GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)

Competency-focused Outcome-based Green Curriculum-2021 (COGC-2021)
Semester-III

Course Title: Principles of Electronic Communication
(Course Code: 4331104)

Diploma programme in which this course is offered	Semester in which offered
Electronics and Communication Engineering	Third

1. RATIONALE

Students of diploma electronics and communication engineering need to have a thorough understanding of fundamental concepts of Electronics and Communication. Diploma students undertaking this course are expected to apply the fundamentals of basic electronic communication system to analyze the different communication (Modulation and Demodulation) methods with its techniques, this basic course develop skills required to learn communication to meet the expectations of the industry.

2. COMPETENCY

The purpose of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- **Maintain Electronic Communication Systems.**

3. COURSE OUTCOMES (COs)

The practical exercises, the underpinning knowledge and the relevant soft skills associated with this competency are to be developed in the student to display the following COs:

a) Distinguish various signals and noise in communication system.
b) Interpret different parameters of analog modulated signals.
c) Describe different analog receivers.
d) Understand sampling theory and waveforms coding techniques.
e) Identify line coding and multiplexing techniques for various applications.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P/2)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	CA	ESE	CA	ESE	
3	0	2	5	30	70	25	25	150

(*): Out of 30 marks under the theory CA, 10 marks are for assessment of the micro-project to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be taken during the semester for the assessing the attainment of the cognitive domain UOs required for the attainment of the COs.

***Legends: L**-Lecture; **T** – Tutorial/Teacher Guided Theory Practice; **P** - Practical; **C** – Credit, **CA** - Continuous Assessment; **ESE** - End Semester Examination.*

5. SUGGESTED PRACTICAL EXERCISES

The following practical outcomes (PrOs) that are the sub-components of the COs. *Some of the **PrOs** marked **'*'** are compulsory, as they are crucial for that particular CO at the 'Precision Level' of Dave's Taxonomy related to 'Psychomotor Domain'*.

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. required
1	Identify and observe different analog and digital signals in time domain and frequency domain using simulator or VLab.		2*
2	Measure amplitude of different sinusoidal frequency signals in frequency domain using Spectrum Analyzer.		2
3	Measure modulation index of an AM envelope.		2*
4	Measure modulation index of an AM envelop by trapezoidal Method.		2
5	Obtain the frequency response of Pre-emphasis and De-emphasis circuit.		2*
6	Determine Modulation Index of Frequency Modulated wave.		2*
7	Locate various sections of AM radio receiver trainer kit and draw the waveforms at input and output side of each section.		2*
8	Locate various sections of FM radio receiver trainer kit and draw the waveforms at input and output side of each section.		2*
9	Check the demodulated AM signal waveform using envelope detector and draw its input output waveform.		2
10	Check the demodulated FM signal waveform using detector and draw its input output waveform.		2
11	Demonstration of fault finding of AM or FM radio receivers.		2
12	Obtain the response of AGC circuit of the radio receiver.		2
13	Based on the sampling frequency, reconstruct the signal.		2*
14	Check the performance PCM system for various sinusoidal Signals		2*
15	Check the performance of PAM system.		2*
16	Check the performance of PWM system.		2
17	Check the performance of PPM system.		2
18	Simulate AM,FM and SSB signal using Simulation software		2*
	Total		**36**

Note

*i. More **Practical Exercises** can be designed and offered by the respective course teacher to develop the industry relevant skills/outcomes to match the COs. The above table is only a suggestive list.*

*ii. The following are some **sample** 'Process' and 'Product' related skills (more may be added/deleted depending on the course) that occur in the above listed **Practical Exercises** of this course required which are embedded in the COs and ultimately the competency..*

S. No.	Sample Performance Indicators for the PrOs	Weightage in %
1	Prepare of experimental setup	20
2	Operate the equipment setup or circuit	20

S. No.	Sample Performance Indicators for the PrOs	Weightage in %
3	Follow safe practices measures	10
4	Record observations correctly	20
5	Interpret the result and conclude	30
Total		**100**

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

This major equipment with broad specifications for the PrOs is a guide to procure them by the administrators to usher in uniformity of practicals in all institutions across the state.

S. No.	Equipment Name with Broad Specifications	PrO. No.
1	RF Signal Generator (10Hz to 100MHz)	2-14
2	Audio Oscillator (20Hz to 20KHz)	2-12
3	CRO 2/3/4 channel (25-100MHz)	2-6,9,10,13-17
4	Spectrum Analyzer	2,4,6-8
5	Digital Multimeter (3-1/2 display)	5,12
6	AC Millivoltmeter	5,12
7	Digital Storage oscilloscope	2-6,9,10,13-17
8	Pulse generator	15-17
9	Trainer Board for different Communication Mod-Demod techniques.	2-17

7. AFFECTIVE DOMAIN OUTCOMES

The following ***sample*** Affective Domain Outcomes (ADOs) are embedded in many of the above mentioned COs and PrOs. More could be added to fulfil the development of this competency.

a) Work as a leader/a team member.
b) Follow safety practices while using electrical appliances.
c) Practice environment friendly methods and processes. (Environment related)

The ADOs are best developed through the laboratory/field based exercises. Moreover, the level of achievement of the ADOs according to Krathwohl's 'Affective Domain Taxonomy' should gradually increase as planned below:

i. 'Valuing Level' in 1st year
ii. 'Organization Level' in 2nd year.
iii. 'Characterization Level' in 3rd year.

8. UNDERPINNING THEORY

Only the major Underpinning Theory is formulated as higher level UOs of *Revised Bloom's taxonomy* in order development of the COs and competency is not missed out by the students
and teachers. If required, more such higher level UOs could be included by the course teacher to focus on attainment of COs and competency.

Unit	Unit Outcomes (UOs) (4 to 6 UOs at Application and above level)	Topics and Sub-topics
Unit – I Basics of Communication System	1a. Describe EM wave spectrum, frequency ranges and its applications. 1b. Represent Sinusoidal, Rectangular, Saw-tooth, Impulse and Pulse waveform. 1c. Describe communication system. 1d. Justify the need for modulation. 1e. Differentiate between analog and digital modulation using waveforms. 1f. Distinguish between external and internal noise and noise sources.	1.1 Electromagnetic (EM) wave spectrum, frequency bands and their applications domain 1.2 Signals and its representation: analog and digital Signal, Pulse, Impulse, Saw-tooth, sinusoidal and rectangular (In Time & frequency domain) 1.3 Block diagram of Analog and Digital communication system 1.4 Modulation: Definition & its classification based on analog & pulse signal as carrier. Concept of digital modulation 1.5 Noise in communication system, classification of noise, signal to noise ratio(S/N) and noise figure
Unit-II Analog Modulation Techniques	2a. Derive the mathematical expression for Double Sideband Full Carrier (DSBFC) Amplitude Modulation (AM) signal 2b. Sketch the frequency spectrum of the DSBFC Amplitude Modulated wave. 2c. Show the mathematical relation between carrier power, modulated signal power and modulation index 2d. Sketch the frequency spectrum of DSBSC and Single sideband (SSB) Amplitude Modulated wave and Pilot carrier 2e. Explain generation of DSBSC signal using balanced modulator circuit. 2h. Define phase modulation and with relevant sketches.	2.1 Mathematical expression, waveform and frequency spectrum for the Double sideband full carrier (DSBFC) Amplitude Modulated wave 2.2 Modulation Index, carrier power, modulated signal power and modulation index 2.3 DSBSC and Single sideband (SSB) frequency spectrum, bandwidth 2.4 Power saving in SSB 2.5 DSBSC signal using balanced modulator circuit. 2.6 Mathematical representation of FM wave, waveforms, Frequency spectrum, Modulation index and Bandwidth of FM 2.7 Mathematical

	2i. Distinguish between Pre-emphasis and De-emphasis 2k. Explain PAM, PWM and PPM signals with definition and waveform.	representation of PM and its waveform 2.8 Compare AM and FM 2.9 Pre-emphasis and De-emphasis 2.10 Generation techniques for FM wave : Phase locked loop FM modulator 2.11 Pulse Modulation techniques: PAM,PWM, PPM
Unit – III Analog Receivers	3a. Define the characteristics of radio receiver 3b. Describe the functions of each block of super heterodyne receiver 3c. Describe AM detection method 3d. Explain functions of various blocks of FM receiver 3e. Explain working of various types of FM demodulator circuits.	3.1 Characteristic of radio receiver, Sensitivity, Selectivity, Fidelity, Image frequency rejection 3.2 Block diagram and working of super heterodyne receiver, IF selection, Image frequency 3.3 Envelope detector using diode 3.4 Block diagram of basic FM receiver 3.5 Basics and types of FM demodulators 3.6 FM demodulator using Phase Locked Loop
Unit IV Sampling theory and waveform coding	4a. State the need for sampling theorem. 4b. Describe the Nyquist criteria, Calculate the sampling frequency for any modulating signal 4c. Effect of Sampling rate 4d. Explain sampling techniques 4e. Define the following: quantization , step - size, resolution, uniform and non- uniform quantizer, Quantization noise, Companding 4g. Describe functions of each block of pulse code modulation (PCM) transmitter and receiver. 4h. Describe effect of noise on PCM signal 4i. Explain delta modulation and adaptive delta modulation 4j. Describe slop overload and granular noise 4k. Differentiate Delta and adaptive delta modulation technique. 4l. Explain working of Differential PCM (DPCM) transmitter and receiver. 4m. Compare the features of PCM, DM,	4.1 Statement and proof of sampling theorem, 4.2 Nyquist rate and interval 4.3 Aliasing error, under sampling, over sampling and critical sampling 4.4 Ideal, Natural and flat top sampling 4.5 Concept of Quantization 4.6 Classification of quantization 4.7 PCM transmitter and receiver 4.8 Advantage, disadvantage and application of PCM 4.9 Block diagram, waveforms, advantage of Delta Modulation 4.10 Disadvantage of DM (slop overload and Granular noise) 4.11 Adaptive Delta Modulation 4.12 Differential PCM 4.13 Comparison between PCM, DM, ADM and DPCM

	ADM and DPCM	
Unit V Line Coding and Multiplexing	5a. Differentiate between bit, symbol & Baud rate 5b. Draw RZ, NRZ (Polar & Unipolar),Manchester coding AMI & HDB-3 signal. 5c. Explain 4 level digital multiplexing hierarchy 5d. Describe TDM frame. 5e. Explain PCM-TDM system	5.1 Bit rate, Baud rate, symbol 5.2 Line coding techniques 5.3 Concept of Time division digital multiplexing, TDM frame 5.4 Block diagram of basic PCM-TDM system

***Note**: The UOs need to be formulated at the 'Application Level' and above of Revised Bloom's Taxonomy' to accelerate the attainment of the COs and the competency.*

9. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A	Total Marks
I	Basics of Communication System	6	6	3	1	10
II	Analog Modulation Techniques	11	6	7	5	18
III	Analog receiver	8	6	4	4	11
IV	Sampling theory and waveform coding	11	6	7	5	21
V	Line Coding and Multiplexing	6	6	3	1	10
Total		**42**	**30**	**24**	**16**	**70**

***Legends:** R=Remember, U=Understand, A=Apply and above (Revised Bloom's taxonomy)*
***Note**: This specification table provides general guidelines to assist student for their learning and to teachers to teach and question paper designers/setters to formulate test items/questions assess the attainment of the UOs. The actual distribution of marks at different taxonomy levels (of R, U and A) in the question paper may vary slightly from above table.*

10. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

a) Prepare specification of electronic components/ICs used in communication system.
b) Give seminar on modulators, demodulators and communication techniques, types and applications.
c) Undertake a survey of different communication methods used in field.

11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a) Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b) Guide student(s) in undertaking micro-projects.
c) ***'L' in section No. 4*** means different types of teaching methods that are to be employed by teachers to develop the outcomes.
d) About ***20% of the topics/sub-topics*** which are relatively simpler or descriptive in nature is to be given to the students for ***self-learning***, but to be assessed using different assessment methods.
e) With respect to ***section No.11***, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
f) Guide students on how to address issues on environment and sustainability
g) Guide students for using data manuals.

12. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her in the beginning of the semester. In the first four semesters, the micro-project are group-based. However, in the fifth and sixth semesters, it should be preferably be ***individually*** undertaken to build up the skill and confidence in every student to become problem solver so that s/he contributes to the projects of the industry. In special situations where groups have to be formed for micro-projects, the number of students in the group should ***not exceed three.***

The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The total duration of the micro-project should not be less than ***16 (sixteen) student engagement hours*** during the course. The student ought to submit micro-project by the end of the semester to develop the industry oriented COs.

A suggestive list of micro-projects is given here. This has to match the competency and the COs. Similar micro-projects could be added by the concerned course teacher:

a) Build AM transmitter circuit using transistor/IC.
b) Demonstrate AM communication System including AM transmitter and receiver.
c) Build FM Transmitter circuit using IC.
d) Demonstrate FM communication System including FM transmitter and receiver.
e) Build a PAM Modulator using 555/OPAMP.
f) Build a PWM Modulator using 555/OPAMP.
g) Build a PPM Modulator using 555/OPAMP.
h) Demonstrate Analog Communication system on Virtual Lab.
i) Visit nearby FM radio station and prepare brief report including Gain, Frequency and Area specifications.
j) Prepare Chart on Different Pulse Modulation techniques.
k) Prepare Chart on Different line coding techniques.

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication with place, year and ISBN
1	Communication systems (Analog and Digital)	Sanjay Sharma	S K Kataria and Sons, 4th Edition KATSON
2	Electronics Communication System (Fundamental to Advance)	Wayen Tomasi	Pearson Education, 5th edition
3	Analog Communication	V.Chandra Sekar	Oxford University Press
4	Electronic Communications Modulation and Transmission	Robert J. Schoenbeck	PHI Learning, 2nd Edition
5	Electronic Communication Systems	George Kennedy and Bernard Davis	Tata McGraw Hill 5th edition or latest
6	Electronics Communication	Dennis Roddy and John Coolen	Pearson Education 4th Edition
7	Digital Communications	Sanjay Sharma	KATSON Books

14. SOFTWARE/LEARNING WEBSITES

a. **Analog communication**
https://nptel.ac.in/courses/117105143

b. **Introduction to Digital Communication**
https://nptel.ac.in/courses/117101051

c. **signals and their properties**
http://ssl-iitg.vlabs.ac.in/Signals%20and%20their%20properties(objectives).html

d. **Sampling Signal reconstruction**
http://ssl-iitg.vlabs.ac.in/Sampling%20and%20signal%20reconstruction%20(objective).html

e. **Amplitude Modulation**
https://www.etti.unibw.de/labalive/index/analogmodulation/

f. **FM transmitter**
https://www.etti.unibw.de/labalive/index/analogmodulation/

g. **FM Signal Spectra**
https://www.etti.unibw.de/labalive/index/analogmodulation/

h. **FM Receiver**
https://www.etti.unibw.de/labalive/index/analogmodulation/

i. **SNR Demonstration**
https://www.etti.unibw.de/labalive/index/analogmodulation/

j. **Quantization**
https://www.etti.unibw.de/labalive/index/analogmodulation/

k. **PAM**
https://www.multisim.com/content/TbNG4WmBH8htyxzRDzkeU8/pulse-amplitude-modulation/open/

l. **PWM**
https://www.falstad.com/circuit/e-555pulsemod.html

m. **PLL FM Modulator**

https://www.researchgate.net/publication/256133199_PLL_Based_High_Frequency_FM_Modulator

n. **PLL FM Demodulator**
https://electronicspost.com/pll-fm-demodulator-phase-locked-loop-fm-demodulator/

15. PO-COMPETENCY-CO MAPPING

Semester I	PEC (Course Code: .....)						
	Pos						
Competency & Course Outcomes	PO 1 Basic & Discipline specific knowledge	PO 2 Problem Analysis	PO 3 Design/ development of solutions	PO 4 Engineering Tools, Experimentation &Testing	PO 5 Engineering practices for society, sustainability & environment	PO 6 Project Management	PO 7 Life-long learning
Competency *"Maintain Electronic Communication Systems."*							
CO a) Distinguish various signals and noise in communication system.	3	2	2	2	1	-	2
CO b) Interpret different parameters of analog modulated signals.	3	3	2	3	2	1	3
CO c) Describe different analog receivers.	3	1	2	2	2	1	3
CO d) Understand sampling theory and waveforms coding techniques.	3	2	1	2	2	1	3
CO e) Identify line coding and multiplexing techniques for various applications.	2	2	1	2	1	-	2

Legend: '**3**' for high, '**2**' for medium, '**1**' for low or '**-**' for the relevant correlation of each competency, CO, with PO/ PSO

16. COURSE CURRICULUM DEVELOPMENT COMMITTEE

GTU Resource Persons

S. No.	Name and Designation	Institute	Contact No.	Email
1	M.N Charel HOD EC Dept.	Government Polytechnic, Ahmedabad	-	manishcharel@yahoo.com
2	K J Pithadiya	BBIT	9898491548	kunalpithadiya1@gmail.com
3				
4				

BoS Resource Persons

Sr. No.	Name and Designation	Institute	Contact No.	Email
1.	Dr. A S Pandya, Principal BoS Chairman Electrical & Allied	AVPTI, Rajkot	9426201171	aspandya22@rediffmail.com

Sr. No.	Name and Designation	Institute	Contact No.	Email
	Branches			
2.	Dr. S N Sampat i/c Principal BoS Member-EC	GGP, Surat	9033777389	snsampat@gmail.com
3.	Shri U V Buch, LEC BoS Member-EC	GP A'bad	9825346922	uvbuch@gmail.com