Bharati Vidyapeeth (Deemed to be University)

College of Engineering, Pune

Faculty of Engineering and Technology

B. Tech. Electronics and Communication Engineering (CBCS-2023 Course)- Curriculum Structure

BHARATI VIDYAPEETH (DEEMED TO BE UNIVERSITY)

COLLEGE OF ENGINEERING, PUNE

Module -I

B.Tech.(Electronics & Communication Engineering): (CBCS 2023 COURSE) Sem-VII

Sr. No.	Category	Course Code	Course	Teaching Scheme			Examination Scheme (Marks)						Credits			
				L	P	T	ESE	IA	TW	PR	OR	Total	L	Pr/ Or	Tut	Total
1			Artificial Intelligence	3	2	-	60	40	25	-	25	150	3	1	-	4
2			Seminar	-	4	-	-	-	50	-	50	100	-	2	-	2
3			Industry/ In-house Internship	-	-	-	-	-	150	-	100	250	-	14	-	14
Total				**3**	**6**	**0**	**60**	**40**	**225**	**0**	**175**	**500**	**3**	**17**	**0**	**20**

B.Tech.(Electronics & Communication Engineering): (CBCS 2023 COURSE) Sem-VIII

Sr. No.	Category	Course Code	Course	Teaching Scheme			Examination Scheme (Marks)						Credits			
				L	P	T	ESE	IA	TW	PR	OR	Total	L	Pr/ Or	Tu t	Total
1			Advanced VLSI Design	3	2	-	60	40	25	-	25	150	3	1	-	4
2			Professional Elective Course -I	3	2	-	60	40	25	-	25	150	3	1	-	4
3			Professional Elective Course -II	3	2	-	60	40	25	-	25	150	3	1	-	4
4			Project Work	-	16	-	-	-	100	-	50	150	-	8	-	8
Total				**9**	**22**	**-**	**180**	**120**	**175**	**-**	**125**	**600**	**9**	**11**	**-**	**20**

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COLLEGE OF ENGINEERING, PUNE

B.Tech.(Electronics & Communication Engineering): (CBCS 2023 COURSE) Sem-VII

Module -II

Sr. No.	Category	Course Code	Course	Teaching Scheme			Examination Scheme (Marks)						Credits			
				L	P	T	ESE	IA	TW	PR	OR	Total	L	Pr/ Or	Tut	Total
1			Advanced VLSI Design	3	2	-	60	40	25	-	25	150	3	1	-	4
2			Professional Elective Course -I	3	2	-	60	40	25	-	25	150	3	1	-	4
3			Professional Elective Course -II	3	2	-	60	40	25	-	25	150	3	1	-	4
4			Project Work	-	16	-	-	-	100	-	50	150	-	8	-	8
Total				**9**	**22**	**-**	**180**	**120**	**175**	**-**	**125**	**600**	**9**	**11**	**-**	**20**

B.Tech.(Electronics & Communication Engineering): (CBCS 2023 COURSE) Sem-VIII

Sr. No.	Category	Course Code	Course	Teaching Scheme			Examination Scheme (Marks)						Credits			
				L	P	T	ESE	IA	TW	PR	OR	Total	L	Pr/ Or	Tut	Total
1			Artificial Intelligence	3	2	-	60	40	25	-	25	150	3	1	-	4
2			Seminar	-	4	-	-	-	50	-	50	100	-	2	-	2
3			Industry/ In-house Internship	-	-	-	-	-	150	-	100	250	-	14	-	14
Total				**3**	**6**	**0**	**60**	**40**	**225**	**0**	**175**	**500**	**3**	**17**	**0**	**20**

PROFESSIONAL ELECTIVE COURSES (PEC)

Professional Elective Course -I	Professional Elective Course-II
• Cellular Communication-II	• Light Wave Communication
• Real-Time Operating System Using QNX	• Fin Tech Systems
• Cyber Security & Forensics	• Computer Vision
• Augmented Reality and Virtual Reality	• Speech and Audio Processing
• Blockchain Technology	• Radar and Satellite Communication

Note: A student can choose either Module -I or Module -II

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B. Tech. Electronics & Communication Engineering Sem. VII / VIII (CBCS 2023 Course)

ARTIFICIAL INTELLIGENCE

TEACHING SCHEME:	EXAMINATION SCHEME:		CREDITS ALLOTTED:
Theory: 03 Hrs/week	End Semester Examination: 60 Marks		Credits:03
Practical: 02 Hrs/week	Internal Assessment: 40 Marks		
	TW: 25 Marks	Oral: 25 Marks	Credits:01
	Total Marks: -150 Marks		Total Credit: 04

Course Pre-requisites:

1.	Database management system
2.	Computer Programming II
3.	Introduction to data Science
4.	Machine Learning

Course Outcomes: After learning this course students will be able to

1	Analyze core concepts and evolution of Artificial Intelligence and Deep Learning.
2	Analyze and implement convolutional and recurrent neural network architectures.
3	Apply transformers and large language models for natural language processing tasks.
4	Design generative models including GANs for data synthesis and representation learning.
5	Develop agent-based and agentic AI systems for decision making and autonomous tasks.
6	Evaluate AI models considering performance, robustness, and ethical implications.

UNIT – I	**Introduction To Artificial Intelligence**	**(06 Hours)**
	Definition and scope of Artificial Intelligence ,Evolution of AI: Symbolic AI to Data-driven AI, Relationship between AI, Machine Learning, and Deep Learning AI problem formulation and task environments, Types of AI systems: Reactive, Limited Memory, Generative AI (overview),Applications of AI in engineering, healthcare, and industry	
UNIT – II	**Deep Learning Foundations**	**(06 Hours)**
	Review of Artificial Neural Networks, Deep neural networks and representation learning, Activation functions and initialization strategies, Regularization techniques: Dropout Batch normalization, Optimization methods: Stochastic Gradient Descent Adaptive optimizers (Adam – conceptual)	

UNIT - III	**Convolutional Neural Networks (CNN)**	**(06Hours)**
	Motivation for CNNs , Convolution operation and feature maps, Pooling layers and padding, CNN architectures:LeNet Alex Net (conceptual),CNNs for image classification and object recognition, Limitations of CNNs.	
UNIT -IV	**Sequence Modeling: RNN, LSTM, and Transformers**	**(06 Hours)**
	Sequential data and time-series modeling ,Recurrent Neural Networks (RNN): Architecture and limitations, Long Short-Term Memory (LSTM): Gates and memory cell, Applications of LSTM in speech and signal processing Introduction to Transformers: Self-attention mechanism Encoder–decoder architecture, Comparison: RNN/LSTM vs Transformers	
UNIT -V	**Generative and Large Language Models**	**(06 Hours)**
	Generative modeling concepts ,Generative Adversarial Networks (GAN): Generator and discriminator Training dynamics and challenges Variants of GANs (overview)Large Language Models (LLMs): Pre-training and fine-tuning concepts Prompting and in-context learning Applications of LLMs in engineering and automation.	
UNIT -VI	**Agentic AI and Responsible AI**	**(06 Hours)**
	Introduction to intelligent agentsAgent architectures: Reactive agents Goal-based and utility-based agents, Agentic AI: Autonomous decision-making Tool-using and planning agents (conceptual), Multi-agent systems (overview)Ethical and responsible AI: Bias and fairness Explain ability Deployment challenges	

List of Experiments: The term work shall consist of a minimum of eight experiments based on Python.

1. Select a simple real-world problem (e.g., shortest path or puzzle) and define its state space, initial state, goal state, possible actions, and constraints in a structured format.
2. Write a Python program to perform Breadth-First Search on a given graph and display the traversal order.
3. Write a Python program to perform Depth-First Search on a graph and compare the traversal with BFS.
4. Build and train a simple Artificial Neural Network using Keras for a classification task (e.g., Iris dataset) and evaluate its accuracy.
5. Plot and compare ReLU, Sigmoid, and Tanh activation functions using Python and analyze their behavior.
6. Train the same ANN model using SGD and Adam optimizers and compare their performance in terms of accuracy and loss.
7. Apply basic image filters such as edge detection and blurring using OpenCV and observe the output images.
8. Run a simple CNN model on the MNIST dataset using Keras and observe training accuracy and loss.
9. Use a pre-trained model (e.g., MobileNet) to classify input images and display predicted labels.
10. Plot time-series data (e.g., stock or weather data) and perform simple prediction using linear regression.

Textbooks/ Reference Books:
1. S. Russell and P. Norvig, *Artificial Intelligence: A Modern Approach*, 3rd ed. Upper Saddle River, NJ, USA: Pearson, 2010.
2. Goodfellow, Y. Bengio, and A. Courville, *Deep Learning*. Cambridge, MA, USA: MIT Press, 2016.
3. C. M. Bishop, *Pattern Recognition and Machine Learning*. New York, NY, USA: Springer, 2006.
4. S. Raschka, Y. Liu, and V. Mirjalili, *Machine Learning with PyTorch and Scikit-Learn: Develop Machine Learning and Deep Learning Models with Python*, 2nd ed. Birmingham, U.K.: Packt Publishing, 2022.
5. A. Géron, *Hands-On Machine Learning with Scikit-Learn, Keras& TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems*, 2nd ed. Sebastopol, CA, USA: O'Reilly Media, 2019.

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B. Tech. Electronics & Communication Engineering Sem-VII / VIII (CBCS 2023 Course)

SEMINAR

TEACHING SCHEME:	**EXAMINATION SCHEME:**		**CREDITS ALLOTTED:**
Practical: 04 Hrs/week	TW: 50 Marks	Oral :50 Marks	Credits: 02
	Total: 100 Marks		**Total Credits: 02**

Course pre-requisites:

The students should have knowledge of subjects learnt till Semester VI

Course Outcomes: After learning this course, students will be able to

CO1	Identify and select a relevant seminar topic in Electronics & Communication Engineering.
CO2	Conduct an effective literature survey using research databases and journals.
CO3	Analyze and interpret technical content from research papers.
CO4	Prepare a well-structured technical report following standard formats
CO5	Deliver an effective seminar presentation using appropriate tools and techniques.
CO6	Respond confidently to questions and participate in technical discussions

Unit 1	**Introduction to Seminar and Topic Selection**	
	• Objectives and importance of seminar • Criteria for selecting seminar topics • Overview of emerging trends in Electronics and Communication • Identification of problem statements	
Unit 2	**Literature Survey Techniques**	
	• Sources of information: journals, conferences, patents • Use of digital libraries (IEEE, Springer, etc.) • Reading and understanding research papers • Note-making and summarization	
Unit 3	**Technical Analysis and Content Development**	
	• Interpretation of data, graphs, and results • Comparative analysis of existing techniques • Structuring seminar content logically • Avoiding plagiarism and maintaining ethics as per global acceptance	
Unit 4	**Technical Report Writing**	
	• Prepare a Seminar report as per the format recommended by seminar Incharge • Referencing styles (IEEE format) • Use of tools (Word/LaTeX)	

Unit 5	**Presentation Skills**	
	• Designing effective presentations (PPT) • Communication skills and body language • Use of visual aids, diagrams, and simulations • Time management during seminar	
Unit 6	**Delivery and Evaluation of Seminar**	
	• Seminar presentation (20–30 minutes per student) • Handling question-answer sessions • Peer review and feedback • Self-assessment and improvement	

GUIDELINES:

Students must select a topic from recent, relevant, and advanced areas such as:

i) Emerging & Recent Technologies such as

6G Wireless: THz bands and Intelligent Reflecting Surfaces (IRS).
Quantum Tech: Quantum Key Distribution (QKD) and Cryptography.
Edge AI: Hardware accelerators and TinyML for IoT devices.
Semiconductors: GAAFET architecture and 2nm node innovations.

ii) Case Studies such as

Systems: Architecture of UPI or 5G Smart City grids.
Failures: Technical analysis of the CrowdStrike outage or the Global Chip Shortage.
Breaches: Ransomware attacks on SCADA or Critical Infrastructure.
Product Tech: Hardware-software stack of Starlink or Tesla Autopilot.

iii) Research-Oriented (IEEE/ACM/Springer)

Surveys: Recent papers (last 3–5 years)

iv) Interdisciplinary Topics such as

Healthcare: Wearable Bio-sensors and Remote Patient Monitoring.
Agriculture: LoRa-based Precision Farming and Drone Imaging.
Education: AR/VR implementation in Virtual Engineering Labs.
Sustainability: Green Communications and Energy-Harvesting Circuits.

What Students Are Expected to Do

Step 1: Topic Selection

Choose a unique topic (no duplication in the batch) and get approval from seminar guide/faculty

Step 2: Literature Survey

Refer minimum 5–8 quality sources like Research papers (IEEE, Springer, etc.), Technical blogs (credible sources), White papers / Industry reports
Focus on recent developments (last 5 years)

Step 3: Content Preparation

Step 4: Report Writing

Students must submit a Seminar Report (Approx. 20–25 pages) containing:

- Abstract (1 page)
- Introduction
- Detailed explanation

• Diagrams / charts • Case study (if applicable) • Conclusion • References (IEEE format)
Step 5: Presentation Prepare PPT (10–15 slides) Duration: 15–20 minutes presentation + 5–10 minutes Q&A Use diagrams, flowcharts, visuals
Step 6: Seminar report : As per shared standard template. Spiral Bind report should be submitted to seminar in-charge before the final presentation

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B. Tech. Electronics & Communication Engineering Sem. VII/VIII (CBCS-2023course)

INDUSTRY / IN-HOUSE INTERNSHIP

TEACHING SCHEME:	EXAMINATION SCHEME:	CREDITS ALLOTTED:
	TW: 150 Marks	Credits: 14
	Oral: 100 Marks	
	Total: 250 Marks	Total Credit: 14

Course Pre-requisites:

	Basic Knowledge of Electronics and Communication Engineering

Course Outcomes: After learning this course students will be able to

1	Identify the various fields for practical training to enhance employability skills in Electronics and Communication Engineering.
2	Apply technical knowledge through hands on experience.
3	Apply the skills such as positive attitude, communication skills, time management and work ethics.
4	Explore the career opportunities during graduation.
5	Create ability to adapt latest technologies in the outside world.
6	Demonstrate innovation and lifelong learning.

In-plant Training:
Every student must undergo training on site or in company in final year to get the exposure and practical experience. He / She must submit the detailed report of training, based on which the term work and oral marks should be awarded.
Note: The student should complete in-plant industrial training after semester-VI for a period of 12/14 weeks. Evaluation will be done in end of semester.
Description: Assessment based on a report on the industrial training carried out and Presentation of the same

Duration and Credit Equivalence
Minimum duration: Full time internship of **12–14 weeks (90 Days)** or more

1. Types of Internships
A. Industrial Internship
Permitted organizations include:

- Core Electronics / Telecom industries
- Semiconductor companies
- Embedded system firms

- Automation / Robotics companies
- Defense / Aerospace labs
- Startups (registered)
- R&D labs (CSIR, DRDO, ISRO, IITs, NITs, etc.)
- Government or PSU organizations

All industry internship activities shall comply with the host organization’s policies and institute guidelines on ethics, safety, confidentiality, and intellectual property (IP). Students must follow workplace safety rules, professional conduct. Students shall maintain a Daily progress log and obtain periodic mentor verification. All submissions must be original and properly referenced; plagiarism and data misrepresentation are strictly prohibited.

B. In-house Internship

Permitted when:

- Students work on funded research projects, patents, product development, incubated startups, or institutional centers of excellence.
- Clear deliverables exist with measurable outcomes.
- Supervision by a faculty mentor and external domain expert (if possible).

All in-house internship activities shall comply with departmental and institute policies on ethics, safety, confidentiality, and intellectual property (IP). Students must complete lab safety/SOP orientation, follow safe equipment handling practices, and maintain a Daily logbook with mentor verification. Any project involving external/sponsored data or sensitive information must follow approved data handling and confidentiality norms. Outcomes must be original and properly cited; plagiarism is not permitted. IP/ownership and publication/disclosure (if applicable) shall be governed by institute policy and project supervisor approval.

2. Eligibility and Approval

Internship proposal must be approved by:

- Department Internship Coordinator
- Head of Department (HoD)
- Proposal must include:
- Organization details
- Nature of work
- Learning objectives
- Expected deliverables
- Mentor details

3. Student Responsibilities

Student should:

- Maintain a weekly logbook / e-log.

Submit:

- Offer letter / acceptance letter
- Completion certificate
- Internship report
- Supervisor feedback form
- Follow professional conduct and safety norms.

Maintain minimum 90% attendance.

Assessment Rubrics

Internship Evaluation Rubric

Criteria	Excellent (4)	Good (3)	Average (2)	Poor (1)
Technical Knowledge	Demonstrates advanced implementation with strong understanding and optimal solutions	Correct and complete design with minor limitations	Partially implemented with noticeable gaps or errors	Incorrect or incomplete implementation
Innovation	Highly original and creative solution beyond standard approaches	Some originality with minor innovative elements	Routine solution with little originality	Lack of any original contribution
Documentation	Clear, well-structured, and professional documentation with proper standards	Mostly clear and well-organized with minor issues	Basic documentation with missing details	Poorly written or insufficient documentation
Presentation	Very clear, confident, and well-organized delivery	Clear presentation with reasonable confidence	Understandable but lacks clarity or confidence	Weak, unclear, or poorly organized presentation
Professional behavior	Demonstrates excellent ethics, responsibility, and professionalism	Generally professional with minor issues	Shows need for improvement in professionalism	Unacceptable or unprofessional behavior

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B. Tech. Electronics & Communication Engineering Sem VII / VIII

ADVANCED VLSI DESIGN TECHNOLOGY

TEACHINGSCHEME:	EXAMINATION SCHEME:		CREDITS ALLOTTED:
Theory: 03 Hrs/week	End Semester Examination (ESE): 60 Marks		Credits: 03
Practical: 02 Hrs/Week	Internal Assessment (IA): 40 Marks		
	TW: 25 Marks	**OR:** 25 Marks	Credits: 01
	Total: 125 Marks		**Total Credits:04**

Course Pre-requisites:

1. The students should have knowledge of
2. VLSI Design Technology.

Course Outcomes: After learning this course, students will be able to

CO1	Analyze and compare advanced CMOS logic styles based on speed, power, and area.
CO2	Design and evaluate sequential circuits using latches and flip-flops with timing constraints.
CO3	Analyze the design and operational characteristics of SRAM, DRAM, and cache memory systems.
CO4	Identify power-dissipation sources and apply basic low-power VLSI techniques.
CO5	Analyze the VLSI design process and execute primary verification techniques such as DRC and LVS.
CO6	Outline the architecture of SoC and FPGA, and evaluate the differences between FPGA and ASIC design flows.

UNIT – I	**Sequential Circuit Design**	**(06 Hours)**
	Latches and Flip-Flops, Timing parameters: setup time, hold time, propagation delay, Clocking issues: clock skew and jitter (basic concepts), Shift registers and counters, Introduction to scan flip-flops.	
UNIT–II	**CMOS Logic Design**	**(06 Hours)**
	Review of CMOS logic styles, Static CMOS logic, Pass Transistor Logic (PTL), Transmission gate logic, Pseudo-NMOS logic, Comparison of logic styles (speed, power, area)	
UNIT-III	**Memory Design Basics**	**(06 Hours)**
	SRAM cell and architecture, DRAM cell operation (overview), Memory timing concepts, Introduction to cache memory, Memory hierarchy (overview)	
UNIT–IV	**Low Power VLSI Design**	**(06 Hours)**

	Sources of power dissipation, Dynamic vs static power, Power-delay trade-off, Voltage scaling, Clock gating, Power gating (basic idea)	
UNIT – V	**VLSI Design Flow & Verification**	**(06 Hours)**
	ASIC design flow, RTL to GDSII flow (overview), Logic synthesis (introduction), Timing analysis basics, Design Rule Check (DRC)and Layout Versus Schematic (LVS), Introduction to VHDL test benches.	
UNIT–VI	**SoC and FPGA Fundamentals**	**(06 Hours)**
	Introduction to System-on-Chip (SoC), SoC architecture basics, IP cores and reuse concept, FPGA architecture overview, FPGA vs ASIC comparison, Simple FPGA-based design examples (conceptual).	

Textbooks:

1. Neil H. E. Weste and David Harris, *CMOS VLSI Design: A Circuits and Systems Perspective*,4th ed Boston, MA, USA: Pearson Education, 2011.
2. Kamran Eshraghian and Douglas A. Pucknell, *Essentials of VLSI Circuits and Systems*, 1st ed. New Delhi, India: PHI Learning, 2005.

List of Experiments:- The term work shall consist of record of minimum of eight experiments

1. Design and Simulation of CMOS Inverter, NAND, and NOR Gates
2. Comparative Study of Static CMOS and Pseudo-NMOS Logic
3. Design and Simulation of Pass Transistor Logic (PTL) and Transmission Gate Circuits
4. Design and Timing Analysis of SR Latch and D Latch
5. Design and Simulation of D Flip-Flop
6. Simulation of 6T SRAM Cell (Basic read/write operation analysis)
7. Power Analysis of CMOS Circuits (Dynamic vs static power estimation)
8. Synthesis and Timing Analysis of a Digital Circuit
9. Clock Divider Implementation on FPGA

Reference Books:

1. J. M. Rabaey, A. P. Chandrakasan, and B. Nikolić, *Digital Integrated Circuits: A Design Perspective*, 2nd ed., Pearson Education, 2016.
2. W. Wolf, *Modern VLSI Design: IP-Based Design*, 4th ed., Pearson Education, 2008.
3. G. K. Yeap, *Practical Low Power Digital VLSI Design*, Springer (India) Pvt. Ltd., 2008.
4. K. V. K. K. Prasad and K. Shyamala, *VLSI Design Black Book*, Wiley India, 2012.

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B. Tech. Electronics & Communication Engineering Sem. VII / VIII: (CBCS 2023 Course)

Professional Elective Course -I

CELLULAR COMMUNICATION -II

TEACHING SCHEME:	**EXAMINATION SCHEME:**		**CREDITS ALLOTTED:**
Theory: 03 Hrs/week	End Semester Examination (ESE): 60 Marks		Credits: 3
Practical: 02 Hrs/week	Internal Assessment (IA): 40 Marks		
	TW:25 Marks	OR:25 Marks	Credits:1
	Total =150 Marks		Total Credit: 4

Course Pre-requisites:

1	Introduction to Electronics Communication
2	Digital Communication
3.	Cellular Communication-I

Course Outcomes: After learning this course students will be able to

1	Interpret the fundamental concepts, requirements, and key performance indicators of the 5G system.
2	Illustrate and explain 5G architecture, its components and functional criteria.
3	Identify and classify 5G radio access technologies.
4	Implement and analyze 5G wireless propagation channel models and MIMO techniques.
5	Evaluate and compare the performance of various relaying techniques
6	Evaluate device-to-device (D2D) and mm Wave communication techniques.

UNIT – I	**5G System Concept**	**(06 Hours)**
	Industrial and technological revolution: 4G to 5G transition requirement standardization activities: ITU-R, 3GPP & IEEE, key performance indicators,5G system concept, Extreme mobile broadband, Massive machine-type communication, Ultra-reliable machine-type communication, Dynamic radio access network, Lean system control plane, Localized contents and traffic flows, Spectrumtoolbox, RF cell planning for 5G.	
UNIT – II	**The 5G architecture, Spectrum**	**(06 Hours)**
	Introduction: Network Functions Virtualization (NFV), Software-Defined Networking (SDN), Basics about Regional Area Network (RAN) architecture, High-level requirements for the 5G architecture. Cell structure for 5G. Functional architecture and 5G flexibility: Functional split criteria, Functional optimization for specific applications, Integration of LTE and new air interface	

	to fulfill 5G requirements, Physical architecture and 5G deployment,5G spectrum landscape and requirements, 5G spectrum technologies	
UNIT - III	**The 5G Radio-Access Technologies**	**(06 Hours)**
	Access design principles for multi-user communications: - Orthogonalmultiple-access (OMA) systems, Capacity limits of multiple-access methods. Multi-carrier with filtering: - Filter-bank based multi-carrier, Universal filtered Orthogonal Frequency Division Multiplexing (OFDM). Non-orthogonal schemes for efficient multiple access:- Sparse code multiple access (SCMA), Interleave division multiple access (IDMA).Radio access for dense deployments: - OFDM numerology for small-cell deployments.	
UNIT -IV	**5G Wireless Propagation Channel Models and Massive Multiple-Input Multiple-Output (MIMO) systems.**	**(06 Hours)**
	Introduction, Modeling requirements and scenarios: Channel model requirements, Propagation scenarios**.** METIS channel models: Map-based model, Stochastic model. MIMO in LTE, Theoretical background: Single user MIMO, Multi-user MIMO. Pilot design for massive MIMO. Resource allocation and transceiver algorithmsfor massive MIMO. RF field measurement parameter for 5G.	
UNIT -V	**Relaying and Wireless Network Coding**	**(06 Hours)**
	Relaying techniques for 5G, Relay-based techniques in 5G use cases and services. Multi-flow wireless backhauling: Coordinated Direct and Relay (CDR) transmission, Four-Way Relaying (FWR), Multi-Flow Relaying (MFR), Buffer-Aided Relaying (BAR), Performance evaluation of relaying techniques	
UNIT -VI	**Enabling Technologies for 5G**	**(06 Hours)**
	Device-to-device (D2D) communication: D2D communication from 4G to 5G. Radio resource management, multi-hop D2Dcommunications for proximity and emergency services. Multi-operator D2D communication, Millimeter wave (mm Wave) Communication: Hardware technologies for mm Wave systems, Antennas Beamforming architectureDeployment scenarios, Architecture and mobility. Evolution roadmap from 5G to 6G	

List of Experiments: The students must perform a minimum of eight experiments on 5G VoLTE smartphone training platform

1. To analyze the mobile battery section and battery charger PMIC circuit of
2. To identify and analyze switch fault conditions in the mobile battery and battery charging section.
3. To examine and diagnose switch fault conditions in the device control section (display and volume control).
4. To evaluate switch fault conditions in the dual SIM interface section.

5. To investigate and troubleshoot switch fault conditions in the user interface section (vibrator, buzzer, speaker, and hands-free).
6. To analyze the I/Q signal constellations of the transceiver section.
7. To examine and analyze the spectrum of the transceiver RF carrier signal.
8. To analyze the spectrum characteristics of the Bluetooth RF carrier signal.
9. To evaluate the spectrum of the RF carrier signal in Wi-Fi mode.
10. To compare and evaluate the spectrum of the RF carrier signal in Hotspot mode.
11. To identify and diagnose switch fault conditions in the RF Spectrum Analyzer section.
12. To analyze the I/Q signal constellations of the transceiver section.
13. To examine and analyze the spectrum of the transceiver RF carrier signal.
14. To design and analyze 5G beamforming techniques using MATLAB.
15. To generate and evaluate 5G waveforms using MATLAB.
Text Books / Reference Books:
1. A. Goldsmith, *Wireless Communications*, 2nd ed. Cambridge, U.K.: Cambridge University Press, Mar. 2020.
2. A. Osseiran and J. F. Monserrat, *5G Mobile and Wireless Communications Technology*. Cambridge, U.K.: Cambridge University Press, 2016.
3. S. Ahmadi, *5G NR: Architecture, Technology, Implementation, and Operation of 3GPP New Radio Standards*. Amsterdam, Netherlands: Elsevier, 2019.
4. E. Dahlman, S. Parkvall, and J. Sköld, *5G NR: The Next Generation Wireless Access Technology*. London, U.K.: Academic Press, 2018.
5. J. Rodriguez, *Fundamentals of 5G Mobile Networks*. Chichester, U.K.: John Wiley & Sons, 2015.

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B. Tech. Electronics and Communication Engineering Sem -VII/VIII (CBCS 2023 course) Programme Specific Elective-I: REAL-TIME OPERATING SYSTEM USING QNX			
TEACHING SCHEME:	**EXAMINATION SCHEME:**		**CREDITS ALLOTTED:**
Theory: 03 Hrs/week	End Semester Examination (ESE): 60 Marks		Credits: 03
ractical: 02 Hrs/week	Internal Assessment (IA): 40 Marks		
	TW=25 Marks	OR=25 Marks	Credits: 01
	Total: 150 Marks		**Total Credits: 04**

Course Pre-requisites:

The students should have knowledge of

1. Embedded System Design,
2. Advanced Embedded System Design

Course Outcomes: After learning this course, students will be able to

CO1	Describe the QNX OS architecture and its microkernel-based design.
CO2	Develop and debug QNX-based applications using appropriate tools.
CO3	Apply process and thread management and synchronization techniques in QNX.
CO4	Implement inter-process communication methods for real-time systems.
CO5	Configure and build QNX boot/OS images for specific hardware platforms.
CO6	Develop Strong Knowledge of the POSIX standards that help in System Application Development.

UNIT – I	**Introduction to QNX OS Architecture**	**(06 Hours)**
	Overview of QNX OS architecture: microkernel, process manager and standards; Protected address spaces, process/thread model, scheduling; Introduction to inter-process communication (IPC) and synchronization; Resource managers and shared objects.	
UNIT–II	**Working with QNX Momentics IDE**	**(06 Hours)**
	Introduction to Eclipse, IDE, create target connection; Create and build QNX project; Debug applications by selection of appropriate tool; Unit testing, writing and building test programs.	
UNIT-III	**Processes, Threads and Synchronization**	**(06 Hours)**
	Process management: creation, termination and memory protection; Thread management: creation, termination and synchronization; Synchronization Techniques: mutexes, semaphores and condition variables; Hands-on exercises: process/thread creation and synchronization.	
UNIT–IV	**Inter-Process Communication (IPC)**	**(06 Hours)**
	Overview of IPC methods in QNX: message passing, pulses, and shared memory; Comparing IPC methods: advantages and disadvantages; Practical implementation of IPC in QNX; Hands on exercises: message passing and shared memory.	

UNIT – V	**Hardware Programming and Timing**	**(06 Hours)**
	Hardware access methods: IO-mapped and memory-mapped IO; Interrupt handling and DMA-safe memory allocation; Timing architecture: periodic timing, one-shot timing, and timeouts. Hands-on exercises: interrupt handling and timing mechanisms.	
UNIT–VI	**Building and Configuring QNX Boot/OS Images**	**(06 Hours)**
	Overview of QNX boot/ OS image structure; Components of a boot image: startup code, kernel, drivers and scripts; Building and loading boot images onto target hardware; Introduction to resource managers and their implementation.	

Textbooks/ Reference Books:

1. QNX Neutrino RTOS User's Guide, QNX Software Systems.
2. Programming for Embedded Systems, Michael Barr, O'Reilly Media.
3. Hands-on RTOS with Microcontrollers, Brian Amos, Packt Publishing, 2020.
4. Operating System Concepts, Abraham Silberschatz, Peter B. Galvin, Greg Gagne, 9th Edition, Wiley, 2018.

List of Experiments: The term work shall consist of a minimum of eight experiments.

1. QNX configuration and application development using QNX Momentics IDE.
2. Process and thread creation, management, and synchronization.
3. Implementation of IPC methods: passing message and shared memory.
4. Interrupt handling and hardware access programming.
5. Building and deploying QNX boot/OS images.
6. Mini capstone project: Design and implement a QNX-based embedded system.

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B. Tech. Electronics & Communication Engineering Sem. VII/VIII:

Professional Elective Course -I

CYBER SECURITY AND FORENSICS

TEACHING SCHEME:	EXAMINATION SCHEME:		CREDITS ALLOTTED:
Theory: 03 Hrs/week	End Semester Examination (Theory): 60 Marks		Credits: 03
Practical: 02 Hrs/week	Internal Assessment (IA): 40 Marks		
	TW: 25	OR: 25	Credit: 01
	Total:150 Marks		Total Credits: 04

Course Pre-requisites:

1	Computer Programming-I
2	Computer Programming-II
3	Computer Communication Networks

Course Outcomes: After learning this course students will be able to

1	Analyze the architecture of cyberspace, internet infrastructure, governance mechanisms, and major cyber security challenges.
2	Evaluate different types of cyber-crimes, reporting mechanisms, mitigation strategies, and legal provisions under the IT Act 2000 and related regulations in India.
3	Compare the security features and privacy risks of major social media platforms.
4	Analyze digital payment systems and propose preventive measures against financial frauds in compliance with RBI guidelines.
5	Implement essential security configurations including endpoint protection, firewall management, patch management, and Wi-Fi security policies.
6	Apply forensic tools and methodologies to acquire, analyze, and retrieve digital evidence from storage devices, including slack space and deleted files, while addressing anti-forensic techniques.

UNIT – I	**Introduction to Cyber security**	**(06 Hours)**
	Defining Cyberspace and Overview of Computer and Web-technology, Architecture of cyberspace, Communication and web technology, Internet, World wide web, Advent of internet, Internet infrastructure for data transfer and governance, Internet society, Regulation of cyberspace, Concept of cyber security, Issues and challenges of cyber security.	
UNIT – II	**Cyber-crime and Cyber law**	**(06 Hours)**

	Classification of cyber-crimes, Common cybercrimes- cyber-crime targeting computers and mobiles, cyber-crime against women and children, financial frauds, social engineering attacks, malware and ransomware attacks, zero day and zero click attacks, Cybercriminals modus-operandi , Reporting of cybercrimes, Remedial and mitigation measures, Legal perspective of cyber-crime, IT Act 2000 and its amendments, Cyber-crime and offences, Organizations dealing with Cyber-crime and Cyber security in India, Case studies.	
UNIT - III	**Social Media Overview and Security**	**(06 Hours)**
	Introduction to Social networks. Types of social media, Social media platforms, Social media monitoring, Hashtag, Viral content, Social media marketing, Social media privacy, Challenges, opportunities and pitfalls in online social network, Security issues related to social media, Flagging and reporting of inappropriate content, Laws regarding posting of inappropriate content, Best practices for the use of Social media, Case studies	
UNIT -IV	**E-Commerce and Digital Payments**	**(06 Hours)**
	Definition of E- Commerce, Main components of E-Commerce, Elements of E-Commerce security, E-Commerce threats, E-Commerce security best practices, Introduction to digital payments, Components of digital payment and stake holders, Modes of digital payments- Banking Cards, Unified Payment Interface (UPI), e-Wallets, Unstructured Supplementary Service Data (USSD), Aadhar enabled payments, Digital payments related common frauds and preventive measures. RBI guidelines on digital payments and customer protection in unauthorized banking transactions. Relevant provisions of Payment Settlement Act,2007.	
UNIT -V	**Endpoint and Network Security Practices**	**(06 Hours)**
	Endpoint device security, Mobile device security, Password policy and authentication mechanisms, Patch management and software update policies, Data backup strategies, Host firewall and antivirus management, Wi-Fi security principles, Configuration of basic security policies and access permissions, Cyber hygiene best practices	
UNIT -VI	**Digital Forensics Investigation Techniques**	**(06 Hours)**
	Introduction to Digital Forensics, Forensic investigation methodology, Disk imaging techniques, Slack space analysis, Data recovery techniques, Retrieval of deleted data (desktop, laptop, mobile), Forensic tools: EnCase, FTK. Vulnerability assessment tools, Anti-forensics techniques and counter measures, Evidence handling and documentation	
List of Practical: Any 8 Experiments		
1. Checklist for reporting cyber crime at Cyber crime Police Station.		
2. Reporting phishing emails.		
3. Demonstration of email phishing attack and preventive measures.		

4. Basic checklist, privacy and security settings for popular Social media platforms.
5. Reporting and redressal mechanism for violations and misuse of Social media platforms.
6. Setting and configuring two factor authentication in the Mobile phone.
7. Setting, configuring and managing three password policy in the computer (BIOS, Administrator and Standard User).
8. Security patch management and updates in Computer and Mobiles.
9. Managing Application permissions in Mobile phone.
10. Installation and configuration of computer Anti-virus.
11. Installation and configuration of Computer Host Firewall
12. Wi-Fi security management in computer and mobile.
Text Books/ Reference Books:
1. C. P. Pfleeger and S. L. Pfleeger, Security in Computing, 5th ed. Boston, MA, USA: Pearson, 2015.
2. N. Godbole and S. Belapure, Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives, 1st ed. New Delhi, India: Wiley India, 2011.
3. B. Nelson, A. Phillips, F. Enfinger, and C. Steuart, Guide to Computer Forensics and Investigations, 6th ed. Boston, MA, USA: Cengage Learning, 2019.

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B. Tech. Electronics & Communication Engineering Sem -VII/VIII (CBCS 2023 Course)

Professional Elective Course-I:

AUGMENTED REALITY AND VIRTUAL REALITY

TEACHING SCHEME:	**EXAMINATION SCHEME:**		**CREDITS ALLOTTED:**
Theory: 03 Hrs/week	End Semester Examination (ESE): 60 Marks		Credits: 03
Practical: 02 Hrs/week	Internal Assessment (IA): 40 Marks		
	TW:25 Marks	Oral :25 Marks	Credits:01
	Total:150 Marks		**Total Credits:04**

Course Pre-requisites:

The students should have knowledge of

	Computer Programming-I

Course Outcomes: After learning this course, students will be able to

CO1	Identify the key components of Virtual Reality (VR) systems and state their applications.
CO2	Apply various geometric modeling techniques.
CO3	Enumerate the hardware and sensors used in virtual environments.
CO4	Illustrate the concepts of Augmented Reality (AR) and related technologies.
CO5	Integrate VR hardware and software components to create interactive virtual environments.
CO6	Implement Virtual and Augmented Reality applications using Unity/Unreal game engines.

UNIT – I	**Virtual Reality (VR)**	**(06 Hours)**
	Virtual Reality and Virtual Environment, Flight simulation, Virtual environment requirements, Benefits of virtual reality, Historical development of VR, Applications of VR in medical, education, manufacturing, entertainment, and gaming, Emerging trends in VR (mixed reality, AI integration, immersive technologies).	
UNIT–II	**Computer Graphics and Geometric Modelling**	**(06 Hours)**
	Computer graphics, Real-time computer graphics, virtual world space, Positioning the virtual observer, Human vision, Stereo perspective projection, Colour theory, 2D to 3D conversion, 3D space curves, 3D boundary representation, Simple 3D modelling, Illumination models, Reflection models, Geometrical transformations: Modelling transformations, Rendering techniques for VR/AR (shading, textures, ray tracing)	
UNIT-III	**Virtual Environment**	**(06 Hours)**
	Input devices: Tracker, Sensor, Digital gloves, Motion capture, Video-based input, 3D Menus, 3D Scanner, etc. Output devices: Visual, Auditory, Haptic devices. Generic VR system: Virtual environment,	

	Computer environment, VR technology, Model of interaction, VR systems, Animating the virtual environment, Modern VR devices and interaction methods (e.g., Oculus, Vive).	
UNIT–IV	**Augmented Reality (AR)**	**(06 Hours)**
	History of AR, AR vs VR, AR systems, AR methods, Visualization techniques for AR, Enhancing interactivity in AR environments, Applications of AR in medical, education, manufacturing, entertainment, and gaming, AR frameworks and development tools, Emerging trends in AR (wearables, mixed reality, AI integration), Interaction devices and techniques (gesture, hand tracking, spatial mapping, haptics).	
UNIT – V	**Development Tools and Frameworks**	**(06 Hours)**
	Human factors: eye, ear, somatic senses. Hardware: sensor hardware, head-coupled displays, acoustic hardware, integrated VR systems. Software: Modeling virtual world, Physical simulation, VR toolkits (including VRML), Modern VR development tools (Unity, Unreal Engine, WebXR).	
UNIT–VI	**Applications of AR and VR**	**(06 Hours)**
	Applications of AR/VR in medical, manufacturing, education, entertainment, science, and game development; Future of VR/AR, including emerging trends such as mixed reality, wearable devices, AI integration, and immersive technologies.	

Textbooks/Reference Books

1. Coiffet, P., Burdea, G. C., *Virtual Reality Technology*, Wiley-IEEE Press, 1995.
2. Schmalstieg, D., Höllerer, T. *Augmented Reality: Principles & Practice*, Pearson, 1st Edition, Pearson, 2016.
3. John Vince, J., *Virtual Reality Systems*, Pearson, 1st Edition, Pearson Prentice Hall, 1995.
4. A. B. Craig, W. R. Sherman, J. D. Will , *Developing Virtual Reality Applications, Foundations of Effective Design*, 1st Edition, Morgan Kaufmann (Elsevier), 2009.
5. Fowler, A., *Beginning iOS AR Game Development: Developing Augmented Reality Appswith Unity and C#*, Apress. 1st Edition, Apress, 2018.

List of Experiments:- The term work shall consist of record of minimum of eight experiments

1. Installation of Unity and Visual Studio, setting up Unity for VR development. Demonstration of the working of HTC Vive, Google Cardboard, Google daydream
2. Develop a scene in Unity that includes a cube, plane and sphere
3. Apply geometric transformations (translation, rotation, scaling, and reflection) on three-dimensional game objects to modify their position, orientation, and size within a virtual environment.
4. Add and manage video and audio sources in a virtual scene for realistic simulation and interaction
5. Design a Unity scene with a cube, plane, and sphere, applying transformations and materials to create an interactive virtual environment.
6. Implement unique materials and textures for three Unity game objects, applying different colors and

surface properties to each.
7. Implement a C# script to modify the color, material, and texture of Unity game objects dynamically through user interaction (Button click).
8. Create a Unity scene with a sphere and plane, assigning Rigidbody, materials, and Box Colliders to demonstrate object physics and collision behavior.
9. Create interactive VR functionality where a sphere can be grabbed and thrown via VR controllers in Unity
10. Implement a basic user interface in Unity using UI elements like Canvas, Buttons, and Sprites for navigation and interaction.
11. Develop a Unity C# script to handle VR trigger input for UI interactions and dynamically update the score in the scene.

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B. Tech. Electronics & Communication Engineering Sem. VII/VIII:

Professional Elective Course -I
BLOCKCHAIN TECHNOLOGY

TEACHING SCHEME:	**EXAMINATION SCHEME:**		**CREDITS ALLOTTED:**
Theory: 03 Hrs/week	End Semester Examination (Theory): 60 Marks		Credits: 03
Practical: 02 Hrs/week	Internal Assessment (IA): 40 Marks		
	TW: 25	OR: 25	Credit: 01
	Total: 150 Marks		Total Credits: 04

Course Pre-requisites:

- Data Structures and Algorithms
- Computer Communication Networks

Course Outcomes: After learning this course students will be able to

1	Understand blockchain architecture, distributed consensus principles, and structural components such as blocks, hashing, and Merkle trees.
2	Apply cryptographic concepts including hashing, ECC, and digital signatures for secure blockchain-based communication systems.
3	Describe cryptocurrency transaction models, mining mechanisms, and validation processes in Bitcoin networks.
4	Develop blockchain consensus algorithms and analyze security vulnerabilities.
5	Evaluate blockchain consensus algorithms and analyze security vulnerabilities.
6	Design conceptual blockchain-based solutions for IoT, communication networks, and enterprise applications in ECE domains.

UNIT – I	**Fundamentals of Blockchain**	**(06 Hours)**
	Distributed systems and peer-to-peer networks, Evolution of blockchain technology, Blockchain architecture and components, Blocks, hashing, hash pointers, Merkle Trees and data integrity, Types of blockchain: Public, Private, Consortium, Characteristics and challenges of blockchain systems	
UNIT – II	**Cryptographic Foundations of Blockchain**	**(06 Hours)**
	Cryptographic primitives, Public key cryptography and digital signatures, Hash functions and SHA-256, Elliptic Curve Cryptography (ECC), Transaction validation mechanisms, Identity management and access control.	

UNIT - III	**Bitcoin and Cryptocurrency Mechanisms**	**(06 Hours)**
	Introduction to Bitcoin, Bitcoin architecture and network, Mining and mining pools, Transactions: lifecycle, fees, data structure, UTXO model, Types of transactions: P2PKH, P2SH, Multisig, Double-spending and prevention, Alternative cryptocurrencies	
UNIT -IV	**Ethereum and Smart Contracts**	**(06 Hours)**
	Introduction to Ethereum, Ethereum accounts and wallets, Ethereum Virtual Machine (EVM) architecture, Gas mechanism, Smart contract structure and lifecycle, Solidity basics, Development tools: Truffle framework, Use cases of smart contracts	
UNIT -V	**Blockchain Security and Consensus Mechanisms**	**(06 Hours)**
	Consensus problem in distributed systems, Nakamoto consensus and Proof of Work, Proof of Stake, PBFT, Algorand consensus, Sharding-based consensus algorithms, Security threats: 51% attack, Sybil attack, Selfish mining, Network attacks. Zero-Knowledge Proofs (ZKP), Privacy-enhancing techniques.	
UNIT -VI	**Blockchain Applications**	**(06 Hours)**
	Blockchain integration with IoT, Blockchain in 5G and communication networks, Supply chain and food security applications, Healthcare data management, Cross-border payments and KYC, Blockchain-as-a-Service (BaaS), Enterprise blockchain platforms (Hyperledger Fabric overview), Emerging trends: DeFi, NFTs, Decentralized Identity	

List of Practicals: Any 8 Experiments

1. To design and implement a basic blockchain and evaluate how data integrity is maintained using hash linking.
2. To implement a Merkle Tree and analyze its effectiveness in ensuring data integrity and efficient transaction verification.
3. To compare different cryptographic hash functions and evaluate their suitability for blockchain applications.
4. To implement and compare RSA and ECC digital signature techniques to evaluate their efficiency and security in blockchain systems.
5. To simulate the lifecycle of a Bitcoin transaction and analyze how transactions are validated using the UTXO model.
6. To simulate the Proof-of-Work mining process and evaluate the impact of difficulty level on mining time and computational effort.
7. To design, develop, and deploy a smart contract and evaluate its functionality and gas consumption.
8. To analyze vulnerabilities in a smart contract and redesign it to improve security and reliability.

9. To implement and compare different blockchain consensus algorithms and evaluate their performance and efficiency.
10. To simulate blockchain security attacks and evaluate their impact on network performance and integrity.
11. To design a blockchain-based system for securing IoT data and evaluate its effectiveness in maintaining data integrity.
12. To develop a blockchain-based application and evaluate its scalability, security, and real-world applicability.
Text Books/ Reference Books:
1. I. Bashir, *Mastering Blockchain: Unlocking the Power of Cryptocurrencies, Smart Contracts, and Decentralized Applications*, 4th ed., Packt Publishing, 2022.
2. A. M. Antonopoulos, *Mastering Bitcoin: Programming the Open Blockchain*, 2nd ed., O'Reilly Media, 2017.
3. C. Dannen, *Introducing Ethereum and Solidity: Foundations of Cryptocurrency and Blockchain Programming for Beginners*, 1st ed., Apress, 2017.
4. A. Bahga and V. K. Madisetti, *Blockchain Applications: A Hands-On Approach*, 1st ed., 2019.

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B. Tech. Electronics & Communication Engineering Sem-VII / VIII (CBCS 2023 Course) **Professional Elective Course-II:** **LIGHT WAVE COMMUNICATION**			
TEACHING SCHEME:	**EXAMINATION SCHEME:**		**CREDITS ALLOTTED:**
Theory: 03 Hrs/week	Examination (UE): 60 Marks		Credits: 03
Practical: 02 Hrs/week	Internal Assessment (IA): 40 Marks		
	TW: 25 Marks	Oral :25 Marks	Credits: 01
	Total: 150 Marks		**Total Credits: 04**

Course Pre-requisites:	
The students should have knowledge of	
	Digital Electronics, Analog Circuits & Applications, Optical Fiber Communication
Course Outcomes: After learning this course, students will be able to	
CO1	Apply knowledge of basic optical network elements for realizing light wave technology
CO2	Identify and formulate different optical networking topologies
CO3	Design Optical Network Routing Algorithms.
CO4	Apply the basic Networking knowledge to realize any sort of end-to-end communication
CO5	Analyse the various design parameters of optical network.
CO6	Analyse the optical networks in its configuration, fault and performance.

UNIT – I	**Introduction :**	**(06 Hours)**
	Evolution of Light wave System, Components of a Light wave System, Communication Channel, Electrical Signals, Channel Multiplexing ,Optical Signal Generation, Digital Data Formats	
UNIT–II	**Light wave Networks Architecture :**	**(06 Hours)**
	Light wave Network Architectures ,Broadcast and Distribution Networks, Ultrahigh capacity networks ,Virtual Topology, Packet Communication, Multiple Point-to-Point Links ,Arbitrary Virtual Topology	
UNIT-III	Lightwave Channels:	**(06 Hours)**
	The Guided Lightwave Channel, The Linear Lightwave Channel, The Nonlinear Lightwave Channel, Multiplexing and Demultiplexing in light waves system, Synchronization, Broadcast OTDM networks, Switch-based networks. Access Networks – Network Architecture overview, Future Access Networks	
UNIT–IV	**Wavelength Routing Networks :**	**(06 Hours)**

	Optical layer, Node design, Network design and operation, routing and wavelength assignment architectural variations. Optical Network Routing Principles - Impairment Aware Routing Optical Circuit Switching, Optical Packet Switching Optical Burst Switching.	
UNIT – V	**Design of Light wave Networks:**	**(06 Hours)**
	Core Optical Networks, Metro Optical networks, Access Optical Networks Wavelength Routing and Assignment, Traffic Grooming and Protection, Multilayer Network Structure ,Transmission system model, power penalty-transmitter, receiver optical amplifiers, crosstalk, dispersion, wavelength stabilization .	
UNIT–VI	**Network Control and Management :**	**(06 Hours)**
	Light wave Networks Control and management, Network management configuration management, Performance management, Dispersion Management, Nonlinearity Management ,fault management and safety.	

Content Delivery Methods: ICT Tools

List of Experiments:- The term work shall consist of record of minimum of eight experiments.

1. Light Source Characteristics
2. Study of Numerical Aperture of fiber.
3. Study of Frequency modulation and demodulation using Optical fiber.
4. Measurement of bending loss and propagation loss in the optical fiber cable
5. To measure the attenuation variation in length of optical cable.
6. Transmission of Analog & Digital signal using a simple fiber optic link.
7. To find the optical power using "Optical Power Meter".
8. To find the optical response using OTDR.
9. Determination of input, output and transfer characteristics of Optocoupler.
10. Study of pulse width modulation and demodulation technique using Optical fiber

Textbooks/Reference Books

1. Govind P. Agrawal " Lightwave Technology", A JOHN WILEY & SONS, INC., PUBLICATION.

2. George C. Papen and Richard E. Blahut ",Lightwave Communications; Cambridge University Press,

3. Gerd Keiser, "Optical Fiber Communications", Tata McGraw Hill, Fourth Edition.

4. John M. Senior, Optical Fiber Communications-Principles and Practice, Prentice Hall ofIndia, second Edition

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B. Tech (Electronics & Communication) Sem: VII / VIII (CBCS 2023 COURSE)

Professional Elective Course-II:

FINTECH SYSTEMS

Teaching Scheme:	**Examination Scheme:**		**Credits Allotted:**
Theory: 03 Hrs/week	End Semester Examination (Theory): 60 Marks		Credits: 03
Practical:02 Hrs/week	Internal Assessment (IA): 40 Marks		
	TW: 25 Marks	OR: 25 Marks	Credit: 01
	Total:150 Marks		Total Credits: 04

Course Pre-requisite:

1. Cybersecurity and Forensics
2. Computer Networks

Course Outcomes: After completion, students will be able to::

1	Explain FinTech ecosystem and technologies
2	Describe and interpret various digital payment systems and their working mechanisms.
3	Apply blockchain concepts and smart contracts in financial applications.
4	Analyze the role of AI and data analytics in FinTech solutions and decision-making.
5	Evaluate security, privacy, regulatory, and risk management issues in FinTech systems.
6	Design and develop simple FinTech-based applications or prototypes.

UNIT – I	**Introduction to FinTech**	**(06 Hours)**
	Evolution of financial systems (Traditional → Digital), Definition, scope and importance of FinTech, FinTech ecosystem & stakeholders, FinTech business models Global and Indian FinTech landscape, Role of telecom & internet in FinTech growth	
UNIT– II	**Digital Payment Systems**	**(06 Hours)**
	Overview of digital payment systems, UPI architecture and working, E-wallets and mobile payments, Payment gateways & transaction flow, NEFT, RTGS, IMPS concepts, POS systems and contactless payments	
UNIT – III	**Digital Banking & Open Banking**	**(06 Hours)**
	Digital banking architecture, Core banking solutions Mobile and internet banking technologies, Open banking concepts, APIs in banking systems, Case studies of digital banks	
UNIT – IV	**Blockchain & Cryptocurrencies in Finance**	**(06 Hours)**
	Blockchain fundamentals in finance, Smart contracts in financial services, Cryptocurrencies and stablecoins	

	Central Bank Digital Currency (CBDC) concept, Cross-border payments using blockchain, Limitations and challenges	
UNIT – V	**AI & Data Analytics in FinTech**	**(06 Hours)**
	Role of AI in FinTech, AI-based credit scoring, Fraud detection systems, Big data analytics in finance, Algorithmic trading basics, Robo-advisors & predictive analytics	
UNIT – VI	**Security, Regulation & Risk Management**	**(06 Hours)**
	Cybersecurity challenges in FinTech, Data privacy & encryption, Regulatory frameworks overview, KYC and AML concepts, Risk management in digital finance Ethical issues & future trends.	

List of Practical: Any 8 Experiments

1. Study of FinTech Ecosystem: Explore major FinTech platforms (payments, lending, insurance).Identify stakeholders and services.
2. Digital Payment Workflow Simulation: Simulate online transaction flow.Understand roles of gateway, bank, and user.
3. UPI Transaction Process Study: Analyse UPI architecture and transaction steps.Document request–response flow.
4. Payment Gateway API Demo: Use sandbox APIs (e.g., mock payment API).Generate and verify transaction tokens.
5. E-Wallet System Study: Examine wallet architecture.Simulate wallet recharge and transfer logic.
6. Blockchain Transaction Demo: Perform a basic blockchain transaction in a test network.
7. Observe block confirmation.
8. Cryptocurrency Wallet Setup: Create a demo crypto wallet.Understand public/private keys.
9. Smart Contract Demo: Deploy a basic smart contract (guided environment).Execute a simple transaction.
10. Fraud Detection Using Simple ML: Use a sample dataset.Identify suspicious patterns.
11. Credit Scoring Model: Basic scoring using financial parameters.Analyse decision logic.
12. Secure Transaction Using Encryption: Apply symmetric/asymmetric encryption.Demonstrate secure data transfer.
13. Mini FinTech Application: Develop a basic prototype:Payment app simulation, Fraud alert system

Text Book/ Reference Books:

1. Chishti, Susanne, and Janos Barberis. *The Fintech book: The financial technology handbook for investors, entrepreneurs and visionaries*. John Wiley & Sons, 2016.
2. Skinner, Chris. *Digital bank: Strategies to launch or become a digital bank*. Marshall Cavendish International Asia Pte Ltd, 2014.
3. Bashir, Imran. *Mastering blockchain*. Packt Publishing Ltd, 2017.
4. Patel, Shreya Rajnikant, and Rishabh Patil. "An Analysis of the Fintech Regulations in India." *Part 2 Indian J. Integrated Rsch. L.* 2 (2022): 1.
5. Kou, Gang. "Introduction to the special issue on FinTech." *Financial Innovation* 5.1 (2019): 45.

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B. Tech. Electronics and Communication Engineering Sem-VII / VIII (CBCS 2023 Course)

Professional Elective Course-II

COMPUTER VISION

TEACHING SCHEME:	EXAMINATION SCHEME:		CREDITS ALLOTTED:
Theory: 03 Hrs/week	End Semester Examination (ESE): 60 Marks		Credits: 3
Practical: 02 Hrs/week	Internal Assessment (IA): 40 Marks		
	TW:25 Marks	OR:25 Marks	
	Total =150 Marks		Total Credit: 4

Course pre-requisites:

1. Machine Learning

Course Outcomes: After learning this course, students will be able to

CO1	Analyze the fundamentals of computer vision systems like image formation, camera models, image reconstruction techniques.
CO2	Apply image processing techniques such as filtering, morphology and segmentation for visual data analysis.
CO3	Extract the image features of images for Image processing.
CO4	Demonstrate the pattern recognition principles, including decision functions, statistical decision theory, classifiers, clustering, dimensionality reduction, and template matching.
CO5	Implement machine learning and neural network models, including linear models, Gaussian classifiers, artificial neural networks, convolutional neural networks, and autoencoders for pattern classification problems.
CO6	Develop computer vision applications such as medical image segmentations, motion estimation, object tracking and face recognition.

UNIT–I	**Introduction to Computer Vision & Image Processing**	**(06 Hours)**
	Introduction to computer vision, Image formation and radiometry, Geometric transformation, Geometric camera models, Image reconstruction from series of projections.	
UNIT–II	**Image Processing Concepts**	**(06 Hours)**
	Fundamentals of Image processing, Image transforms, Image filtering, Color image processing, Mathematical morphology, Image Segmentation.	
UNIT-III	**Image Descriptors and features**	**(06 Hours)**

	Texture descriptors, Color features, Edge detection methods, Boundary and shape representations, Interest or corner point detectors, Histogram of Oriented Gradients, Scale Invariant Feature Transform, Speeded up Robust Features.	
UNIT–IV	**Fundamentals Pattern Recognition**	**(06 Hours)**
	Fundamental Pattern Recognition, Linear regression, Basic Concepts of Decision Functions, Elementary Statistical Decision Theory, Gaussian classifier, Parameter Estimation, Clustering for Knowledge Representation, Dimension reduction, Template Matching, Artificial Neural Network for Pattern Classification, Convolutional Neural Networks, Autoencoder.	
UNIT–V	**Fundamentals of Machine Learning**	**(06 Hours)**
	Linear Regression, Basic Concepts of Decision Functions, Elementary Statistical Decision Theory, Parameter Estimation, Clustering for Knowledge Representation, Dimension Reduction, Linear Discriminant Analysis.	
UNIT–VI	**Applications of Computer Vision**	**(06 Hours)**
	Machine Learning Algorithms and their Applications in Medical Image Segmentation, Motion Estimation and Object Tracking, Face and Facial Expression Recognition, Gesture Recognition, Image Fusion, Programming Examples.	

List of Experiments: The term work shall consist of a minimum of eight experiments based on Python.

1. Perform Scaling, rotation, translation and affine transformations.
2. Apply smoothing filters (Gaussian, Median) and sharpening filters
3. Perform Fourier Transform and visualize frequency components.
4. Convert between RGB, HSV, and grayscale; color-based segmentation.
5. Implement dilation, erosion, opening, and closing in morphological operations.
6. Apply thresholding, edge-based and region-based segmentation.
7. Implement Sobel, Prewitt, and Canny edge detectors
8. Extract features using Histogram of Oriented Gradients.
9. Apply K-means clustering for image segmentation.
10. Implement a simple Gaussian classifier for image classification.
11. Build a basic CNN model using TensorFlow/Keras.
12. Implement one application: Face detection/ Object tracking/Motion detection.

Text Books / Reference Books

1. M.K. Bhuyan, "*Computer Vision and Image Processing: Fundamentals and Applications*", CRC Press, USA, 2020.
2. Rafael C. Gonzalez and Richard E. Woods, *Digital Image Processing*, Pearson, 2018.
3. Richard Szeliski, *Computer Vision: Algorithms and Applications*, Springer, 2011.
4. Adrian Kaehler and Gary Bradski, *Learning OpenCV*, O'Reilly,2008.
5. Ian Goodfellow, Yoshua Bengio, Aaron Courville, *Deep Learning*, MIT Press,2016.
6. Forsyth and Ponce, *Computer Vision: A Modern Approach*, Pearson,2011.

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B. Tech. Electronics & Communication Engineering Sem -VII/VIII(CBCS 2023Course) **Professional Elective Course-II:** **SPEECH AND AUDIO PROCESSING**			
TEACHING SCHEME:	**EXAMINATION SCHEME:**		**CREDITS ALLOTTED:**
Theory:03 Hrs/week	Examination (UE): 60 Marks		Credits: 03
Practical: 02 Hrs/week	Internal Assessment (IA): 40 Marks		
	TW: 25 Marks	Oral : 25 Marks	Credits:01
	Total:150 Marks		**Total Credits:04**

Course Pre-requisites:

The students should have knowledge of

	Digital Signal Processing
	Computer Programming-II

Course Outcomes: After learning this course, students will be able to

CO1	Enumerate the key principles of Speech: Processing, Production, and Perception.
CO2	Apply time- and frequency-domain techniques for speech signal analysis.
CO3	Implement fundamental Speech Synthesis Techniques
CO4	Evaluate basic speech recognition systems using feature extraction techniques
CO5	Enumerate fundamental Audio Recording Principles for Speech Applications
CO6	Implement studio recording workflows using DAWs and recording systems.

UNIT – I	**Speech and Audio signal Processing**	**(06 Hours)**
	Introduction to Speech and Audio Processing; Speech production mechanism; Articulatory and acoustic phonetics; Human auditory system; Sound perception; Vowel and consonant perception; Types of audio signals; Sampling, quantization, and digital representation of speech signals.	
UNIT–II	**Digital Signal Processing for Speech signal**	**(06 Hours)**
	Time-domain and frequency-domain analysis; Time-domain parameters of speech signals and parameter extraction methods; Frequency-domain parameters; Short-Time Autocorrelation Function; Pitch period estimation using autocorrelation; Linear Predictive Coding (LPC) analysis; Cepstral analysis; Pitch estimation techniques; Windowing techniques; Digital filtering.	
UNIT-III	**Speech Coding and Speech Synthesis**	**(06 Hours)**
	Quantization and redundancies in speech; Waveform coding; Linear Predictive (LP) coding; Frequency-domain coders; Vector Quantization (VQ) coders; Principles of speech synthesis; Synthesis methods: Text-to-Speech (TTS), Prosody in speech synthesis.	

UNIT–IV	**Speech Recognition & Processing**	**(06 Hours)**
	Speech recognition fundamentals; Parametric representation of speech; Modes of speech recognition; Segmental feature extraction; Mel-Frequency Cepstral Coefficients (MFCC); Hidden Markov Models (HMM); Acoustic modeling; Evaluation metrics; Speech-based applications (ASR, spoken language systems); Artificial Intelligence in speech and music processing applications.	
UNIT – V	**Recording Fundamentals**	**(06 Hours)**
	Overview of modern audio recording systems; analog and digital recording concepts; Sound Pressure Level (SPL) and the decibel scale; signal chain and gain staging; microphones for speech capture; audio interfaces and ADC/DAC conversion; studio acoustics and noise control; digital audio formats and sampling standards.	
UNIT–VI	**Sound Recording & Engineering**	**(06 Hours)**
	Digital Audio Workstations (DAWs); signal flow in recording systems; studio operation fundamentals; microphones and accessories; recording and signal processing devices; recording acoustic instruments; recording vocals and speech; working with electronic instruments.	

Textbooks/ Reference Books:

1. L. Rabiner, Biing-Hwang Juang and B. Yegnanarayana , “Fundamentals of Speech Recognition”, 1st Edition, Pearson Education Inc. (Prentice Hall), 1993.
2. Thomas F Quatieri , “Discrete Time Speech Signal Processing”, 1st Edition, Pearson Education Inc. (Prentice Hall), 2001.
3. Rabiner and Schafer, "Digital Processing of Speech Signals", 1st Edition, Pearson Education (Prentice Hall), 1978.

List of Experiments: The term work shall consist of a minimum of eight experiments.

1. Record a speech signal and observe its waveform characteristics.
2. Study the digital representation of speech by comparing different sampling rates and quantization levels
3. Compute and analyze the Short-Time Fourier Transform (STFT) of a speech signal.
4. Study and implement pitch estimation using the autocorrelation method.
5. Study and extract LPC (Linear Predictive Coding) coefficients of a speech signal**.**
6. Study and compare speech compression using PCM and ADPCM formats.
7. Study the characteristics of different types of microphones (dynamic, condenser) and observe their recording behaviour.
8. Perform basic speech recording using a Digital Audio Workstation (DAW)
9. Study and apply basic audio effects such as equalization, noise reduction, compression, and reverb.
10. Create a Mini Audio Podcast Episode (1–2 minutes)

Bharati Vidyapeeth
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B. Tech. Electronics and Communication Engineering Sem–VII/VIII (CBCS 2023 course)

Professional Elective Course-II:

RADAR AND SATELLITE COMMUNICATION

TEACHING SCHEME:	**EXAMINATION SCHEME:**		**CREDITS ALLOTTED:**
Theory: 03 Hrs/week	End Semester Examination (ESE): 60 Marks		Credits: 3
Practical: 02 Hrs/week	Internal Assessment (IA): 40 Marks		
	TW:25 Marks	OR:25 Marks	
	Total =150 Marks		Total Credit: 4

Course pre-requisites:

The students should have knowledge of

1.	Introduction to Electronics Communication
2.	Digital Communication
3.	Electromagnetic Waves & Propagation

Course Outcomes: After learning this course, students will be able to

CO1	Describe the basic principles and applications of radar systems.
CO2	Analyze radar transmitters, receivers, and antenna characteristics.
CO3	Evaluate different radar types and signal processing methods.
CO4	Understand satellite orbits, subsystems, and communication principles.
CO5	Design and analyze satellite communication links.
CO6	Interpret satellite navigation systems and satellite applications.

UNIT– I	**Introduction to Radar Systems**	**(06 Hours)**
	Basic concept of radar, Radar block diagram and operation, Radar frequencies and bands, Radar applications, Radar range equation (simple form), Minimum detectable signal, Factors affecting radar performance	
UNIT–II	**Radar Transmitters, Receivers and Antennas**	**(06 Hours)**
	Radar transmitters: Magnetron, Klystron, Traveling Wave Tube (TWT), Radar receivers: Superheterodyne receiver, Receiver noise and sensitivity, Duplexers, Radar antennas: Parabolic reflector, phased array, Antenna parameters: Gain, beamwidth, Scanning techniques	
UNIT-III	**Radar Types and Signal Processing**	**(06 Hours)**
	Continuous Wave (CW) radar, Frequency Modulated CW (FMCW) radar, Pulsed radar system, Moving Target Indication(MTI) radar and Pulse Doppler radar, Radar tracking techniques, Basics of radar signal processing, Clutter and noise effects	
UNIT–IV	**Fundamentals of Satellite Communication**	**(06 Hours)**
	Introduction to satellite communication, Advantages and limitations, Satellite orbits, Kepler's laws of planetary motion, Orbital parameters, Satellite subsystems overview, Launch vehicles and launching methods.	

UNIT– V	**Satellite Subsystems and Link Design**	**(06 Hours)**
	Satellite bus and payload, Transponders: Bent-pipe and regenerative, Satellite antennas and power systems, Uplink and downlink frequency bands, Link budget analysis, Noise temperature and G/T ratio, EIRP and carrier-to-noise ratio.	
UNIT–VI	**Satellite Navigation and Applications**	**(06 Hours)**
	Satellite navigation systems: Global Positioning System(GPS), Global Navigation Satellite System (GLONASS), Galileo Global Navigation Satellite System (GALILEO), Indian Regional Navigation Satellite System (IRNSS), Principle of GPS operation, Tracking, Telemetry and Command (TT&C), Earth station components, Multiple access techniques: FDMA, TDMA, CDMA, Applications of satellite communication, Recent trends in radar and satellite technology.	

List of Experiments :- The term work shall consist of record of minimum of eight experiments using MATLAB.

1. To calculate radar range using the radar range equation.
2. To analyze receiver sensitivity and noise figure in a radar receiver.
3. To plot antenna radiation pattern and determine beamwidth.
4. To study Doppler frequency and range measurement using CW and FMCW radar.
5. To analyze pulse width, pulse repetition frequency (PRF), and maximum range in a pulsed radar system.
6. To simulate satellite motion and plot its orbital trajectory using Kepler's Laws of Planetary Motion.
7. To analyze different satellite orbits (GEO, LEO, MEO) and their coverage characteristics.
8. To study various satellite subsystems including payload, bus, power system, and antennas. (Case study of real satellites such as INSAT / GSAT).
9. To calculate satellite link budget parameters such as EIRP, path loss, G/T ratio, and carrier-to-noise ratio.
10. To compare multiple access techniques such as FDMA, TDMA, and CDMA in satellite communication.

TextBooks/ ReferenceBooks:

1. I. Skolnik, *Introduction to Radar Systems*, 3rd ed. New York, NY, USA: Tata McGraw-Hill, 2001.

2. G. K. Prajapati, *Basic of RADAR and Its Applications in Wireless Communication*. Saarbrücken, Germany: Scholar's Press, 2014.

3. D. Roddy, *Satellite Communications*, 4th ed. New York, NY, USA: McGraw-Hill, 2006.

4. T. Pratt, C. W. Bostian, and J. E. Allnutt, *Satellite Communications*, 2nd ed. Hoboken, NJ, USA: Wiley, 2003.

5. D. R. Cheruku, *Satellite Communication*. New Delhi, India: I. K. International Publishing House Pvt. Ltd., 2010.

6. B. R. Elbert, *Introduction to Satellite Communication*, 3rd ed. Norwood, MA, USA: Artech House, 2008.

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B. Tech. Electronics & Communication Engineering Sem. VII (CBCS 2023)
MAJOR PROJECT

TEACHING SCHEME:	EXAMINATION SCHEME:	CREDITS ALLOTTED:
Practical:16 Hrs/week	TW: 100 Marks	Credit :8
	Oral: 50 Marks	
	Total Marks: - 150 Marks	Total Credit: 08

Course Pre-requisites:

Course Outcomes: After learning this course students will be able to

1	Apply engineering knowledge to solve real-world problems.
2	Design and implement engineering systems.
3	Use modern engineering tools and techniques.
4	Demonstrate professional ethics and teamwork.
5	Communicate effectively and prepare technical documentation.
6	Demonstrate innovation and lifelong learning.

Major Project includes various steps such as
1. Problem statement & objectives, scope and limitations
2. Literature survey with proper citation
3. Feasibility study along with Architecture / block diagram
4. Synopsis
5. System requirements/specifications (measurable)
6. Requirement analysis
7. System Design - Design methodology + implementation details (hardware/software/algorithm)
8. Testing - Results with analysis and comparison against benchmarks/targets
8. Costing, feasibility, and scalability
9. Ethics/safety/IP statement
10. System documentation and Project report

1. **Project Nature**

Project may be:
- Hardware-centric
- Software-centric
- Embedded systems
- Communication systems
- AI / Signal Processing
- Biomedical / Industrial IoT
- Simulation / Modeling

- Product / Prototype development

Must demonstrate:

- Engineering depth
- System integration
- Quantitative validation
- Safety and compliance

2. **Team Structure**

Team size: 2–3 students

Each team must have:

- One internal guide
- One co-guide (optional)
- Industry co-mentor (optional)

3. **Project Phases**

Phase	**Deliverable**
Phase I	Problem identification, literature survey, proposal
Phase II	Design, modelling, simulation
Phase III	Implementation, testing
Phase IV	Validation, documentation, presentation

4. **Mandatory Outcomes**

Each project must deliver:

- Functional prototype / validated simulation
- Block diagram and system architecture
- Experimental results
- Cost analysis and feasibility
- Safety and ethical compliance
- Future scope and scalability
- Plagiarism check (<10%) and AI check (<10%)