Program Name : **Electronics & Tele-Communication Engineering, Electronics, Electronics & Communication Engineering, Electronics Engg. and Electronics & Communication Technology**

Program Code : **EJ/ET/EN/EX/EQ**

Semester : **Third**

Course Title : **Principles of Electronics Communication**

Course Code : **22334**

1. RATIONALE

In the 21st century electronic communication plays vital role in every aspect of human life. Diploma Engineers (also called technologists) have to deal with the various electronic communication circuits while maintaining electronics communication systems. The study of basic operating principles and handling of various electronics communication system will help them to troubleshoot and maintain electronics communication systems used for various type of communication. This course is developed in such a way that, students will be able to apply the domain knowledge to solve broad communication engineering application problems in electronic communication engineering field.

2. COMPETENCY

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

- **Maintain basic Electronic Communication Systems.**

3. COURSE OUTCOMES (COs)

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:

a. Use relevant frequency range for different communication systems.
b. Use relevant modulation technique for the specified application.
c. Maintain transmitter and receiver circuits of AM and FM.
d. Use relevant media for transmission and reception of signals.
e. Use relevant type of antenna for various applications.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme			Credit (L+T+P)	Examination Scheme											
				Theory						Practical					
L	T	P		Paper Hrs.	ESE		PA		Total		ESE		PA		Total	
					Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
4	-	2	6	3	70	28	30*	00	100	40	25@	10	25	10	50	20

(*): Under the theory PA, Out of 30 marks, 10 marks are for micro-project assessment to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be taken during the semester for the assessment 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,* ***ESE*** *- End Semester Examination;* ***PA*** *- Progressive Assessment*

5. COURSE MAP (with sample COs, PrOs, UOs, ADOs and topics)

This course map illustrates an overview of the flow and linkages of the topics at various levels of outcomes (details in subsequent sections) to be attained by the student by the end of the course, in all domains of learning in terms of the industry/employer identified competency depicted at the centre of this map.

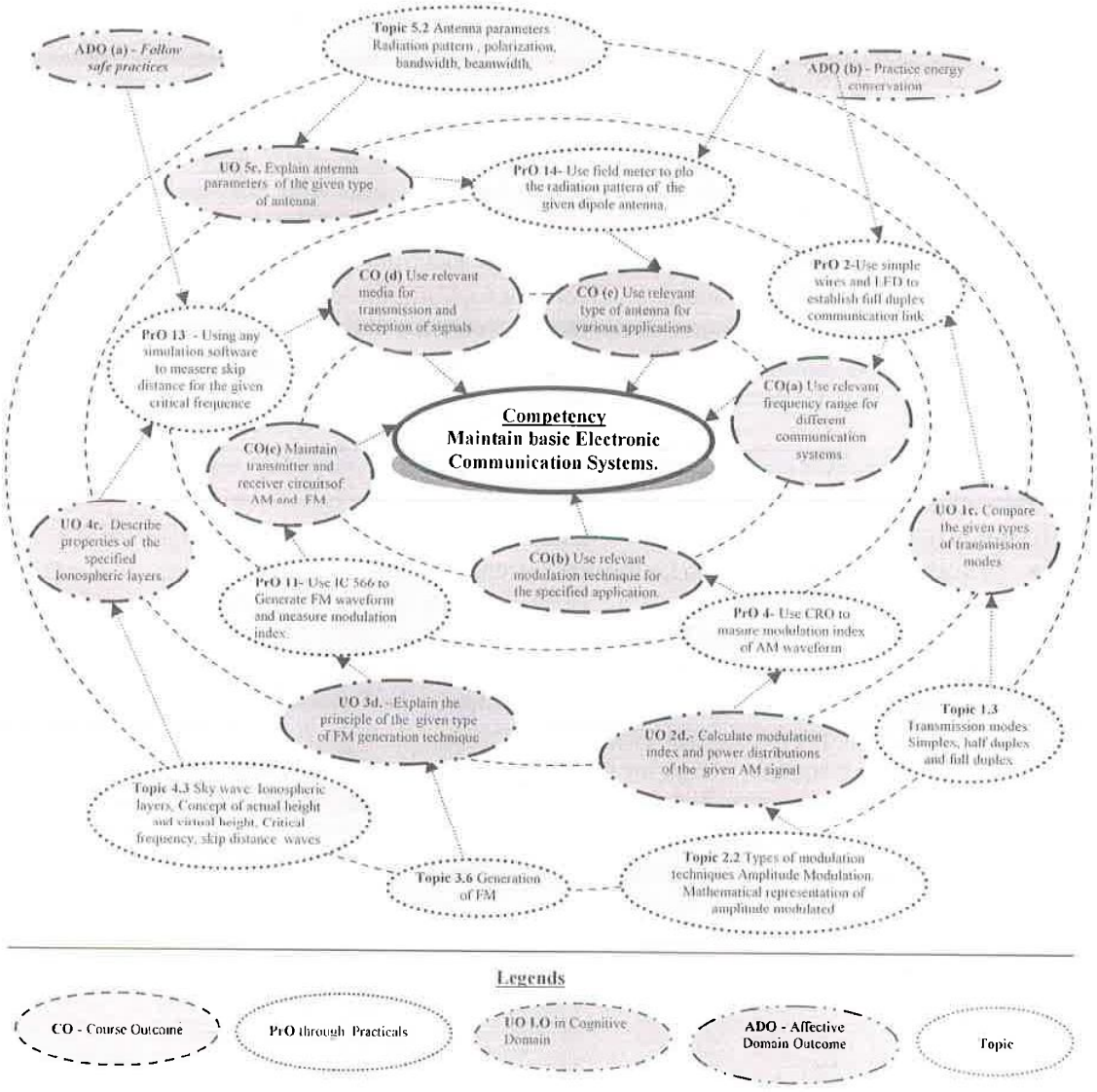

Figure 1 - Course Map

6. SUGGESTED PRACTICALS/ EXERCISES

The practicals in this section are PrOs (i.e. sub-components of the COs) to be developed and assessed in the student for the attainment of the competency.

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
1	Use simple wires, switches and LEDs to establish simplex and half duplex communication link	I	02
2	Use simple wires, switches and LEDs to establish full duplex communication link	I	02
3	Observe the AM modulated waveforms generated for different carrier frequencies.	II	02
4	Generate AM wave and measure its modulation index .	II	02*
5	Use any simulation software to generate AM wave.	II	02
6	Use voltage controlled oscillator to generate FM wave and measure the frequency deviation.	II	02
7	Generate FM wave and measure its modulation index.	II	02
8	Use any simulation software to generate FM wave.	II	02*
9	Use AM demodulator circuit to detect the received AM signal.	III	02*
10	Use IC 566 to generate FM waveform and measure modulation index	III	02
11	Use IC 564 / IC 565for FM demodulation and trace it's input and output waveforms.	III	02
12	Use any simulation software to measure 1. MUF for the given critical frequency and incident angle. 2. Radio horizon for given height of transmitting and receiving antenna	IV	02*
13	Use field meter to plot the radiation pattern of the given dipole antenna.	V	02*
14	Use field meter to plot the radiation pattern of given Yagi-Uda antenna.	V	02
15	Use any simulation software to plot radiation pattern of the given type of antenna.	V	02
	Total		**30**

Note

*i. A suggestive list of **PrOs** is given in the above table. More such PrOs can be added to attain the COs and competency. A judicial mix of minimum 12 or more practical need to be performed, out of which, the practicals marked as '*' are compulsory, so that the student reaches the 'Precision Level' of Dave's 'Psychomotor Domain Taxonomy' as generally required by the industry.*

ii. The 'Process' and 'Product' related skills associated with each PrO is to be assessed according to a suggested sample given below:

S. No.	Performance Indicators	Weightage in %
1	Preparation of experimental set up	20
2	Setting and operation	20

S. No.	Performance Indicators	Weightage in %
3	Safety measures	10
4	Observations and Recording	10
5	Interpretation of result and Conclusion	20
6	Answer to sample questions	10
7	Submission of report in time	10
	Total	**100**

The above PrOs also comprise of the following social skills/attitudes which are Affective Domain Outcomes (ADOs) that are best developed through the laboratory/field based experiences:

a. Follow safety practices.
b. Practice good housekeeping.
c. Demonstrate working as a leader/a team member.
d. Maintain tools and equipment.
e. Follow ethical practices.

The ADOs are not specific to any one PrO, but are embedded in many PrOs. Hence, the acquisition of the ADOs takes place gradually in the student when s/he undertakes a series of practical experiences over a period of time. Moreover, the level of achievement of the ADOs according to Krathwohl's 'Affective Domain Taxonomy' should gradually increase as planned below:

- 'Valuing Level' in 1st year
- 'Organising Level' in 2nd year
- 'Characterising Level' in 3rd year.

7. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

The major equipment with broad specification mentioned here will usher in uniformity in conduct of experiments, as well as aid to procure equipment by authorities concerned.

S. No.	Equipment Name with Broad Specifications	PrO. S. No.
1	Cathode Ray Oscilloscope Dual Trace 20Mhz, 1MegaΩ Input Impedance	3 to12
2	RF signal generator with Wide frequency range 100 KHz to 150 MHz Fine frequency adjustment by calibrated dial built in audio frequency generator	3 to12
3	DSO with Bandwidth : 50/100MHz TFT Colour LCD Dual Channel Real Time Sampling: 1GSa/s Equivalent Sampling 25GSa/s Memory 1M pts 10 Waveforms & 10 Setups can be stored	3 to12
4	Regulated power supply: DC Supply Voltages Dual DC : 2 x 0 - 30V;0-2 A Automatic Overload (Current Protection) Constant Voltage & Constant Current Operation	1-12
5	AM trainer kit for DSB/SSB AM modulation and demodulation	3,4
6	Digital Multimeter : 3 1/2 digit display, 9999 counts digital multimeter measures: V_{ac}, V_{dc} (1000V max) , A_{dc}, A_{ac} (10 amp max) , Resistance (0 - 100 MΩ) , Capacitance and Temperature measurement	3 to12
7	FM trainer kit for FM modulation and demodulation	3
8	Trainer kit for FM modulator using IC566: AC Source: 600Hz to 2.5 KHz. FM Modulator : VCO Test Points , circuit diagram engraved on front panel with transparent rear panel	6.7.10, 11

S. No.	Equipment Name with Broad Specifications	PrO. S. No.
9	Trainer kit for FM demodulator using IC 564: AC Source: 600Hz to 2.5 KHz.FM Demodulator :PLL Test Points	12
10	Antenna trainer kit:for dipole and yagi-uda antenna, mobile antenna,omindirection antenna, horn antenna and other common type of antennas	14,15
11	Software for program : SCILAB,MATLAB ,TINA PRO.	5,8,13,16
12	Simulation software suitable for communication experiments .	5,8, 13,16

8. UNDERPINNING THEORY COMPONENTS

The following topics/subtopics should be taught and assessed in order to develop UOs in cognitive domain for achieving the COs to attain the identified competency.

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Unit – I Basics of Electronic Communication	1a. Interpret the working of the given block of basic electronic communication system. 1b. Identify the relevant frequency band of electromagnetic spectrum for the specified application with justification. 1c. Compare features of the given types of transmission modes. 1d. Differentiate properties of the given types of noise.	1.1 The elements of basic electronic communication system 1.2 Electromagnetic spectrum 1.3 Transmission modes: Simplex, half duplex and full duplex, Synchronous and Asynchronous 1.4 Sources of Noise (internal and external), signal to noise ratio

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Unit – II AM and FM Modulation	2a. Interpret necessity of the given type of modulation technique . 2b. Compare the working of the given type of AM generation technique. 2c. Describe with sketches the given parameters of AM signal. 2d. Calculate modulation index and power distributions of the given AM signal. 2e. Describe with sketches the specified parameters of FM and PM signal. 2f. Determine the modulation index of given FM signal.	2.1 Need for modulation 2.2 Types of modulation techniques Amplitude Modulation: Mathematical representation of amplitude modulated wave, modulation index, bandwidth requirement , representation of AM signal in time and frequency domain. types of AM with respect to frequency spectrum (DSB, SSB and VSB), Power relations in AM wave 2.3 Frequency Modulation: representation of FM signal in time domain and frequency domain , frequency deviation ratio, modulation index(β), mathematical representation of FM, bandwidth requirement, types of frequency modulation (NB and WBFM) 2.4 Phase Modulation
Unit– III Transmitters and Receivers	3a. Explain with sketches the working of the given type of AM generation technique. 3b. Explain the function of the given blocks of AM super heterodyne receiver. 3c. Explain with sketches the given types of AM demodulation technique. 3d. Explain with sketches principle of the given type of FM generation technique. 3e. Compare the working of the given types of FM detectors.	3.1 Generation of AM 3.2 Block diagram of AM super heterodyne receiver and its working with waveforms 3.3 Demodulation of AM signal: Diode detector and practical diode detector 3.4 Automatic gain control and its types. 3.5 Concept of pre-emphasis and De-emphasis 3.6 Generation of FM using direct (varactor diode and reactance modulator) and indirect method (Armstrong method) 3.7 Block diagram of FM receiver and its working with waveforms 3.8 FM detector circuits: Ratio detector and PLL as FM demodulator
Unit– IV Wave Propagation	4a. Describe the properties of the given types of electromagnetic waves. 4b. Describe with sketches propagation mode of the given type of radio wave.	4.1 Concept of propagation of radio waves 4.2 Ground Wave propagation 4.3 Sky wave: Ionospheric layers, Concept of actual height and virtual height, Critical frequency, skip

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
	4c. Describe properties of the specified Ionospheric layer. 4d. Explain parameters and properties of the given types of wave propagation. 4e. For the given application, identify the type of wave propogation to be used with justification.	distance , skip zone, concept of fading, maximum usable frequency, multiple hop sky wave propagation 4.4 Space Wave propagation : line of sight, multipath space wave propagation , optical and radio horizon, shadow zones 4.5 Duct propagation (microwave space-wave propogation) 4.6 Troposphere scatter propagation.
Unit– V Antennas	5a. Explain with sketches the working principle of the given type of antenna. 5b. Compare with sketches working of the given type of antenna on the basis of radiation pattern. 5c. Explain antenna parameters of the given type of antenna. 5d. Choose type of antenna required with broad specification for the given applications.	5.1 Antenna fundamentals :Resonant antenna and Non-resonant antennas 5.2 Antenna parameters : Radiation pattern , polarization, bandwidth, beamwidth, antenna resistance, directivity and power gain, antenna gain 5.3 Dipole antenna: Half wave dipole antenna (Resonant Antenna) and its Radiation pattern. Folded dipole antenna and its radiation pattern, Radiation pattern for Dipole Antenna of different length 5.4 Loop antenna, Telescopic antenna, Yagi-Uda antenna, Micro wave antenna – Dish antenna, Horn antenna and Micro-strip patch antenna ,rectangular, square and circular (Structure, radiation pattern and application of antennas)

***Note**: To attain the COs and competency, above listed UOs need to be undertaken to achieve the 'Application Level' and above of Bloom's 'Cognitive Domain Taxonomy'.*

9. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Basics of Electronic Communication	08	4	4	4	12
II	AM and FM Modulation	16	4	6	8	18
III	Transmitters and Receivers	16	2	6	6	14
IV	Wave propagation	10	4	4	6	14
V	Antennas	14	4	4	4	12
Total		**64**	**18**	**24**	**28**	**70**

Legends: *R=Remember, U=Understand, A=Apply and above (Bloom's Revised taxonomy)*
Note*: This specification table provides general guidelines to assist student for their learning and to teachers to teach and assess students with respect to attainment of UOs. The actual distribution of marks at different taxonomy levels (of R, U and A) in the question paper may vary 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 chart for electromagnetic spectrum.
b. Give seminar on any relevant topic related to electronic communication medium.
c. Library survey regarding different communication books and manuals.
d. Prepare power point presentation for recent communication applications.
e. Undertake a market survey of different communication devices.
f. Visit radio transmitter station.
g. Visit auditorium near your campus and make layout of PA system.

11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

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

a. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b. ***'L' in item No. 4*** does not mean only the traditional lecture method, but different types of teaching methods and media that are to be employed to develop the outcomes.
c. About ***15-20% of the topics/sub-topics*** which is relatively simpler or descriptive in nature is to be given to the students for ***self-directed learning*** and assess the development of the COs through classroom presentations (see implementation guideline for details).
d. With respect to item No.10, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
e. Guide student(s) in undertaking micro-projects.
f. Demonstrate students thoroughly before they start doing the practice.
g. Encourage students to refer different websites to have deeper understanding of the subject.
h. Observe continuously and monitor the performance of students in Lab.
i. Arrange visit for students to make clear certain communication concepts.

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.
Micro project report may be of four to five pages.

A suggestive list of micro-projects is given here. Similar micro-projects could be added by the concerned faculty:

a. **Modulation:** Build a circuit for modulation using IC MC1496/8038 on general purpose PCB and prepare the report.
b. **FM transmitter:** Build a circuit on general purpose PCB for FM transmitter using IC 8038/ transistor BF549 and prepare a report.
c. Find **different channels frequencies** associated with Am and FM stations.
d. **Antenna**: Simulate a microstrip patch antenna for frequency 2.4GHz frequency using HFSS (high frequency structure simulator) software.
e. **Tuning of IFT:** Build a circuit on general purpose PCB for tuning IFT at 455KHz.

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	Electronic Communication Systems	Kennedy George; Davis Bernard; Prasanna SRM	Mc-Graw Hill 5th Edition, New Delhi,2011, ISBN : 9780071077828
2	Principles of Electronics Communication system	Frenzel Louis E.	Mc-Graw Hill 5th Edition, New Delhi,2007, ISBN : 9780073222783
3	Electronic communication system: Fundamentals Through Advanced	Tomasi W.	Pearson Education India, New Delhi, 4th Edition, 2001, ISBN: 9780130221254
4	Antenna Theory: Analysis and Design	Constantine A. Balanis	Wiley-Student edition India,New Delhi, 2015-16, ISBN: 9788126524228
5	Audio and video systems principals, maintenance and troubleshooting	Gupta R.G.	Tata McGraw Hill,New Delhi, 2010, ISBN : 9780070699762

14. SUGGESTED SOFTWARE/LEARNING WEBSITES

a. www. turbofuture.com/industrial/Elements-of-Electronic-Communications-System
b. www.st-andrews.ac.uk/~www_pa/Scots_Guide/iandm/part3/page1.html
c. www.antenna-theory.com/basics/main.php
d. www.explainthatstuff.com/antennas.html
e. www.circuitdiagram.org/am-radio-receiver-with-mk484.html
f. www.circuitstoday.com/single-chip-fm-radio-circuit