhaniyakula Ushasri	21	17	19	5	5	5	5	29
31	22C11A0492	Athkuri Vamshi	20	16	18	5	5	5	5	28
32	22C11A0493	Thammineni Vennela	17	10	14	5	5	5	5	24
33	22C11A0494	Palla Vijay Kumar	AB	AB	0	0	0	0	0	0
34	22C11A0495	Gunnam Vijay Simha Reddy	10	8	9	5	5	5	5	19
35	22C11A0496	Kasani Vinay Teja	17	23	20	5	5	5	5	29
36	22C11A0497	Telagorla Vinay	24	21	23	5	5	5	5	33
37	22C11A0498	Dammalapati Vinod Kumar	22	18	20	5	5	5	5	30
38	22C11A0499	Katikam Vishva Teja	5	14	10	5	5	5	5	20
39	22C11A04A0	Banothu Yamini Naik	19	23	21	5	5	5	5	31
40	22C11A04A1	Basanakarra Yashwanth	22	19	21	5	5	5	5	31
41	22C11A04A2	Remidala Yashwanth	20	19	20	5	5	5	5	30
42	22C11A04A3	Sayyad Yasin	14	12	13	5	5	5	5	23
43	22C11A04A4	Machireddy Prathyusha	25	22	24	5	5	5	5	34
44	22C11A04A5	Reddimalla Bhanu Prakash	18	13	11	5	5	5	5	21
45	23C15A0401	Akhileshwari	27	19	23	5	5	5	5	33

		Suddala								
46	23C15A0402	Anjalichilakam Arri	28	15	22	5	5	5	5	32
47	23C15A0403	Durga Sai Achanta	26	17	22	5	5	5	5	32
48	23C15A0404	Harini Shanagapati	28	20	24	5	5	5	5	34
49	23C15A0405	Laxmi Gayathri Nerella	27	21	24	5	5	5	5	34
50	23C15A0406	Mukesh Sivakavi	25	15	20	5	5	5	5	30
51	23C15A0407	Navya Sri Maduri	28	22	25	5	5	5	5	35
52	23C15A0408	Ramarao Thodeti	25	18	22	5	5	5	5	32
53	23C15A0409	Samad Shaik	24	24	24	5	5	5	5	34
54	23C15A0410	Sandeep Athmakuru	27	25	26	5	5	5	5	36
55	23C15A0411	Venkata Krishna Karamsetti	24	18	21	5	5	5	5	31

Signature of HOD **Signature of faculty**

Date: **Date:**

ANURAG ENGINEERING COLLEGE

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Ananthagiri (V & M), Kodad, Suryapet (Dist), Telangana.

Program		
B.Tech. ✓	M.Tech.	M.B.A.

YEAR	SEMESTER	MID EXAMINATION
II	II	I

HALL TICKET NO.: 2 3 C 1 5 A 0 4 0 4

Regulation : R22 | Branch or Specialization: ECE

Course: ADC

Signature of Student: S. Hanini

Signature of invigilator with date: 2/4/24

Signature of the Evaluator:

Q.No.	1	2	3	4	5	6	7	8	9	10	11
Marks Awarded											

Maximum Marks: 30 | Marks Obtained: 28

(Start Writing From Here)

PART-A

Q.1. A

Q.2. C

Q.3. Modulation Index of an AM wave:-

The ratio of amplitude of the message or modulating signal to the amplitude of the carrier signal is known as Modulation Index. Represented by "μ".

$\mu = \frac{A_m}{A_c}$

Q.4. B

Q.5. D

Q.6. B

Q.7. C

Q.8. B

Q.9. C

Q.10. Main functions of Radio Receiver:-

1. Tracking the incoming frequency modulated signal's phase and frequency.

PART-B

Q.11. MODULATION

The process of changing the characteristics of the high frequency carrier signal in accordance with the instantaneous (amplitude) values of the message (or) modulating signal is known as Modulation.

Generally, there are three types of modulations in continuous time signals. They are.

1. Amplitude Modulation.
2. Frequency Modulation.
3. Phase Modulation

NEED FOR MODULATION

Generally, the message signals are low frequency signals and are not suitable to transmitt them for long distances. That's why prefer modulation, so, that it can transmitted to long distances.

1. To Reduce the height of the antenna.

For low frequency signals the height of the antenna is more (in kilometers). As it is not possible to design a antenna with more height, instead we can Reduce it's height by modulating signal by increasing the frequency.

$$\ell = \lambda f$$

$$f = \frac{c}{\lambda}$$

c = Speed of the light

2. Used for Multiplexing of signals.

When we have to transmit many signals at a time, there is a change of interference of the signals while transmitting. So, to avoid the mixing of signals or interference of signals, each signal is modulated with different carrier frequency. Hence, the interference is reduced.

3. To Reduce Noise.

As we know that the noise is an unwanted signal which is added to the signal while transmitting it through the channel, that can be eliminated by either increasing the frequency (or) Amplifier circuits consisting some filters to avoid noise.

4. Increase in Noise immunity:

Since, the modulated signal is having high frequency, it cannot be interrupted to any noise at the channel, by increasing the noise immunity.

5. Reducing the Bandwidth of the signal

If the bandwidth of the signal is more then the power required for transmission of that signal gets increased. By the process of modulation, the usage of Bandwidth is reduced, and hence the power consumption for transmission of the signal is reduced.

9.13.

Demodulator :-

An electronic device, which is used to produce

The process of extracting the original message at the receiver is known as demodulation and is done by the demodulator.

OPERATION OF PLL as FM DEMODULATOR

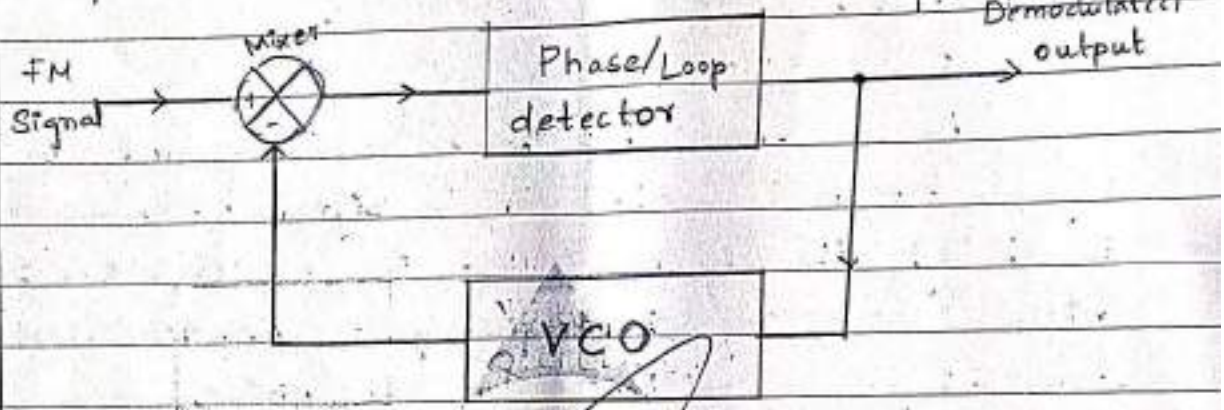


Fig: Block Diagram of PLL as FM Demodulator

PLL → Phase Locked Loop.

(PLL) Phase locked loop (used) uses a negative feedback technique and this technique is also known as indirect method of FM demodulation.

Generally, PLL as FM demodulator circuit consists of mainly three components.

1. Phase/Loop detector.
2. Mixer.
3. Voltage Controlled Oscillator. (VCO).

$$S(t) = 2\pi A_c \left[\cos 2\pi f_c(t) + 2\pi k_f \cos 2\pi f_m(t)\right]$$

$$S(t) = 2\pi A_c \left[\cos 2\pi f_c(t) + \phi_1(t)\right]$$

Error Signal

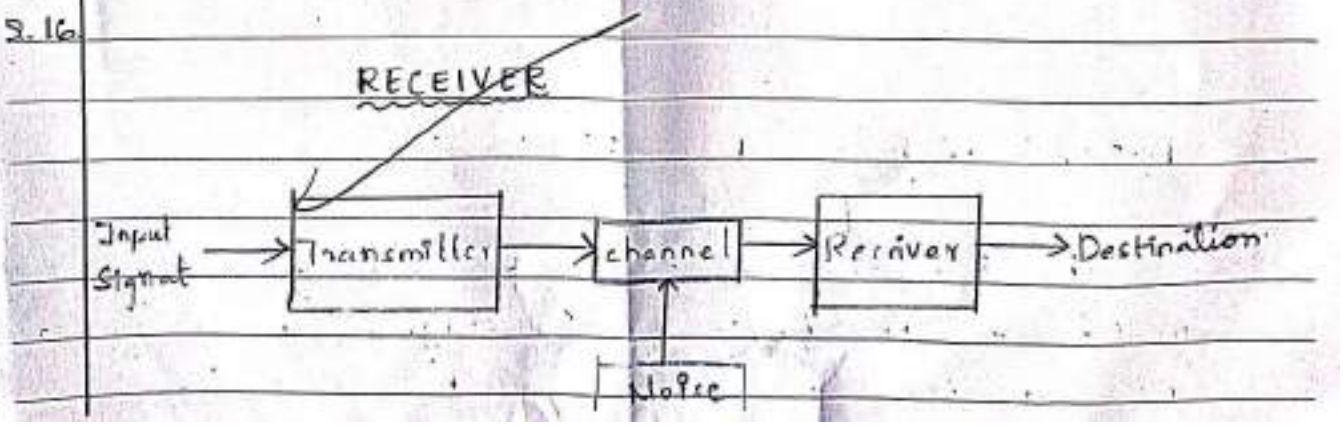
Mixer :- A mixer is circuit, which is used to mix the two signals and produce the difference signal which is fed to the Loop detector.

VCO :- The Voltage Controlled Oscillator (VCO) is used to control the frequency by using voltage. As the mixer output is feed to the Loop detector and the loop detector's output is again fed VCO, it gradually removes all high frequency components in the signal, when it's frequency is reduced to the original message signal frequency; immediately the loop gives the output signal from Loop detector. Hence, the input message signal is obtained.

Loop Detector :-

The VCO output is fed to the loop detector, if the signal high frequency then the signal is again given to VCO, and this process gets repeated upto, when the mixer's output reaches to the message signal frequency. And once the signal is obtained then the signal is directly (fed) given to the output by unlocking the loop.

2.16



Receiver:- A circuit consisting of receiving antenna, demodulator or) decoder, output transducer, and destination is known as Receivers.

⇒ Receiver, generally receives the signal and gives it to demodulator for demodulation and again fed to the output transducer which can produce one form of signal to another in here electrical signal to orgional form and directly taken to the destination. This process is done to extract the original message signal.

TRF RECEIVER

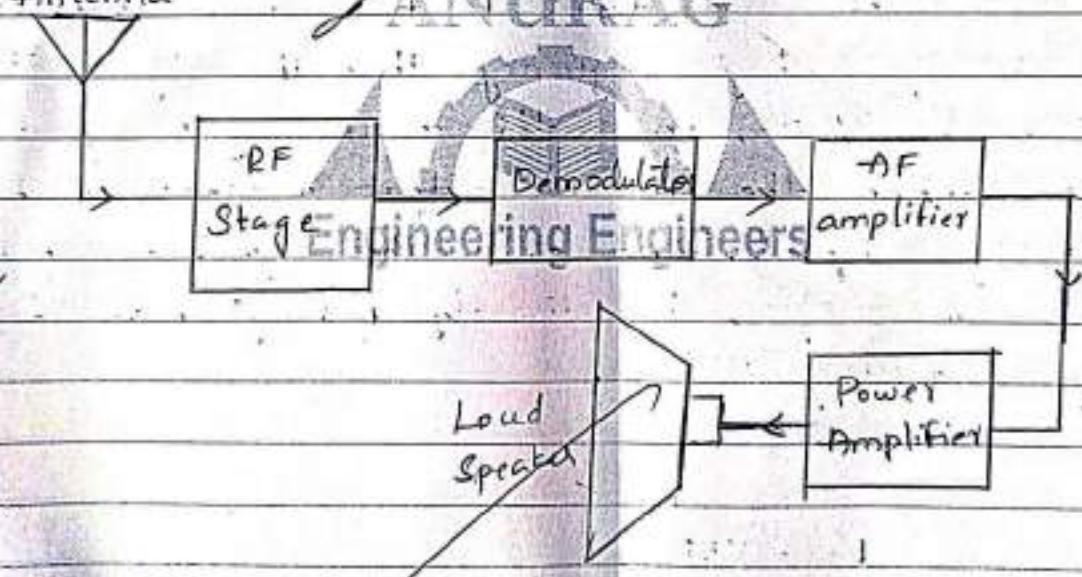


fig: Block diagram of TRF Receiver.

The Blockdiagram of TRF Receiver generally consists of an Antenna, RF stage, Demodulator, an AF amplifier and power amplifier and Loud

Receiving Antenna:-

The Receiving antenna is used to receives the required or desired signal that has to be demodulated.

RF stage :-

The RF stage consists of number of RF amplifiers to amplify the Radio frequency signals. In TRF receiver there are more no. of RF amp stages.

Demodulator :-

It is circuit which produces the original modulating or electrical message as the output.

AF amplifier :-

The AF amplifier means the Audio frequency amplifier. As the output of Demodulator is the Audio frequency signal it can be amplified by the AF amplifier and it can also reduce the unwanted signals or noise.

Power Amplifier :-

The power amplifier is used to increase the power of the signal so that the output is given to the Loudspeaker.

Loud Speaker :-

It can be also called as output transducer, which helps the signal to convert

Q.14 Comparision of AM, FM and PM.

AM	FM	PM
① The process of changing the amplitude of the carrier signal in accordance with the instantaneous amplitude of the message signal is known as Amplitude Modulation.	① The process of changing the frequency of the carrier signal in accordance with the instantaneous values of the message signal is known as frequency Modulation.	① The process of changing the phase of the carrier signal in accordance with the instantaneous values of message signal is known as Phase modulation.
② Frequency and phase are remains constant.	② Amplitude and phase remains constant.	② Amplitude and frequency remains constant.
③ Transmission efficiency is poor.	③ Transmission efficiency is better.	③ Transmission efficiency is better.
④ It is amplitude modulation technique	④ It is an angle modulation technique.	④ It is an angle modulation technique.
⑤ Amplitude is varied.	⑤ Frequency is Varied.	⑤ Phase is Varied.
⑥ Applications ① Audio frequency Communication system. ② T.V broad	⑥ Applications ① FM radio broadcasting. ② Radio Communication	⑥ Applications ① Communication systems. ② TVs

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Department of Electronics and Communication Engineering
II B.Tech–II SEM (R22)

II B.Tech-II Sem I MID ASSIGNMENT

Name: M. Sindhu. BRANCH: ECE

HT.NO: 22011A04479

SUB: Analog and Digital Communications (ADC) A.Y:2023-24

Q.No.	Questions	Course Outcome	Blooms Level
1	a) Define Modulation and what is the need for Modulation b) Explain the generation of AM signals using Square Law Modulator	CO1	L1&L2
2	a) Compare AM with DSB-SC and SSB-SC? b) Explain the coherent detection of DSB-SC modulated wave with a neat block diagram?	CO1	L1&L2
3	a) Define FM and PM ? b) Explain about Indirect method of generation of FM?	CO2	L1&L2
4	a) Compare AM and FM ? b) Explain the operation of PLL as FM Demodulator?	CO2	L1&L2
5	a) Define Receiver? b) Explain about TRF Receiver and give its Drawbacks?	CO3	L1&L2
6	a) Explain about Superheterodyne Receiver in detail? b) Give the characteristics of Radio Receivers?	CO3	L1&L2

UNIT-① UNIT-1 -ADC 22C11A0479

35

1) a) Define Modulation and what is the need for modulation.

Ans: Modulation :- The process of changing characteristics of carrier signal in accordance to instantaneous value to message signal.

Need for Modulation :-

⇒ Baseband signals are incompatible for direct transmission over the medium so, modulation is used to convey (baseband) signals from one place to another.

⇒ Allows frequency translation:

- frequency Multiplexing
- Reduce the antenna height
- Avoids mixing of signals
- Narrowbanding

⇒ efficient transmission

⇒ Reduced noise and interference.

⇒ To increase the range of Communication.

b) Explain the generation of AM signals using square law Modulator.

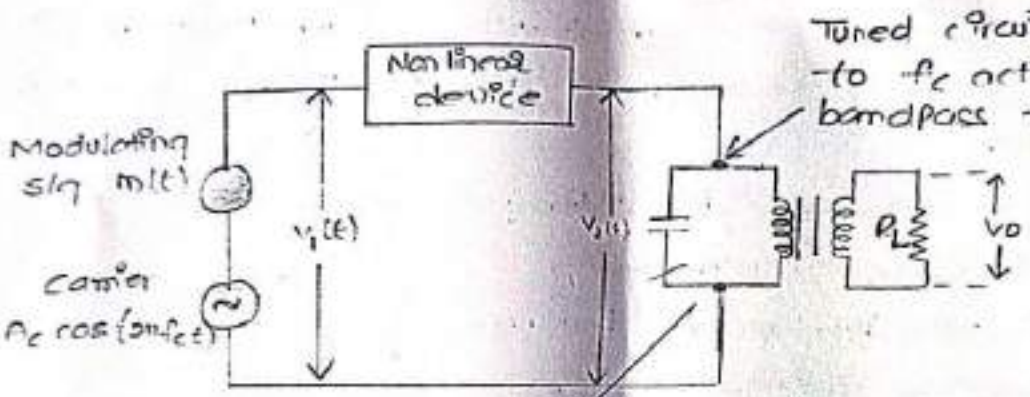
A: Square-law Modulator

→ A square-law modulator requires three features.

- A means of summing the carrier and modulating waves.
- A non linear element and
- A band-pass filter.

for extracting the desired modulation products. Semiconductor diodes and transistors are the most common non linear devices used for implementing square-law modulators. The filtering requirement is usually satisfied by using a single or double tuned filter.

⇒ The square law modulator circuit is as shown in figure below: It consists of the following.



When a non-linear element such as diode is suitably biased and operated on a restricted portion of its characteristic curve, we can represent the output by a square law "in the figure":

$$V_2(t) = a_1 V_1(t) + a_2 V_1^2(t)$$

where a_1 and a_2 are constants. The input voltage $V_1(t)$ consists of the carrier wave plus the modulating wave, that is

$$V_1(t) = A_c \cos 2\pi f_c t + m(t)$$

Therefore $V_2(t) = a V_1(t) + b V_1^2(t)$.

$$V_2(t) = a[m(t) + A_c \cos(2\pi f_c t)] + b[m(t) + A_c \cos(2\pi f_c t)]^2$$

2)

$v_2(t) = am(t) + a A_c \cos(2\pi f_c t) + b[m^2(t) + 2m(t) A_c \cos(2\pi f_c t) + A_c^2 \cos^2(2\pi f_c t)]$

$= \underset{(1)}{am(t)} + \underset{(2)}{a A_c \cos(2\pi f_c t)} + \underset{(3)}{bm^2(t)} + \underset{(4)}{2bm(t) A_c \cos(2\pi f_c t)} + \underset{(5)}{bA_c^2 \cos^2(2\pi f_c t)}]$

→ The five terms in the expression for $v_2(t)$ are as follows:

Term 1 : $am(t)$ → modulating signal

Term 2 : $a A_c \cos(2\pi f_c t)$ → carrier signal.

Term 3 :- $bm^2(t)$ → squared modulating signal.

Term 4 :- $2bm(t) A_c \cos(2\pi f_c t)$ → AM wave with only sidebands.

Term 5 : $bA_c^2 \cos^2(2\pi f_c t)$ → squared carrier.

⇒ out of these five terms, terms 2 and 4 are useful whereas the remaining terms are not useful. let us club terms 2, 4 and 3, 5 as follows to get

$v_2(t) = am(t) + bm^2(t) + bA_c^2 \cos^2(2\pi f_c t) + a A_c \cos(2\pi f_c t) + 2bm(t) A_c \cos(2\pi f_c t)$

→ The LC tuned circuit acts as a bandpass filter. The circuit is tuned to frequency f_c and its bandwidth is equal to $2f_m$.

→ Hence the output voltage $v_0(t)$ contains only the

Useful terms:

$V_0(t) = a \cdot Ac \cos(2\pi f_c t) + 2\, b\, m(t)\, Ac \cos(2\pi f_c t)$

$= [a\, Ac + 2\, b\, m(t) Ac] \cos(2\pi f_c t)$

$V_0(t) = a \cdot Ac \left[1 + \frac{2b}{a} m(t)\right] \cos(2\pi f_c t)$

(2) a) Compare AM with DSB-SC and SSB-SC?

S.NO	parameter	standard AM	SSB-SC	DSB-SC
1	power	High	less	medium
2.	Bandwidth	2fm	fm	fm
3.	carrier suppression	No	yes	yes
4.	Receiver complexity	Simple	complex	complex
5.	Modulation Type	Non-linear	linear	linear
6.	Transmission efficiency	Minimum	maximum	moderate
7.	Applications	Radio communi-cation	point-to point communi-cation referred for long distance transmission.	point-to point communication.

3)

b) Explain the coherent detection of DSB-SC modulated wave with a neat block diagram?

Ans Detection of DSB-SC wave:-

Coherent Detection:-

The message signal $m(t)$ can be uniquely recovered from a DSBSC wave $s(t)$ by first multiplying $s(t)$ with a locally generated sinusoidal wave and then low pass filtering the product as shown.

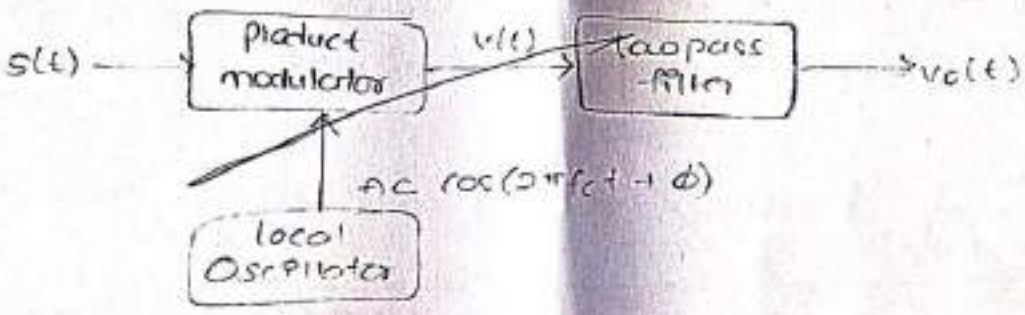


fig: Coherent detection

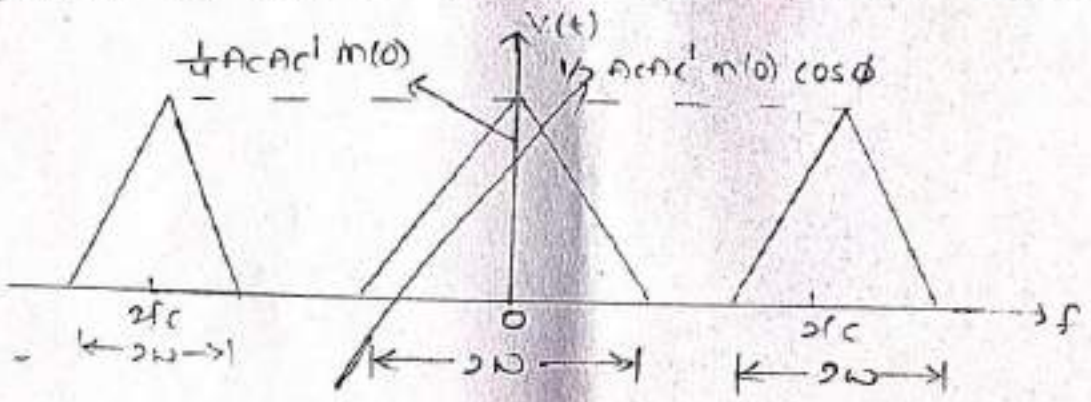
It is assumed that the local oscillator signal is exactly coherent or synchronized in both frequency and phase with the carrier wave $c(t)$ used in the product modulator to generate $s(t)$. This method of demodulation is known as coherent detection or synchronous detection.

Let $A_c \cos(2\pi f_c t) \cos(2\pi f_c t + \phi)\, m(t)$ be the DSBSC wave. Then the product modulator output $v(t)$ is given by.

$$V(t) = A_c A_c' \cos(2\pi f_c t) \cos(2\pi f_c t + \phi)\, m(t)$$

$$V(t) = \frac{A_c A_c'}{4} \cos(4\pi f_c t + \phi)\, m(t) + \frac{A_c A_c'}{2} \cos(\phi)\, m(t)$$

The first term in above expression represents a DSB SC modulated signal with a carrier frequency $2f_c$, and the second term represents the scaled version of message signal. Assuming that the message signal is band limited to the interval $-\omega < f < \omega$, the spectrum of $V(t)$ is plotted as shown in below.



From the spectrum it is clear that the unwanted component can be removed by the low-pass filter provided that the cut-off frequency of filter is greater than ω but less than $2f_c$.

$$v_0(t) = \frac{A_c A_c'}{2} \cos(\phi)\, m(t)$$

The demodulated signal $v_0(t)$ is therefore proportional to $m(t)$ when the phase error ϕ is constant.

ADC UNIT – (2) 22C11A0479. ①

① a) Define FM and PM ?

A:- Frequency Modulation :- FM is that form of angle modulation in which the instantaneous frequency $f_i(t)$ is varied linearly with the message signal $m(t)$, as shown by

$$f_i(t) = f_c + k_f m(t)$$

The term $f_i(t)$ represents the frequency of the unmodulated carrier and the constant k_f represents the frequency sensitivity of the modulator, Hz/v.

⇒ The frequency modulated signal $s(t)$ is thus described in the time domain by

$$\theta_i(t) = 2\pi \int_0^t f_i(t)\,dt$$

$$s(t) = A_c \cos\left[2\pi f_c(t) + 2\pi k_f \int_0^t m(t)\,dt\right]$$

Phase Modulation (PM) :- PM is that form of angle modulation in which the angle $\theta_i(t)$ is varied linearly with the message signal $m(t)$, as shown by

$$\theta_i(t) = 2\pi f_c t + k_p m(t)$$

⇒ The term $2\pi f_c t$ represents the angle of the unmodulated carrier and the constant k_p represents the phase sensitivity of the modulator, rad/v.

⇒ The phase modulated signal $s(t)$ is thus described in the time domain by.

$$s(t) = A_c \cos\left[2\pi f_c t + k_p m(t)\right].$$

b) Explain about Indirect method of generation of FM.

A:⇒ In the indirect method, the modulating signal is first used to produce a narrowband FM signal, and frequency multiplication is next used to increase the frequency deviation to the desired level.

Indirect – FM

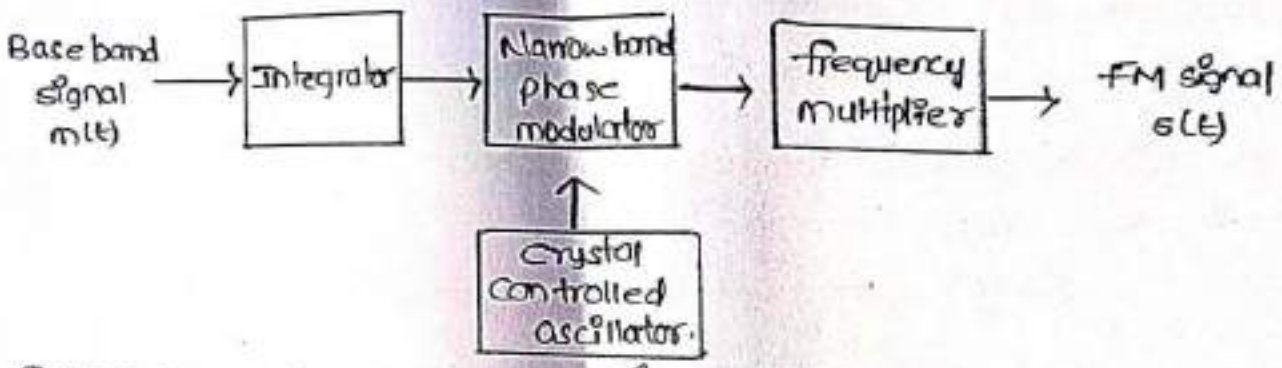


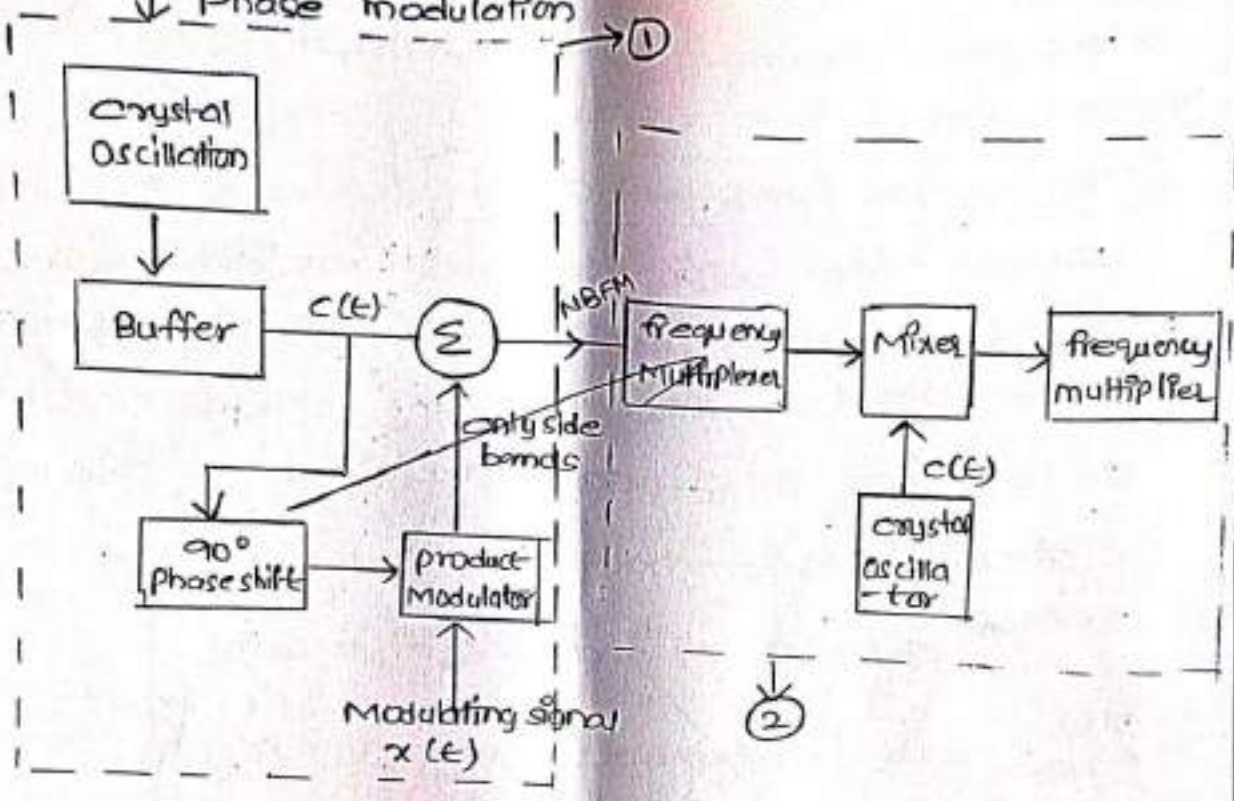
figure :- Block diagram of indirect method generating a wideband FM signal.

* Indirect method (Armstrong Modulator).

Armstrong Modulator : A complete Armstrong modulator is supposed to provide a ±5kHz frequency deviation. It uses a balanced modulator and 90° phase shifter to phase-modulate a crystal oscillator. Required deviation is obtained by combination of multipliers and mixing, raise the signal from 400kHz ± 14.49Hz to 90.2 MHz ± 75 kHz suitable for broadcasting.

⇒ In this armstrong method we can generate FM signal using two stages of operations. Those are

* Generation of NBFM signal using phase modulation
* using frequency multiplier and mixer circuits we can get required values of carrier frequency, frequency deviation and modulation index of FM signal.



Stage I :-

* In this method we generate NBFM signal using Phase modulator as follows as

→ The carrier signal is generated from the crystal oscillator as shown in above figure.

→ for the product modulator we can apply message signal modulating signal and also 90° phase shift unmodulated carrier as shown in above figure.

→ Hence, the output of product modulator consists of only side bands.

→ In this manner, we can generate NBFM signal by the addition of carrier signal from the Buffer and output of product modulator.

Analysis :-

We can generate NBFM signal using indirect method and it is given by s(t)

$$s(t) = V_c \cos [2\pi f_c t + \phi_1(t)]$$

In the above expression 'fc' is carrier frequency and $\phi_1(t)$ is phase angle of the signal w.r.t message signal.

$$s(t) = V_c [\cos 2\pi f_c t \cos\phi_1(t) - \sin 2\pi f_c t \sin\phi_1(t)]$$

since, $\phi_1(t)$ is small

Consider, $\cos\phi_1(t) = 1$ and $\sin\phi_1(t) = \phi_1(t)$

$$s(t)_{NBFM} = V_c [\cos 2\pi f_c t - \sin 2\pi f_c t \cdot \phi_1(t)]$$

but

$$\phi_1(t) = 2\pi k \int_0^t x(t)dt$$

Where k = frequency sensitivity of a modulator

Hence

$$s(t)_{NBFM} = V_c \left[\cos 2\pi f_c t - \sin 2\pi f_c (t) \left(2\pi k \int_0^t x(t)dt\right)\right]$$

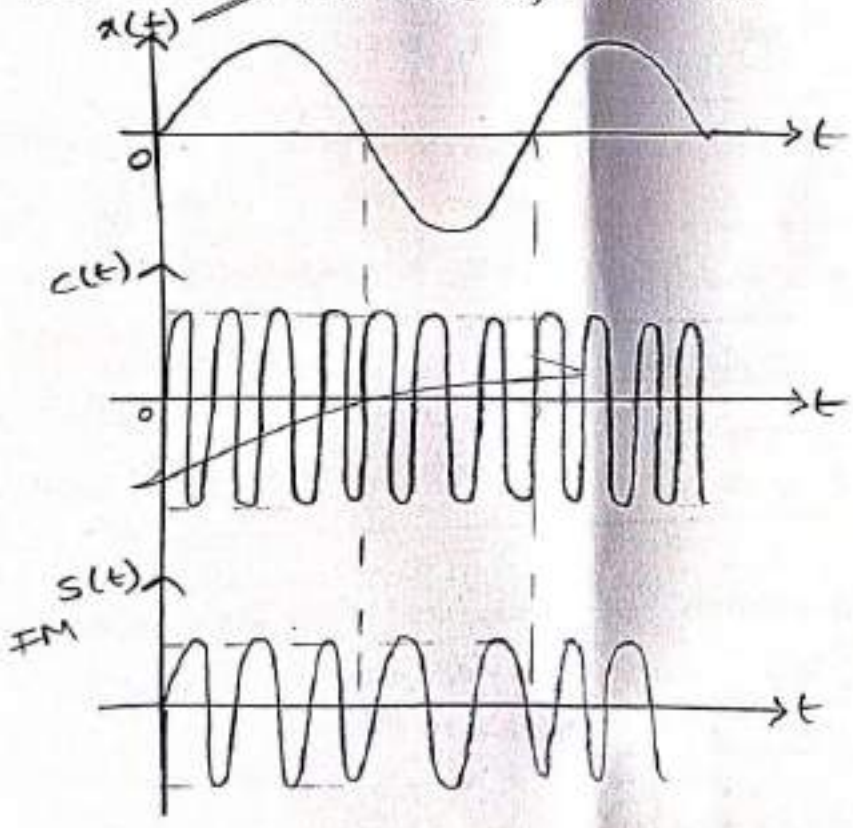
In this manner we can generate NBFM signal using phase modulator.

Stage (2):-

In stage 2 of indirect FM generation using frequency multipliers and mixer circuits, we can generate WBFM signal i.e Required values of frequency deviation and modulation index of FM signal from the 'NBFM' signal.

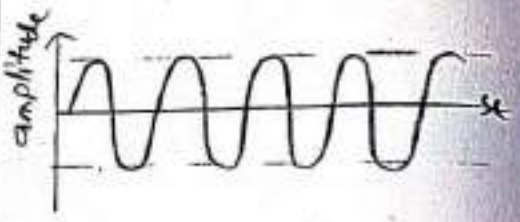
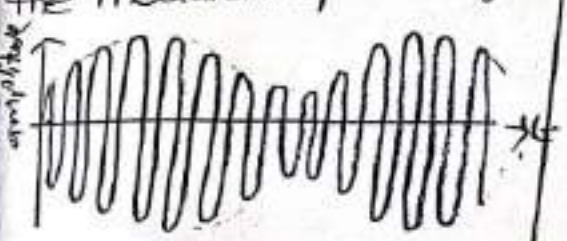
* In this manner by using frequency multipliers we can increase the modulation index and frequency deviation of FM signal.

Wave forms of message, carrier.



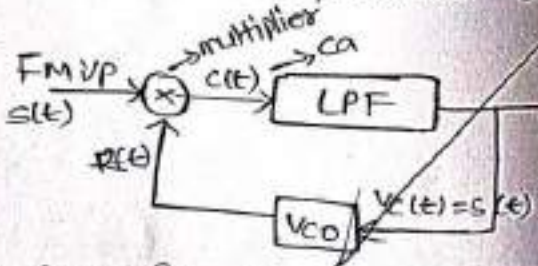
(2) a) Explain & compare AM and FM ?

A:

FM	AM
1) Amplitude of FM wave is constant 	1) Amplitude of AM wave will change with the modulating voltage 
2) All the transmitted powers is useful	2) Carrier and due side band power is wasted
3) Bandwidth is larger	3) Bandwidth is less than the FM.
4) It is complex in design	4) It is less complex
5) Information is contained in the frequency variation of a carrier	5) Information is contain-ed in the amplitude variation of a carrier.

b) Explain the operation of PLL as FM Demodulator ?

A:



→ PLL is a one of the FM Demodulator circuit consists of three basic elements as shown in above

figure those are

VCO, multiplier and low pass filter, basically it is a Negative feedback system and this PLL is also used for AM demodulator. In this circuit we can apply FM input and VCO output to the multiplier to produce the error signal. generally it is a difference between S(t) and R(t) as shown in above figure.

The i/p for multiplier (fm) i/p is given by

$$S(t) = A_c \cos(2\pi f_c t + 2\pi k_f \int m(t)\,dt)$$

$$\therefore \boxed{S(t) = A_c \cos(2\pi f_c t + \phi_1(t))} \quad -(1)$$

→ The VCO is sensitive to the phase and frequency of i/p of signal

→ We know that, the o/p signal of VCO is 90° shifted by i/p signal,

Hence, the o/p of VCO is given by

$$R(t) = A_v \sin(2\pi f_c t + 2\pi k_v \int V_0(t)\,dt)$$

$$\boxed{R(t) = A_v \sin(2\pi f_c t + \phi_2(t))} \quad -(2)$$

→ The o/p of multiplier is given by (1) x (2)

$$e(t) = S(t) \cdot R(t)$$

$$= A_c \cos(2\pi f_c t + \phi_1(t)) \times A_v \sin(2\pi f_c t + \phi_2(t))$$

$$= \frac{A_c \cdot A_v}{2} \sin\left[(2\pi f_c t + \phi(t)) - (2\pi f_c(t) + \phi_2(t))\right].$$

$$\therefore \boxed{e(t) = \frac{A_C \cdot A_V}{2} \sin[\phi_1(t) - \phi_2(t)]}$$

Assume that pratically these exists an error blw $S(t)$ & $R(t)$

$\sin = \theta$

and it is small, Hence we consider

$\frac{A_C \cdot A_V}{2} \simeq 1$, $\sin\theta \simeq \theta$

So $e(t) = \phi_1(t) - \phi_2(t) = \phi_e(t)$

$$\boxed{\phi_e(t) = \phi_1(t) - \phi_2(t)} \text{ (error signal)}$$

→ The error signal is applied to the low pass filter having the impulse response of $h(t)$ and transfer function of $H(f)$

→ Hence, the o/p low pass filter is given by

$$v_0(t) = \phi_e(t) \oplus h(t)$$

→ In frequency domain, the o/p of low pass filter is

$$V_0(f) = \phi_e(f) \cdot H(f) \quad \text{—(3)}$$

but we have

$$\phi_e(t) = \phi_1(t) - \phi_2(t) \Rightarrow$$

$$\phi_e(t) = \phi_1(t) - 2\pi k_v \int v_0(t) \cdot dt \quad \text{→(4)}$$

diff (4)

$$\frac{d}{dt}\phi_e(t) = \frac{d}{dt}\phi_1(t) - 2\pi k_v v_0(t) \quad \text{→(5)}$$

Taking fourier transform of (5)

$$j\omega\phi_e(f) = j\omega\phi_1(f) - 2\pi k_v V_0(f).$$

$$V_0(f) = \frac{jf}{k_v} \phi_1(f)$$

I.F.T

$$V_0(t) = \frac{j}{2\pi k_v} \frac{d}{dt} \cdot (\phi_1(t)\,(jf))$$

$$= \frac{1}{2\pi k_v} \frac{d}{dt} \left[2\pi k_f \int m(t) \cdot dt\right)$$

$$V_0(f) = \frac{k_f}{k_v} \left[\frac{d}{dt} \int m(t) \cdot dt\right)$$

$$V_0(t) = \frac{k_f}{k_v} m(t)$$

$$\therefore V_0(t) \leftarrow \frac{k_f}{k_v} \cdot m(t)$$

Note :- when the difference b/w fm i/p and Receiver o/p is zero then this condition is said to be phase locked conditions. when this condition is acheived then the phase shift between i/p and o/p is same.

$$j2\pi f \phi_e(f) = j2\pi f \phi_i(f) - 2\pi k_v v_o(f)$$

$$j \cdot f \cdot \phi_e(f) = j \cdot f \cdot \phi_i(f) - k_v \cdot v_o(f)$$

$$j \cdot f \cdot \phi_e(f) = j \cdot f \phi_i(f) - k_v \left[\phi_e(f) \cdot H(f)\right]$$

$$j \cdot f \cdot \phi_e(f) + k_v\left(\phi_e(f) \cdot H(f)\right) = j \cdot f \cdot \phi_i(f)$$

$$\phi_e(f)\left[jf + k_v \cdot H(f)\right] = j \cdot f \cdot \phi_i(f)$$

$$\phi_e(f) = \frac{j f \phi_i(f)}{jf\left[1 + \frac{k_v}{jf} \cdot H(f)\right]}$$

$$\therefore \boxed{\phi_e(f) = \frac{\phi_i f}{1 + \frac{k_v}{jf} \cdot H(f)}}$$

→ Practically, the low pass filter is designed having high value of transfer function i.e

$$H(f) >> 1 \left(\cong H(f)\right)$$

→ Hence

$$\phi_e(f) = \frac{\phi_i(f)}{\frac{kH(f)}{j \cdot f}}$$

but

$$v_o(f) = \phi_e(f) \cdot H(f)$$

$$= \frac{\phi_i(f)}{\frac{k_v}{j \cdot f}} \cdot H(f)$$

$$v_o(f) = \frac{\phi_i(f)}{\frac{k_v}{j \cdot f}}$$

UNIT – 3

(1) a) Define Receiver?

A:- Receivers are essential components in communication systems, converting and decoding signals into usable forms.

* Receiver is an electronic equipment which picks up the desired signal, reject the unwanted signal and demodulate the carrier signal to get back the original modulating signal.

b) Explain about TRF Receiver and give its drawbacks?

A:- Tuned Radio Frequency Receiver (TRF):

The tuned radio frequency (TRF) receiver is the simplest radio receiver. Block figure shows the block diagram of a tuned radio frequency receiver. The very first block of this receiver is an RF stage. This stage generally contains two or three RF amplifiers. Actually these RF (radio frequency) amplifiers are tuned RF amplifiers i.e they have variable tuned circuit at the i/p and o/p sides. At the i/p of receiver, there is a receiving antenna as shown in below block diagram.

At this antenna signals from different sources (i.e stations) are present. However, with the help of input variable tuned circuit of RF amplifiers the desired signal (i.e station) is selected. But this selected signal is usually very weak of the order of μV. This selected weak signal is amplified by the RF amplifier.

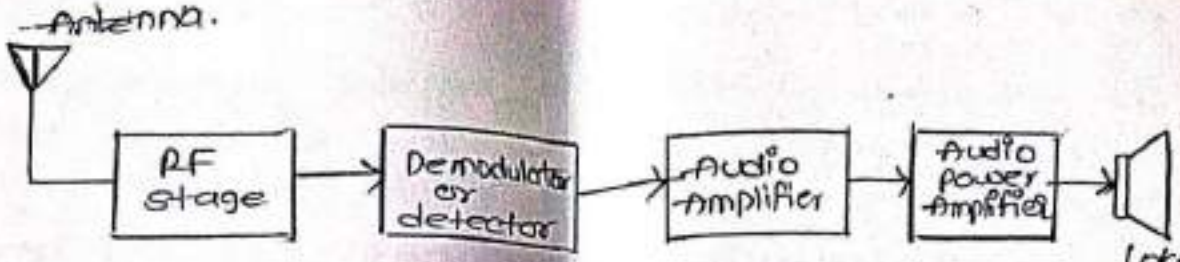


Fig:- Block diagram of a TRF receiver.

The function of RF stage is to select the desired signal and amplify it.
After this, amplified incoming modulated signal is applied to the demodulator. The demodulator or detector demodulates the modulated signal and thus at the output of demodulator, we get modulating audio signal. This audio signal is amplified by audio amplifier. After that, this audio signal is further amplified by power amplifier upto desired power level to drive loudspeaker. The last stage of receiver is loudspeaker. A loudspeaker is a transducer which changes electrical signal into sound signal.

* Drawbacks of TRF Receiver :-

→ poor selectivity and low sensitivity in proportion to number of tuned amplifiers used.
→ Instability due to large number of RF stages.
→ Gain is non-uniform over a wide range of frequencies
→ Received Bandwidth increases with frequency.

(2)

(2) a) Explain about superheterodyne Receiver in detail?

A:- Superheterodyne Receiver:-

In a superheterodyne receiver, the incoming RF signal frequency is combined with the local oscillator signal frequency through a mixer and is converted into a signal of lower fixed frequency. This lower fixed frequency is known as intermediate frequency. However the intermediate frequency signal contains the same modulation as the original signal. This intermediate frequency signal is now amplified and demodulated to reproduce the original signal.

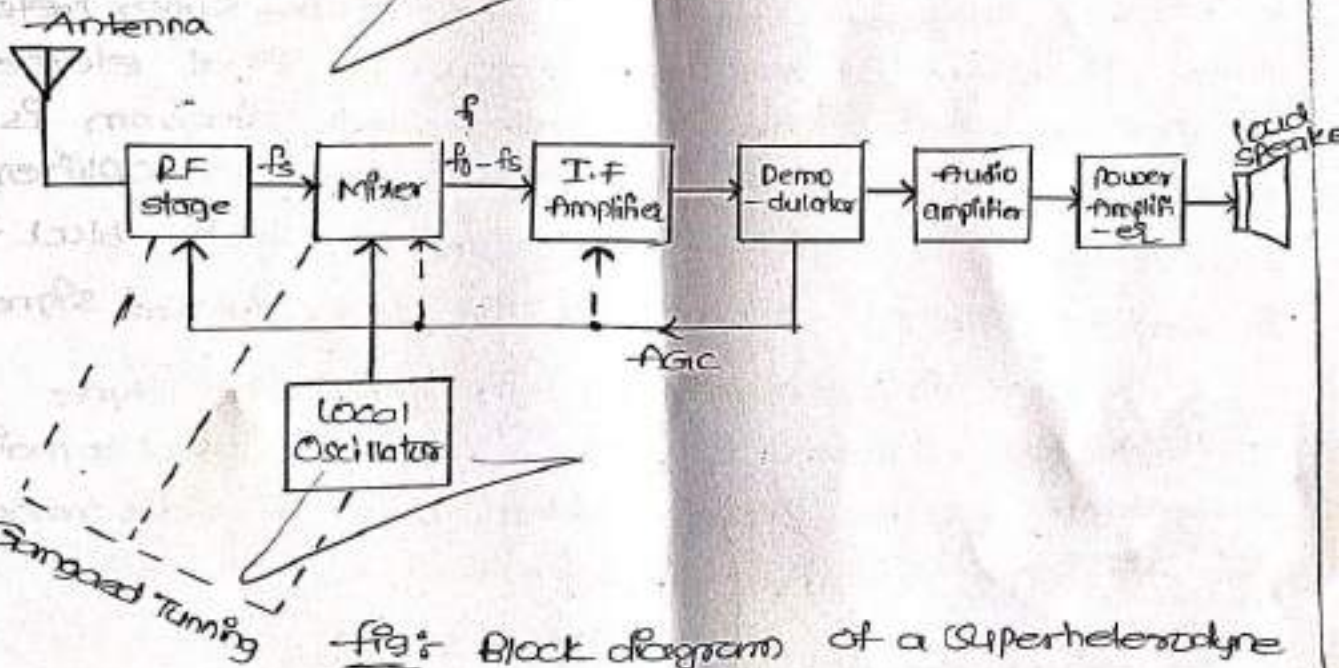


fig:- Block diagram of a superheterodyne receiver.

The word heterodyne stands for mixing. Here we have mixed the incoming signal frequency

with the local oscillator frequency. Therefore this receiver is called "superheterodyne receiver".

Operation:

Signals enter the receiver from the antenna and are applied to RF amplifier where they are tuned to remove the image signal and also reduce the general level of unwanted signals on other frequencies that are not required.

The signals are then applied to the mixer along with local oscillator where the wanted signal is converted down to the intermediate frequency. The advantage of IF filter as opposed to RF filtering is that the filter can be designed for a fixed frequency.

Once filtered the next block in the Super hetero-dyne receiver is the demodulator. The final element in the superhetrodyne receiver block diagram is shown as an audio amplifier and power amplifier, although this could be any form of circuit block that is used to process or amplified the demodulated signal.

Another important circuit in superheterodyne receiver block diagram is AGC. AGC is used to maintain a constant output voltage level over a wide range of RF input signal levels.

Advantages of superheterodyne receiver:-

→ High sensitivity and selectivity.
→ less expensive
→ Improved circuit stability.

Signature of HOD **Signature of faculty**

Date: **Date:**