WIRELESS & MOBILE COMMUNICATION **Course Code : 316336**

Programme Name/s : **Electrical and Electronics Engineering/ Electronics & Computer Engg.**
Programme Code : **EK/ TE**
Semester : **Sixth**
Course Title : **WIRELESS & MOBILE COMMUNICATION**
Course Code : **316336**

I. RATIONALE

The next generation of mobile communications technology, has already begun to bring various services to consumers and businesses. This course will be one of the most important drivers of industry, economic and societal growth, generating millions of new jobs. Through this course, students will get an opportunity to develop skills to handle the latest wireless and mobile communication systems

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

The aim of this course is to help the student to attain the following industry/employer expected outcome through various teaching learning experiences: "Maintain wireless and mobile communication system."

III. COURSE LEVEL LEARNING OUTCOMES (COS)

Students will be able to achieve & demonstrate the following COs on completion of course based learning

- CO1 - Interpret the working of various blocks of the Mobile Communication system.
- CO2 - Analyse GSM and 4G mobile standards.
- CO3 - Interpret 5G and 6G architecture.
- CO4 - Maintain Adhoc networks.
- CO5 - Use relevant wireless technology suitable for various applications.

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme					Credits	Assessment Scheme											
				Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory				Based on LL & TL				Based on SL		Total Marks
															Practical						
				CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
											Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
316336	WIRELESS & MOBILE COMMUNICATION	WMC	DSE	4	-	2	2	8	4	3	30	70	100	40	25	10	25#	10	25	10	175

Total IKS Hrs for Sem. : 0 Hrs
Abbreviations: CL- ClassRoom Learning , TL- Tutorial Learning, LL-Laboratory Learning, SLH-Self Learning Hours, NLH-Notional Learning Hours, FA - Formative Assessment, SA -Summative assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment
Legends: @ Internal Assessment, # External Assessment, *# On Line Examination , @$ Internal Online Examination
Note :

1. FA-TH represents average of two class tests of 30 marks each conducted during the semester.
2. If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester.
3. If candidate is not securing minimum passing marks in SLA of any course then the candidate shall be declared as fail and will have to repeat and resubmit SLA work.
4. Notional Learning hours for the semester are (CL+LL+TL+SL)hrs.* 15 Weeks
5. 1 credit is equivalent to 30 Notional hrs.
6. * Self learning hours shall not be reflected in the Time Table.
7. * Self learning includes micro project / assignment / other activities.

V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

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Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
1	TLO 1.1 Explain block diagram of Mobile Communication System. TLO 1.2 Draw block diagram of 5G enabled Smartphone. TLO 1.3 Describe the given Terms with respect to Cellular systems. TLO 1.4 Explain the Cellular concept used for mobile communication system. TLO 1.5 Describe the various interference occurring in cellular system. TLO 1.6 Describe method to improve coverage and system capacity of the cellular system.	**Unit - I Basics of Mobile Communication System.** 1.1 Basic Block diagram of Mobile Communication System. 1.2 Block diagram of 5G enabled Smartphone. 1.3 Cellular fundamentals :cell, cell structure, cluster, reuse factor, minimum reuse distance. 1.4 Basic cellular system : mobile station, base station, traffic channel (Forward and Reverse) , control channel (Forward and Reverse), frequency reuse, channel assignment strategies. 1.5 Interference : Co-Channel interference, Adjacent Channel Interference. 1.6 Improving Coverage and capacity in cellular systems: Cell splitting, Sectoring, Microcell Zone concept. Repeaters for range extension.	Lecture Using Chalk-Board Video Demonstrations Assignments Brain Storming Session
2	TLO 2.1 Describe GSM architecture with sketch. TLO 2.2 Interpret call routing process in GSM. TLO 2.3 Describe LTE(4G) Network architecture with relevant sketch. TLO 2.4 Describe multiple-input, multiple-output (MIMO)antenna system. TLO 2.5 Analyse 3GPP services.	**Unit - II Fundamentals of Global System for Mobile communication (GSM) and 4G Communication.** 2.1 Global System for Mobile Communication(GSM): Architecture,Features and service aspect, GSM radio aspect ,channel types. 2.2 GSM call routing, mobile originated call sequence,Mobile terminated call and stages of call processing in GSM. 2.3 LTE enabler Technologies:LTE(4G)Network Architecture including eNodeB,MME,SGW,PGW,HSS, PDN. 2.4 Basics of MIMO. Massive MIMO (Advanced Antenna Systems - AAS)Definition,diagram,benefits, Beamforming. 2.5 Introduction to 3GPP Release 18 List of services.	Lecture Using Chalk-Board Video Demonstrations Assignment Presentations
3	TLO 3.1 Describe 5G network architecture and 5G enable technologies. TLO 3.2 List IMT 2020 standards. TLO 3.3 Elaborate 5G Radio spectrum. TLO 3.4 Explain 5G network slicing. TLO 3.5 Describe basic concepts of 6G. TLO 3.6 List Advantages of 6G over 5G. TLO 3.7 Compare 3G ,4G , 5G, 5.5G ,6G.	**Unit - III Introduction to 5G and 6G.** 3.1 Introduction to 5G: 5G network architecture, 5G enable technologies. 3.2 IMT2020 standards. 3.3 5G Radio spectrum : low band, medium band,millimeterwave(Ultrahigh) band,5G service providers. 3.4 5G network slicing. 3.5 Basics of 6G -frequency bands, features and applications of 6G. 3.6 Advantages of 6G over 5G. 3.7 Compare 3G,4G,5G,5.5G,6G.	Lecture Using Chalk-Board Video Demonstrations Presentations Flipped Classroom

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Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
4	TLO 4.1 Describe the Components of a Wireless Network. TLO 4.2 Describe Wi-Fi and its different modes. TLO 4.3 State features of Wi-Fi 6E(6GHz). TLO 4.4 State challenges of Wi-Fi 6E(6GHz). TLO 4.5 Interpret Wi max. TLO 4.6 Differentiate between Wi-Fi vs Wi max.	**Unit - IV Wireless Adhoc Networks.** 4.1 Components of a Wireless Network - Clients,Access Point (AP) Infrastructure of Adhoc Network. 4.2 Features ,architecture, frequency band of Wi-Fi ,connection modes of Wi-Fi - Wi-Fi direct,Wi-Fi hotspot. 4.3 Features of Wi-fi 6E(6GHz) ,IEEE Standards for Wi-Fi - IEEE 802.11a & 802.11ax (speed,bandwidth,compatibilty). 4.4 Challenges of Wi-Fi 6E(6GHz). 4.5 Architecture,advantages ,disadvantages and applications of Wi max. 4.6 Wi-Fi vs Wi max.	Lecture Using Chalk-Board Video Demonstrations Hands-on Presentations
5	TLO 5.1 Compare Wireless networks such as LAN,PAN,WAN,MAN. TLO 5.2 Explain Features ,architecture, frequency band of Bluetooth- BLE. TLO 5.3 Analyse Near Field Communication (NFC) services. TLO 5.4 State features and Applications of Mobile Ad Hoc Network(MANET). TLO 5.5 Explain challenges in MANET.	**Unit - V Recent Wireless Technologies & applications.** 5.1 Attributes ,advantages ,disadvantages and compare Wireless networks such as LAN,PAN,WAN,MAN. 5.2 Features ,architecture, frequency band of Bluetooth- BLE (Bluetooth 4.0,5.0, Bluetooth Low Energy), IEEE 802.15.1. 5.3 NFC services . 5.4 MANET-features and Applications of MANET. 5.5 Design challenges in MANET.	Lecture Using Chalk-Board Video Demonstrations Presentations Case Study

VI. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL / TUTORIAL EXPERIENCES.

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 1.1 Find relevant information of mobile phone using open source software applications such as Network Cell Info Lite or AIDA 64 or cellmapper or open signal or any other relevant app. LLO 1.2 Detect the hardware details of mobile handset. LLO 1.3 Signal strength,frequency	1	*Find out Relevant information of the mobile handset (4G/5G) and network information using relevant software.	2	CO1
LLO 2.1 Identify Dual sim interface section,Touch screen display section, battery charging circuit, power management unit of 4G or 5G smartphone and test working.	2	*Identification of different sections of smartphones using 4G or 5G experimental setup .	2	CO1 CO2
LLO 3.1 Find relevant information using appropriate mobile app, Avearge strength of signal,power of signals and neighbouring signals ,Download speed & upload speed.	3	*Finding out relevant information of mobile phone .	2	CO1

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Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 4.1 Analyse and manage Personal Area Network of mobile devices using Bluetooth.	4	*Building of Personal Area Network of mobile devices using Bluetooth.	2	CO5
LLO 5.1 Identify and list various sensors used in smartphone(5G) .	5	*Identification of different sensors used in smartphone(5G) .	2	CO3
LLO 6.1 Transfer an image, audio and video files using Bluetooth and check bluetooth range.	6	Transfer data using Bluetooth and check bluetooth range.	2	CO5
LLO 7.1 Configure Wi-Fi setting in mobile devices using mobile tethering to connect two devices such as mobile phone to mobile phone and mobile phone to laptop.	7	*Configuration of Wi-Fi setting in mobile devices.	2	CO4
LLO 8.1 Analyse the cellular frequency reuse concept.	8	Find the co-channel cells for a particular cell and Finding the cell clusters within certain geographic area using virtual lab. (http://vlabs.iitkgp.ac.in/fcmc/exp6/index.html#)	2	CO1
LLO 9.1 Demonstrate any one service using Near Field Communication(NFC)services such as data transfer/money transfer/healthcare(fitbit use to measure health parameters)	9	*Demonstration of any one service using Near Field Communication(NFC)services.	2	CO5
LLO 10.1 Install and authenticate eSIM(virtual SIM) on mobile handset .	10	*Installation and authentication of eSIM(virtual SIM) on mobile handset .	2	CO3
LLO 11.1 Analyse WiFi parameters such as Download speed ,upload speed,Data network type,Internet speed test . LLO 11.2 Analyse WiFi parameters such as Signal testing,Uplink bandwidth,downlink bandwidth . LLO 11.3 Analyse WiFi paramters such as Signal strength graphs using any app.(5G, 4G LTE WIFI app).	11	Analyze WiFi parameters using relevant app.	2	CO4
LLO 12.1 Establish seamless wireless connectivity using multiple access points.	12	Establishment of seamless wireless connectivity using multiple access points using Wi-Fi/ bluetooth/nearby share /any other recent technology.	2	CO4
LLO 13.1 Analyse Wi-Fi network using android app like AIDA 64 app(or any other relevant app). LLO 13.2 Analyse signal strength,link speed ,signal frequency,battery details,sensor details. LLO 13.3 Analyse internal devices in handset,display technology details,phone network type.	13	Analyse Wi-Fi network using AIDA 64 app(or any other relevant app).	2	CO4
LLO 14.1 Create a simple LAN using cisco packet tracer .	14	Creating a simple LAN using cisco packet tracer .	2	CO5

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Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 15.1 Implement manual and auto selection of network using mobile handset.	15	Implementation of manual and auto selection of network using mobile handset.	2	CO4
LLO 16.1 Create a simple WAN using cisco packet tracer.	16	Creating a simple WAN using cisco packet tracer.	2	CO5

Note : Out of above suggestive LLOs -

- '*' Marked Practicals (LLOs) Are mandatory.
- Minimum 80% of above list of lab experiment are to be performed.
- Judicial mix of LLOs are to be performed to achieve desired outcomes.

VII. SUGGESTED MICRO PROJECT / ASSIGNMENT/ ACTIVITIES FOR SPECIFIC LEARNING / SKILLS DEVELOPMENT (SELF LEARNING)

Assignment

- Prepare abstract report on given video lecture of NPTEL on 5G -3GPP https://www.youtube.com/watch?v=eye6bGePNVg
- Prepare report on 5G Developments Across the World
- Analyse 5G Initiatives Taken By Government and Standard Agencies and prepare report
- Prepare pictorial chart on roadmap for 5G Architecture in India
- Collect relevant information/technical specifications required for 4G/5G/6G communication.
- Compare various service providers considering quality of service and cost.
- Prepare report on recent Trends in Telecommunication domain
- Learn how to simulate 4G/5G/6G,By using relevant learning material/tutorials
- Learn how to simulate 4G/5G/6G , by using relevant learning material/tutorials and prepare report on it.
- Prepare report on Key areas in which satellites can play a part in 5G.
- Prepare report on 5G network technology & impact on society

Industrial Visit

- Industrial Visit to nearest service provider base station.
- Industrial Visit to nearest location any demostrating adhoc network.

Micro project

- Set up LAN network between 3 or 4 devices using WiFi wireless router. Prepare report on it
- Prepare chart on comparision of 4G, 5G, 6G and 7G.
- Prepare chart on various applications of wireless communication.
- Prepare report and ppt presentation on MIMO beam forming
- Prepare chart to show all releases of 3GPP till date.
- Prepare ppts and report on 6G generation of mobile communication.
- Prepare chart on comparison of 4G,4.5G, 5G, 6G

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Note :

- Above is just a suggestive list of microprojects and assignments; faculty must prepare their own bank of microprojects, assignments, and activities in a similar way.
- The faculty must allocate judicial mix of tasks, considering the weaknesses and / strengths of the student in acquiring the desired skills.
- If a microproject is assigned, it is expected to be completed as a group activity.
- SLA marks shall be awarded as per the continuous assessment record.
- For courses with no SLA component the list of suggestive microprojects / assignments/ activities are optional, faculty may encourage students to perform these tasks for enhanced learning experiences.
- If the course does not have associated SLA component, above suggestive listings is applicable to Tutorials and maybe considered for FA-PR evaluations.

VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	Cisco Packet Tracer 6.2 student version	16,14
2	5G VoLTE Smart Phone Training System: Technology : 5G Sub 6 FDD, 5G Sub 6 TDD, 4G LTE FDD, 4G LTE TDD, 3G WCDMA, 2G GSM ,On board sections : Touch display, Dual SIM interface, user interface, Battery charging circuit, Power management unit, and RF Spectrum Aanalyzer module User interface : Buzzer, Vibrator, Mic, Speaker, Hands free port, and display LEDs Test points : More than 55 nos.	4
3	4G VoLTE Smart Phone Scientech 2139 :Cellular system : GSM - Band (2 / 3 / 5 / 8); WCDMA - Band (1 / 2 / 5 /8); 4G VoLTE (TDD) - Band (38 / 40 / 41), LTE (FDD) - Band (1 / 3 / 5 / 7 / 8 / 20) Tx/Rx Frequency band : GSM / HSPA / LTE (850, 900, 1800, 1900 MHZ) UMTS/HSPA+ (850, 900, 1900, 2100 MHZ) 4G VoLTE ,WLAN :Wi-Fi 802.11 b/g/n, Wi-Fi Direct	5
4	Software app on android phone such as AIDA64, 5G 4G LTE Wi Fi,Network cell info lite,LTE coverage map,open signal,wireshark,cisco or as applicable.	All

IX. SUGGESTED WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE (Specification Table)

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	Basics of Mobile Communication System.	CO1	12	4	6	4	14
2	II	Fundamentals of Global System for Mobile communication (GSM) and 4G Communication.	CO2	14	2	4	8	14
3	III	Introduction to 5G and 6G.	CO3	12	4	6	6	16
4	IV	Wireless Adhoc Networks.	CO4	12	2	4	6	12
5	V	Recent Wireless Technologies & applications.	CO5	10	4	4	6	14
Grand Total				**60**	**16**	**24**	**30**	**70**

X. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)

- Two offline unit tests of 30 marks and average of two unit test marks will be consider for out of 30 marks. For formative assessment of laboratory learning 25 marks. Each practical will be assessed considering 60% weightage to process, 40% weightage to product.

Summative Assessment (Assessment of Learning)

- End semester assessment is of 70 marks. End semester summative assessment is of 25 marks for laboratory learning.

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XI. SUGGESTED COS - POS MATRIX FORM

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)		
	PO-1 Basic and Discipline Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO-1	PSO-2	PSO-3
CO1	3	2	-	2	3	-	3			
CO2	3	3	2	3	3	-	3			
CO3	3	3	2	3	3	-	2			
CO4	3	3	3	3	3	2	2			
CO5	3	2	3	3	3	3	2			

Legends :- High:03, Medium:02,Low:01, No Mapping: -
*PSOs are to be formulated at institute level

XII. SUGGESTED LEARNING MATERIALS / BOOKS

Sr.No	Author	Title	Publisher with ISBN Number
1	Theodore S. Rappaport	Wireless Communications principles & practice	Pearson Education India; 2nd edition (1 January 2010), ISBN : 978-8131731864
2	Upena Dalal	Wireless Communication and Networks	Oxford UP January 1, 2014 ISBN13: 9780198098881
3	Leeladhar Malviya, Rajib Kumar Panigrahi, M.V. Kartikeyan	MIMO Antennas for Wireless Communication	CRC Press; 1st edition (16 December 2020) ISBN : 978-0367530471
4	Imrich Chlamtac , Yi-Bing Lin	Wireless and Mobile Network Architectures	Wiley; 1st edition (30 October 2000) ISBN-13 ? : ? 978-0471394921
5	Simon Haykin,Michael Moher	Modern Wireless Communication	Pearson Education India; 1st edition (1 January 2011), ISBN: 978-8131704431

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://mobilepacketcore.com/lte-4g-network-architecture/	4G architecture
2	https://www.spiceworks.com/tech/networking/articles/what-is-near-field-communication/	NFC SERVICES
3	https://www.youtube.com/watch?v=VhWpetDlehQ	Beam forming and MIMO
4	https://youtu.be/eye6bGePNVg?si=e2_zU4n9N-B7gpLP	5G 3GPP standard
5	https://youtu.be/uhylZxSOKIA?si=SqOLszGUWuzzdnck	3GPP & ITU standard
6	https://ele.kyocera.com/en/topics/block_smartphone/	Smartphone block diagram
7	https://www.broadcom.com/solutions/wireless-mobile-communications/smart-phones	Smartphone sensors
8	https://www.geeksforgeeks.org/wimax-in-computer-network/	Details about Wimax
9	https://www.techtarget.com/searchnetworking/definition/6G	6G
10	https://www.simplilearn.com/tutorials/networking-tutorial/importance-of-types-of-networks-lan-man-wan#:~:text=PAN%20(Personal%20Area%20Network),WAN%20(Wide%20Area%20Network)	Attributes of LAN,PAN,WAN

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Sr.No	Link / Portal	Description

Note :

- Teachers are requested to check the creative common license status/financial implications of the suggested online educational resources before use by the students

MSBTE Approval Dt. 04/09/2025 **Semester - 6, K Scheme**