SYLLABUS

(With effect from 2024 -25)

ಪಠ್ಯಕ್ರಮ

(ಶೈಕ್ಷಣಿಕ ವರ್ಷ 2024-25)

Bachelor Degree

In

Electronics & Communication Engineering

VII & VIII Semester

Out Come Based Education

With

Choice Based Credit System

[National Education Policy Scheme]

P.E.S. College of Engineering, Mandya - 571 401, Karnataka

[An Autonomous Institution affiliated to VTU, Belagavi,
Grant – in – Aid Institution (Government of Karnataka),
Accredited by NBA (All UG Programs), NAAC and Approved by AICTE, New Delhi]

ಪಿ.ಇ.ಎಸ್. ತಾಂತ್ರಿಕ ಮಹಾವಿದ್ಯಾಲಯ

ಮಂಡ್ಯ–571 401, ಕರ್ನಾಟಕ

(ವಿ.ಟಿ.ಯು, ಬೆಳಗಾವಿ ಅಡಿಯಲ್ಲಿನ ಸ್ವಾಯತ್ತ ಸಂಸ್ಥೆ)

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VISION

"PESCE shall be a leading institution imparting quality Engineering and Management education developing creative and socially responsible professionals."

MISSION

- *Provide state of the art infrastructure, motivate the faculty to be proficient in their field of specialization and adopt best teaching-learning practices.*
- *Impart engineering and managerial skills through competent and committed faculty using outcome based educational curriculum.*
- *Inculcate professional ethics, leadership qualities and entrepreneurial skills to meet the societal needs.*
- *Promote research, product development and industry-institution interaction.*

QUALITY POLICY

Highly committed in providing quality, concurrent technical education and continuously striving to meet expectations of stake holders.

CORE VALUES

***P**rofessionalism*

***E**mpathy*

***S**ynergy*

***C**ommitment*

***E**thics*

Department of Electronics and Communication Engineering

The department of Electronics and Communication Engineering was incepted in 1967 with an undergraduate program in Electronics and Communication Engineering. Initially, the program had an intake of 60 students, which increased to 120 in 2012, and further increased to 180 in 2019. Almost 200 students graduate every year, and the long journey of 50 years has seen satisfactory contributions to society, the nation, and the world. The alumni of this department have a strong global presence, making their alma mater proud in every sector they represent.

The department started its PG program in 2012 in the specializations of VLSI design and embedded systems. Equipped with well qualified and dedicated faculty, the department has a focus on VLSI design, embedded systems, and image processing. The quality of teaching and training has yielded a high growth rate of placement at various organizations. The large number of candidates pursuing research programs (M.Sc. and Ph.D.) is a true testimonial to the research potential of the department. The department is recognized as a research centre by VTU, and Mysore University offers a part-time and full-time Ph.D. Program.

Vision

The department of E & C would endeavour to create a pool of Engineers who would be extremely competent technically, ethically strong also fulfil their obligation in terms of social responsibility.

Mission

- M1: Adopt the best pedagogical methods and provide the best facility, infrastructure and an ambience conducive to imbibe technical knowledge and practicing ethics.
- M2: Group and individual exercises to inculcate habit of analytical and strategic thinking to help the Students to develop creative thinking and instil team skills.
- M3: MoUs and Sponsored projects with industry and R & D organizations for collaborative learning.
- M4: Enabling and encouraging students for continuing education and moulding them for life-long learning process.

Program Educational Objectives (PEOs)

- **PEO1:** Graduates to exhibit knowledge in mathematics, engineering fundamentals applied to Electronics and Communication Engineering for professional achievement in industry, research and academia.
- **PEO2:** Graduates to identify analyse and apply engineering concepts for design of Electronics and Communication Engineering systems and demonstrate multidisciplinary expertise to handle societal needs and meet contemporary requirements.
- **PEO3:** Graduates to perform with leadership qualities, team spirit, management skills, attitude and ethics need for successful career, sustained learning and entrepreneurship.

Program Outcomes (POs)

- **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
- **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
- **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
- **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
- **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
- **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
- **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
- **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
- **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multi-disciplinary settings.
- **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
- **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multi-disciplinary environments.
- **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes (PSOs)

Electronics and Communication Engineering Graduates will be able to

- **PSO1:** An ability to understand the basic concepts in Electronics and Communication Engineering and to apply them in the design and implementation of Electronics and Communication Systems.
- **PSO2:** An ability to solve complex problems in Electronics and Communication Engineering, using latest hardware and software tools, along with analytical skills to arrive at appropriate solutions.

Bachelor of Engineering (VII –Semester)											
Sl. No.	**Course Code**	**Course Title**	**Teaching Department**	**Hrs / Week**				**Credits**	**Examination Marks**		
				L	**T**	**P**	**PJ**		**CIE**	**SEE**	**Total**
1	P21EC701	Wireless and Mobile Communication	EC	3	-	-	-	3	50	50	100
2	P21EC702X	Professional Elective Course – IV	EC	3	-	-	-	3	50	50	100
3	P21EC703X	Professional Elective Course - V	EC	3	-	-	-	3	50	50	100
4	P21EC704	Computer Communication Network and IoT (Integrated)	EC	3	-	2	-	4	50	50	100
5	P21RMI705	Research Methodology and IPR	EC	3	-	-	-	3	50	50	100
6	P21EC706	Project Work Phase – I	EC	-	-	-	3	4	100	-	100
Total								**20**	**350**	**250**	**600**

Professional Elective Course – IV (P21EC702X)	
Course Code	**Course Title**
P21EC7021	Low Power VLSI Design
P21EC7022	Cryptography and Network Security
P21EC7023	Wireless Sensor Networks
P21EC7024	Multicore architecture and Programming

Professional Elective Course – V (P21EC703X)	
Course Code	**Course Title**
P21EC7031	Satellite Communications
P21EC7032	System on Chip
P21EC7033	Advanced Wireless Technologies
P21EC7034	Biomedical Signal Processing

Bachelor of Engineering (VIII –Semester)											
Sl. No.	**Course Code**	**Course Title**	**Teaching Department**	**Hrs / Week**				**Credits**	**Examination Marks**		
				L	**T**	**P**	**PJ**		**CIE**	**SEE**	**Total**
1	P21EC801	Self-Study Course	EC	-	-	-	-	2	100	-	100
2	P21ECINT802	Research/Industry Internship- III	EC	-	-	-	-	6	-	100	100
3	P21EC803	Project Work Phase – II	EC	-	-	-	3	8	100	100	200
Total								**16**	**250**	**150**	**400**

L: Lecture	T: Tutorial	CIE: Continuous Internal Evaluation
P: Practical/ Drawing	PJ: Project	SEE: Semester End Examination

Academic Year: 2024-25	Semester: VII	Scheme: P21
Course Title: **Wireless and Mobile Communication**		
Course Code: **P21EC701**	CIE Marks: 50	CIE Weightage: 50%
Teaching hours/week (L:T:P)=3 : 0 : 0	SEE Marks:100	SEE Weightage: 50%
Teaching hours of Pedagogy: 40	Exam Hours: 3 Hours	
Credits: 3		

Prerequisite:
Basic knowledge of computer networks, Digital and Analog communications, transmission lines and antennas and digital signal processing.

Course learning Objectives:

CLO1: Understand the various modern wireless communication systems.
CLO2: Discuss the concept of cellular architecture and system design fundamentals to improve channel capacity.
CLO3: Describe different wireless systems and standards.
CLO4: Study the Mobile Radio Propagation
CLO5: Study the modern cellular architectures LTE, VOLTE etc.

UNIT - I	**8 Hours**

Introduction to Wireless Communication Systems and Wireless Networks: Examples of Wireless Communication Systems. Wireless local loop (WLL) and LMDS, Wireless Local Area Networks(WLANs), Bluetooth and Personal Area Networks (PANs).

Self-Study Content: List out modern wireless communications networks are available to the user around the world with their services and type of technologies used.

Textbook Map: **1.4, 2.3-2.5**

Teaching Learning Process: 1. Power Point Presentation
2. Chalk and board
3. Quiz.

UNIT – II	**8 Hours**

The Cellular Concept- System Design Fundamentals: Handoff strategies, Interference and system capacity, Trunking and Grade of service, Improving coverage and capacity in cellular systems.

Self-Study Content: Understand the latest/recent capacity enhancement techniques in cellular system.

Textbook Map: **3.4-3.7**

Teaching Learning Process: 1. Power Point Presentation with illustrations
2. Chalk and board
3. Quiz

UNIT - III	**8 Hours**

GSM and Modulation Techniques for Mobile Radio: Global System for Mobile (GSM), Constant envelope modulation, Combined Linear and Constant Envelope Modulation Techniques, Spread Spectrum Modulation Techniques.

Self-Study Content: Compare and contrast CDMA with GSM mobile standards.

Textbook Map: **11.3 and 6.9-6.11**

Teaching Learning Process: 1. Power Point Presentation
2. Chalk and board
3. Quiz.

UNIT - IV	8 Hours
Mobile Radio Propagation: Large-Scale Path Loss: Introduction to Radio Wave Propagation, Free Space Propagation Model, Relating Power to Electric Field, The 3 Basic Propagation Models, Reflection, Ground Reflection, Diffraction, Okumura Model, Hata Model. **Mobile Radio Propagation: Small-Scale Fading and Multipath:** Small-Scale Multipath Propagation, Impulse Response Model of a Multipath Channel.	
Self-Study Content: Study the empirical models for Indoor and outdoor propagation.	
Textbook Map: **4.1-4.7, 4.10.3, 4.10.4, 5.1, 5.2.**	
Teaching Learning Process: 1. Power Point Presentation 2. Chalk and board 3. Quiz.	
UNIT - V	**8 Hours**
Introduction to 4G and Advanced: The Need for LTE, From UMTS to LTE, From LTE to LTE-Advanced, Carrier Aggregation, Principles of Operation, Career Aggregation, Enhanced Downlink & Uplink MIMO. **VoLTE:** Introduction, Hardware Architecture of IMS, VoLTE Registration Procedure, Call Setup and Release. **LTE Advanced:** Peak Data Rates of and LTE Advanced, Coverage & Capacity of an LTE Cell. Performance.	
Self-Study Content: Study the white papers on 5G and 6G wireless technologies in cellular systems and submit a report on recent developments in it.	
Textbook Map: **1.3-1.5, 19.1-19.3, 22.1-22.2, 22.5-22.6, 23.1-23.3**	
Teaching Learning Process: 1. Power Point Presentation 2. Chalk and board 3. Case study	

Course Outcomes: At the end of the course students should be able to :

CO1: **Apply** signal processing for wireless communication system to realize basic principles of wireless communication.

CO2: **Analyze** various standards and methodologies to improve the cellular capacity.

CO3: **Illustrate** fundamentals of cellular communication system to study various advanced wireless systems, standards and mobile radio propagation.

CO4: **Create** a cellular system for various parameters like capacity, interference, handoff, radio propagation etc.

Suggested Learning Resources:

Text books:

Sl. No.	Title	Author	Year & Edition	Publisher
1	Wireless Communications-Principles and Practice	Theodre. S. Rappaport	2nd Edition, 2010..	ISBN-13: 9788131731864
2	An Introduction to LTE: LTE, LTE-Advanced, SAE and 4G Mobile Communications	Christopher Cox		

Reference Books:				
1	Wireless and Cellular Communications	William. C. Y. Lee Mc-Graw Hill,	2005	ISBN: 978-00-714-3686-1.
2	Introduction to Wireless Telecommunications Systems and Networks	Gary. J. Mullet	2010	ISBN-13: 978-81-315-0559-5.
3	Ad-HOC Wireless Networks: A Communication-Theoretic Perspective	Ozan. K. Tonguz, Giianluigi Ferrari	2009	ISBN: 9788126523047
4	GSM to LTE-Advanced PRO and 5G,	Martin Sauter	3rd Edition	

Web links and Video Lectures (e-resources)
1. https://onlinecourses.nptel.ac.in/noc21_ee66/preview 2. https://archive.nptel.ac.in/courses/117/104/117104099/

Active Based Learning (Suggested Activity in Class)/ Practical Based Learning (Example)
1. Flip Class 2. Seminar/ poster Presentation 3. Individual Role play/Team Demonstration/ Collaborative Activity 4. Case study 5. Learn by Doing

Academic Year: 2024-25	Semester: VII	Scheme: P21
Course Title: **Low Power VLSI Design**		
Course Code: **P21EC7021**	CIE Marks: 50	CIE Weightage: 50%
Teaching hours/week (L:T:P)=3 : 0 : 0	SEE Marks:100	SEE Weightage: 50%
Teaching hours of Pedagogy: 40	Exam Hours: 3 Hours	
Credits: 3		
Prerequisite: Digital Electronics Circuits, Digital VLSI Design		
Course learning Objectives:		
CLO1: Provide the basic knowledge of low power VLSI design CLO2: Understand the types of power dissipation in CMOS devices CLO3: Discuss different techniques of power analysis and digital cell library CLO4: Discuss the concepts of Low power Clock Distribution CLO5: Design low power arithmetic circuits and systems CLO6: Understand the architecture and performance management of the system		
UNIT – I		**8 Hours**
Introduction: Needs for Low Power VLSI Chips, Charging and Discharging Capacitance, Short-circuit Current in CMOS Circuit, CMOS Leakage Current, Static Current, Basic Principles of Low Power Design, Low Power Figure of Merits. **Simulation Power Analysis:** SPICE Circuit Simulation, Discrete Transistor Modeling and Analysis, Gate-level Logic Simulation, Architecture-level Analysis, Data Correlation Analysis in DSP Systems.		
Self-Study Content: 1. Study on minimizing the power consumption in Digital CMOS Circuits. 2. Study and develop a report on Monte Carlo Simulation techniques.		
Textbook Map: **1.1-1.7, 2.1-2.6**		
Teaching Learning Process: Power Point Presentation with illustrations/ Chalk and board		
UNIT – II		**8 Hours**
Probabilistic Power Analysis: Random Logic Signals, Probability and Frequency, Probabilistic Power Analysis Techniques, Signal Entropy. **Circuit:** Transistor and Gate Sizing, Equivalent Pin Ordering, Network Restructuring and Reorganization, Special Latches and Flip- flops, Low power Digital Cell Library.		
Self-Study Content: 1. Compare various power reduction techniques for ADC circuits. 2. Analyse the how the power loss takes place during switching activity and way to reduce that.		
Textbook Map: **3.1-3.4, 4.1-4.6**		
Teaching Learning Process: Power Point Presentation / Seminar		
UNIT – III		**8 Hours**
Logic: Gate Reorganization, Signal Gating, Logic Encoding, State Machine Encoding, Precomputation Logic. **Special Techniques:** Power Reduction in Clock Networks, CMOS Floating Node, Low Power Bus, Delay Balancing, Low Power Techniques for SRAM.		
Self-Study Content: 1. Application of Bus inverts coding for low power I/O. 2. Study on low power techniques for DRAM.		
Textbook Map: **5.1-5.5, 6.1-6.5**		
Teaching Learning Process: Power Point Presentation/ Quiz		

UNIT – IV	8 Hours
Architecture and System: Power and Performance Management, Switching Activity Reduction, Parallel Architecture with Voltage Reduction, Flow Graph Transformation. **Advanced Techniques:** Adiabatic Computation, Pass Transistor Logic Synthesis, Asynchronous System Basics.	
Self-Study Content: 1. Understand the trade-off between power and area in low power architecture. 2. Discuss the low power digital system based on Adiabatic Switching principle.	
Textbook Map: **7.1-7.4, 8.1-8.3**	
Teaching Learning Process: Case study/ Power Point Presentation	
UNIT – V	**8 Hours**
Low–Energy Computing Using Energy Recovery Techniques: Energy Dissipation in transistor channel using an RC Model, Energy Recovery Circuit Design, Designs with Partially Reversible Logic: Designs with Reversible Logic, Simple Charge Recovery Logic Modified from Static CMOS Circuits, Adiabatic Dynamic Logic. Energy recovery SRAM Core, Another Core Organization, Energy Dissipation in Memory Core, Comparison of Two Memory Core Organizations, Design of Peripheral Circuits, Optimal Voltage Selection, Supply clock generation.	
Self-Study Content:1. Discuss memory allocation technique for low energy embedded software. 2. Study on instruction level power analysis and optimization of software.	
Textbook Map: **7.1- 7.4,**	
Teaching Learning Process: Power Point Presentation / Usage of modern EDA tools	

Course Outcomes: At the end of the course students should be able to :
CO1: **Apply** the basic knowledge of physics and the fundamental circuit concept in understanding low power circuits and its necessities.
CO2: **Apply** suitable optimization technique for a given scenario/problem in low power VLSI Design and synthesis
CO3: **Analyze** low power VLSI circuits using different circuit technologies and design levels.
CO4: **Create** a reversible logic and partially reversible logic in low power circuits

Suggested Learning Resources:

Text books:

Sl. No.	Title	Author	Year & Edition	Publisher
1	Practical Low Power Digital VLSI Design	Gary K, Yeap, Kluwer	2008.	ISBN – 13: 978-0792380092,
2	Low–Power CMOS VLSI Circuit Design	Kaushik Roy and Sharat C Prasad, Wiley	2009	ISBN: 978-81-265-2023-7.

Reference Books:

1	Low Power Design Methodologies,	Rabaey, Pedram, Kluwer	2009	ISBN – 978-1-4613-5975-3,

Web links and Video Lectures (e-resources)
1.https://www.youtube.com/watch?v=TFOO1JAll2Y&list=PLBU5KursMXEMWAkoUPB5aqUPb3lKYqN6q

Active Based Learning (Suggested Activity in Class)/ Practical Based Learning (Example)
1. Flip Class 2. Seminar/ poster Presentation 3. Individual Role play/Team Demonstration/ Collaborative Activity 4. Case study 5. Learn by Doing

Academic Year: 2024-25	Semester: VII	Scheme: P21
Course Title: **Cryptography and Network Security**		
Course Code: **P21EC7022**	CIE Marks: 50	CIE Weightage: 50%
Teaching hours/week (L:T:P)=3 : 0 : 0	SEE Marks:100	SEE Weightage: 50%
Teaching hours of Pedagogy: 40	Exam Hours: 3 Hours	
Credits: 3		
Prerequisite: Computer Organization, Mathematics, Operating Systems		
Course learning Objectives:		
CLO1: Illustrate the Cryptography, Network Security and its Principles. CLO2: Analyze different Private and Public Key Cryptographic Algorithms. CLO3: Demonstrate the application of Hash Functions and Message Authentication Code for different security contexts. CLO4: Compare and contrast different security frameworks, models and architectures. CLO5: Identify the different security issues involved in networking. CLO6: Analyze different case study on Email Threats/Security and IP Security		
UNIT – I	**8 Hours**	
Classical Encryption Techniques: Symmetric Cipher Model,Substitution Techniques, Transposition Technique. **Block Ciphers and the Data Encryption Standard:** Traditional Block Cipher Structure, The Data Encryption Standard. **Advanced Encryption Standard:** AES Structure, AES Transformation Functions.		
Self-Study Content: Design and Implement an AES-based system for a specific application, selecting appropriate key sizes, block sizes, and modes of operation to meet security and performance goals.\		
Textbook Map: **3.1-3.3, 4.1-4.2, 6.2-6.3**		
Teaching Learning Process: Classroom Teaching.		
UNIT – II	**8 Hours**	
Public-Key Cryptography and RSA: Principles of Public-Key Cryptosystems, The RSA Algorithm. **Other Public-Key Cryptosystems:** Diffie-Hellman Key Exchange, Elgamal Cryptographic System, Elliptic Curve Cryptography, Pseudorandom Number Generation Based on an Asymmetric Cipher.		
Self-Study Content: 1. Discuss how Elliptic Curve Arithmetic is used in cryptographic applications, describing the properties and security benefits of elliptic curves. 2. Analyze the basic principles and algorithms of pseudorandom number generation using block ciphers, including cipher modes and key scheduling.		
Textbook Map: **9.1-9.2, 10.1-10.2, 10.4 – 10.5.**		
Teaching Learning Process: Flipped Classroom.		
UNIT – III	**8 Hours**	
Cryptographic Hash Functions: Applications of Cryptographic Hash Functions, Two Simple Hash Functions, Requirements and Security.. **Message Authentication Code:** Message Authentication Requirements, Message Authentication Functions, Requirements for Message Authentication Codes, Security of MACs, MACs Based on Hash Functions: HMAC MACs Based on Block Ciphers: DAA and CMAC.		

Digital Signatures: Digital Signatures, Elgamal Digital Signature Scheme, Schnorr Digital Signature Scheme**,** NIST Digital Signature Algorithm, Elliptic Curve Digital Signature Algorithm.	
Self-Study Content: 1. Demonstrate the basic principles and constructions of hash functions based on Cipher Block Chaining (CBC), including encryption and decryption processes. 2. Compare and contrast CCM and GCM, analyzing their security, performance, and implementation advantages and disadvantages in various applications.	
Textbook Map: **11.1-11.3,12.1-12.6, 13.1-13.5**	
Teaching Learning Process: Active Learning Techniques.	
UNIT – IV	**8 Hours**
Network Access Control and Cloud Security: Network Access Control, Extensible Authentication Protocol, Cloud Computing, Cloud Security Risks and Countermeasures, Data Protection in the Cloud, Cloud Security as a Service, Addressing Cloud Computing Security Concerns. **Transport-Level Security:** Web Security Considerations, Transport Layer Security, HTTPS, Secure Shell (SSH). **Wireless Network Security:** Wireless Security, Mobile Device Security.	
Self-Study Content: 1. Illustrate the basic principles and components of IEEE 802.1X, including port-based access control, authentication protocols, and EAP (Extensible Authentication Protocol). 2. Compare and contrast different Wireless LAN security protocols and implementations, analyzing their security, performance and interoperability in various network environments.	
Textbook Map: **16.1-16.2, 16.4-16.8, 17.1-17.4, 18.1-18.2**	
Teaching Learning Process: Mentorship and Peer Learning.	
UNIT – V	**8 Hours**
Electronic Mail Security: Internet Mail Architecture, Email Formats, Email Threats and Comprehensive Email Security, S/MIME, Pretty Good Privacy. **IP Security** - IP Security Overview, IP Security Policy, Encapsulating Security Payload.	
Self-Study Content: 1. Analyze and Present the Case Study on Email Threats and Security: Refer the journal, Altulaihan, E., Alismail, A., Hafizur Rahman, M. M., & Ibrahim, A. A. (2023). "Email Security Issues, Tools and Techniques used in Investigation". Sustainability, 15(13), 10612. https://www.mdpi.com/2375272. 2. Analyze and Present the Case Study on IP Security: Refer the journal, Alphy Shahrin Sadma, Md. Safiul Mujnebin. "A Case Study on IP Security"(2023). https://www.researchgate.net/publication/373832770_A_Case_Study_on_IP_Security_CSE_406_Cryptography_and_Network_Security	
Textbook Map: **19.1- 19.5, 20.1- 20.3**	
Teaching Learning Process: Group discussion with Case Study.	

Course Outcomes: At the end of the course students should be able to :
CLO1: **Apply** the fundamentals of communication systems to understand basic principle of cryptography and network security
CLO2: **Illustrate** the functionality of various private and public cryptographic algorithms
CLO3: **Infer** the applicability of hash functions and Message Authentication code for **develop**ing and comparing different security contexts
CLO4: **Characterize** and identify different security threats in networking applications.

Suggested Learning Resources:

Text books:

Sl. No.	Title	Author	Year & Edition	Publisher
1	Cryptography and Network Security Principles and Practice	William Stallings	7th edition	ISBN 10:1-292-15858-1 ISBN 13: 978-1-292-15858-7.

Reference Books:

1	Cryptography and Information Security	V. K Pachghare,	2nd Edition	ISBN: 9788120350823
2	Cryptography and Network Security	BehrouzA.Foruzan	2007	ISBN 978–0–07–287022–0.

Web links and Video Lectures (e-resources)

1. https://nptel.ac.in/courses/106105031
2. https://onlinecourses.nptel.ac.in/noc21_cs16
3. https://www.digimat.in/nptel/courses/video/106105031
4. https://www.youtube.com/watch?v=PHsa_Ddgx6w

Active Based Learning (Suggested Activity in Class)/ Practical Based Learning (Example)

1. Flip Class
2. Seminar/ poster Presentation
3. Individual Role play/Team Demonstration/ Collaborative Activity
4. Case study
5. Learn by Doing

Academic Year: 2024-25	Semester: VII	Scheme: P21
Course Title: **Wireless Sensor Networks**		
Course Code: **P21EC7023**	CIE Marks: 50	CIE Weightage: 50%
Teaching hours/week (L:T:P)=3 : 0 : 0	SEE Marks:100	SEE Weightage: 50%
Teaching hours of Pedagogy: 40	Exam Hours: 3 Hours	
Credits: 3		

Prerequisite:
Basic knowledge of computer networks, wireless communication, and programming skills, along with a general understanding of embedded systems.

Course learning Objectives:

CLO1: Provide an understanding of common wireless sensor node architectures.
CLO2: Discuss various applications of wireless sensor architectures.
CLO3: Provide an understanding of essential networking architecture.
CLO4: Describe current technology trends for the implementation and deployment of wireless sensor networks.
CLO5: Discuss the general issues of task-driven sensing.
CLO6: Provide an overview of few sensor node hardware platforms.

UNIT - I	**8 Hours**

Overview of Wireless Sensor Networks: The vision of Ambient Intelligence, Application examples, Types of Applications, Challenges for WSNs, why are sensor networks different? **Architectures:** Hardware components, Energy Consumption of Sensor Nodes, Operating systems and execution environments, Some example of sensor nodes.

Self-Study Content: 1. Implement a Network of N nodes using any simulation environment
2. Illustrate the concept of Power supply of sensor nodes and design principles for WSNs

Textbook Map: **1.1 to 1.5, 2.1 to 2.4**

Teaching Learning Process: Flipped Classroom

UNIT – II	**8 Hours**

Communication Protocol: Physical Layer- Introduction, Wireless Channel and Communication Fundamentals, Physical layer and transceiver design considerations in WSNs
MAC Protocols: Fundamentals of MAC Protocols, Low Duty cycle protocols and wakeup concepts, Contention Based Protocols, Scheduled Based protocols.

Self-Study Content: 1. Implement a Network of N nodes and verify the changes in power usage using schedule-based concepts
2. Illustrate the Fundamentals of Wireless MAC Protocols

Textbook Map: **4.1 to 4.3, 5.1, to 5.4**

Teaching Learning Process: Quizzes and Assessments

UNIT - III	**8 Hours**

Communication Protocol: Link Layer Protocols: Fundamentals: tasks and requirements, Error Control, Framing, Link management.
Naming and Addressing: Fundamentals, Address and name management in wireless sensor networks, Assignment of MAC addresses, distributed assignment of locally unique addresses, Content-based and geographic addressing

Self-Study Content: 1. Establish communication between N nodes and demonstrate how Error Control can improve efficiency of network using any simulator
2. Establish network of N nodes and represent address each node with an address using different addressing methods

Textbook Map: **6.1 to 6,4, 7.1 to 7.5**	
Teaching Learning Process: Think Pair share- peer teaching.	
UNIT - IV	**8 Hours**
Network Establishment and Routing: Topology Control, Motivation and Basic idea, controlling topology in flat networks, Hierarchical networks by clustering, **Routing Protocols:** the many faces of forwarding and routing, Gossiping and agent- based unicast forwarding, Energy efficient unicast, Broadcast and Multicast, Geographic routing. Security in WSN, Fundamentals, Security considerations in wireless sensor networks.	
Self-Study Content: 1. Establish communication between N nodes and illustrate efficiency achieved using Clustering using any simulator 2. Establish network of N nodes and demonstrate unicast, broadcast and multicast routing using any simulator	
Textbook Map: **10.1, 10.2, 10.4, 11.1 to 11.5, 14.2**	
Teaching Learning Process: Seminars with Backup Videos	
UNIT - V	**8 Hours**
Sensor Network Platforms and Tools: Sensor network Hardware, Sensor network programming challenges, Node–Level software platforms–Tiny OS, nesC component implementation, nesC–concurrency and atomicity, Tiny GALS, Node– Level simulators– ns2 simulator, TOSSIM. **Advanced applications:** Emerging Applications-Asset and warehouse management, Automotive, Building Monitoring, Environment Monitoring, Industrial Process Control, Military battlefield awareness, security and surveillance, Future Research directions: Secure embedded systems, Light weight Signal Processing, Networks of High Data Rate sensors, google for the physical world, closing the loops with Actuators.	
Self-Study Content: 1. Establish network of N nodes using NS2 simulator and demonstrate data communication at different levels of network 2. Study Future research directions in the Field of Network of High Data rate sensors	
Textbook Map: **7.1 to 7.4, 8.2,8.3.1, 8.3.4, 8.3.5,8.3.6,8.3.7**	
Teaching Learning Process: Simulation based learning	

Course Outcomes: At the end of the course students should be able to :
CO1: **Apply** fundamentals of Computer communication networks to understand characteristics and architecture of Wireless sensor networks
CO2: **Analyze** Communication protocols and controlling mechanisms which can enhance efficiency of Wireless sensor network
CO3: **Analyze** and compare different infrastructure establishment principles on sensor network platform
CO4: **Illustrate** and Identify the unique constraints, applications and resource fairness in context of wireless sensor networks
CO5: **Simulate** Wireless sensor network platforms using modern tools

Suggested Learning Resources:				
Text books:				
Sl. No.	Title	Author	Year & Edition	Publisher
1	Protocols and Architectures for Wireless Sensor Networks,	Holger Karl and Andress Willig, John Willey	2005	ISBN-13 978-0-470-09510-2
2	Wireless Sensor Networks–An Information Processing Approach,	Feng Zhao and Leonidas.J. Guibas, Elsevier,.	2007	ISBN: 978-1-55860-914-3.

Reference Books:				
1	Wireless Sensor Networks Technology, Protocols and Applications	Kazem Sohraby, Daniel Minoli, and Taieb Znati, John Wiley	2007	ISBN-10: 0471743003, ISBN-13: 978-0471743002.
2	Wireless Sensor Network Designs, Anna	Hac, John Wiley	2003	ISBN 10: 0470867361and ISBN 13: 9780470867365

Web links and Video Lectures (e-resources)
1. https://nptel.ac.in/courses/106/105/106105160/ (By Prof Sudip Misra, IIT Kharagpur)

Active Based Learning (Suggested Activity in Class)/ Practical Based Learning (Example)
1. Flip Class 2. Seminar/ poster Presentation 3. Individual Role play/Team Demonstration/ Collaborative Activity 4. Case study 5. Learn by Doing

Academic Year: 2024-25	Semester: VII	Scheme: P21
Course Title: **Multicore Architecture and Programming**		
Course Code: **P21EC7024**	CIE Marks: 50	CIE Weightage: 50%
Teaching hours/week (L:T:P)=3 : 0 : 0	SEE Marks:100	SEE Weightage: 50%
Teaching hours of Pedagogy: 40	Exam Hours: 3 Hours	
Credits: 3		
Prerequisite: Digital Electronics, Operating Systems		
Course learning Objectives:		
CLO1: Understand the concept of multi–core architecture and system overview of threading. CLO2: Cover fundamental concepts of parallel programming and its constructs. CLO3: Describe in detail the concepts of threading APIs. CLO4: Explain the different aspects of Open MP. CLO5: Use Open MP for parallel programming		
UNIT - I		**8 Hours**
Introduction to Multi– core Architecture: Motivation for Concurrency in software, Parallel Computing Platforms, Parallel Computing in Microprocessors, Differentiating Multi–core Architectures from Hyper– Threading Technology, Multithreading on Single–Core versus Multi–Core Platforms Understanding Performance, Amdahl's Law, Growing Returns: Gustafson's Law. **System Overview of Threading:** Defining Threads, System View of Threads, Threading above the Operating System, Threads inside the OS, Threads inside the Hardware, What Happens When a Thread Is Created, Application Programming Models and Threading.		
Self-Study Content: Undersand the concepts present in the thesis: Bulpin, James Roy. 2004. Operating System Support for Simultaneous Multithreaded Processors. PhD thesis, King's College, University of Cambridge, September.		
Textbook Map: **2.4, 3.1to 3.5**		
Teaching Learning Process: 1. Brainstorming session, 2. Power Point Presentation 3. Video Clips, Animations		
UNIT – II		**8 Hours**
Fundamental Concepts of Parallel Programming: Designing for Threads, Task Decomposition, Data Decomposition, Data Flow Decomposition, Implications of Different Decompositions, and Challenges You will Face, Parallel Programming Patterns. A Motivating Problem: Error Diffusion, Analysis of the Error Diffusion Algorithm. An Alternate Approach: Parallel Error Diffusion, Other Alternatives. **Threading and Parallel Programming Constructs**: Synchronization, Critical Sections, Deadlock, Synchronization Primitives, Semaphores, Locks, Condition Variables, Messages, Flow Control–based Concepts, Fence, Barrier		
Self-Study Content: Study and write a report on: Barney, Blaise. Introduction to Parallel Computing. Lawrence Livermore National Laboratory, Livermore Computing.Available at: http://www.llnl.gov/computing/tutorials/parallel_comp/.		
Textbook Map: **4.1 to 4.3, 4.4 to 4.5**		
Teaching Learning Process: 1. Power Point Presentation with illustrations 2. Case Study 3. Quiz		

UNIT - III	8 Hours
Solutions to Common Parallel Programming Problems: Too Many Threads, Data Races, Deadlocks, and Live Locks, Deadlock, Heavily Contended Locks, Priority Inversion, Solutions for Heavily Contended Locks, Non–blocking Algorithms, ABA Problem, Cache Line Ping– ponging, Memory Reclamation Problem, Recommendations, Memory Issues, Bandwidth, Working in the Cache, Cache related Issues, False Sharing, Memory Consistency.	
Self-Study Content: Study and write a report on: Blumofe, Robert D., Christopher F. Joerg, Bradley C. Kuszmaul, Charles E. Leiserson, Keith H. Randall, and Yuli Zhou. 1995. Cilk: An Efficient Multithreaded Runtime System. Proceedings of the 5th ACM SIGPLAN Symposium on Principles and Practice of Parallel Programming (July):207–216.	
Textbook Map: **Chapter 7**	
Teaching Learning Process: 1. Power Point Presentation with illustrations 2. Case Study 3. Seminars	
UNIT - IV	**8 Hours**
OpenMP: A Portable Solution for Threading Challenges in Threading a Loop, Loop–carried Dependence, Data– race Conditions, Managing Shared and Private Data, Loop Scheduling and Portioning, Effective Use of Reductions, Minimizing Threading Overhead, Work–sharing Sections, Performance– oriented Programming, Using Barrier and No wait, Interleaving Single– thread and Multi– thread Execution, Data Copy–in and Copy–out, Protecting Updates of Shared Variables, OpenMP Library Functions, OpenMP Environment Variables, Compilation, Debugging, performance.	
Self-Study Content: Understand the concepts: Hill, Mark D. 1998. Multiprocessors Should Support Simple Memory Consistency Models. IEEE Computer (August), 31(8):28–34.	
Textbook Map: **6.4-6.6, 9.1 to 9.6**	
Teaching Learning Process: 1. Power Point Presentation with illustrations 2. Case Study 3. Seminars	
UNIT - V	**8 Hours**
OpenMP Language Features: Introduction Terminology Parallel Construct Sharing the Work among Threads in an OpenMP Program Clauses to Control Parallel and Work-Sharing Constructs OpenMP Synchronization Constructs Interaction with the Execution Environment More OpenMP Clauses Advanced OpenMP Constructs .	
Self-Study Content: Understand multithreaded programming: Mattson, Tim. Nuts and Bolts of Multithreaded Programming. Santa Clara, CA: Intel Corporation. Available at: http://www.intel.com.	
Textbook Map: **Chapter 4**	
Teaching Learning Process: 1. Brainstorming session, 2. Power Point Presentation 3. Seminars	

Course Outcomes: At the end of the course students should be able to :
CO1: **Evaluate** the Multicore Hardware and Software concepts.
CO2: **Analyze** the Parallel Programming concepts with examples along with Deadlocks and Semaphores.
CO3: **Develop** the theories related to parallel programming problems and methods to overcome them.
CO4: **Describe** the various programming concepts of OpenMP with examples.

Suggested Learning Resources:

Text books:

Sl. No.	Title	Author	Year & Edition	Publisher
1	Multicore Programming, Increased Performance Through Software Multi–threading	Shameem Akhter and Jason Roberts	2006	ISBN 0-9764832-4-6.
2	Using OpenMP, Portable Shared Memory Parallel Programming	Barbara Chapman, Gabriele Jost, Ruud van der Pas	2008	ISBN 978-0-262-53302

Reference Books:

1	Principles of Parallel Programming	Calvin Lin, Lawrence Snyder	2009	ISBN-13: 978-0321487902
2	Parallel Programming in C with MPI and OpenMP	Michael J. Quinn, Tata McGraw Hill	2004	ISBN 13: 9780070582019.
3	Parallel Computer Architecture A Hardware / Software	Culler, Jaswinder Pal Singh with Anoop Gupta		ISBN: 9781558603431

Web links and Video Lectures (e-resources)

1. Multi-Core Computer Architecture – Storage and Interconnects, NPTEL IIT Guwahati.
   https://www.youtube.com/playlist?list=PLwdnzlV3ogoU0TR333JyxG8T3HDg52S0h
2. Introduction to parallel Programming in Open MP
   https://www.youtube.com/playlist?list=PLJ5C_6qdAvBFMAko9JTyDJDIt1W48Sxm

Active Based Learning (Suggested Activity in Class)/ Practical Based Learning (Example)

1. Flip Class
2. Seminar/ poster Presentation
3. Individual Role play/Team Demonstration/ Collaborative Activity
4. Case study
5. Learn by Doing

Academic Year: 2024-25	Semester: VII	Scheme: P21
Course Title: **Satellite Communications**		
Course Code: **P21EC7031**	CIE Marks: 50	CIE Weightage: 50%
Teaching hours/week (L:T:P)=3 : 0 : 0	SEE Marks:100	SEE Weightage: 50%
Teaching hours of Pedagogy: 40	Exam Hours: 3 Hours	
Credits: 3		

Prerequisite:
Electromagnetic field theory, Antenna theory and design, Communication systems.

Course learning Objectives:

CLO1: Identify and describe the various frequency bands allocated for satellite communications and their specific uses.
CLO2: Understand the concepts of Kepler's law of planetary motion be applied to the case of geostationary satellite.
CLO3: Analyze the various satellite subsystem Components and also design trade-offs and limitations inherent in satellite system design.
CLO4: Describe different advanced satellite access methods.
CLO5: Design communication links and calculate accurate link budgets by considering various factors to ensure optimal performance of satellite communication systems.

UNIT - I	**8 Hours**

Overview of Satellite Systems: Introduction, frequency allocations for satellite services, INTELSAT.
Orbits and Launching Methods: Introduction, Kepler's first law, Kepler's second law, Kepler's third law, definitions of terms for earth orbiting satellites, orbital elements, apogee and perigee heights, orbit perturbations, effects of a non-spherical earth, atmospheric drag.
The Geostationary Orbit: Introduction, antenna look angles, the polar mount antenna, limits of visibility, near geostationary orbits, earth eclipse of satellite, sun transit outage

Self-Study Content: Study various calendar systems, universal time, Julian dates, and sidereal time.

Textbook Map: **1.1 to 1.3, 2.1 to 2.8, 3.1 to 3.6, 3.7**

Teaching Learning Process: PPT, One minute paper

UNIT – II	**8 Hours**

The Space Segment: Introduction, power supply, attitude control, spinning satellite stabilization, momentum wheel stabilization, station keeping, thermal control, TT&C subsystem, transponders, the wideband receiver, the input de–multiplexer, the power amplifier.
The Earth Segment: Introduction, receive–only home TV system, the outdoor unit, the indoor unit for analog (FM) TV, master antenna TV system, Community Antenna TV system.

Self-Study Content: Understand the functioning of antenna subsystems and transmit-receive earth stations.

Textbook Map: **7.1 to 7.7, 8.1 to 8.4**

Teaching Learning Process: PPT, Flipped classroom

UNIT - III	**8 Hours**

Satellite Access: Introduction, single access, pre–assigned FDMA, Demand– assigned FDMA, Spade system, bandwidth limited and power–limited TWT amplifier operation, FDMA downlink analysis, TDMA, reference burst, preamble and post amble, carrier recovery, network synchronization, Unique word detection, Traffic data, Frame efficiency and channel capacity, code–division multiple access, direct–sequence spread spectrum, the code signal c(t), acquisition and tracking, spectrum spreading and dispreading, CDMA throughput.

Self-Study Content: Study and write a report on the article "Modulation and Signal Processing for LEO-LEO Optical Inter-Satellite Links" **https://ieeexplore.ieee.org/abstract/document/10155111**	
Textbook Map: **14.1 to 14.7, 14.7.1 to 14.7.7, 14.10, 14.10.1 to 14.10.5**	
Teaching Learning Process: Assessment for learning(Quiz)	
UNIT - IV	**8 Hours**
The Space Link: Introduction , Equivalent Isotropic Radiated power, transmission losses, free–space transmission, feeder losses, antenna misalignment losses, fixed atmospheric and ionospheric losses, the link power budget equation, system noise, antenna noise, amplifier noise temperature, amplifier in cascade, noise factor, noise temperature of absorptive networks, overall system noise temperature, carrier–to–noise ratio, the uplink, saturation flux density, input back off, the earth station HPA, Downlink, output back–off, satellite TWTA output. **Satellites in Networks:** Introduction, Asynchronous transfer mode (ATM), ATM over satellite, satellite links and TCP, enhancing TCP over satellite channels using standard mechanisms (RFC–2488), requests for comments.	
Self-Study Content: Explore the intricacies of simulating Effective Isotropic Radiated Power (EIRP), mitigating transmission losses, and managing system noise to enhance satellite communication efficiency.	
Textbook Map: **12.1 to 12.8, 15.1, 15.4, 15.5, 15.9 to 15.11**	
Teaching Learning Process: Think, pair and share.	
UNIT - V	**8 Hours**
Direct Broadcast Satellite (DBS) Television: Introduction, orbital spacing, power rating and number of transponders, frequency and polarization, transponder capacity, bit rates for digital television, MPEG compression standards, forward error correction (FEC). **Satellite Mobile and Specialized Services:** Introduction, satellite mobile services, VSATs, radar sat, orbcomm. **Satellite Navigation and global positioning system:** Introduction, Radio and satellite navigation, GPS position location principles, GPS receivers and codes, satellite signal acquisition, GPS navigation message.	
Self-Study Content: Analyze and present the application of satellites in the context of the article "A survey on satellite communication system security applications". **https://www.mdpi.com/1424-8220/24/9/2897**	
Textbook Map: **16.1 to 16.14, 17.1 to 17.7 & 12.1 to 12.6**	
Teaching Learning Process: Seminars	

Course Outcomes: At the end of the course students should be able to :
CO1: **Apply** advanced mathematical concepts and communication principles to the field of satellite communications.
CO2: **Analyze** essential communication satellite systems, including design trade-offs and limitations.
CO3: **Evaluate** various multiple access techniques, benefits, and drawbacks in modern communication systems.
CO4: **Examine** specialized satellite services for various applications practicality and impact.

Suggested Learning Resources:

Text books:

Sl. No.	Title	Author	Year & Edition	Publisher
1	Satellite Communications	Tata McGraw–Hill, Dennis Roddy	4th edition 2009	ISBN 13: 978-0-07-007785-0 ISBN 10:0- 07-007785-1
2	Satellite Communications	Timothy Pratt, Charles Bostian and Jeremy Allnutt	2nd edition, 2010	ISBN: 9788126508334

Reference Books:

1	Satellite Communications Systems Engineering	W.L. Pitchand, H.L. Suyderhoud, R.A. Nelson	2nd edition, 2007	ISBN: 9788131702420
2	Satellite Communications	Anil K.Maini, Varsha Agrawal	3rd edition, 2012	ISBN: 9788126520718

Web links and Video Lectures (e-resources)

1. NPTEL course on Satellite Communication Systems by Prof. Kalyan kumar Bandyopadhyay, IIT Kharagpur https://nptel.ac.in/courses/117/105/117105131/
2. Coursera on "Introduction to Satellite Communication" https://www.coursera.org/learn/satellite-communications#enroll

Active Based Learning (Suggested Activity in Class)/ Practical Based Learning (Example)

1. Flip Class
2. Seminar/ poster Presentation
3. Individual Role play/Team Demonstration/ Collaborative Activity
4. Case study
5. Learn by Doing

Academic Year: 2024-25	Semester: VII	Scheme: P21
Course Title: **System On Chip**		
Course Code: **P21EC7032**	CIE Marks: 50	CIE Weightage: 50%
Teaching hours/week (L:T:P)=3 : 0 : 0	SEE Marks:100	SEE Weightage: 50%
Teaching hours of Pedagogy: 40	Exam Hours: 3 Hours	
Credits: 3		

Prerequisite:
1. Understand basic computer architecture, including how CPUs, memory, and I/O systems work.
2. Learn digital logic design and the functions of digital circuits.
3. Get familiar with embedded systems, such as microcontrollers and processors.
4. Know about operating systems and how they manage hardware and software resources.
5. Understand memory systems, including how different types of memory operate and interact.

Course learning Objectives:

CLO1: Understand SoC architecture with processor, memory, NoC and bus models.
CLO2: Comprehend system construction with numerous components and the significance of system-level interconnections and NoC.
CLO3: Explore the trade-offs between hardware and software programmability versus performance.
CLO4: Gain knowledge hierarchy and implementation of memory organization.
CLO5: Study customization and reconfigurable technologies in SoC design along with their applications.

UNIT - I	**8 Hours**

Introduction to the systems approach: System Architecture: An Overview, Components of the System: Processors, Memories, and Interconnects Hardware and Software: Programmability, Versus Performance, Processor Architectures-Processor: A functional view, Processor: An architectural view, Memory and Addressing, SOC Memory Examples, Addressing: The architecture of Memory, Memory for SOC Operating System, System - Level Interconnection, Bus - Based Approach, Network - on - Chip Approach, An Approach for SOC Design, Requirements and Specifications, Design Iteration.

Self-Study Content: 1. Identify the applications of SOC in today electronics industry.
2. Prepare the report on the tools available for the SOC Design.

Textbook Map: **1.1-1.7.**

Teaching Learning Process: 1. Lectures with Multimedia Presentations
2. Quizzes

UNIT – II	**8 Hours**

Chip Basics: Time, Area, Power, Reliability, and Configurability-Introduction, Cycle Time, Die Area and Cost, Processor Area, Ideal and Practical Scaling, Power, Area – Time – Power Trade - Offs in Processor Design. Reliability, Configurability
Processors: Introduction, Processor Selection for SOC, Basic Concepts in Processor Architecture, Basic Concepts in Processor Microarchitecture,

Self-Study Content: 1. Discuss the Area Estimate of Reconfigurable Devices.
2.Prepare a report on the recent Processor used in Computers, laptop, mobiles.

Textbook Map: **2.1-2.7 3.1-3.4,**

Teaching Learning Process: 1. Flipped Classroom 2. Group Discussion	
UNIT - III	**8 Hours**
Processors: Basic Elements in Instruction Handling, Buffers: Minimizing Pipeline Delays. **Memory Design: System- on- Chip and Board - Based Systems-** Introduction,Overview, Scratchpads and Cache Memory, Basic Notions, Cache Organization, Cache Data, Write Policies, Strategies for Line Replacement at Miss Time, Other Types of Cache, Split I - and D - Caches and the Effect of Code Density, Multilevel Caches, Virtual - to - Real Translation, SoC (On - Die) Memory Systems, Board - Based (Off - Die) Memory Systems, Simple Dram and The Memory Array.	
Self-Study Content: Study on Models of Simple Processor.	
Textbook Map: **3.5- 3.6, 4.1-4.15.**	
Teaching Learning Process: 1. Research-Based Learning 2. Case-Based Learning	
UNIT – IV	**8 Hours**
Interconnect: Introduction, Overview: Interconnect Architectures, Bus: Basic Architecture, SOC Standard Buses, Analytic Bus Models, Beyond the Bus: NOC with Switch Interconnects, SOC interconnect Switches, ,	
Self-Study Content: 1. Identify the usage of AMBA in real time. 2. Discuss the tools available for NOC design.	
Textbook Map: **5.1-5.6.**	
Teaching Learning Process: 1. Research-Based Learning 2. Active Learning Techniques	
UNIT - V	**8 Hours**
Customization and Configurability: Introduction, Estimating Effectiveness of Customization, SoC Customization: An Overview, Customizing Instruction Processors, Reconfigurable Technologies, Mapping Designs onto Reconfigurable Devices, Instance - Specific Design. **Application Studies:** Application Study: 3D graphics processors, image compression, video compression, MP3 audio decoding.	
Self-Study Content: 1. Application Study: AES- algorithm and requirements. 2. Identify the different algorithms used in video compression.	
Textbook Map: **6.1-6.7,7.4, 7.5, 7.6, 7.7.1.**	
Teaching Learning Process: 1. Workshops and Seminars 2. Interactive Online Modules	

Course Outcomes: At the end of the course students should be able to :
CO1: **Apply** the fundamentals of processors to **understand** the SoC architecture and its components
CO2: **Interpret** different trade-offs in System-on-Chip design.
CO3: **Analyze** the impact of processor architecture, memory and bus on performance of SoC.
CO4: **Discuss** the role of Configurability in SoC design.

Suggested Learning Resources:				
Text books:				
Sl. No.	Title	Author	Year & Edition	Publisher
1	Computer System Design System-On-Chip	Michael J. Flynn, Wayne Luk		John Wiley & Sons, Inc., Publication, ISBN: 9781118009925, 2011.

Reference Books:				
1	Reuse Methodology Manual for System-On-A-Chip,	Michael Keating, Designs, Pierre Bricaud	2nd edition	Kluwer Academic Publishers, ISBN: 9781461550372
2	SoC Verification-Methodology and Techniques	Prakash Rashinkar, Peter Paterson and Leena Singh,		Kluwer Academic Publishers, ISBN – 8580000264227
3	On-Chip Communication Architectures: System on Chip Interconnect	Sudeep Pasricha and B Nikil B Dutt,		Morgan Kaufmann, ISBN: 9780123738929

Web links and Video Lectures (e-resources)
1.https://www.youtube.com/watch?v=_E2PS9jxkrA&list=PLZU5hLL_713ygweO3b_9KiZUJuEI7I5yK

Active Based Learning (Suggested Activity in Class)/ Practical Based Learning (Example)
1. Flip Class 2. Seminar/ poster Presentation 3. Individual Role play/Team Demonstration/ Collaborative Activity 4. Case study 5. Learn by Doing

Academic Year: 2024-25	Semester: VII	Scheme: P21
Course Title: **Advanced Wireless Technologies**		
Course Code: **P21EC7033**	CIE Marks: 50	CIE Weightage: 50%
Teaching hours/week (L:T:P)=3 : 0 : 0	SEE Marks:100	SEE Weightage: 50%
Teaching hours of Pedagogy: 40	Exam Hours: 3 Hours	
Credits: 3		

Prerequisite:
Fundamentals of Network Communication, Microwave and antenna.

Course learning Objectives:

CLO1: Analyse the various (4G, 5G) advanced wireless technologies.
CLO2: Describe LTE architecture, Users equipment, Communication protocols and standardization of LTE.
CLO3: Describe the basic network architectures, equipment, methodologies, specifications and topologies used by 5G wireless technologies.
CLO4: Explain the use case scenarios, design principles, performance parameters, and security, safety requirements of advanced wireless technologies.
CLO5: Analyse the working, fundamental techniques and protocols used in device to device (D2D) and machine to machine communication (M2M).
CLO6: Analyse and contrast advanced wireless technologies and wireless devices.

UNIT - I	**8 Hours**

Introduction: Architectural Review of UMTS and GSM, History of Mobile Telecommunication Systems, the Need for LTE, From UMTS to LTE, From LTE to LTE-Advanced, 3GPP Specifications for LTE.
System Architecture Evolution: High-Level Architecture of LTE, User Equipment, Evolved UMTS Terrestrial Radio Access Network.
Quality of Service, Policy and Charging: Policy and Charging Control, Policy and Charging Control Architecture, Session Management Procedures.

Self-Study Content: 1. Study VoLTE Technology.
2. Understand all the IP Multimedia Applications of LTE.

Textbook Map: **1.1 to 1.6, 2.1 to 2.3, 13.1 to 13.3**

Teaching Learning Process: Think-Pair-Share

UNIT – II	**8 Hours**

Orthogonal Frequency Division Multiple Access: Principles of OFDMA, Benefits and Additional Features of OFDMA, Single Carrier Frequency Division Multiple Access.
Random Access: Transmission of Random Access Preambles on the PRACH, Non-Contention-Based Procedure, Contention-Based Procedure.

Self-Study Content: 1. Explore the advantages of Multiple Antenna Transmission in LTE
2.Understand the concept of Cell Acquisition Procedure in LTE

Textbook Map: **4.1 to 4.3, 9.1 to 9.3**

Teaching Learning Process: Chalk and talk.

UNIT - III	**8 Hours**

Introduction to 5G Mobile and Wireless Communications Technology: Historical background, From ICT to the whole economy, Rationale of 5G: high data volume, twenty-five billion connected devices and Wide requirements, Global initiatives.
5G use cases and system concept: Use cases and requirements, 5G system concepts.

Self-Study Content: 1. Hash Functions Based on Cipher Block Chaining.
2. Authenticated Encryption: CCM and GCM.

Textbook Map: **1.1 to 1.4, 2.1 to 2.2**	
Teaching Learning Process: Flipped Classroom	
UNIT - IV	**8 Hours**
The 5G Architecture: Introduction, High-level requirements for the 5G architecture, Functional architecture and 5G flexibility, Physical architecture and 5G deployment. **Machine-Type Communications:** Introduction, Fundamental techniques for MTC, Massive MTC, Ultra-reliable low-latency MTC.	
Self-Study Content: 1. Explore new relaying techniques of 5G. 2. Understand all the key applications of 5G.	
Textbook Map: **3.1 to 3.4, 4.1 to 4.4**	
Teaching Learning Process: Think –Pair-Share	
UNIT - V	**8 Hours**
Device-to-Device (D2D) Communication: D2D: From 4G to 5G, Radio resource management for mobile broadband D2D, Multi-hop D2D communications for proximity and emergency services, Multi-operator D2D communication. **Millimeter wave communications:** Spectrum and regulations, Channel propagation, Hardware technologies for mmW systems, Deployment scenarios.	
Self-Study Content: 1. Investigate various Spectrum challenges in 5G. 2. Understand 5G spectrum landscape and its requirements.	
Textbook Map: **5.1 to 5.4, 6.1 to 6.4**	
Teaching Learning Process: Chalk and talk.	

Course Outcomes: At the end of the course students should be able to :

CO1: **Apply** knowledge of digital communication to understand modulation techniques and evolution of various wireless technologies

CO2: **Evaluate** the network architectures, equipment, methodologies, specifications and topologies used by various wireless technologies.

CO3: **Analyse** the use case scenarios, design principles, performance parameters, and security and safety requirements of advanced wireless technologies.

CO4: **Examine** the standards and protocols used for communication by LTE, 4G and 5Gtechnologies

CO5: **Inspect** and **Contrast** various advanced wireless technologies, wireless components and devices.

Suggested Learning Resources:

Text books:

Sl. No.	Title	Author	Year & Edition	Publisher
1	An Introduction to LTE: LTE,LTE-Advanced, SAE, VOLTE and 4G Mobile Communication	Christopher Cox Director	2nd edition	Chris Cox Communication Ltd ISBN 978-1-118-81803-9
2	5G mobile and wireless communications technology	AfifOsseiran, Ericsson, Jose F. Monserrat	-	Cambridge university press ISBN 978-1-107-13009-8

Reference Books:				
1.	LTE for UMTS: Evolution to LTE-Advanced	HarriHolma, AnttiToskala	2nd edition, 2011	ISBN 978-0-470-66000-3.
2.	Smart Device to Smart Device Communication	Shahid Mumtaz, Jonathan Rodriguez Aveiro	-	Springer, ISBN 978-3-3 19-04962-5
3.	Wireless Communications and Networking	Vijay. K.Garg	2014	Morgan Kaufman Publishers, ISBN: 978-81-312-1889-1.

Web links and Video Lectures (e-resources)

1. Advanced 3G and 4G Wireless Mobile Communications, IIT Kanpur by Prof. Aditya K. Jagannatham https://nptel.ac.in/courses/117104099
2. 5G Wireless Technology, PPT by Vishwa https://www.youtube.com/watch?v=h5Lxn328zlw

Active Based Learning (Suggested Activity in Class)/ Practical Based Learning (Example)

1. Flip Class
2. Seminar/ poster Presentation
3. Individual Role play/Team Demonstration/ Collaborative Activity
4. Case study
5. Learn by Doing

Academic Year: 2024-25	Semester: VII	Scheme: P21
Course Title: **Biomedical Signal Processing**		
Course Code: **P21EC7034**	CIE Marks: 50	CIE Weightage: 50%
Teaching hours/week (L:T:P)=3 : 0 : 0	SEE Marks:100	SEE Weightage: 50%
Teaching hours of Pedagogy: 40	Exam Hours: 3 Hours	
Credits: 3		
Prerequisite: Signals and Systems, DSP, Mathematics		
Course learning Objectives:		
CLO1: Introduce students to the principles of signal processing techniques when applied specifically to biomedical signals, including: ECG, MEG, EEG, SPO2, heart rate etc. CLO2: Provide the student with a firm grounding methods and tools for extracting information from digitally acquired biomedical signals. CLO3: Understand data reduction techniques on Biomedical signals and their utility CLO4: Elaborately discuss analysis of EEG and ECG signals CLO5: Understand models related to Event related Potentials CLO6: Introduce the practical implementation of signal processing techniques to digitally acquired biomedical signals.		
UNIT - I		**8 Hours**
Introduction to Biomedical Signals: The nature of biomedical signals, Examples of Biomedical Signals, Objectives of biomedical signal analysis, Difficulties encountered in biomedical signal acquisition and analysis.		
Self-Study Content: 1. Study of Challenges in Biomedical Signal Analysis. 2. Study of instruments and modalities for acquisition of biomedical signals of different origin. 3. Study of Computer aided diagnosis		
Textbook Map: **1.1, 1.2.1, 1.2.2, 1.2.3, 1.2.4, 1.2.5,1.2.6, 1.2.8, 1.3, 1.4.**		
Teaching Learning Process: PPT/Quiz		
UNIT – II		**8 Hours**
Filtering for Removal of Artifacts: Problem Statement-Artifacts in Biomedical Signals, Types of noise, Illustration of the Problem with-Case Studies, Time domain filters, Frequency–Domain Filters.		
Self-Study Content: 1. Application of Synchronized Averaging for the detection of QRS Complex from same ECG cycles. 2. Design of Butterworth low pass filter for the removal of high frequency noise in carotidpulse signal. 3. Review of Butterworth filters, Removal of noise using Butterworth filters.		
Textbook Map: **3.1-3.4**		
Teaching Learning Process: PPT/Simulation		
UNIT - III		**8 Hours**
Adaptive Interference/Noise Cancellation: A review of Weiner Filtering Problem, Principle of an Adaptive filter, The steepest Descent Algorithm, The Windrow – Hoff Least –Mean– square Adaptive algorithm.		

Self-Study Content: 1. Cancellation of maternal ECG in fetal ECG and Cancellation of High Frequency noise in Electro-surgery 2. Study of ECG enhancement by Adaptive cancellation of Electro surgical Interference 3. Study of Adaptive Noise Canceller.	
Textbook Map: **6.1-6.4.**	
Teaching Learning Process: Flip classroom/PPT	
UNIT - IV	**8 Hours**
EEG and ECG Signal Processing: EEG analysis, Linear Prediction Theory, The Autoregressive Method, Recursive estimation of AR parameters, Special Error measure, Adaptive segmentation, ECG parameters and their Estimation.	
Self-Study Content: 1. Study of article "Deep learning for electroencephalogram (EEG) classification tasks: A Review". 2. Study ECG data compression using Wavelet Transform. 3. Study of the Use of Multi – scale Analysis for Parameters Estimation of ECG waveforms.	
Textbook Map: **4.4, 4.5, 4.6, 4.7, 4.8, 4.9, 7.4.**	
Teaching Learning Process:Simulation/PPT	
UNIT - V	**8 Hours**
Event Detection: Illustration of the Problem With Case-Studies, Detection of Events and Waves. **Modeling Event Related Potentials**: Exponential modeling, Exponential Parameter estimation, Theoriginal Prony Problem, Least Squares Prony Method, Theco variance method of Linear Prediction.	
Self-Study Content: 1. Clinical application of Prony's Method and Prony's method in the presence of noise. Reference: https://www.researchgate.net/publication/329193563_Coding_Prony'smethod_in_MATLAB_and_apply_it_to_biomedical_signal_filtering	
Textbook Map: **4.1-4.3. & 9.1-9.5**	
Teaching Learning Process: PPT/Presentation by students	

Course Outcomes: At the end of the course students should be able to :
CO1: **Apply** the knowledge of electronics in biomedical signal acquisition and processing
CO2: **Characterize** the biomedical signals and filtering technique
CO3: **Create** different types of filters for the removal of artifacts in biomedical signals.
CO4: **Implementation of a** case based application using tools

Suggested Learning Resources:				
Text books:				
Sl. No.	Title	Author	Year & Edition	Publisher
1	Biomedical Signal Processing: Principles and Techniques	D.C Reddy		ISBN-13:978-0-07-058388-7
2	Biomedical Signal Analysis**:** A Case – Study Approach	Rangaraj M Ragayyan		ISBN-0-471-20811-6.

Reference Books:				
1	Biomedical Signal	Wills J Tompkins		ISBN 10:

	Processing			8120314786
2	Digital Signal Processing: Principles, Algorithms and Applications	Johan G Proakis and Dimitris		SBN: 9788131710005, 8131710009
3	Digital Signal Processing: A Computer based approach	Sanjit K Mitra		ISBN: 9781259098581, 1259098583.

Web links and Video Lectures (e-resources)
1. https://nptel.ac.in/courses/108/105/108105101/ (Prof Sudipta Mukhopaddhyay, IIT, Kharagpur) 2. http://www.digimat.in/nptel/courses/video/108105101/L64.html 3. http://www.infocobuild.com/education/audio-video-courses/electronics/BiomedicalSignalProcessing-IIT-Kharagpur/lecture-21.html

Active Based Learning (Suggested Activity in Class)/ Practical Based Learning (Example)
1. Flip Class 2. Seminar/ poster Presentation 3. Individual Role play/Team Demonstration/ Collaborative Activity 4. Case study 5. Learn by Doing

Academic Year: 2024-25	Semester: VII	Scheme: P21
Course Title: **Computer Communication Networks and IOT (Integrated)**		
Course Code: **P21EC704**	CIE Marks: 50	CIE Weightage: 50%
Teaching hours/week (L:T:P)=3 : 0 : 2	SEE Marks:100	SEE Weightage: 50%
Teaching hours of Pedagogy: 40	Exam Hours: 3 Hours	
Credits: 4		
Prerequisite: Digital Electronics and course on any programming language		
Course learning Objectives:		
CLO1: Describe computer network applications, network hierarchy, TCP/IP layers functioning, their dependency and interaction. CLO2: Compute and characterize different types of delays and error detection schemes in a computer network CLO3: Analyze and optimize the network delay and path for the given specifications. CLO4: Understand the Communication and layered architectures pertaining to IoT. CLO5: Describe LPWAN in IoT, LoRa based network architectures.		
UNIT - I		**8 Hours**
Overview of The Internet, Networks , Switching, The Internet, Accessing the Internet, Hardware and Software, Protocol Layering, Scenarios, TCP/IP Protocol Suite, Standards And Administration, Internet Standards, Internet Administration, Introduction, Providing Services , Application-Layer Paradigms, Client-Server Paradigm.		
Self-Study Content: 1. Understand the issues in protocol implementation. 2. Study the quantitative performance metrics that drive network design		
Practical Topics: (2 Hours)	**1.** Implement prescribed number of nodes (a) (Point – to – point network) with duplex links between them. Set the queue size, vary the bandwidth and find the number of packets dropped (b) For data transmission with stop and wait protocol.	
Textbook Map: **1.1.1-1.1.5, 1.2.1-1.2.2, 1.4.1-1.4.2, 2.1.1-2.1.2, 2.2.**		
Teaching Learning Process: 1. RFC documentation with example. 2. Slides containing photos of network components.		
UNIT – II		**8 Hours**
Standard Client-Server Applications, World Wide Web and HTTP, FTP, Electronic Mail, Introduction, Transport-Layer Services, Transport-Layer Protocols, Simple Protocol, Stop and-Wait Protocol, Go-Back-N Protocol (GBN), Selective-Repeat Protocol, USER Datagram Protocol (UDP), User Datagram, UDP Services, UDP Applications.		
Self-Study Content: 1. Identify the issues that link-level protocol must address. 2. Develop a program to simulate (i) Bit stuffing and destuffing (ii) Character stuffing and destuffing.		
Practical Topics: (2 Hours)	**1.** Implement an Ethernet LAN using n nodes and set multiple traffic nodes and plot congestion window for different source / destination. **2.** Conduct an experiment to provide reliable data transfer between two nodes over an unreliable network using the Sliding Window Protocol-Selective Repeat.	
Textbook Map: **2.3.1-2.3.3, 3.1, 3.2.1 - 3.2.4, 3.3-3.3.3**		

Teaching Learning Process: 1. Protocol document of wireshark 2. Animations of Go-back N, selective repeat, stop and wait protocol.	
UNIT - III	**8 Hours**
Introduction, Network-Layer Services, Packet Switching, Network-Layer Performance, Network-Layer Congestion, Structure of A Router, Network-Layer Protocols, IPv4 Datagram Format, IPv4 Addresses, Forwarding of IP Packets.	
Self-Study Content: 1. Discuss the mechanisms used to provide quality of service in IP. 2. Write a program to implement CRC-CCITT polynomial.	
Practical Topics: (2 Hours)	**1.** Test DSR and DSDV routing protocols over wired network and compare the performance. **2.** Implement establish a wireless network with minimum of 3 nodes and compare the operation of TCP and UDP protocols over transmission delay, throughput and packet loss.
Textbook Map: **4.1.1 – 4.1.4, 4.1.5, 4.2.1 – 4.2.3.**	
Teaching Learning Process: 1. Demonstration with wire shark 2. Show case RFC of network layer protocol.	
UNIT - IV	**8 Hours**
IoT Communication: M2M and IoT, Layered Architectures, System Components **Concepts of IoT Networking:** IoT Networking, Types of Networks, Devices- Sensors, Actuators and Controllers, Gateways, Security, Wireless Sensor Networks. **Physical and Link Layers:** Ethernet, ITU-T G.9903, IEEE 1901.2,IEEE 802.11, IEEE 802.15.3, IEEE 802.15.4, Bluetooth Low Energy.	
Self-Study Content: 1. Discuss and understand IOT architecture and IOT Stack. 2. Discuss the mechanism of Header Compression.	
Practical Topics: (2 Hours)	**1.** Establishing Wired/Wireless Communication using Peripherals: a) Develop a controller system to sense a specific data and send the sensed data to the PC through communication module. **2.** GSM and Long Range Communication: a) Develop a controller system, to communicate and alert the registered mobile number using GSM module interface.
Textbook Map: **1.1-1.3, 2.1-2.5,3.2.1-3.2.3, 3.3.1-3.3.4**	
Teaching Learning Process: 1.Slides containing photos of IOT sensors and actuators. 2. RFC of link and physical layer protocol used in IOT.	
UNIT - V	**8 Hours**
Network and Transport Layers: Why IP?, IPv6, 6LoWPAN - Addresses, Header Format, Routing and Forwarding ,Header Compression, Fragmentation. **Application Layer:** Architectures, Request/Response- REST Architecture, HTTP, XMPP, CoAP, SIP and RTP, OPC UA. **LPWAN Technologies:** LPWAN in IoT, LoRa- Physical Layer, Link Layer, SigFox-Physical Layer, Link Layer.	
Self-Study Content: 1. Discuss and understand the concepts of IoT Services and Resources 2. Refer and understand any LoRa based mini project.	
Practical Topics: (2 Hours)	**1.** Design a small or medium sized computer network including media types, enddevices, and interconnecting devices that meets a customer‘s specific needs. **2.** Perform configurations on routers and Ethernet switches.

	Simulate computer networksand analyze the simulation results. **3.** Demonstrate knowledge of programming for network communications **4.** Troubleshoot connectivity problems in a host occurring at multiple layers of the OSI model.
Textbook Map: **4.1-4.3.5,5.1-5.2.6, 8.1-8.3**	
Teaching Learning Process: 1. Simulators for demonstration of IOT.	

Course Outcomes: At the end of the course students should be able to :

CO1: **Apply** basic mathematics and fundamentals of digital communication to understand concepts of computer networks
CO2: **Analyse** and compare the various algorithms and protocols of TCP/IP
CO3: **Analyse** and characterise IoT stack and computer networks for delay, error resilience and performance.
CO4: **Understand** the conceptualization of networking in the area of IoT

Suggested Learning Resources:

Text books:

Sl. No.	Title	Author	Year & Edition	Publisher
1	Computer Networks, A Top-Down Approach	Behrouz A. Forouzan and Firouz Mosharraf, Tata McGraw-Hill Education	2011	ISBN 13: 9781259001567.
2	Fundamentals of IoT Communication Technologies	Rolando Herrero Springer	2022	ISBN 978-3-030-70079-9ISBN 978-3-030-70080-5 (eBook).

Reference Books:

1	Computer Networks	James F. Kurose and Keith W. Ross		ISBN-13:9789332585492
2	Computer Networks	Andrew S. Tanenbaum		ISBN-13: 9789332518742
3	Computer and Communication Networks	Nader F Mir		ISBN-13: 9788131715437

Web links and Video Lectures (e-resources)

1. NPTEL course on "Computer Networks" by Prof. Sujoy Ghosh, IIT Kharagpur, https://nptel.ac.in/courses/106/105/106105081/
2. NPTEL course on "Computer Networks and Internet Protocol", IIT Kharagpur by Prof. Soumya Kanti Ghosh and Sandip Chakraborty https://archive.nptel.ac.in/courses/106/105/106105183//
3. NPTEL course on "Internet of Things" by Prof. SudipMisra, IIT Kharagpur https://archive.nptel.ac.in/courses/106/105/106105166/

Active Based Learning (Suggested Activity in Class)/ Practical Based Learning (Example)

1. Flip Class
2. Seminar/ poster Presentation
3. Individual Role play/Team Demonstration/ Collaborative Activity

4.	Case study
5.	Learn by Doing

Academic Year: 2024-25	Semester: VII	Scheme: P21
Course Title: **Research Methodology and IPR**		
Course Code: **P21RMI705**	CIE Marks: 50	CIE Weightage: 50%
Teaching hours/week (L:T:P)= **3:0:0**	SEE Marks:50	SEE Weightage: 50%
Teaching hours of Pedagogy: 40	Exam Hours: 3 Hours	
Credits: **3**		

Course Learning Objectives: This course will enable the students to:

CO1. Gain comprehensive understanding of research methodology & IPR importance

CO2. Create a framework for literature review and data sample collection

CO3. Interpret and write research reports

CO4. Understand the life cycle of IPR and its related legal aspects

UNIT – I	**8 Hours**

Research Methodology: Introduction, Meaning of Research, Objectives of Research, Motivation in Research, Types of Research, Research Approaches, Significance of Research, Research Methods versus Methodology, Research and Scientific Method, Importance of Knowing How Research is Done, Research Process, Criteria of Good Research, and Problems Encountered by Researchers in India.

Research Problem: Introduction, Selecting the Problem, Necessity of Defining the Problem, Technique Involved in Defining a Problem, An Illustration.

Self-study component:	Case study to define research problem in the area of your interest.

UNIT – II	**8 Hours**

Reviewing the literature: Place of the literature review in research, Bringing clarity and focus to research problem, Improving research methodology, Broadening knowledge base in research area, Enabling contextual findings, How to review the literature, searching the existing literature, reviewing the selected literature, Developing a theoretical framework, Developing a conceptual framework, Writing about the literature reviewed.

Research Design: Meaning of Research Design, Need for Research Design, Features of a Good Design, Important Concepts Relating to Research Design, Different Research Designs, Basic Principles of Experimental Designs,.

Self-study component:	Know about Important Experimental Designs

UNIT – III	**8 Hours**

Design of Sampling: Introduction, Steps in Sample Design, Criteria of Selecting a Sampling Procedure, Characteristics of Good Sample Design.

Measurement Technique: Introduction, Measurement Scales, Sources of Error in Measurement, Technique of Developing Measurement Tools.

Data Collection: Collection of Primary Data, Difference between Questionnaires and Schedules, Collection of Secondary Data, Selection of Appropriate Method for Data Collection, Experiment and Survey.

Self-study component:	Case Study on Method of data collection

UNIT – IV	8 Hours
Interpretation and Report Writing: Meaning of Interpretation, Technique of Interpretation, Precaution in Interpretation, Significance of Report Writing, Different Steps in Writing Report, Layout of the Research Report, Types of Reports, Oral Presentation, Mechanics of Writing a Research Report, Precautions for Writing Research Reports. **Intellectual Property:** Introduction, Intellectual Property Regime in India, Copyrights, Trademarks, Patents, Designs, Trade Secrets, Geographical Indications and their Salient Features, Berne Convention, Paris Convention, Trade Related Aspects of Intellectual Property Rights (TRIPS) Agreement, Issues Covered under TRIPS Agreement, Features of the Agreement, Protection of Intellectual Property under TRIPS, Paris Convention for the Protection of Industrial Property, Berne Convention for the Protection of Literary and Artistic Works.	
Self-study component:	Patent Cooperation Treaty (PCT)
UNIT – V	**8 Hours**
Indian Patent Law: Introduction, Concept of Patent, Product/Process Patents and Terminology, Patents Act 1970, Amendments to the Patent Act 1970, Patent Rules, Patentable Subject Matter and Patentability Critria, Duration of Patents - Law and Policy Consideration, Elements of Patentability, Procedure for Filing Patent applications and Types of Applications.	
Self-study component:	Ownership and Maintenance of Patents

Course Outcomes: On completion of this course, students are able to:

COs	**Course Outcomes** with ***Action verbs*** for the Course topics	**Bloom's Taxonomy Level**	**Level Indicator**
CO1	To know the meaning of Research Methodology and the technique of defining the Research Problem.	Understand	L2
CO2	Describe the framework of Literature Review, research design and report writing.	Understand	L2
CO3	Illustrate the Sampling Design and Data Collection and Procedure of Report Writing	Understand	L2
CO4	Understand the fundamentals of Intellectual Property, Patent and Drafting Procedure.	Understand	L2

Academic Year: 2024-25	Semester: VII	Scheme: P21
Course Title: **Project Work Phase – I**		
Course Code: **P21EC706**	CIE Marks: 100	CIE Weightage: 50%
Teaching hours/week (L:T:P:PJ)=0 : 0 : 0: 3	SEE Marks:____	SEE Weightage: 50%
Teaching hours of Pedagogy: 40	Exam Hours: 3 Hours	
Credits: 4		

Course Learning Objectives: This course will enable the students to:

- Practice acquired knowledge within the chosen area of technology for project development.
- Identify, discuss and justify the technical aspects of the chosen project with a comprehensive and systematic approach.
- Reproduce, improve and refine technical aspects for engineering projects.
- Work as an individual or in a team in development of technical projects.
- Communicate and report effectively project related activities and findings.

Course Outcomes: On completion of this course, students are able to:

COs	Course Outcomes with *Action verbs* for the Course topics	Bloom's Taxonomy Level	Program Outcome Addressed (PO #) with BTL
CO1	**Apply** the domain knowledge for addressing engineering problems related to society	L3	PO1 (L3)
CO2	**Formulate**, review literature and analyze the problem definition.	L6	PO2 (L6)
CO3	**Design** and develop sustainable solutions for the problem definition to meet the specified needs with consideration for public health and safety and sustainable development.	L6	PO3, PO6, PO7 (L6)
CO4	**Build** the functional units of circuits and systems for the identified problem so as to provide sustainable solution	L6	PO3, PO7 (L6)

Academic Year: 2024-25	Semester: VIII	Scheme: P21
Course Title: **Self-Study Course**		
Course Code: **P21EC801**	CIE Marks: 100	CIE Weightage: 100%
Teaching hours/week (L:T:P:PJ)= -	SEE Marks:____	SEE Weightage: -
Teaching hours of Pedagogy: -	Exam Hours: -	
Credits: **02**		

The student has to choose and study the course related to the program discipline with her / his own efforts under the guidance of Course Instructor / Project guide, using study materials available in Open Sources i.e., Massive Open Online Courses (MOOCs) – NPTEL Courses. The intention of the course is to encourage the habit of self-learning. In this regard, the department has to release the pool of courses from the list of available 8 weeks NPTEL online courses according to NPTEL calendar of events. The student has to register for the course from the available pool during VII / VIII Semester and the same will be reflected in the Grade Card of VIII Semester. The 100 marks CIE assessment is based on the final NPTEL score (i.e. Online assignments: 25% + Proctored exam: 75%). The NPTEL score will be mapped directly to the CIE marks as per the calculation below only if he /she has completed the NPTEL course (i.e. Certification).

CIE = (NPTEL Score X 1.5) = [Maximum CIE should be 100 Marks]

[Ex. – 1: If NPTEL Score is 52 then the CIE will be = 52 X 1.5 = 78

Ex. – 2: If NPTEL Score is 80 then the CIE will be = 80 X 1.5 = 100 (Subjected to a Maximum CIE Marks of 100)]

If the student fails to complete the NPTEL course at the end of the VIII Semester, then the department has to constitute a committee consisting of the Head of the department, two senior faculty members of the department, one of them may be the internal guide. The evaluation is based on a Report, Presentation, and Viva-Voce of the NPTEL chosen topic and the assessment is a relative evaluation in context to the student's completed NPTEL course Certification (i.e. the CIE Score should be less than the score of the student who cleared the NPTEL Course).

Note: The student who fails to enroll and appear for the proctored exam in NPTEL is considered to have failed.

Academic Year: 2024-25	Semester: VIII	Scheme: P21
Course Title: **Research / Industry Internship - III**		
Course Code: **P21INT802**	CIE Marks: -	CIE Weightage: -
Teaching hours/week (L:T:P:PJ)= **0:0:0**	SEE Marks:100	SEE Weightage: 100%
Teaching hours of Pedagogy: -	Exam Hours: -	
Credits: **6**		

Guidelines for Internship:

I. Internship is of minimum Fifteen weeks duration and to be completed between the vacation period of VI & VII semester and VII & VIII semester.

II. The internship can be carried out in any industry/ R & D Organization/ Research/ Institute/ Educational institute of repute/ Internshala (ACITE MoU Internship).

III. The Department/college shall nominate staff member/s to facilitate, guide and supervise students under internship.

IV. The Internal Guide has to visit place of internship at least once during the student's internship.

V. The students shall report the progress of the internship to the guide in regular intervals and seek his/her advice.

VI. After the completion of Internship, students shall submit a report with completion and attendance certificates to the Head of the Department with the approval of both internal and external guides.

VII. There will be 100 marks for Viva Voce conducted during Semester End Examination (SEE) of VIII Semester. For the conduction of Internship Semester End Examination following instructions are issued:

a. The Semester End Examination (SEE) for 100 marks shall be conducted similar to final semester project work / lab examination.

b. Internal & External Examiners shall be appointed by the BoE – Chairperson in consultation with HoD and approval of the same by the Principal & Controller of Examination.

c. External Examiner may be from the Industry. If the external examiner from the industry is not available, alternative arrangement shall be made by the BoE - Chairperson by appointing a faculty from out of the available faculty in the department, wherein the student is studying.

VIII. The students are permitted to carry out the internship anywhere in India or abroad. The Institution will not provide any kind of financial assistance to any student for carrying out the Internship.

IX. Failing to undergo Internship: Internship is one of the head for obtaining degree, therefore completion of internship is mandatory.

Academic Year: 2024-25	Semester: VIII	Scheme: P21
Course Title: **Project Work Phase – II**		
Course Code: **P21EC803**	CIE Marks: 100	CIE Weightage: 100%
Teaching hours/week (L:T:P:PJ)=0 : 0 : 0 : 3	SEE Marks:100	SEE Weightage: 100%
Teaching hours of Pedagogy: 40	Exam Hours: 3 Hours	
Credits: 8		

Project Work: The Project Work (Phase I + Phase II) carries 12 credits (4 credits+8 credits) and spreads over TWO semesters, i.e. during 7th and 8th semesters.

I. Project Phase – I and Project seminar Comprises of Literature Survey, Problem identification, Objectives and Methodology. CIE marks shall be based on the report covering Literature Survey, Problem identification, Objectives and Methodology and seminar presentation skill.

II. The Assessment marks (CIE) in the case of Project Work - Phase I, shall be based on the evaluation at the end of the 7th semester by a committee consisting of Head of the concerned department, two senior faculty members of the department, one of them may be the internal guide. The work may be evaluated by the committee for award of Assessment marks (CIE) based on a Report [comprising of synopsis, Introduction, Literature survey, Objective and Methodology], presentation and viva voce.

III. The project work shall be carried out by candidate(s) independently/in a group (maximum of four) during the seventh and eighth semester under the guidance of one of the faculty members of the Department of study. If the project work is of inter-disciplinary nature, a co-guide shall be taken from the same or any other relevant Department. If a project work has to be carried out in any industry / factory / organization, outside the campus, the permission for the same and the name of co-guide at any of these organizations shall be intimated to the authorities at the beginning of seventh semester by the Head of the Department.

IV. The weekly progress of the Project work shall be monitored and reviewed by the Project Guide assigned by DUGC. The method of evaluation, including intermediate assessment shall be evolved by the pertinent DUGC.

V. A candidate shall submit N+3 (No. of candidates+3) copies of the Report of the Project Work to Head, DUGC on or before the specified date. The report shall be in the format prescribed by the Institute. The candidate shall submit a report of the project work (dissertation) duly approved by the guide and co-guide. The project report shall be countersigned by the guide, co-guide (if any) and the Head of the Department

VI. The last date for the submission of Report shall be Two weeks before the closure of the semester in which the project work credits have been registered for and is expected to be completed or as announced by the COE. The date of submission of the dissertation may be extended up to a maximum of eight academic years, from the date of commencement of the first semester in which the candidate has taken admission to the course.

VII. The final evaluation (CIE & SEE) for Project Work - Phase II is done by a Project Work Evaluation Committee (PWEC) constituted by the pertinent DUGC. There shall be an open seminar followed by a viva – voce examination as part of the final evaluation. After the final evaluation, appropriate letter grade is awarded.

VIII. If in the opinion of the PWEC, the Project Report is acceptable with minor modifications for the minimum passing grade 'E' (Fair) in the case of project, the PWEC shall value and instruct the candidate suitably to incorporate the necessary modifications and to resubmit it to the Chairman, PWEC. After such resubmission, the Chairman, PWEC will certify that the necessary modification has been incorporated.

IX. The Assessment marks in case of Project Work - Phase II and seminar shall be based on the evaluation, as per the guidelines, at the end of the 8th semester by a committee consisting of Head of the concerned department, two senior faculty members of the department (one of them may be the internal guide).

X. The Assessment marks sheet shall bear the signature of all those concerned, along with the date and seal of the Principal.