Program : **Diploma in Computer Engineering / Computer Hardware Engineering / Computer Science & Engineering / Communication & Computer Networking / Cyber Forensics and Information Security / Cloud Computing and Big Data / Information Technology / Artificial Intelligence / Artificial Intelligence & Machine Learning / Biomedical Engineering**	
Course Code : **6131D**	Course Title: **Introduction to 5G**
Semester : **5**	Credits: **4**
Course Category: **Program Elective**	
Periods per week: **4 (L:4, T:0, P:0)**	Periods per semester: **60**

Course Objectives:

- To provide the students with the conceptual knowledge of the different generations of mobile communications.
- To provide the basic knowledge of 5G Technology
- To equip the students with the updation of the next generation wireless Technology (5G and 6G)

Course Pre-requisites:

Topic/Description	Course code	Course Title	Semester
Basic Engineering Mathematics Principles		Mathematics I & II	1 & 2
Basics of Digital Electronics		Digital Electronics	3

Course Outcomes:

On completion of the course, the student will be able to:

COn	Description	Duration (Hours)	Cognitive level
CO1	Explain features and implementation of first- and second-generation mobile Networks	18	Understanding
CO2	Outline the fundamentals of third generation mobile Networks and introduction to fourth generation mobile networks	14	Understanding
CO3	Outline the trends in fifth generation wireless communication system	14	Understanding

CO4	Explain the features and architecture of fifth generation mobile networks	12	Understanding
	Series test	2	

CO-PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	2	-	-	-	-	-	-
CO2	2	-	-	-	-	-	-
CO3	2	-	-	-	-	-	-
CO4	2	-	-	-	-	-	-

3 – Strongly mapped 2 – Moderately mapped 1 – Weakly mapped

Course Outline

Module Outcomes	Description	Duration (Hours)	Cognitive Level
CO1	**Explain features and implementation of first- and second-generation mobile Networks**		
M1.01	Summarize the concepts of Cellular Communication	5	Understanding
M1.02	Explain features and implementation of first- and second-generation mobile Networks	5	Understanding
M1.03	Outline different multiple access methods and differentiate between them	4	Understanding
M1.04	Explain about the enhancement of 2nd - Generation mobile Technology for provisioning of data.	4	Understanding

Evolution of Cellular Networks -

Overview of Wireless Communication - Shannon-Hartley capacity theorem – Overview of Frequency Bands and Propagation properties - Cellular Network Organization - Frequency Reuse-Increasing Capacity Through Network Densification -Operation of Cellular Systems – Mobile Cellular Call Scenario - Mobile Radio Propagation Effects -Handoff -Power Control- Multiple Access Techniques- FDMA, TDMA, SSMA, SDMA- First Generation Wireless Networks -Second Generation Mobile Networks: Global System for Mobile Communications (GSM) -Overview of General Packet Radio Service (GPRS) and EDGE

CO2	**Outline the fundamentals of third generation mobile Networks and introduction to fourth generation mobile networks**		
M2.01	Outline the fundamental wireless concepts for third generation mobile networks	4	Understanding
M2.02	Distinguish between the architecture of different releases of third generation mobile networks	4	Understanding
M2.03	Outline the salient features of fourth generation wireless networks.	3	Understanding
M2.04	Summarize the differences between LTE and LTE-A	3	Understanding
	Series Test – I	1	
Third and Fourth Generation Mobile Networks: UMTS Architecture based on different releases by 3GPP - New Concepts of UMTS- UMTS CDMA Concepts -Spreading Factor, Chip Rate, Process Gain, OVSF Code Tree, HSDPA, HSPA, Long Term Evolution -Network Architecture and Interfaces -Voice and SMS over LTE, LTE Advanced (3GPP Release 10) -Machine Type Communication and the IoT, NB-IoT- Mobile Tower Radiation And Its Impact On Human Health – EM Radiation measurement			
CO3	**Outline the trends in fifth generation wireless communication system**		
M3.01	Identify the potential of 5G networks and various 5G usage scenarios	4	Understanding
M3.02	Summarize the wireless concepts for 5G mobile networks.	4	Understanding
M3.03	Summarize the differences between SDN and NFV	3	Understanding
M3.04	Explain the different frequency bands for 5G wireless networks.	3	Understanding
Basics of 5G: 5G Potential and applications; Usage scenarios; enhanced Mobile Broadband (eMBB), Ultra Reliable Low latency communication (URLLC), Massive machine type communication (MMTC), D2D communication, V2X communication, OFDM, MIMO, Massive MIMO, SDN and NFV (Software Defined Networking and Network Function Virtualization), Spectrum for 5G			
CO4	**Explain the features and architecture of fifth generation mobile networks.**		
M4.01	Describe features of Standalone and Non-	3	Understanding

	standalone architecture of 5G Mobile networks.		
M4.02	Explain about 5G mobile core networks.	3	Understanding
M4.03	Describe the features and applications of 5G Private networks and 5G slicing	3	Understanding
M4.04	Outline the future trends and opportunities of 5G/6G wireless networks.	3	Understanding
	Series Test – II	1	

5G Architecture and Technologies:

5G Architecture – SA and NSA Architecture -5G Core Network – Open RAN – NOMA (Non-Orthogonal Multiple Access), FAPI (functional application platform interface),5G Private Networks, Network Slicing in 5G, 5G Penetration in developed countries, Deployment challenges in low -middle income countries, Unlicenced spectrum and its usage in 5G, non-terrestrial fronthaul/backhaul solutions: LEOs, HAP/UAV, Application of AI in 5G/6G Network

Text / Reference:

T/R	Book Title/Author
T1	From GSM to LTE-Advanced Pro and 5G- An Introduction to Mobile Networks and Mobile Broadband -Third Edition- Martin Sauter-John Wiley and Sons, Ltd., Publication
R2	Theodore S. Rappaport, 'Wireless Communication Principles and Practice', 2nd Edn., Pearson Education India
R3	An Introduction To LTE- LTE, LTE-Advanced, SAE, VoLTE and 4G Mobile Communications - Second Edition -Christopher Cox- John Wiley and Sons, Ltd., Publication
R4	An Introduction to 5G - The New Radio, 5G Network and Beyond - - First Edition - Christopher Cox- John Wiley and Sons, Ltd., Publication

Online Resources

Sl No	Website Link
1	https://www.3gpp.org/
2	http://www.3gpp2.org/
3	https://www.ngmn.org/
4	https://www.gsma.com/