

GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)

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

Semester-V

Course Title: Mobile & Wireless Communication

(Course Code: 4351104)

Diploma program in which this course is offered	Semester in which offered
Electronics and Communication Engineering	5 th semester

1. RATIONALE

The mobile communication has seen an exponential growth over the years. Not only that, but there are different technologies, such as GSM and CDMA with their variations and the 5th generation mobile technology is the latest one. This scenario demands the need for more skilled technicians for operation, maintenance and servicing of mobile cellular systems. Also wireless connectivity provides mobility, flexibility to the users, so it is necessary to understand different wireless technologies. This course gives the opportunity to the students to learn the fundamentals of these technologies, which they will find in the workplace. Hence this course is designed to maintain various types of mobile communication systems and wireless technologies.

2. COMPETENCY

The course content should be taught and with the aim to develop different types of skills, So that students are able to acquire following competency:

Maintain mobile communication systems and establish wireless network.

3. COURSEOUTCOMES(COs)

The practical exercises, the underpinning knowledge and the relevant soft skills associated with the identified competency are to be developed in the student for the achievement of the following COs:

- i. Identify different standards of mobile communication systems.
- ii. Maintain Global System for Mobile (GSM) systems.
- iii. Troubleshoot GSM mobile handsets.
- iv. Test the functionality of spread spectrum based cellular systems.
- v. Test the functionality of various advanced wireless standards and wireless technologies.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P/2)	Examination Scheme				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	CA	ESE	CA	ESE	
3	0	2	4	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 of 11 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

Following practical outcomes (PrOs) are the sub-components of the Course Outcomes (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’.

Sr. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
1	To Analyze cluster and frequency reuse technique.	1	2
2	Measure network information using android applications like signal strength checker, network monitor, network signal info.	3	2*
3	To explore various blocks and working of GSM mobile phone handset.	3	2*
4	To demonstrate general fault finding procedure in GSM mobile handset.	3	2*
5	To measure Test Point Voltages on different parts of GSM Mobile Trainer Kit.	2	2
6	To Analyze Direct Sequence Spread Spectrum (CDMA) and single Channel CDMA multiplexing.	4	2*
7	To Analyze Two Channel CDMA multiplexing.	4	2
8	To analyze the RF waveforms using spectrum analyzer.	2	2
9	To demonstrate blue tooth applications using btprox software.	5	2
10	To generate and observe PN signal using software or trainer board.	4	2*
11	To use mobile as GPRS modem through cable & via Bluetooth.	2	2
12	To study and observe OFDM signal using software codes (Matlab).	5	2
13	To transmit a message using at command from microcontroller to a mobile (Serial communication).	2	2
14	To prepare wireless ADHOC network.	5	2*
15	Build a personal area network using Bluetooth.	5	2
16	Analyze RFID based systems like Fastag.	5	2*

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s 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.

The following are some **sample** ‘Process’ and ‘Product’ related skills (more maybe 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
3	Follow safe practices measures.	10
4	Record observations correctly	20
5	Interpret the result and conclude	30
Total		100

6. Major Equipments, Tools and Consumables Required

These major equipments with broad specifications for the PrOs are a guide to procure them by the administrators to user in uniformity of practical's in all institutions across the state.

Sr. No.	Equipment Name with Broad Specifications	PrO.No.
1.	Digital Multi meter: 3 1/2 digit display, digital multimeter measures: Vac, Vdc, A _{dc} , A _{ac} , Resistance , Capacitance, hfe etc.	5
2.	Cathode Ray Oscilloscope (CRO) Dual channel 100 MHz	6, 7,10
3.	Spectrum Analyzer For signals with frequency range used in mobile communication	8
4.	GSM Trainer Dual band 900 / 1800 MHz GSM / GPRS Modem. Up to 2-3 GHz capture bandwidth RS-232 & USB connector for PC Communication	5
5.	CDMA trainer AC, DC Power Supply Input- AC 220V ±10% Output-DC ±12V ±5%, CDMA Spread spectrum code speed-100kbit/s, 200kbit/s etc. Spread spectrum gain- 50, 100 etc. Spread spectrum mode- Direct spread spectrum	6, 7
6.	Mobile Handset Trainer GSM based handset trainer with fault creation and test points. GSM capability : GSM 900/1800	3, 4
7.	PN sequence generator training board.	10
8.	Digital storage oscillator- 100MHz.	6, 7, 10

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 fulfill the development of this course competency.

- a) Work as a leader/a team member.
- b) Follow safety practices while using electrical, electronic instruments and tools.
- c) Follow ethical practices

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

The major underpinning theory is given below based on the higher level UOs of *Revised Bloom's taxonomy* that are formulated for development of the COs and competency. If required, more such UOs could be included by the course teacher to focus on attainment of Cos and competency.

Unit	Unit Outcomes (UOs)	Topics and Sub-topics
Unit – I Fundamental of Cellular Communication	1a. Describe evolution of cellular communication -1G to 5G. 1b. Explain the basic cellular concept and cellular system. 1c. Describe cell shape selection and explain macro, micro, pico, selective and umbrella cell. 1d. Explain concept of cluster, frequency re-use and system capacity. 1e. Discuss the impact of Co- channel and adjacent channel interference. 1f. Explain the fixed, dynamic and hybrid channel assignment strategies. 1g. Differentiate cell splitting and cell sectoring. 1h. Define handoff and differentiate hard and soft, intra and intersystem handoff.	1.1 Evolution of Cellular communication - 1G to 5G 1.2 Basic cellular concept and cellular system. 1.3 Cell shape selection and type of cell: macro, micro, pico, selective and umbrella cell. 1.4 Cluster concept, frequency reuse and system capacity. 1.5 Co-channel and adjacent channel interference 1.6 Channel assignment strategies 1.7 Enhancing coverage and capacity of cellular system: cell splitting and cell sectoring. 1.8 Handoff : soft and hard, inter and intra system, MAHO(mobile assisted handoff)
Unit– II GSM Networks and its evolutions	2a. Explain functions of various blocks of GSM system architecture. 2b. List GSM 900 specifications 2c. Classify the GSM traffic channel and Control channel. 2d. Describe location updating procedure. 2e. Explain call origination (mobile to landline), call termination (landline to mobile) with the help of line diagram. 2f. Explain frequency hopping. 2g. Explain block diagram of signal processing in GSM. 2h. Explain working of GPRS with the help of suitable block diagram. 2i. Explain EDGE- Enhanced Data rate for Global Evolution. 2j. Explain functional importance of IMSI, IMEI, MSISDN, TMSI, MSRN, LAI and BSIC.	2.1 GSM architecture 2.2 GSM 900 system specification 2.3 GSM channel Classification (List and use only) 2.4 GSM call Procedure 2.5 Concept of authentication and ciphering. 2.6 Frequency hopping: Fast and Slow. 2.7 Block diagram of Signal processing in GSM. 2.8 GPRS- General Packet Radio Service: Block diagram, applications 2.9 EDGE- Enhanced Data rate for Global Evolution. 2.10 GSM Identifier: IMSI, IMEI, TMSI, MSISDN, LAI and BSIC

Unit–III Mobile Handset	3a. Explain the block diagram of mobile handset. 3b. Explain block diagram of baseband section. 3c. Describe working function of charging control section. 3d. Explain types of batteries used for mobile communication and their importance. 3e. Explain the subscriber identity module (SIM) pin connection. 3f. Discuss the SIM card interface. 3g. Explain the effect of radiation hazards due to mobile and SAR.	3.1 Mobile handset: block diagram. 3.2 Baseband section: block diagram 3.3 Charging control section. 3.4 Batteries. 3.5 SIM card and SIM card interface. 3.6 Radiation hazards due to Mobile, SAR
Unit– IV Spread spectrum techniques and its evolution	4a. Explain the concept of spread spectrum. 4b. State the criteria and application of spread spectrum. 4c. Explain DSSS and FHSS. 4d. Explain CDMA and list advantages of CDMA 4e. Describe mode of call processing in CDMA. 4f. List key features of CDMA standards: IS-95, CDMA2000 AND WCDMA. 4g. Explain High speed downlink packet access (HSDPA).	4.1 Concept of Spread spectrum, its criteria and applications. 4.2 Types of spread spectrum technique <ul style="list-style-type: none"> • DSSS- Direct sequence spread spectrum • FHSS- Frequency hopping spread spectrum 4.3 CDMA 4.4 Advantages of CDMA 4.5 compare CDMA and GSM 4.6 Call Processing in CDMA. 4.7 Key features of CDMA standards: IS-95, CDMA2000 and WCDMA. 4.8 High speed downlink packet access (HSDPA).
Unit-V Advance wireless standards and wireless technologies	5a. Explain the OFDM with the help of suitable block diagram. 5b. Explain MIMO system. 5c. Describe long term evolution and all IP networks 5d. Explain system architecture of 5G system. 5e. List advantages of 5G. 5f. Describe various wireless technologies in brief with applications: Bluetooth, RFID, ZIBEE, MANET.	5.1 4 th Generation technology: OFDM, MIMO, LTE. 5.2 5G –system Architecture and Advantages of 5G 5.3 Bluetooth: Architecture, features and advantages, applications. 5.4 RFID: Basic concept, types of RFID, advantages, applications 5.5 ZIGBEE: Basic concept, features and advantages. 5.6 Mobile Adhoc Network (MANET): Basic concept, advantages, disadvantages, comparison with cellular network.

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	Fundamental of Cellular Communication	9	06	06	04	16
II	GSM Networks and its evolutions	11	06	08	04	18
III	Mobile Handset	5	02	04	02	8
IV	Spread spectrum techniques and its evolution	8	04	06	04	14
V	Advance wireless standards and wireless technologies	9	04	08	02	14

Legends: R=Remember, U=Understand, A=Apply and above (Revised Bloom's taxonomy)

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 perform following activities in group and prepare reports of about 5 pages for each activity. They should also collect/record physical evidences for their (student's) portfolio which may be useful for their placement interviews:

- Industrial visit to BTS site or MSC.
- Workshop on mobile repair by service technician of any mobile repairing centre.
- To explore websites to understand repairing of various mobile handsets.
- To visit sites, where wireless technology based applications are used/designed.

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:

- Massive open online courses (**MOOCs**) may be used to teach various topics/subtopics.
- Guide student(s) in under taking micro-projects.
- 'L' in section No.4** means different types of teaching methods that are to be employed by teachers to develop the outcomes.
- 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.
- With respect to **section No.10**, teachers need to ensure to create opportunities and provisions for **co-curricular activities**.
- Guide students for reading datasheets.
- Motivate student to install and use different wireless technologies.

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-projects are group-based (group of 3 to 5). However, **in the fifth and sixth semesters**, 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 duration of the micro project should be about 14-

16 (fourteen to sixteen) student engagement hours during the course. The students 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:

- Seminar on recent and upcoming trends in Wireless technology.
- Poster preparation for recent advances in wireless networks.
- Seminar on analysis of recent mobile operating system technologies.
- Poster preparation for recent mobile phone architectures.

13. SUGGESTED LEARNING RESOURCES

Sr. No.	Title of Book	Author	Publication with place, year and ISBN
1	Wireless communication principle & Practice	Rapport T.S	PHI Learning, New Delhi, (Latest Edition)
2	Mobile and Personal Communication System and Servicing	Pandya Raj	IEEE
3	Mobile Communication	Lee C. Y.	Pearson, New Delhi
4	Wireless communication	Dalal Upena	OXFORD New Delhi
5	Advance Mobile Repairing	Pandit Sanjib	BPB
6	Related IEEE/IEE publication		

14. SOFTWARE/LEARNING WEBSITES

- www.nptel.iitm.ac.in
- www.academia.edu
- www.larnerstv.com
- <https://www.3gpp.org/technologies/5g-system-overview>
- www.mathwork.com

15. PO-COMPETENCY-COMAPPING

Semester V	Mobile & Wireless Communication (Course Code: 4351104)						
	POs						
Competency & Course Outcomes	PO1 Basic & Discipline specific knowledge	PO2 Problem Analysis	PO3 Design/development of solutions	PO4 Engineering Tools, Experimentation & Testing	PO5 Engineering Practices for society, Sustainability & environment	PO6 Project Management	PO7 Life-long learning
Competency	Maintain mobile communication systems and establish wireless network.						
Course Outcomes	3	1	1	2	1	2	3
CO1) Identify different standards of mobile communication systems							

CO2) Maintain Global System for Mobile (GSM) systems.	3	2	2	2	2	2	3
CO3) Troubleshoot GSM mobile handsets.	3	3	3	3	2	3	2
CO4) Test the functionality of spread spectrum based cellular systems.	2	2	1	1	1	1	2
CO5) Test the functionality of various advanced wireless standards and wireless technologies.	3	2	2	2	2	2	2

Legend: '3' for high, '2' for medium, '1' for low and '-' for no correlation of each CO with PO.

16. COURSE CURRICULUM DEVELOPMENT COMMITTEE

GTU Resource Persons

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