SYLLABUS

(With effect from 2018-19)

ಪಠ್ಯಕ್ರಮ

(ಶೈಕ್ಷಣಿಕವರ್ಷ 2018–19)

VII & VIII Semester

Bachelor Degree
in

Electronics & Communication Engineering

Out Come Based Education with Choice Based Credit System

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, New Delhi
Approved by AICTE, New Delhi.

ಪಿ.ಇ.ಎಸ್. ತಾಂತ್ರಿಕ ಮಹಾವಿದ್ಯಾಲಯ
ಮಂಡ್ಯ-571 401, ಕರ್ನಾಟಕ
(ವಿ.ಟಿ.ಯು, ಬೆಳಗಾವಿ ಅಡಿಯಲ್ಲಿನ ಸ್ವಾಯತ್ತ ಸಂಸ್ಥೆ)

ಕು : 08232- 220043, ಈಚಿಥ : 08232 222075,ಫಜಬಳ : [ತಿತಿತಿ.ರಿಛಟಿಜಟಚಟಿಜಡಿಚಿ.ಠಡಿರ](http://www.pesce.ac.in)

Preface

PES College of Engineering, Mandya, started in the year 1962, has become autonomous in the academic year 2008-09. Since, then it has been doing the academic and examination activities successfully. The college is running Eight undergraduate and Eight Postgraduate programs. It consists of Six M.Tech programs, which are affiliated to VTU. Other postgraduate programs are MBA and MCA.

India has recently become a Permanent Member by signing the Washington Accord. The accord was signed by the National Board of Accreditation (NBA) on behalf of India on 13th June 2014. It enables not only the mobility of our degree globally but also establishes equivalence to our degrees with that of the member nations such as Taiwan, Hong Kong, Ireland, Korea, Malaysia, New Zealand, Russia, Singapore, South Africa, Turkey, Australia, Canada and Japan. Among other signatories to the international agreement are the US and the UK. Implementation of Outcome Based Education (OBE) has been the core issue for enabling the equivalence and of Indian degrees and their mobility across the countries.

Our Higher Educational Institution has adopted the CBCS based semester structure with OBE scheme and grading system.

The credit based OBE semester system provides flexibility in designing curriculum and assigning credits based on the course content and hours of teaching.

The OBE, emphasize setting clear standards for observable, measurable outcomes of programs in stages. There lies a shift in thinking, teaching and learning processes moving towards Students Centric from Teacher Centric education. OBE standards focus on mathematics, language, science, attitudes, social skills & moral values.

The key features which may be used to judge, if a system has implemented an outcome based education system is mainly Standard based assessments that determines whether students have achieved the stated standard. Assessments may take any form, so long as the process actually measure whether the student knows the required information or can perform the required task. Outcome based education is a commitment that all students of all groups will ultimately reach the same minimum standards. Outcome Based Education is a method or means which begins with the end in mind and constantly emphasizes continuous improvement.

Choice Based Credit System (CBCS) provides choice for students to select from the prescribed courses (core, Foundation, Foundation Elective, elective, open elective and minor or soft skill courses). The CBCS provides a 'cafeteria' type approach in which the students can Choose electives from a wide range of courses of their choice, learn at their own pace, undergo additional courses and acquire more than the required credits, adopt an interdisciplinary approach to learning which enables integration of concepts, theories, techniques, and, perspectives from two or more disciplines to advance fundamental understanding or to solve problems whose solutions are beyond the scope of a single discipline. These greatly enhance the skill/employability of students.

In order to increase the Industry/Corporate readiness, many Soft Skills and Personality Development modules have been added to the existing curriculum of the academic year 2015-16. Industry Interactions have been made compulsory to enhance the field experience. In order to enhance creativity and innovation Mini Project and Industrial visit & Interaction are included in all undergraduate programs.

PES College of Engineering

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.

DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

The department of Electronics and Communication Engineering was incepted in the year 1967 with an undergraduate program in Electronics and Communication Engineering. Initially program had an intake of 60 students and presently 150 students graduate every year. The long journey of 50 years has seen satisfactory contributions to the society, nation and world. The alumni of this department has strong global presence making their alma mater proud in every sector they represent.

Department has started its PG program in the year 2012 in the specialization of VLSI design and Embedded systems. Equipped with qualified and dedicated faculty department has focus on VLSI design, Embedded systems and Image processing. The quality of teaching and training has yielded high growth rate of placement at various organizations. Large number of candidates pursuing research programs (M.Sc/Ph D) is a true testimonial to the research potential of the department.

VISION

The department of E & C would Endeavour to create a pool of Engineers who would be extremely competent technically, ethically strong also fulfill 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

Programme Education 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.

Programme Specific Outcomes (PSOs)

Program Specific Outcomes of bachelor degree (B.E, E&C) program are defined as follows which are in line with the Program specific criteria (PSC) as defined by IEEE.

After the graduation, the student will have:

- An ability to **understand the basic concepts** in Electronics & Communication Engineering and to **apply them in the design and implementation** of Electronics and communication systems.
- 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.

SCHEME OF TEACHING AND EXAMINATION
VII SEMESTER B.E. ELECTRONICS AND COMMUNICATION ENGINEERING

Sl. No.	Course Code	Course Title	Teaching Department	Hrs / Week			Credits	Examination Marks		
				L	T	P		CIE	SEE	Total
1	P18EC71	Computer Communication Networks (CC-1)	ECE	4	-	-	4	50	50	100
2	P18EC72	Fundamentals of Wireless Communication (CC-2)	ECE	4	-	-	4	50	50	100
3	P18EC73	Embedded System and IOT (CC-3)	ECE	4	-	-	4	50	50	100
4	P18EC74	**Professional Elective - III**	ECE	3	1	-	3	50	50	100
5	P18EC75	**Open Elective - II**	ECE	3	-	-	3	50	50	100
6	P18ECL76-Advanced Communication lab		ECE	-	-	3	1.5	50	50	100
7	P18ECL77	Embedded system and IoT Lab	ECE	-	-	3	1.5	50	50	100
8	P18EC78	Project Work Phase – I and Project seminar	ECE	-	-	4	2	100	-	100
Total							**23**	**450**	**350**	**800**

List of Electives

Professional Elective - III			**Open Elective – II**		
Sl. No	**Course Code**	**Course Title**	**Sl. No.**	**Course Code**	**Course Title**
1.	P18EC741	Wireless Sensor Networks and Technology	1.	P18ECO751	Data Acquisition and Instrumentation
2.	P18EC742	Low Power VLSI Design	2.	P18ECO752	Embedded Systems
3.	P18EC743	Artificial Intelligence and Machine Learning	3.	P18ECO753	Internet of Things and Applications
4.	P18EC744	Avionics	4.	P18ECO754	Introduction to Image Processing
5.	P18EC745	Network Security			

SCHEME OF TEACHING AND EXAMINATION
VIII SEMESTER B.E. ELECTRONICS AND COMMUNICATION ENGINEERING

Sl. No.	Course Code	Course Title	Teaching Department	Hrs / Week			Credits	Examination Marks		
				L	T	P		CIE	SEE	Total
1	P18EC81	Digital Image Processing(CC-1)	ECE	4	-	-	4	50	50	100
2	P18EC82X	**Professional Elective - IV**	ECE	3	1	-	3	50	50	100
3	P18EC83	Internship	ECE			-	2	50	50	100
4	P18EC84	Project Work Phase – II	ECE	-	-	-	6	100	100	200
5	P18EC85	Self Study Course and Seminar	ECE	-	-	4	2	50	-	50
Total							**17**	**300**	**250**	**550**

Professional Elective - IV		
Sl. No	**Course Code**	**Course Title**
1.	P18EC821	Satellite Communication
2.	P18EC822	Algorithms for VLSI Physical Design Automation
3.	P18EC823	Advanced Wireless Technologies
4.	P18EC824	Bio Medical Signal Processing
5.	P18EC825	Stochastic Models and Applications

Course Plan: Core			
Course Title: Computer Communication Networks(CC-1)			
Course Code: P18EC71	**Semester : VII**	**L-T-P-H: 4 – 0– 0-4**	**Credits:04**
Contact Period : Lecture :52Hrs., Exam: 3Hrs.		**Weightage :CIE:50% SEE:50%**	

A. Course Learning Objectives (CLOs)

This course aims to:

1. Describe/explain the computer network applications, network hierarchy, TCP/IP layers functioning, their dependency and interaction.
2. Compute and characterize different types of delays and error detection schemes in a computer network.
3. Analyze and optimize the network delay and path for the given specifications.
4. Identify and illustrate the roles, responsibilities, limitations and resource fairness in context of computer networks.
5. Understand and compare various channel access schemes/techniques and routing algorithms.

B. Course Content

UNIT – I

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, Application Programming Interface, Using Services of the Transport Layer, Multimedia Data, Multimedia in the internet.

Text 1: 1.1.1-1.1.5, 1.2.1-1.2.2, 1.4.1-1.4.2, 2.1.1-2.1.2, 2.2.1, 2.2.2, 8.2-8.3. 11 Hrs

Self Learning Component:

1. Understand the issues in protocol implementation.
2. Study the quantitative performance metrics that drive network design.

UNIT – II

Standard Client-Server Applications,World Wide Web and HTTP, FTP, Electronic Mail, TELNET, Domain Name System (DNS), PEER-TO-PEER PARADIGM,P2P Networks, Distributed Hash Table (DHT),A Popular P2P Network: Bit Torrent.

Text 1: 2.3.1-2.3.4, 2.3.6, 2.4.1, 2.4.2, 2.4.6 10 Hrs

Self Learning Component:

1. Identify the issues that all link-level protocol must address.
2. Write a program to simulate (i) Bit stuffing and destuffing (ii) Character stuffing and destuffing.

UNIT – III

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, Transmission Control Protocol (TCP), TCP Services, TCP Features, Segment, A TCP Connection, TCP Congestion Control.

Text1: 3.1, 3.2.1 - 3.2.5, 3.3, 3.4.1, 3.4.2, 3.4.3, 3.4.4, 3.4.9 11 Hrs

Self Learning Component:
1. what are Real-time Transport Protocol (RTP).
2. Write a program to simulate shortest path algorithm using Dijkstra's algorithm.

UNIT – IV

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 ,ICMPv4 ,Next Generation Ip, Packet Format, Transition from IPv4 to IPv6.

Text 1: 4.1.1 – 4.1.4, 4.1.5, 4.2.1 – 4.2.4, 4.5.1, 4.5.3 **10 Hrs**

Self Learning Component:
1. Discuss the mechanisms used to provide quality of service in IP.
2. Write a program to implement CRC-CCITT polynomial.

UNIT – V

Introduction, Nodes and Links, Two Types of Links, Two Sub layers, Data Link Control (Dlc), Framing, Flow and Error Control, Error Detection and Correction, Two DLC Protocols, Multiple Access Protocols (MAC), Random Access, Controlled Access, Channelization, Other Wired Networks, Point-to-Point Networks, Connecting Devices, Repeaters or Hubs, Link-Layer Switches.

Text1: 5.1, 5.2, 5.3, 5.6.1, 5.7.1, 5.7.2 **10 Hrs**

Self Learning Component:
1. Discuss the Web services architectures for developing new application protocols.
2. Write a program to encrypt and decrypt a given message in (i) Substitution cipher method & (i i) Transposition Cipher method.

SLC Programs can be written in C/C++, Python, MATLAB, JAVA etc.

Note: <u>No questions</u> from SLC component in the Semester End Exam (SEE), it is evaluated only in Continuous Internal Evaluation (CIE)

TEXT BOOK:

1. **"Computer Networks, A Top-Down Approach"** by Behrouz A. Forouzan and FirouzMosharraf,Tata McGraw-Hill Education, 2011. ISBN 13: 9781259001567.

REFERENCE BOOKS:

1.**"Computer Networks",** James F. Kurose and Keith W. Ross, Pearson education, 6e. ISBN-13:9789332585492.
2.**"Computer Networks",** Andrew S. Tanenbaum, Pearson education, 5e. ISBN-13: 9789332518742.
3.**"Computer and Communication Networks",** Nader F Mir, Pearson education, ISBN-13: 9788131715437.

Video Lecture Reference:

1. NPTEL course on "Computer Networks " by Prof. Sujoy Ghosh, IIT Kharagpur, https://nptel.ac.in/courses/106/105/106105081/

C. Course Outcomes

CO #	Course Outcome	Program Outcome Addressed (PO #) with BTL
CO1	Apply basic mathematics and fundamentals of digital communication to understand concepts of networks.	**PO1[L3]**
CO2	Analyse and compare the various algorithms and protocols	**PO2[L4]**
CO3	Analyse and characterise computer networks.	**PO2[L4]**
CO4	Analyse and optimize the network delay and path for the given specifications.	**PO2 [L4]**
CO5	Identify and illustrate the roles, responsibilities, limitations and resource fairness in context of computer networks.	**PO1[L3],P08[L3]**

D. Course Articulation Matrix

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
#1	**2**												**2**	
#2		**3**												**3**
#3		**3**												**3**
#4		**2**												**2**
#5	**3**							**1**					**3**	

Course Plan: Core			
Course Title : Fundamentals of Wireless Communication (CC-2)			
Course Code: P18EC72	**Semester : VII**	**L-T-P-H: 4 – 0 – 0**	**Credits: 4**
Contact Period : Lecture :52 Hr, Exam: 3Hr		**Weight age: CIE:50% SEE:50%**	

A. Course Learning Objectives (CLOs)

This course aims to

1. Understand the evolution and various modern wireless communication systems.
2. Discuss the concept of cellular architecture.
3. Describe the system design fundamentals to improve channel capacity
4. Discuss and analyse different multiple access techniques.
5. Describe different wireless systems and standards.

B. Course Content

UNIT-I

Introduction to Wireless Communication Systems and Wireless Networks: Introduction to Wireless Networks. Differences between Wireless and Fixed Telephone Networks,Examples of Wireless Communication Systems, Trends in cellular radio and Personal communications. Third generation (3G) wireless networks, Wireless local loop (WLL) and LMDS, Wireless Local Area Networks(WLANs), Bluetooth and Personal Area Networks (PANs).

Text 1: 10.1,10.2, 1.4-1.5 and 2.1-2.5 **10 Hrs**

Self-learning components:

1.List out modern wireless communications networks available to the user around the world with their services and type of technologies used.

UNIT-II

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

Text 1: 3.1-3.7 **10 Hrs**

Self-learning components:

1**.** Discuss latest/recent capacity enhancement techniques.

UNIT-III

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.

Text 1: 11.3 and 6.9-6.11 **10 Hrs**

Self-learning components:

1. Discuss 4G and 5G mobile standards.

UNIT-IV

Multiple Access Techniques for Wireless Communications: Introduction, Frequency Division Multiple Access (FDMA), Time Division Multiple Access (TDMA), Spread Spectrum Multiple Access, Space Division Multiple Access (SDMA), Packet Radio, Capacity of cellular Systems.

Text 1: 9.1-9.7 **11 Hrs**

Self-learning components:

1. Discuss the type of multiple access technique is used in WIFI technology.

2. Explain how CDMA is better than TDMA and FDMA?
3. What multiple access techniques do typical GSM systems use?

UNIT-V

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, **Mobile Radio Propagation: Small-Scale Fading and Multipath:** Small-Scale Multipath Propagation, Types of Small-Scale Fading.
Text 1: 4.1-4.8, 5.1, 5.2, and 5.5 **11 Hrs**

Self-learning components:
1.Study the empirical models for Indoor and outdoor propagation.

Note: No questions from SLC component in the Semester End Exam (SEE), it is evaluated only in Continuous Internal Evaluation (CIE)

TEXT BOOKS:

1. Theodre. S. Rappaport **"Wireless Communications- Principles and Practice"**,Pearson, 2nd Edition, 2010. **ISBN-13:** 9788131731864.

REFERENCE BOOKS:

1. William. C. Y. Lee**"Wireless and Cellular Communications",** Mc-Graw Hill, 2005. **ISBN:**978-00-714-3686-1.
2. Gary. J. Mullet**"Introduction to Wireless Telecommunications Systems and Networks"**, Cengage Learning, 2010. ISBN-13: 978-81-315-0559-5.
3. Ozan. K. Tonguz, Giianluigi Ferrari **"Ad-HOC Wireless Networks: A Communication-Theoretic Perspective"**, Wiley India Edition, 2009, **ISBN:** 9788126523047.

C. Course Outcome

CO #	Course Outcome	Program Outcome Addressed (PO #) with BTL
CO1	Apply signal processing for wireless communication system to understand basic principles of wireless communication.	**PO1[L2]**
CO2	Analyze various standards and methodologies to improve the cellular capacity.	**PO2[L3]**
CO3	Apply communication system to interpret multiple access techniques and capacity in cellular system.	**PO2[L2]**
CO4	Apply fundamentals of cellular communication system to understand handoff, roaming strategies and various wireless systems, standards and mobile radio propagation.	**PO1[L3]**
CO5	Design and analyze a cellular system for various parameters like capacity, interference, handoff, radio propagation etc.	**PO2[L4]**

D. Course Articulation Matrix (CAM)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
#1	3												3	
#2		3												3
#3		2												2
#4	2												2	
#5		2												2

Course Plan: Core			
Course Title: Embedded Systems and IOT(CC - 3)			
Course Code: P18EC73	**Semester : VII**	**L-T-P-H : 4-0-0-4**	**Credits: 4**
Contact Period : Lecture : 52 Hrs, Exam: 3 Hrs	**Weightage: CIE: 50%**		**SEE: 50%**

A. Course Learning Objectives (CLOs)

This course aims to:

1. Provide the knowledge about basic concepts of Embedded Systems.
2. Outline the concepts of typical embedded systems.
3. Describe the characteristics and quality attributes of embedded systems.
4. Provide the knowledge of software hardware co–design.
5. Describe the basics, definition and vision of Internet of Things(IoT).
6. Analyse IoT in terms of a suggested IoT conceptual framework.
7. Explain wireless and wired communication Technologies for physical cum data-link layer functions.
8. Illustrate the usage of messaging protocols between connected devices and the web.

B.Course Content

UNIT – I

Introduction to Embedded Systems: What is an Embedded system? Embedded System vs. General Computing Systems, History of Embedded Systems, Classification of Embedded Systems, Major Application Areas of Embedded Systems, Purpose of Embedded Systems, 'Smart' Running Shoes from Adidas-The Innovative Bonding of Lifestyle with Embedded Technology.

Typical Embedded System: Core of the Embedded System, Memory, Sensors and Actuators, Communication Interface Embedded Firmware, Other System Components.

Text 1:1.1 to 1.7, 2.1 to 2.6 **10 Hrs**

Self Learning Component:

1. Study the working of IR proximity sensor, temperature sensor, humidity sensor to understand the operation of input devices
2. Study the working of Hydraulic and Rotatory Actuators to understand the operation of output devices.
3. Tabulate the different on board and external communication interface.

UNIT – II

Characteristics and Quality Attributes of Embedded Systems: Characteristics of an embedded system, Quality attributes of embedded systems.

Embedded System- Application and Domain Specific: Consumer (Washing Machine), Automotive.

Hardware Software Co-Design and Program Modeling: Fundamental Issues in Hardware Software Co-Design, Computational Models in Embedded Design.

Text 1: 3.1, 3.2, 4.1, 4.2, 7.1, 7.2 **10 Hrs**

Self Learning Component:

1. List the different sensors and actuators used in automobiles.

2. Write the state diagram that shows how UML can be used for designing a door system (that can only be opened and closed)

UNIT – III

Real-Time Operating System (RTOS) based Embedded System Design: Operating System Basics, Types of OS, Tasks, Process and Threads, Multiprocessing and Multitasking, Task Scheduling, Threads, Processes and Scheduling: Putting them altogether, Task Communication, Task Synchronization, Device Drivers(**Excluding Programs**).

Text 1: 10.1 to 10.9 ((Excluding Programs) 11 Hrs

Self Learning Component:

1. Understand the basic of Real time operating system using the below link
   https://youtu.be/dHsHP9RrXBw
2. Implement the multithread application to satisfy i) two child threads are created with normal priority ii) thread 1 receives and prints its priority, sleeps for 10msec and then quits.

UNIT – IV

Internet of Things: an Overview :- Internet of things, IOT Conceptual Framework, IOT Architectural View, Technology Behind IoT, Sources of IoT, M2M Communication, Examples of IoT**.**

Design Principles for Connected Devices: Introduction, IoT/M2M Systems Layers and Design Standardization, Communication Technologies, Data Enrichment, Data Consolidation and Device Management at Gateway, Ease of Designing and Affordability.

Text 2: 1.1-1.7, 2.1-2.5. 10 Hrs

Self Learning Component:

1. Understand the importance of IoT in today's reality.
2. Develop a brief Report on Introduction to IoT -- https://youtu.be/BXDxYh1EV2w
3. Develop a brief Report on Basics of IoT networking -- https://youtu.be/fByKuk2VmJc

UNIT – V

Design Principles for Web Connectivity: Introduction, Web Communication Protocols for Connected Devices, Message Communication Protocols for Connected Devices, Web connectivity for Connected- Devices Network using Gateway, SOAP, REST, HTTP RESTful and WebSockets.

Data Acquiring, Organizing, Processing: Introduction, Data Acquiring and Storage, Organizing the Data, Transaction, Business Processes, Integration and Enterprise Systems.

Text 2: 3.1-3.4, 5.1, 5.2, 5.3, 5.4 11 Hrs

Self Learning Component:

1. Understand the functionalities of HTTP, HTTPS, FTP, Telnet, CoAP and LWM2M.
2. Understand the IP Addressing -- https://youtu.be/5vbPS-KnhvI
3. Develop a brief Report on IoT Connectivity -- https://youtu.be/TrFaCBV7joY

Note: <u>No questions</u> from SLC component in the Semester End Exam (SEE), it is evaluated only in Continuous Internal Evaluation (CIE)

TEXT BOOK:

1. **"Introduction to Embedded Systems"** Shibu K V, Tata McGraw Hill Education Private Limited, 2009, ISBN (13): 978-0-07-014589-4
2. **"Internet of Things: Architecture And Design Principles",** Raj kamalMcGraw Hill, First Edition, Fifth Reprint ,2019, **ISBN-13:** 978-9352605224.

REFERENCE BOOK:

1. **"Embedded Systems – A contemporary Design Tool**" James K Peckol, John Weily, 2008.
2. **"Embedded Systems Design: An Introduction to Processes, Tools, and Techniques "** by Arnold S. Berger ISBN: 1578200733 CMP Books © 2002
3. "**IoT and Edge Computing for Architects: Implementing edge and IoT systemsfrom sensors to clouds with communication systems, analytics, and security, 2nd Edition**" Perry Lea, Packt Publishing (March 6, 2020), ISBN-10: 1839214805 ISBN-13: 978-1839214806.
4. **"Internet of Things: A Hands on Approach"**, ArshdeepBahga, Vijay Madisetti,Orient Blackswan Private Limited - New Delhi; First Edition ,2015,ISBN-13: 978-8173719547.

C. Course Outcomes

CO #	Course Outcome	Program Outcome Addressed (PO #) with BTL
CO1	**Apply** the knowledge of Microcontrollers to understand and explain the concepts of Embedded systems.	**PO1 (L1,L2)**
CO2	**Analyse** and understand the design challenges, methodology and Performance criteria of Embedded systems.	**PO2 (L2)**
CO3	Understand and **Analyse** various sources of IoT& M2M communication protocols.	**PO1,PO2 [L2,L3]**
CO4	**Analyse** the data-acquiring and processing methods for IOT/M2M devices data and messages.	**PO2[L2]**
CO5	**Analyse** and understand the challenges and scheduling strategies for real time operating systems.	**PO3[L2]**

D. Course Articulation Matrix

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	**3**												**3**	
CO2		**2**												**2**
CO3	**3**	**2**											**3**	**2**
CO4		**2**												**2**
CO5			**2**											

Course Plan: Elective – III			
Course Title : Wireless Sensor Networks and Technology			
Course Code: P18EC741	**Semester : VII**	**L-T-P-H : 3-1-0-4**	**Credits: 3**
Contact Period : Lecture : 52 Hrs, Exam: 3 Hrs	**Weightage: CIE: 50%**		**SEE: 50%**

A. Course Learning Objectives (CLOs)

This course aims to:

1. Provide an understanding of common wireless sensor node architectures.
2. Discuss various applications of wireless sensor architectures.
3. Provide an understanding of essential networking architecture.
4. Understand the MAC protocols developed for WSN.
5. Understand the routing protocols developed for WSN.
6. Describe current technology trends for the implementation and deployment of wireless sensor networks.
7. Discuss the general issues of task-driven sensing.
8. Provide an overview of few sensor node hardware platforms.
9. Provide an overview of node level simulators such as ns-2 and TOSSIM.
10. Understand the security requirements of WSN

B. Course Content

UNIT – I

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. Network architecture – Sensor network scenarios, Optimization and Figures of merit, Gateway Concepts
Text 1: 1.1 to 1.5, 2.1 to 2.4, 3.1,3.2,3.5 **11 Hrs**
Self Learning Component:
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

UNIT – II

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, Schedule Based Protocols.
Text 1: 4.1 to 4.3, 5.1, to 5.4 **10 Hrs**
Self Learning Component:
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

UNIT – III

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

Text 1: 6.1 to 6,4, 7.1 to 7.5 **10 Hrs**

Self Learning Component:

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

UNIT – IV

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.

Text 1: 10.1, 10.2, 10.4 11.1 to 11.5, 14.2 **10 Hrs**

Self Learning Component:

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

UNIT – V

Sensor Network Platforms and Tools: 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.

Text 2: 7.1 to 7.5, 8.2,8.3.1, 8.3.4, 8.3.5,8.3.6,8.3.7 **11 Hrs**

Self Learning Component:

1. Establish network of N nodes using NS2 simulator and demonstrate data communication at different levels of network
2. Analyze Future research directions in the Field of Network of High Data rate sensors

Note: <u>No questions</u> from SLC component in the Semester End Exam (SEE), it is evaluated only in Continuous Internal Evaluation (CIE)

TEXT BOOKS:

1. **"Protocols and Architectures for Wireless Sensor Networks",**Holger Karl and AndressWillig, 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"**, KazemSohraby, Daniel Minoli, and TaiebZnati, 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.
3. **"Wireless Sensor Network",**Kazemshraby, Daniel Minoli, TaiebZnati, Wiley, ISBN 10: 0471743003 and ISBN-13: 978-0471743002.

ONLINE COURSES AND VIDEO LECTURES:

1. https://nptel.ac.in/courses/106/105/106105160/(By Prof Sudip Misra, IIT Kharagpur)

C. Course Outcomes

CO #	Course Outcome	Program Outcome Addressed (PO #) with BTL
CO1	Apply fundamentals of Computer communication networks to understand characteristics and architecture of Wireless sensor networks	**PO1 (L3)**
CO2	Analyze Communication protocols and controlling mechanisms which can enhance efficiency of Wireless sensor network	**PO2 (L3)**
CO3	Analyze and Compare different infrastructure establishment principles on sensor network platform	**PO2 (L3)**
CO4	Identify and illustrate the unique constraints , applications and resource fairness in context of wireless sensor networks	**PO1(L3), PO8(L3)**
CO5	Simulate Wireless sensor network platforms using modern tools(Network simulators,tiny OS,etc)	**PO1,PO5 (L4)**

D. Course Articulation Matrix (CAM)

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2
#1	**2**												**2**	
#2		**3**												**3**
#3		**2**												**2**
#4	**2**							**1**					**2**	
#5	**2**				**2**								**2**	

Course Plan: Elective III			
Course Title : Low Power VLSI Design			
Course Code: P18EC742	**Semester : VII**	**L-T-P-H : 3-1-0-4**	**Credits: 3**
Contact Period : Lecture : 52 Hrs, Exam: 3 Hrs	**Weightage: CIE: 50%**		**SEE: 50%**

A. Course Learning Objectives (CLOs)

This course aims to:

1. Provide the basic knowledge of low power VLSI design.
2. Understand the types of power dissipation in CMOS devices.
3. Discuss different techniques of power analysis and digital cell library.
4. Discuss the concepts of Low power Clock Distribution.
5. Design low power arithmetic circuits and systems
6. Understand the architecture and performance management of the system

B. Course Content

UNIT – I

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, Monte Carlo Simulation.

Text 1: 1.1-1.7, 2.1-2.6 **11 Hrs**

Self Learning Components:

1. Study on minimizing the power consumption in Digital CMOS Circuits.
2. Study and develop a report on advanced Monte Carlo Simulation techniques.

UNIT – II

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, Adjustable Device Threshold Voltage

Text 1: 3.1-3.4, 4.1-4.6 **10 Hrs**

Self Learning Components:

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.

UNIT – III

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.

Text 1: 5.1-5.5, 6.1-6.5 **10 Hrs**

Self Learning Components:

1. Application of Bus inverts coding for low power I/O.
2. Study on low power techniques for DRAM.

UNIT – IV

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.

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.

Text 1:7.1-7.4, 8.1-8.3

Text 2: 7.1, 7.2, 7.3.1-7.3.3 **10 Hrs**

Self Learning Components:

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.

UNIT – V

Low–Energy Computing Using Energy Recovery Techniques: 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.

Software Design for Low Power: Introduction, Sources of Software Power Dissipation, Software Power Estimation, Software Power Optimizations, Automated Low Power Code Generation, Co-design for Low Power.

Text 2: 7.3.4-7.3.9, 7.4, 8.1- 8.6 **11 Hrs**

Self Learning Components:

1. Discuss memory allocation technique for low energy embedded software.
2. Study on instruction level power analysis and optimization of software.

Note: <u>No questions</u> from SLC component in the Semester End Exam (SEE), it is evaluated only in Continuous Internal Evaluation (CIE)

TEXT BOOK:

1. **"Practical Low Power Digital VLSI Design",** Gary K, Yeap, Kluwer Academic Publishers, ISBN – 13: 978-0792380092, 2008,
2. **"Low–Power CMOS VLSI Circuit Design",** Kaushik Roy and Sharat C Prasad, Wiley Student edition, 2009. ISBN: 978-81-265-2023-7.

REFERENCE BOOKS:

1. **"Low Power Design Methodologies"** Rabaey, Pedram, Kluwer Academic Publishers, ISBN – 978-1-4613-5975-3, 2009.

C. Course Outcomes

CO #	Course Outcome	Program Outcome Addressed (PO #) with BTL
CO1	Apply the basic knowledge of physics and the fundamental circuit concept in understanding low power circuits and its necessities.	**PO1 (L3)**
CO2	Apply suitable optimization technique for a given scenario/problem in low power VLSI Design and synthesis	**PO1 (L3)**
CO3	Analyze low power VLSI circuits using different circuit technologies and design levels.	**PO2 (L4)**
CO4	Design reversible logic and partially reversible logic in low power circuits.	**PO3 (L5)**
CO5	Discuss issues of power estimation and optimization in software design.	**PO1 (L2)**

D. Course Articulation Matrix (CAM)

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2
#1	**3**												**3**	
#2	**2**												**2**	
#3		**3**												**3**
#4			**2**											
#5	**2**												**2**	

Course Plan: Elective III			
Course Title : Artificial Intelligence and Machine Learning			
Course Code: P18EC743	**Semester : VII**	**L-T-P-H : 3-1-0-4**	**Credits: 3**
Contact Period : Lecture : 52 Hrs, Exam: 3 Hrs	**Weightage: CIE: 50%**		**SEE: 50%**

A. Course Learning Objectives (CLO)

This Course Aims to:

1. Introduce Machine learning and AI.
2. Learn machine learning and AI methods and algorithms for learning, classification.
3. Learn the method of problem solving, knowledge representation and reasoning.
4. Familiarize different learning methods.
5. Understand various classification and learning approaches.

B. Course Content

Unit I

Introduction: What is AI, The Foundations of Artificial Intelligence, The History of Artificial Intelligence, The State of the Art, Risks and Benefits of AI.
Solving Problems by Searching: Problem Solving Agents, Example Problems.
Quantifying Uncertainty: Acting under Uncertainty, Basic Probability Notation.
Applying Machine Learning to Sentiment Analysis (*Qualitative discussion without Coding)**.**
Text 1: 1.1-1.5, 3.1-3.2, 12.1-12.2, **Text 3:** Chapter-8. **11 Hrs**
Self Learning Components:
1. Write a python program for Depth-first search and the problem of memory, A star search.

Unit II

Quantifying Uncertainty: Inference Using Full Joint Distribution, Independence, Bayes' Rule and Its Use, Naive Bayes Models.
Probabilistic Reasoning: Representing Knowledge in an Uncertain Domain, The Semantics of Bayesian Networks, Exact Inference in Bayesian Networks , Approximate Inference for Bayesian Networks.
Text1: 12.3-12.6, 13.1-13.5 **10 Hrs**
Self Learning Components:
1. Simulate a Bayesian networks for the given problems.

Unit III

Learning and Association Learning: Types of Learning: Rote Learning, Learning by Parameter Adjustment, Learning by General Problem Solving, Concept Learning, Learning by Analogy.
Machine Learning: Why Machine Learning?, Types of Problems in Machine Learning, History of Machine Learning, Aspects of Inputs to Training, Learning Systems, Machine Learning Applications, Quantification of Classification. Intelligent agents.
Basics of Association, Apriori Algorithm, Eclat Algorithm, FP Growth Algorithm,Tertius Algorithm, Case Studies.
Text 2: 7.1-7.2, 8.1-8.6. **10 Hrs**
Self Learning Components:
1. Develop a code for apriori and Eclat algorithm for searching n frequent items.

Unit IV

Clustering Learning: k-Means Clustering, Fuzzy Clustering, Hierarchical Clustering, Agglomerative and Divisive Clustering (ADC), Hierarchical Agglomerative Clustering (HAC), Cluster Similarity, Case Studies.
Reinforcement Learning: Markov Decision Problem, Q-learning, temporal difference learning.
Statistical learning: Hidden Markov Models, Linear Classifiers
Text 2: 9.1-9.5, 10.1-10.3, 11.1-11.2 **11 Hrs**
Self Learning Components:
1. Case study of K-means clustering and Markov decision problem algorithm in MATLAB/Python.

Unit V

Statistical learning: Quadratic Classifiers, Decision Trees, Bayesian Networks, Case Studies.
Supervised learning: Support Vector Machines, Inductive Logic Programming, Case-based Reasoning, Ensemble Classifiers, Nearest Neighborhood, Case Studies.
Text 2:11.3 -11.5, 11.6.1, 11.6.2, 13.1-13.5 and 13.7. **10 Hrs**
Self Learning Components:
1. Introduction to inference for Bayesian networks" by R Cowell -Learning in graphical models, 1998 - Springer. Write a interpretation note/summary highlighting major findings.

Note: <u>No questions</u> from SLC component in the Semester End Exam (SEE), it is evaluated only in Continuous Internal Evaluation (CIE)

Text Books:

1. Stuart J. Russell and Peter Norvig , Artificial Intelligence :A Modern Approach, *Prentice Hall,4th Edition,1995,* ISBN
2. Vinod Chandra S.S and AnandHareendran S, Artificial Intelligence and Machine Learning, PHI Learning Private Ltd, ISBN-978-81-203-4934-6, 2014.
3. Sebastian Raschka, Python Machine Learning, PACKT Publishing, ISBN 978-1-78355-513-0, 2015.

References Books:

1. Daugherty, Paul R., and H. James Wilson. Human+ machine: reimagining work in the age of AI. Harvard Business Press, 2018.
2. Prateek, J, Artificial Intelligence with Python, Packt Publishing, Birmingham 2017.
3. ShaiShalev-Shwartz, Shai Ben-David, Understanding Machine Learning From Theory to Algorithms, Cambridge University Press, ISBN-9781107057135, 1107057132, 2014.
4. David Barber, Bayesian Reasoning and Machine Learning, Cambridge University Press, ISBN-9780511804779, 2012.

C. Course Outcomes (CO)

CO #	Course Outcome	Program Outcome Addressed (PO #) with BTL
CO1	Apply the knowledge of Artificial Intelligence and Machine Learning.	PO1,[L2,L3]
CO2	Analyze the problem and identify the appropriate method to solve it.	PO2 [L4]
CO3	Design and conduct experiments as well as analyze and interpret data using Machine Learning Algorithms	PO3 [L5]
CO4	Design and develop the different models of AI and ML.	PO2 ,PO3[L4,L5]
CO5	Get familiarized with the tools mandatory for handling problem solving techniques.	PO5[L5,L6]

D. Course Articulation Matrix

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2
#1	**3**												**3**	
#2		**3**												**3**
#3			**2**											
#4		**3**	**3**											**3**
#5					**2**									

Course plan: Elective – III			
Course Title : Avionics			
Course Code: P18EC744	**Semester : VII**	**L-T-P-H : 4-0-0-4**	**Credits: 3**
Contact Period : Lecture : 52 Hrs, Exam: 3 Hrs	**Weightage: CIE: 50%**		**SEE: 50%**

A. Course Learning Objectives (CLOs)

This course aims to:

Understand the act of physics in avionics.

1. Learn how system engineering is implemented over different technological developments.
2. Study how control system is implemented over the flight operations.
3. Analyse different engineering wings to be accompanied for the efficient flight operation.
4. Design different engineering elements for the enhancement of efficiency of an avionic system.
5. Analyse multiple advancements in the technology for the performance improvisation.
6. Understand integration of different mechanical, electrical and electronic sub systems in the overall flight management.

B. Course Content

UNIT – I

Introduction to Systems Engineering: Systems Thinking and Systems Engineering, Overview of Systems Thinking, Modern Systems Thinking in Engineering, Application of SE to Design, Systems and SE, Overview of Systems Engineering, Role of Quality and T&E in Systems Development, Integrating the Hard and Soft Aspects of System Design-Qualitative Regimes, Setting up SE Activity for a Project.

Text 1: 1.1-1.3, 1.5, 2.1, 2.3, 2.5, 2.6, 2.7. **10 Hrs**

Self Learning Components:

1**.** Study of Development of the Holistic Detail Design Philosophy and Programmatic viewpoints needed to execute a good design and measurement of performance control compared with the time and cost control techniques

2. Study of problematic differences between SE and Project Management and implementation T&E at the higher levels of Project Management.

UNIT – II

Flight Control Systems: Introduction, Principles of Flight Control, Flight Control Surfaces, Primary Flight Control, Secondary Flight Control, Commercial Aircraft, Flight Control Linkage Systems, High Lift Control Systems,Trim and Feel, Flight Control Actuation, Civil System Implementations, Fly-By-Wire Control Laws, A380 Flight Control Actuation, Interrelationship of Flight Control, Guidance and Flight Management.

Text 2: 1.1-1.13, 1.15. **11 Hrs**

Self Learning Components:

1. Understanding the Role of Actuation in Aircrafts Systems-- White, J.A.P. (1978) 'The Development of Electromechanical Actuation for Aircraft Systems', Aerospace, November.

2. Detail Study of Boeing 777 Implementation. **--B.G.S. Tucker (1993)** 'Boeing 777 Primary Flight Control Computer System – Philosophy and Implementation', RAeS Conference – Advanced Avionics on the A330/A340 and the Boeing 777, November.

UNIT – III

Electrical Systems: Introduction, Aircraft Electrical System, Power Generation, Primary Power Distribution, Power Conversion and Energy Storage, Secondary Power Distribution, Typical Aircraft DC System, Typical Civil Transport Electrical System, Electrical Loads,Emergency Power Generation,Recent Systems Developments,Recent Electrical System Developments.
Text 2: 5.1-5.12. **11 Hrs**

Self Learning Component:

1. Study of Electrical Load Management System (ELMS) and Variable Speed Constant Frequency (VSCF) Cycloconverter -**Bonneau,V.(1998)** 'Dual-Use of VSCF Cycloconverter', FITEC'98, London.
2. Detail Study of generation of DC Power in Aircraft Electrical System -**Rinaldi, M.R.,** 'A Highly Reliable DC Power Source for Avionics Subsystems', SAE Conference.

UNIT – IV

Advanced Systems: Introduction, Stealth, Integrated Flight and Propulsion Control (IFPC), Vehicle Management System, More-Electric Aircraft, More-Electric Actuation, More-Electric Engine, Impact of Stealth Design. Technology Developments/Demonstrator
System Design: Introduction, System Design, Major Safety Processes, Requirements Capture,Fault Tree Analysis (FTA),Dependency Diagram,Failure Modes and Effects Analysis (FMEA).
Text 2: 10.1-10.9, 11.1-11.7. **10 Hrs**

Self Learning Component:

1.Study of recent developments in the technologies in Advanced Systems -**Cronin, M.J.,** 'All Electric Technologies in Future Advanced Aircraft'.
2. Role of Electric Actuation in Aircraft Systems-**Schley, W.R., Kotalik, R.J. (2000)** 'Implementation of Flightworthy Electrical Actuators for the F-16',IMech E Conference.

UNIT – V

Avionics Technology: Introduction, The Nature of Microelectronic Devices, Data Bus Integration of Aircraft Systems, Fibre Optic Buses.Avionics Packaging Standards, Typical LRU Architecture, Integrated Modular Avionics.
Environmental Conditions: Introduction,Environmental Factors,Testing and Validation Process
Text 2: 12.1-12.7,13.1-13.3 **10 Hrs**

Self Learning Component:

1. Data Bus Integration of Aircraft Systems-Case Study: **Aplin, Newton & Warburton (1995)** 'A Brief Overview of Databus Technology', RAeS Conference, the Design and Maintenance of Complex Systems on Modern Aircraft, April.
2. Illustrate the Environmental factors affecting the behavior of the aircraft equipment

Note: <u>No questions</u> from SLC component in the Semester End Exam (SEE), it is evaluated only in Continuous Internal Evaluation (CIE)

Case Study:

1. Your Aircraft Electrical System Explained! | From the Ground Up! https://www.youtube.com/watch?v=3NCWLkFZPQs
2. NPTEL course on "Aerospace Engineering NOC:Aircraft Design" by Prof. A.K. Ghosh, IIT,Kanpur,https://nptel.ac.in/courses/101/104/101104069/
3. NPTEL course on "Aerospace Engineering NOC:Introduction to Aircraft Design" by Prof. Rajkumar Pant, IIT,Bombay,https://nptel.ac.in/courses/101/101/101101083/

TEXT BOOKS:

1. **"Systems Approach to Engineering Design"** by Peter. Sydenham, Artech house, Inc, London, 2003, ISBN: 1-58053-479-1.
2. **"Aircraft Systems Mechanical, Electrical, and Avionics Subsystems Integration"** by Ian Moir and Allan Seabridge John Wiley and Sons Ltd (2009), ISBN:978-0-470-05996-8.

REFERENCES BOOKS:

1. **"Systems Engineering"** by Erik Aslaksen and Rod Belcher. Prentice Hall (January 1, 1992) ISBN-13: 978-0138804022, ISBN-10: 0138804028.
2. **"Design and Development of an Aircraft Systems**" by Ian Moir and Allan Seabridge. Wiley; 3rd edition (March 23, 2020), ISBN: 9788126560301, 8126560304.
3. **"Introduction to Systems Engineering"** by Andrew P. Sage and James E. Armstrong, Wiley Series in Systems Engineering and Management ISBN 13: 9780471027669 ISBN 10: 0471027669.

C. Course Outcome

CO #	Course Outcome	Program Outcome Addressed (PO #) with BTL
CO1	To Apply basic engineering knowledge to understand System engineering	**PO1 (L1)**
CO2	To Apply basic knowledge of physics to learn flight control operations.	**PO1 (L2)**
CO3	To Study different electrical and mechanical requirements for the design of aero systems.	**PO1,PO2 (L1)**
CO4	To Design different avionic systems for the most efficient energy storage and body balancing.	**PO3 L4)**
CO5	To Analyze advancements in avionics, to improve the outcome.	**PO2 (L3)**

D. Course Articulation Matrix (CAM)

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
#1	3												3	
#2	3												3	
#3	2	2											2	2
#4			2											
#5		2												2

Course Plan: Elective -III			
Course Title : Network Security			
Course Code: P18EC745	**Semester : VII**	**L-T-P-H : 3-1-0-4**	**Credits: 3**
Contact Period : Lecture : 52 Hrs, Exam: 3 Hrs	**Weightage: CIE: 50%**		**SEE: 50%**

A. Course Learning Objectives (CLOs)

This course aims to:

1. Define three security goals, security attacks and security mechanisms
2. Discuss methods to provide security services for e-mail
3. Discuss the need for security services at the transport layer of the internet model
4. Discuss the general architecture of SSL and TLS
5. Define the architecture of IPSec and discuss how it can be used to provide authentication and confidentiality
6. Understand the importance of security at the system level

B. Course Content

UNIT – I

Introduction: Security goals, Cryptographic Attacks, Services and Mechanism, Technique.
Security at the Application Layer: E-Mail, PGP and S/MIME
Text 1: 1.1 to 1.5 and 16.1 to 16.3 **10 Hrs**
Self Learning Component*:*

1. Study of Cryptography – Prepare a comprehensive report referring to below:
   Arun Kumar Agrawal and Sanchit Mehrotra, "Application of elliptic curve cryptography in pretty good privacy (PGP)", 2016, International Conference on Computing, Communication and Automation (ICCCA), April 2016, pp. 924-929

UNIT – II

Security at the Transport Layer: SSL Architecture, Four Protocols, SSL Message Formats, Transport layer security.
Text 1: 17.1 to 17.4 **10 Hrs**
Self Learning Component*:*

1. Study about TLS 1.2 protocol.

UNIT – III

Security at the Network Layer: IPSec: Two Modes, Two Security Protocols, Security Association, Security Policy, Internet Key Exchange, ISAKMP.
Text 1: 18.1 to 18.6 **10 Hrs**
Self Learning Component*:*

1. Study of Internet Key Exchange Protocols – Prepare a comprehensive report referring to below;
   Safdar Hussain Shaheen, Muhammad Yousaf & Muhammad Younas Majeed, "Comparative analysis of Internet Key Exchange protocols",International Conference on Information and Communication Technologies (ICICT), may 2016.

UNIT – IV

Malicious Software:Types of Malicious Software (Malware), Advanced Persistent Threat, Propagation-Infected Content-Viruses, Propagation-Vulnerability Exploit-Worms, Propagation-Social Engineering-Spam E-mail, Trojans, Payload-System Corruption, Payload-Attack Agent-Zombie, Bots, Payload-Information Theft-Keyloggers, Phishing, Spyware, Payload-Stealthing-Backdoors, Rootkits, Countermeasures, Distributed Denial of Service Attacks.

Text 2: 10.1 to 10.11 **11 Hrs**

Self Learning Component:

1. Discuss the client side vulnerabilities that can be exploited by malware.

UNIT – V

Intruders: Intruders, Intrusion Detection, Password Management

Firewalls: The Need for Firewalls, Firewall Characteristics and Access Policy, Types of Firewalls, Firewall Basing, Firewall Location and Configurations.

Text 2: Chapter 11 and 12 **11 Hrs**

Self Learning Component*:*

1. Discuss the threats to the UNIX password scheme

Note: <u>No questions</u> from SLC component in the Semester End Exam (SEE), it is evaluated only in Continuous Internal Evaluation (CIE)

TEXT BOOKS:

1. **"Cryptography and Network Security",** Behrouz A. Forouzan and Debdeep Mukhopadhya, Tata McGraw-Hill, Second Edition 2010, ISBN:978-0-07-070208-0.
2. **"Network Security Essentials: Applications and Standards",** William Stallings, Pearson, Sixth Edition 2017, ISBN:978-1-292-15485-5.

REFERENCE BOOKS:

1. **"Cryptography and Network Security"** by AtulKahate, Tata McGraw Hill, 2003.
2. **"RSA Security's official guide to cryptography"** by Steve Burnett, Stephene Paine, RSA Pren, Tata McGraw Hill Edition, 2001
3. "**Network Security: Private Communication in a Public World**" Charlie Kaufman, Radia Perlman, Mike Speciner, Pearson, Second Edition, ISBN: 9789332578210

C. Course Outcomes

CO #	Course Outcome	Program Outcome Addressed (PO #) with BTL
CO1	Understand various concepts of security and attacks on the system.	**PO1, PO2[L1, L2]**
CO2	Demonstrate knowledge of various security protocols in attaining the secure communication.	**PO2 - L1,2**
CO3	Analyze security at various levels of protocol stack.	**PO 2 - L2,3**
CO4	Analyze attacks by various malicious software	**PO1,4,8,12 - L2,3**
CO5	Demonstrate the need for security	**PO 1,4,12 - L2,3**

D. Course Articulation Matrix (CAM)

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2
#1	**3**	**2**											**3**	**2**
#2		**2**												**2**
#3		**2**												**2**
#4	**1**			**1**				**1**				**1**	**1**	
#5	**1**			**1**								**1**	**1**	

Open Elective – II			
Course Title: Data Acquisition and Instrumentation			
Course Code: P18ECO751	**Semester : VII**	**L-T-P-H : 3-1-0-4**	**Credits: 3**
Contact Period : Lecture :52 Hrs, Exam: 3 Hrs	**Weightage: CIE:50%**	**SEE: 50%**	

A. Course Learning Objectives (CLOs)

This course aims to:

1. Discuss the concepts of signal conditioning and data acquisition system
2. Explain the different types of transducers and measurement errors
3. Differentiate between the DC and AC voltmeters
4. Analyze different types of digital voltmeter
5. Analyze the operation of ADC and different types of digital instruments.
6. Describe the operation of instrumentation amplifier and its applications.

B. Course Content

UNIT – I

Data Acquisition System (DAS): Introduction, Objective of a DAS, Signal Conditioning of the Inputs, Single Channel Data Acquisition System, Multi-Channel DAS, Computer Based DAS, Digital to Analog and Analog to Digital Converters, Data Loggers, Sensors Based Computer Data Systems.

Text 1: 17.1 to 17.9 **10 Hrs**

Self Learning Components:

1. Gather information about data acquisition systems and its uses in fiber optic receivers
2. Simulate an ADC and DAC using any simulator (Multisim, LTspiceetc)

UNIT – II

Transducers: Introduction, Electrical Transducer, Selecting a Transducer, Resistive Transducer, Resistive Position Transducer, Strain Gauges, Resistance Thermometer, Thermistor, Inductive Transducer, Differential Output Transducers, Linear Variable Differential Transducer, Piezo Electrical Transducer, Photo Electric Transducer, Photo-Voltaic Cell, Semiconductor Photo Diode, the Photo-Transistor.

Text 1: 13.1 to 13.11, 13.15 to 13.19 **11 Hrs**

Self Learning Components:

1. List out few electronic and fiber optic sensors which work on the principal of Transducers
2. Design a weighing machine using single strain gage (Block diagram approach)

UNIT – III

Qualities of Measurements: Introduction, Performance Characteristics, Static Characteristics, Error in Measurement, Types of Static Error, Sources of Error, Dynamic Characteristics.

Voltmeters and Multimeters: Introduction, Basic Meter as a DC Voltmeter, DC Voltmeter, Multirange Voltmeter , Extending Voltmeter Ranges, Loading , Transistor Voltmeter (TVM), Chopper Type DC Amplifier Voltmeter (Micro voltmeter), Solid State Voltmeter , Differential Voltmeter, DC Standard/Difference Voltmeter, AC Voltmeter Using Rectifiers, AC Voltmeter Using Half Wave Rectifier, AC Voltmeter Using Full Wave Rectifier, Multirange AC

Voltmeter, Average Responding Voltmeter, Peak Responding Voltmeter, True RMS Voltmeter, True RMS Meter, Considerations in Choosing an Analog Voltmeter.

Text 1: 1.1 to 1.7, 4.1 to 4.20 **11 Hrs**

Self Learning Components:

1. List out the companies that manufacture standard voltmeters and ammeters, range of operation and salient features of each

UNIT – IV

Digital Voltmeters: Introduction, RAMP Technique, Dual Slope Integrating Type DVM, Integrating Type DVM, Most Commonly Used Principles of ADC, Successive Approximations, Continuous Balance or Servo Balancing Potentiometer Type DVM, 3½ Digit, Resolution and Sensitivity of Digital Meters, Microprocessor-Based RAMP Type DVM.

Digital Instruments: Introduction, Digital Multimeters, Digital Frequency Meter, Digital Measurement of Time , Universal Counter, Decade Counter, Electronic Counter, Digital Measurement of Frequency (Mains), Digital Tachometer, Digital pH Meter , Automation in Digital Instruments, Digital Phase Meter.

Text 1: 5.1 to 5.9, 5.11, 6.1 – 6.12 **10 Hrs**

Self Learning Components:

1. List few practical applications of digital Instruments
2. Design a digital meter to measure light intensity(Block diagram approach)

UNIT – V

Signal Conditioning: Introduction, operational amplifier, basic instrumentation amplifier, Applications of instrumentation amplifiers, chopped and modulated DC amplifier, Modulators.

Recorders: Introduction, strip chart recorder, galvanometer type recorder, null type recorder, circular chart recorder, X-Y recorder, magnetic recorder, Frequency modulation recorder, digital data recording.

Text 1: 14.1 to 14.6, 12.1 to 12.9 **10 Hrs**

Self Learning Components:

1. Design an op-amp which amplifies every signal by a factor of 2.5 using any simulator tool ((Multisim, LTspiceetc)

Note: <u>No questions</u> from SLC component in the Semester End Exam (SEE), it is evaluated only in Continuous Internal Evaluation (CIE)

TEXT BOOKS:

1. "Electronic Instrumentation", H. S. Kalsi,3rd edition, McGraw Hill, 2010 ISBN: 978-0-07-070206-6 ISBN: 0-07-070206-3

REFERENCE BOOKS:

1. "Electronic Instrumentation and Measurements", David A. Bell, 3rd edition, Oxford University Press, 2015. ISBN:978-0-19-5669614-1

2. "Modern Electronic Instrumentation and Measuring Techniques", Cooper, Helfrick, Prentice Hall of India.

C. Course Outcomes

CO #	Course Outcome	Program Outcome Addressed (PO #) with BTL
CO1	Apply the knowledge of basic electrical engineering in understanding basic principles of data acquisition system, measuring systems, transducers, instrumentation amplifier and recorders	**PO1 (L2)**
CO2	Apply appropriate measuring techniques in measuring electrical and mechanical parameters	**PO1 (L3)**
CO3	Identify and Determine various measuring errors and other measurable parameters in measuring instruments	**PO1 (L3) PO2 (L4)**
CO4	Analyze the working principle of various electronic measuring instruments.	**PO2(L3)**
CO5	Design a system for the desired specification in electronic instrumentation.	**PO3 (L4)**

D. Course Articulation Matrix

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2
#1	**3**												**3**	
#2	**3**												**3**	
#3	**3**	**2**											**3**	**2**
#4		**3**												**3**
#5			**2**											

Course Plan: Open Elective -II			
Course Title: Embedded Systems			
Course Code: P18ECO752	**Semester : VII**	**L-T-P-H: 3-1-0-4**	**Credits:03**
Contact Period : Lecture :52 Hrs., Exam: 3Hrs.		**Weightage :CIE:50% SEE:50%**	

A. Course Learning Objectives (CLOs)

This course aims to:

1. Provide the knowledge about basic concepts of Embedded Systems.
2. Outline the concepts of typical embedded systems and its applications.
3. Describe the characteristics and quality attributes of embedded systems.
4. Provide the knowledge of software hardware co–design and EDLC.
5. Describe the concepts of real time operating system based embedded systems.

B. Course Content

UNIT – I

Introduction to Embedded Systems: What is an Embeddedsystem? Embedded System vs. General Computing Systems, History of Embedded Systems, Classification of Embedded Systems, Major Application Areas of Embedded Systems, Purpose of Embedded Systems, 'Smart' Running Shoes from Adidas-The Innovative Bonding of Lifestyle with Embedded Technology.

Typical Embedded System: Core of the Embedded System, Memory, Sensors and Actuators, Communication Interface, Embedded Firmware, Other System Components.

Text 1:1.1 to 1.7, 2.1 to 2.6 **10 Hrs**

Self Learning Component:

1. Study and understand the working operation of the following input devices:
   (i) IR proximity sensor.
   (ii) Temperature sensor.
   (iii) Humidity sensor
2. Study the working of Hydraulic and Rotatory Actuators to understand the operation of output devices.

UNIT – II

Characteristics and Quality Attributes of Embedded Systems: Characteristics of an embedded system, Quality attributes of embedded systems.

Embedded System- Application and Domain Specific: Washing Machine – Application-Specific Embedded System, Automotive – Domain Specific Examples of Embedded System

Hardware Software Co-Design and Program Modeling: Fundamental Issues in Hardware Software Co-Design, Computational Models in Embedded Design, Introduction to Unified Modeling Language (UML), Hardware Software Trade-offs.

Text 1: 3.1, 3.2, 4.1, 4.2, 7.1 to 7.4 **11 Hrs**

Self Learning Component:

1. List the different areas that UML has been used.
2. Write the state diagram that shows how UML can be used for designing a door system (that can only be opened and closed)

UNIT – III

Real-Time Operating System (RTOS) based Embedded System Design:
Operating System Basics, Types of OS, Tasks, Process and Threads, Multiprocessing and Multitasking, Task Scheduling, Task Communication (Excluding Programs)
Text 1: 10.1 to 10.5, 10.7 **10 Hrs**
Self Learning Component:

1. Understand the basic of Real time operating system using the below link https://youtu.be/dHsHP9RrXBw
2. Implement the multithread application to satisfy i) two child threads are created with normal priority ii) thread 1 receives and prints its priority, sleeps for 50 msec and then quits

UNIT – IV

Real-Time Operating System (RTOS) based Embedded System Design:
Device Drivers, How to choose an RTOS.
Embedded Firmware Design and Development: Embedded Firmware Design Approaches, Embedded Firmware Development Languages
The Embedded System Development Environment: The Integrated Development Environment(IDE), Types of Files Generated on Cross compilation, Disassembler/Decompiler, Simulators, Emulators and Debugging, Target Hardware Debugging, Boundary Scan
Text 1: 10.9, 10.10, 9.1, 9.2, 13.1 (excluding sub articles), 13.2 – 13.6 **10 Hrs**
Self Learning Component:

1. List different IDE tools used for the development of embedded systems with proper examples.
2. Understand the concept of software for Embedded Systems using the below link https://youtu.be/IY4xrpJQwOY

UNIT –V

The Embedded Product Development Life Cycle (EDLC): What is EDLC, Why EDLC, objectives of EDLC, different phases of EDLC, EDLC approaches.
Trends in the Embedded Industry: Processor Trends in Embedded System, Embedded OS Trends, Development Language Trends, Open Standards, Frameworks and Alliances, Bottlenecks.
Design case studies: Battery operated smartcard reader, Automated Meter Reading System (AMR), Digital camera.
Text 1: 15.1 to 15.5 and 16.1 to 16.5, Appendix II: 2 - 4 **11 Hrs**
Self Learning Component:

1. Discuss the different languages used in embedded system design
2. Understand the concept of Embedded system software by referring the below paper:
   B. M. Medvedev, S. A. Molodyakov, S. M. Ustinov and S. A. Fyodorov, "Embedded systems software: Trends in industry and education," 2018 International Symposium on Consumer Technologies (ISCT), 2018, pp. 66-69, doi: 10.1109/ISCE.2018.8408921.

Note: No questions from SLC component in the Semester End Exam (SEE), it is evaluated only in Continuous Internal Evaluation (CIE)

TEXT BOOK:

1. **"Introduction to Embedded Systems"** Shibu K V, Tata McGraw Hill Education Private Limited, 2009, ISBN (13): 978-0-07-014589-4

REFERENCE BOOK:

1. **"Embedded Systems – A contemporary Design Tool**" James K Peckol, John Weily, 2008.
2. **"Embedded Systems Design: An Introduction to Processes, Tools, and Techniques "** by Arnold S. Berger ISBN: 1578200733 CMP Books © 2002

C. Course Outcomes

CO #	Course Outcome	Program Outcome Addressed (PO #) with BTL
CO1	Apply the knowledge of Microcontrollers to understand and explain the concepts of Embedded systems.	**PO1 (L1,L2)**
CO2	Analyze and understand the different issues involved in embedded system development using real time operating systems.	**PO2 (L2)**
CO3	Discuss recent trends, EDLC and overview in the Design of Embedded systems	**PO2 (L3)**
CO4	Design and Develop a domain specific Embedded System Applications	**PO3 (L4)**
CO5	Design and Develop a domain specific Real Time Embedded System Applications	**PO3 (L4)**

D. Course Articulation Matrix

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2
#1	**3**												**3**	
#2		**2**												**2**
#3		**2**												**2**
#4			**3**											
#5			**3**											

Course Plan: **Open Elective – II**			
Course Title : **Internet of Things and Applications**			
Course Code: **P18ECO753**	Semester : **VII**	**L**-T-P-**H** : **3**-1-0-**4**	Credits: **3**
Contact Period : Lecture : **52 Hrs,** Exam: **3 Hrs**	Weightage: CIE: **50%**	SEE: **50%**	

A. Course Learning Objectives (CLOs)

This course aims to:

1. To understand the fundamentals of IOT.
2. To learn about the basics of IOT Protocol.
3. Illustrate Mechanism and Key Technologies in IOT.
4. To learn about the IOT Platforms design Methodology and logical design of IOT system using Python.
5. To develop IOT applications using Raspberry Pi and apply Cloud services for IOT systems.

B. Course Content

UNIT – I

Introduction to Internet of Things: Definition and Characteristics of IoT, Physical Design of IoT, IoT Protocols, IoT communication models, IoT Communication APIs, IoT enabled Technologies, Wireless Sensor Networks, Cloud Computing, Big data analytics, Communication protocols, Embedded Systems, IoT Levels and Templates.
Domain Specific IoTs: Introduction, Home Automation, Cities, Environment, Energy, Retail.
Text 1: 1.1 to 1.5 and 2.1 to 2.5 **10 Hrs**
Self Learning Component:

1. Understand the concepts of introduction to IoT- Part I: https://www.digimat.in/nptel/courses/video/106105166/L01.html
2. Understand the concepts of introduction to IoT- Part II: https://www.digimat.in/nptel/courses/video/106105166/L02.html

UNIT – II

Realization of IoT Ecosystem Using Wireless Technologies: Introduction, Architecture for IoT using Mobile Devices, Mobile Technologies for supporting IoT Ecosystem, Energy harvesting for power conservation in the IoT system, Mobile application development platforms, Mobile use cases for IoT, Low power Wide Area Networking Technologies.
Infrastructure and Service Discovery Protocols for the IoT Ecosystem: Introduction, Layered Architecture for IoT, Protocol Architecture of IoT, Infrastructure Protocols, Protocols for IoT Service Discovery, Prominent IoT Service Discovery Products Available in the Market.
Text 2: Chapter 2 and 3 **11 Hrs**
Self Learning Component:

1. Developing complex services in an IoT ecosystem, IEEE. DOI: 10.1109/WF-IoT.2015.7389026.
2. Understand A lightweight service discovery protocol for 6LoWPAN, IEEE. DOI: 10.1109/ICCW.2016.7503801

UNIT – III

Internet of Thing and Machine-to-Machine: Introduction, M2M, Difference between IoT and M2M, Software Defined Radio (SDR) and Network Function Virtualization (NFV).

IoT Systems – Logical Design using Python: Introduction, Python data types and data structures, Control flow, Functions, Modules, Packages, File handling, Date/Time Operations, Classes.

Text 1: 3.1 to 3.4.1 and 6.3 to 6.10 **10 Hrs**

Self Learning Component:

1. Study and prepare a report on https://www.researchgate.net/publication/348455861_Domain-Specific_IoT_Applications
2. Study and develop a report on the paper Singh, Sharad& Kumar, Vinesh& Singh, Akhilesh& Singh, Shalini. (2020). A Survey on Internet of Things (IoT): Layer Specific vs. Domain Specific Architecture. 10.1007/978-3-030-37051-0_39

UNIT – IV

IoT Physical Devices and Endpoints: What is an IOT device, Raspberry Pi, About the board, Linux on Raspberry Pi, Raspberry Pi interfaces, Programming Raspberry Pi with Python.

IOT Physical Servers and Cloud Offerings: Introduction to Cloud storage models and communication APIS, WAMP-AutoBahn for IOT, Xively Cloud for IOT, Python Web – Application Framework-Django.

Text 1: 7.1 to 7.6 and 8.1 to 8.4 **10 Hrs**

Self Learning Component:

1. Understand the concept of python packages of interest for IoT using Java Script Object Notation (JSON). Develop a python code parsing XML file (both creating and parsing).
2. Understand the need of different IoT devices used to implement an embedded application.

UNIT – V

Smart Use Cases of IoT: Introduction, Governance Use Cases, Ubiquitous Connectivity, Omnipresent Devices, Collaboration Platforms, Cloud Computing , Open Standards and Service-Oriented Architecture (SOA), Geospatial Platforms, Neogeography in Smart Cities, Internet of Things (IoT), Advanced Analytics , Open Access to Public Data, Digitally Controlled Devices, Social Media Networking, Strategic Governance Framework for the Implementation of Smart Cities, City Objectives, Indicators, Components, Content, Smart Industrial Use Cases of IoT, Smart Lighting for Energy Conservation, Smart Transportation Systems, Connected Cars, Consumer Use Cases of IoT.

Security Management of an IoT Ecosystem: Introduction, Security Requirements of an IoT Infrastructure, Authentication, Authorization, and Audit Trial (AAA) Framework, Defense-in-Depth, Security Concerns of Cloud Platforms, Virtual Machine Segmentation, Database Segmentation, VM Introspection, Distributed Denial of Service, Virtual Machine/Hypervisor-Based Security Threats, Security Threats of Big Data, Requirements of Security Management Framework for Big Data, Security Solutions for Mobile Devices, Security Concerns in IoT Components, Security Measures for IoT Platforms/Devices, Security Threats in Different Use Cases of IoT.

Text 2: Chapter 11 and 12 **11 Hrs**

Self Learning Component:

1. Internet of things (IoT) security: Current status, challenges and prospective measures, IEEE. DOI: 10.1109/ICITST.2015.7412116.
2. Distinguishing 5G IoT Use-Cases through Analyzing Signaling Traffic Characteristics, IEEE. DOI: 10.1109/TSP.2019.8769045.

Note: No questions from SLC component in the Semester End Exam (SEE), it is evaluated only in Continuous Internal Evaluation (CIE)

TEXT BOOKS:

1. **"Internet of Things: A Hands-on Approach",** ArshdeepBahga and Vijay Madisetti, Universities Press, 2015, ISBN:978-81-7371-954-7.
2. **"The Internet of Things: Enabling Technologies, Platforms, and Use cases",** Pethuru Raj and Anupama C Raman, CRC Press, 2017, ISBN: 978-1-4987-6128-4.

REFERENCE BOOKS:

1. **"Designing the Internet of Things"** by Adrian McEwen, Hakim Cassimally, First Edition, Wiley Publishers. ISBN- 9781118430651
2. **"The Internet of Things", Michael Miller,** First Edition, Pearson, 2015. ISBN-13: 978-0-7897-5400-4, ISBN-10: 0-7897-5400-22. "Designing Connected Products", Claire

C. Course Outcomes

CO #	Course Outcome	Program Outcome Addressed (PO #) with BTL
CO1	Understands the essentials and requirement of IOT	**PO1 [L1]**
CO2	Analyze the Concept of Cloud and Web services to access/control IOT devices and security of IoT devices	**PO2 [L2]**
CO3	Identify and Understand the requirement of Physical devices to deploy on IOT application which connect to the cloud for real time scenario	**PO1 [L2]**
CO4	Develop a Portable IOT using Raspberry PI	**PO3 [L3]**

D. Course Articulation Matrix (CAM)

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2
#1	2												2	
#2		2												2
#3	2												2	
#4			3											

Course Plan: Open Elective			
Course Title: Introduction to Image Processing			
Course Code: P18ECO754	**Semester : VII**	**L-T-P-H: 3 – 1 – 0-4**	**Credits:03**
Contact Period : Lecture :52 Hrs., Exam: 3Hrs.		**Weightage :CIE:50% SEE:50%**	

A. Course Learning Objectives (CLOs)

This course aims to

1. Understand the fundamentals of digital image processing
2. Understand the image enhancement techniques used in digital image processing
3. Understand the image restoration techniques and methods used in digital image
4. processing
5. Understand the Morphological Operations and Segmentation used in digital image processing

B. Course Content

UNIT – I

Digital Image Fundamentals: What is Digital Image Processing?, Origins of Digital Image Processing, Examples of fields that use DIP, Fundamental Steps in Digital Image Processing, Components of an Image Processing System, Elements of Visual Perception, Image Sensing and Acquisition, Image Sampling and Quantization.

Text: Chapter1: 1.1-1.5, Chapter2: 2.1-2.4 **10 Hrs**

Self-Learning Component:

Prepare a report on basic relationships between pixels of an image.

UNIT – II

An Introduction to the Mathematical Tools used in Digital image Processing: Array versus Matrix Operations, Arithmetic Operations, Set and Logical Operations, Spatial Operations, Vector and Matrix Operations, Image Transform.

Spatial Domain: Some Basic Intensity Transformation Functions, Histogram Processing.

Text: Chapter2: 2.6, Chapter 3: 3.1 - 3.3 (only Histogram equalization) **11 Hrs**

Self-Learning Component:

Comprehend the local Histogram Processing techniques.

UNIT – III

Spatial Filters: Fundamentals of Spatial Filtering, Smoothing Spatial Filters, Sharpening Spatial Filters.

Restoration: A model of the image Degradation/Restoration Process, Noise models, Restoration in the Presence of Noise Only Spatial Filtering.

Text: Chapter3: 3.4 - 3.6. Chapter5: 5.1- 5.3 **10 Hrs**

Self-Learning Component:

Develop an algorithm to add various intensity levels of salt and pepper noise to an image and remove.

UNIT – IV

Segmentation: Fundamentals, Point, Line, and Edge Detection, Thresholding, Region Based Segmentation, Morphological Image Processing: Preliminaries, Erosion and Dilation, Opening and Closing,

A case study on impulse noise and Morphological Image Processing. (Refer, Ref1 and Ref2)

Text: Chapter 10:10.1, 10.2.1 - 10.2.5, 10.3-10.3.2, 10.4. Chapter 9: 9.1- 9.3 **11 Hrs**

Self- Learning Component:

Develop an algorithm to show dilation and erosion of an image.

UNIT – V

Morphological operations: The Hit-or-Miss Transforms, Some Basic Morphological Algorithms.

Color Image Processing: Color Fundamentals, Color Models, Pseudo color Image Processing**,** Basics of Full-Color Image Processing.

A case study on Enhancement of Images using image processing methods.(Refer: Ref-3).

Text: Chapter 9: 9.5.1, 9.5.5, 9.5.6, Chapter 7: 7.1-7.4 **10 Hrs**

Self- Learning Component:

Develop an algorithm to convert colors of an image from RGB to HIS and vice versa.

Note: <u>No questions</u> from SLC component in the Semester End Exam (SEE), it is evaluated only in Continuous Internal Evaluation (CIE)

TEXT BOOK:

1. Digital Image Processing- Rafael C Gonzalez and Richard E. Woods, PHI 3rd Edition 2010.

Ref-1: A Case Study of Impulse Noise Reduction Using Morphological Image Processing with Structuring Elements by V. Elamara et.al., Asian Journal of Scientific Research / DOI: 10.3923/ ajsr.2015.291.303

Ref-2: Image Analysis Using Mathematical Morpholog by Robert M. Haralicket. al., IEEE Transactions on Pattern Analysis and Machine Intelligence, Volume: PAMI-9, Issue: 4, July 1987, DOI: 10.1109/TPAMI.1987.4767941.

Ref-3: Enhancement of Images using Morphological Transformations by K.Sreedhar and B.Panlal International Journal of Computer Science & Information Technology (IJCSIT) Vol 4, No 1, Feb 2012.

REFERENCE BOOKS:

1. **Digital Image Processing**- S.Jayaraman, S.Esakkirajan, T.Veerakumar, Tata McGraw Hill 2014.

2. **Fundamentals of Digital Image Processing**-A. K. Jain, Pearson 2004.

C. Course Outcomes

CO #	Course Outcome	Program Outcome Addressed (PO #) with BTL
CO1	Apply basic mathematical and signal processing knowledge to understand different image processing stages.	**PO1[L1]**
CO2	Analyze images in the spatial domain using various methods.	**PO2[L2]**
CO3	Analyze animage through image enhancement ,image compression and segmentation.	**PO2[L2]**
CO4	Apply knowledge of signal processing in image restoration, color and morphological processing.	**PO1 [L2]**
CO5	Develop algorithms to perform image processing using modern tool in a group and acquire team playing skills.	**PO3-PO5-PO9-P010 [L4]**

D. Course Articulation Matrix

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
#1	**3**												**3**	
#2		**2**												**2**
#3		**2**												**2**
#4	**3**												**3**	
#5			**2**		**2**				**2**	**2**				

Course Plan: Laboratory			
Course Title: Advanced Communication lab			
Course Code: P18ECL76	**Semester : VII**	**L-T-P-H: 0-0-3-3**	**Credits: 1.5**
Contact Period: Lecture: 36 Hrs., Exam: 3 Hrs.		**Weightage :CIE:50% SEE:50%**	

A. Course Learning Objectives (CLOs)

This course aims to

1. Provide the basic practical knowledge of microwave, micro–strip–line applications.
2. Design and simulate a micro-strip antenna using MatLab.
3. Understand and demonstrate an experiment to measure Directivity and Gain of micro-strip Yagi/Patch antenna.
4. Understandand demonstrate the Measurement of frequency, guide wavelength, power, VSWR and attenuation in a microwave test bench using klystron/gunn oscillator as source.
5. Analyze the coupling and isolation characteristics of a micro–strip–line directional coupler.
6. Develop different network topologies using Network Simulator.
7. Understand the scenario and study the performance of various network protocols through simulation.
8. Examine the operation ofdifferent routing protocols for efficient communication in a network.
9. Understand the congestion control techniques.

B. Course Content

Part A: Using MatLab and Microwave Test Components

1. Plot the Radiation pattern and measure the Directivity of Micro strip-Rectangular Patch antenna.
2. Plot the Radiation pattern and measure the Directivity of Dipole antenna.
3. Design and Simulate Dipole antenna and Micro strip rectangular patch antenna using Mat lab.
4. Determination of coupling and isolation characteristics of a micro–strip directional coupler.
5. Measurement of resonance characteristics of a micro– strip ring resonator and determination of dielectric constant of the substrate.
6. Measurement of power division and isolation characteristics of a micro–strip 3dB power divider.
7. Measurement of frequency, guide wavelength, power, VSWR and attenuation in a microwave test bench

Part B: Using NS-2/NS-3

8. 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.

9. Implement an Ethernet LAN using n nodes and set multiple traffic nodes and plot congestion window for different source / destination.
10. Conduct an experiment to provide reliable data transfer between two nodes over an unreliable network using the Sliding Window Protocol-Selective Repeat.
11. Test DSR and DSDV routing protocols over wired network and compare the performance.
12. 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.
13. Plot the Radiation pattern and measure the Directivity of Micro-strip Yagi antenna.(**Only for Demonstration**)

Open Ended Experiments (any Two):

1. Measurement of Guide Wavelength, Power, VSWR as well as Isolation and Coupling factor of Magic Tee.
2. Design a "mixed network" having 5 nodes (n0-n4), where n1 & n2 are connected to n0 through Ethernet (LAN) and n3 & n4 are connected to n0 via wireless connection and compare the data movement in the network.
3. Realize the performance of AODV routing protocol on NS2/NS3.
4. Understand the working of CSMA protocol through NS platform.

REFERENCE BOOK:

1. "Advanced Digital Communication Laboratory Manual", PreethaSharan, R Bhargava Rama Gowda, CBS Publishers & Distributors Pvt. Ltd., First Edition, 2013.
2. **Referred for Microwave Exp:** Microwave Engineering Lab (IV Sem), Prasad V Potluri Siddhartha Institute Of Technology, Vijayawada Andhra Pradesh.

C. Course Outcomes

CO #	Course Outcome	Program Outcome Addressed (PO #) with BTL
CO1	Design and simulate Micro-Strip Antenna using Matlab and determine its directivity and gain.	PO1, PO3, PO5 [L4]
CO2	Determine Guide wavelength, VSWR, Micro-wave Power using the Micro-wave Test Bench.	PO4 [L2]
CO3	Analyse coupling and isolation characteristics of a micro–strip directional coupler and 3dB Power Divider	PO4 [L3]
CO4	Design a network of nodes and verify the properties of link layer protocols via network simulator.	PO1, PO3 [L4]
CO5	Develop programs to understand the operation of different routing protocols.	PO3 [L4]

D. Course Articulation Matrix

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO1 1	PO12	PSO1	PSO2
#1	2		3		2								2	
#2				2										
#3				3										
#4	2		3										2	
#5			2											

Course Plan: Laboratory			
Course Title : Embedded and IOT Laboratory			
Course Code: P18ECL77	**Semester : VII**	**L-T-P-H : 0-0-3-3**	**Credits: 1.5**
Contact Period : Lab: 36 Hrs, Exam: 3 Hrs		**Weightage: CIE: 50%**	**SEE: 50%**

A. Course Learning Objectives (CLOs)

This course aims to:

1. Understand different properties and capabilities of programming for micro controller implementations.
2. Understand the working and interfaces for a Micro controller.
3. Understand interface of perform multiple real-time experiments.
4. Understand the overall operation of Automations using controllers.
5. To learn the concepts of IOT
6. To learn different applications in IOT
7. Address the real world problems and find the required solution.

B. Course Content

Sl No	**List of Experiments**
	Embedded
1	Interface and Control of on-board LEDs through Switch control.
2	Develop a controller system, which can take inputs through various sensors and provide its outputs
3	Develop a controller system to control the rotation of a Motor
4	Write a program and develop a controller system, to display environmental temperature.
5	Develop a controller system to interface 7-Segment Display or QLED to display the A Message.
6	Develop a controller system, which can identify the registered RFID Tags and result in some specific action
	IOT
7	Familiarization on IOT environmentwith development Kit.
8	Interface and Control of on-board LEDs through any cloud platform.
9	Develop a controller system, which can take inputs through various sensors and provide its outputs to cloud platform.
10	Interface and smart control of Motors to open a door through any cloud platform (application specific).
11	Design of a system for home automation and analytics.
12	Design an acknowledgement based attendance monitoring system.

Open Ended experiment:

1. Implement an IOT based parking assistant system.

C. Course Outcome (CO)

CO #	Course Outcome	Program Outcome Addressed (PO #) with BTL
CO1	Understand thefundamentals Principles and implementation details of Embedded System and IOT.	**PO1, L2**
CO2	Develop a code for any given specific application.	**PO3, PO5, L6**
CO3	Design embedded and IOT applications using EDA Tools.	**PO3, PO5,L6**
CO4	Ability to work Effectively in a Team to analyse the given specifications and Build Practical applications.	**PO2, PO9, L4**

D. Course Articulation Matrix

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2
#1	**2**												**2**	
#2			**3**		**3**									
#3			**3**		**3**									
#4		**2**							**3**					**2**

Course Plan: Core			
Course Title: Digital Image Processing			
Course Code: P18EC81	**Semester : VIII**	**L-T-P-H: 4 – 0– 0-4**	**Credits:04**
Contact Period : Lecture :52 Hrs., Exam: 3Hrs.		**Weightage :CIE:50% SEE:50%**	

A. Course Learning Objectives (CLOs)

This course aims to:

1. Understand the fundamentals of digital image processing.
2. Understand the image enhancement techniques used in digital image processing.
3. Understand the image restoration techniques and Wavelets and Multi resolution Processing used in digital image processing.
4. Understand the Morphological Operations and Segmentation used in digital image processing.
5. Understand the image Representation and Description in digital image processing.

B. Course Content

UNIT – I

Digital Image Fundamentals:

What is Digital Image Processing?, Origins of Digital Image Processing, Examples of fields that use DIP, Fundamental Steps in Digital Image Processing, Components of an Image Processing System, Elements of Visual Perception, Image Sensing and Acquisition, Image Sampling and Quantization.

Text 1: 1.1-1.5,2.1-2.4 **10 Hrs**

Self Learning Components:

Comprehend the array versus matrix operations.

UNIT – II

Spatial Domain:

Some Basic Intensity Transformation Functions, Histogram Processing, Fundamentals of Spatial Filtering, Smoothing Spatial Filters, Sharpening Spatial Filters.

Filtering in the Frequency Domain: The basic of Filtering in the Frequency Domain, Image Smoothing and Image Sharpening Using Frequency Domain Filters.

Text 1: 3.1-3.6, 4.7, 4.8, 4.9 **11 Hrs**

Self Learning Component:

Develop an algorithm to enhance image quality using histogram equalization.

UNIT – III

Restoration:

A model of the image Degradation/Restoration Process, Noise models, Restoration in the Presence of Noise Only using Spatial Filtering and Frequency Domain Filtering, Linear, Position Invariant Degradations, Estimating the Degradation Function, Inverse Filtering, Minimum Mean Square Error (Wiener) Filtering.

Text 1: 5.1-5.8. **11 Hrs**

Self Learning Component:

Develop an algorithm to add various intensity levels of a given noise to an image and remove.

UNIT – IV

Color Image Processing:
Color Fundamentals, Color Models, Pseudocolor Image Processing.
Morphological Image Processing: Erosion and Dilation, Opening and Closing, the Hit-or-Miss Transforms, Some Basic Morphological Algorithms.
Text 1: 7.1 - 7.3, 9.2-9.5,9.5.1 - 9.5.7 **10 Hrs**
Self Learning Component:
Develop an algorithm to extractboundary pixels of an image using morphological operations.

UNIT – V

Segmentation:
Point, Line, and Edge Detection, Thresholding, Region Based Segmentation.
Text 1: 10.2.1 -10.2.7, 10.3.1- 10.3.3, 10.4 **10 Hrs**
Self Learning Component:
Define a procedure for estimating the median of an image from its histogram. Threshold the image at the resulting median value and verify that the foreground and background partitions are of approximately equal size.

Note: No questions from SLC component in the Semester End Exam (SEE), it is evaluated only in Continuous Internal Evaluation (CIE)

TEXT BOOK:

1. **"Digital Image Processing",** Rafael C. Gonzalez and Richard E. Woods, Pearson4th Edition 2018, ISBN:9789353062989.

REFERENCE BOOKS:

1. **"Digital Image Processing",**S.Jayaraman, S.Esakkirajan, T.Veerakumar, Tata McGraw Hill 2014.
2. **"Fundamentals of Digital Image Processing",** A. K. Jain, Pearson 2004.

C. Course Outcomes

CO #	Course Outcome	Program Outcome Addressed (PO #) with BTL
CO1	Apply basic mathematical and signal processing knowledge to understand different image processing stages.	**PO1[L1]**
CO2	Analyze images in the spatial/frequency domain using various methods.	**PO2[L2]**
CO3	Analyze animage through image segmentation, Wavelets and Multi resolution Processing.	**PO2[L2]**
CO4	Apply knowledge of image processing in Image Restoration, Color, Morphological processing and Representation and Description .	**PO1 [L2]**
CO5	Develop algorithms to perform image processing using modern tool in a group and acquire team playing skills.	**PO3-PO5-PO9-P010 [L4]**

D. Course Articulation Matrix

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO1 1	PO12	PSO1	PSO2
#1	**3**												**3**	
#2		**2**												**2**
#3		**2**												**2**
#4	**3**												**3**	
#5			**2**		**2**				**2**	**2**				

Course Plan: Elective -IV			
Course Title: Satellite Communication			
Course Code: P18EC821	**Semester : VIII**	**L-T-P-H: 3 – 1 – 0-4**	**Credits:03**
Contact Period : Lecture :52 Hrs., Exam: 3Hrs.		**Weightage :CIE:50% SEE:50%**	

A. Course Learning Objectives (CLOs)

This course aims to

1. Provide an idea of different frequency bands allocated to satellite communications.
2. Illustrate how Kepler's law of planetary motion be applied to the case of geo-stationary satellite.
3. Provide details about stabilizing a satellite.
4. Examine the concepts of MATV and CATV.
5. Distinguish between pre-assigned and demand-assigned traffic in relation to a satellite communications network.
6. Describe the general operating principles of a TDMA network.
7. Examine the noise factor with respect to satellite communication.
8. Examine the technical parameters used in measuring ATM performance.
9. Provide an overview of the process of video compression and audio compression.
10. Provide details about the classification of satellites.

B. Course Content

UNIT – I

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, inclined orbits, calendars, universal time, Julian dates, sidereal time.

The Geostationary Orbit: Introduction, antenna look angles, the polar mount antenna, limits of visibility, near geostationary orbits, earth eclipse of satellite, sun transit outage

Text 1: 1.1 to 1.3, 2.1 to 2.8, 2.9, 2.9.1 to 2.9.4, 3.1 to 3.7 **11 Hrs**

Self-learning Component:

1. Article on how do satellite Communicate:
https://www.nasa.gov/directorates/heo/scan/communications/outreach/funfacts/txt_satellite_comm.html

2. Study of Two Line Element:https://www.celestrak.com/NORAD/elements/

UNIT – II

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 antenna subsystem.

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, Transmit– Receive earth stations.

Text 1: 7.1 to 7.8, 8.1 to 8.5

Propagation Effects and their Impact on Satellite-Earth Links: Introduction, Quantifying Attenuation and Depolarization, Propagation Effects that are not associated with Hydrometeors.

Text 2:8.1, 8.2, 8.3 **11 Hrs**

Self-learning Component:

1. **Article on DTH Satellite Broadcasting :(Page. No:18)**

https://www.satelliteevolutiongroup.com/PDFs/SEA-Mar-Apr-2016.pdf

2. **Article** *"Routersin Space.":*

https://spectrum.ieee.org/aerospace/satellites/building-an-orbiting-internet-just-for-satellites

UNIT – III

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.

Text 1: 14.1 to 14.7, 14.7.1 to 14.7.7, 14.10, 14.10.1 to 14.10.5

Modulation and multiplexing Techniques for satellite links: Frequency Modulation, Analog FM Transmission by satellite

Text 2: 5.1, 5.2 **10 Hrs**

Self-learning Component:

1. **Research report on Satellite anomalies:**

https://www.rand.org/pubs/research_reports/RR560.html

2. **Article :**Australia – smart satellite use for homeland security(Page.No:28)

https://www.satelliteevolutiongroup.com/PDFs/SEA-Mar-Apr-2016.pdf

UNIT – IV

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, split TCP connections, asymmetric channels.

Text 1: 12.1 to 12.8, 15.1, 15.4, 15.5, 15.9 to 15.13 **10 Hrs**

Self-learning Component:

1. **Article "***Microsatellites Spot Mystery Methane Leaks.":*

https://spectrum.ieee.org/aerospace/satellites/spotting-mystery-methane-leaks-from-space

2. Article on banking services using satellite networks(Page.No:24):
https://www.satelliteevolutiongroup.com/PDFs/SEA-Mar-Apr-2016.pdf

UNIT – V

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), the home receiver outdoor unit(ODU), the home receiver indoor unit(IDU), downlink analysis, uplink, high definition television (HDTV) – HDTV displays, video frequency Bandwidth.
Satellite Mobile and Specializes Services: Introduction, satellite mobile services, VSATs, radar sat, global positioning satellite system (GPS), orbcomm, iridium.
Text 1: 16.1 to 16.14, 17.1 to 17.7 **10 Hrs**

Self-learning Component:

1. Iridium Satellite system: https://www.marsat.ru/en/Technologies-Iridiumnetwork
2. Article *"Wanted: A Fallback for GPS."* https://spectrum.ieee.org/aerospace/satellites/us-transportation-officials-seek-alternative-tech-for-gps

Note: No questions from SLC component in the Semester End Exam (SEE), it is evaluated only in Continuous Internal Evaluation (CIE)

TEXT BOOK:

1. **"Satellite Communications",** Dennis Roddy, 4th edition, Special Indian Edition 2009, 11th reprint 2013, Tata McGraw–Hill, ISBN13:978-0-07-007785-0 ISBN 10:0-07-007785-1.
2. **"Satellite Communications",** Timothy Pratt, Charles Bostian and Jeremy Allnutt, 2nd edition, John Wiley & Sons, 2010. ISBN: 9788126508334.

REFERENCE BOOKS:

1. **"Satellite Communications Systems Engineering",** W.L.Pitchand, H.L. Suyderhoud, R.A. Nelson, 2nd edition, Pearson education, 2007, ISBN: 9788131702420.
2. **"Satellite Communications",** Anil K.Maini, VarshaAgrawal, 3rd edition, Wiley India Pvt.Ltd, Reprint, 2012, ISBN: 9788126520718.

Video Lecture Reference:

1. NPTEL course on "Satellite Communication Systems" by Prof. KalyankumarBandyopadhyay, IIT Kharagpur.: https://nptel.ac.in/courses/117/105/117105131/

2. 2.Coursera on "Introduction to Satellite Communication":https://www.coursera.org/learn/satellite-communications#enroll

C. Course Outcomes

CO #	Course Outcome	Program Outcome Addressed (PO #) with BTL
CO1	Recall the fundamentals of orbital mechanics, the characteristics of common orbits used by communications another satellites	**PO1[L1]**
CO2	Understand the systems required by a communications satellite to function and the trade-offs and limitations encountered in the design of a communications satellite system.	**PO2[L2]**
CO3	Model the concepts of signal propagation affects, link design, rain fading and link availability and perform interference calculations	**PO3[L3]**
CO4	Calculate an accurate link budget for a satellite or other wireless communication links	**PO4 [L3]**
CO5	Understand the analog and digital technologies used for satellite communication networks.	**PO1,PO2,PO5 [L2]**

D. Course Articulation Matrix

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
#1	**3**												**3**	
#2	**3**												**3**	
#3			**2**											
#4				**3**										
#5	**3**	**2**			**1**								**3**	**2**

Course Plan: Elective-IV			
Course Title: Algorithms for VLSI Physical Design			
Course Code: P18EC822	**Semester: VIII**	**L-T-P-H : 3-1-0-4**	**Credits: 3**
Contact Period : Lecture: 52 Hrs. Exam: 3 Hrs.		**Weightage: CIE: 50%**	**SEE: 50%**

A. Course Learning Objectives (CLOs)

This course aims to:

1. Study of various physical design methods in VLSI.
2. Understand the concepts of Physical Design Process such as partitioning, Floorplanning, Placement, Routing and Timing Closure.
3. Discuss the concepts of design optimization algorithms and their application to physical design.
4. Formulate CAD design problems using physical design algorithms methods.

B. Course Content

UNIT – I

Introduction: Electronic Design Automation, VLSI Design Flow, VLSI Design Styles, Layout Layers and Design Rules, Physical Design Optimizations, Algorithms and Complexity, Graph Theory Terminology, Common EDA Technology.

Netlist and System Partitioning: Introduction, Terminology, Optimization Goals, Partitioning Algorithms.

Text 1: 1.1-1.8, 2.1-2.4 **10 Hrs**

Self Learning Components:

1. Learn Tool Command Language (TCL).
2. Identify, list and compare proprietary/open source tools for Netlist and System Partition.

UNIT – II

Chip Planning: Introduction to Floorplanning, Optimization goals in Floorplanning, Terminology, Floorplan representations, FloorPlanning Algorithms:Floor plan sizing, cluster growth, Simulated annealing, Pin assignment, Power and Ground Routing:Design of Power-Ground Distribution Network, Planar Routing, Mesh Routing.

Global and Detailed Placement: Introduction, Optimization Objectives, Global placement algorithms:Min-Cut Placement.

Text 1:3.1-3.7, 4.1-4.3.1 **10 Hrs**

Self Learning Components:

1. Analyse the synthesis report files for Area, Power and Timing.
2. Develop and Demonstrate a code for given Floorplanning algorithms.

UNIT – III

Global and Detailed Placement: Global Placement Algorithms: Analytic Placement, Simulated Annealing, Modern Placement Algorithms.

Global Routing: Introduction, Terminology and Definitions, Optimization Goals, Routing terminology and goals, Representations of Routing Regions, The Global Routing Flow, Single-Net Routing**,** Full-Netlist Routing.

Text 1: 4.3.2-4.3.3, 5.1-5.7 **11 Hrs**

Self Learning Components:

1. Develop and Demonstrate a code for given Placement and Routing algorithms.

UNIT – IV

Detailed Routing: Terminology, Horizontal and Vertical Constraint Graphs, Channel Routing Algorithms,Switchbox Routing, Over-the-Cell Routing Algorithms, Modern Challenges in Detailed Routing

Specialized Routing: Introduction to Area Routing, Net Ordering in Area Routing, Non-Manhattan Routing, Basic Concepts in Clock Networks, Modern Clock Tree Synthesis

Text 1:6.1-6.6, 7.1-7.5 **11 Hrs**

Self Learning Components:

1. Demonstration the place and route steps for any design using cadence innovous/encounter

UNIT – V

Timing Closure: Introduction, Timing Analysis and Performance Constraints, Timing-Driven Placement, Timing-Driven Routing, Physical Synthesis, Performance-Driven Design Flow.

Text 1:8.1-8.6 **10 Hrs**

Self Learning Components:

1. Demonstrate the clock tree synthesis steps for any design using cadence innovous/encounter
2. Investigate the given circuits for timing constraints.

Note: <u>No questions</u> from SLC component in the Semester End Exam (SEE), it is evaluated only in Continuous Internal Evaluation (CIE)

TEXT BOOKS:

1. **"VLSI Physical Design: From Graph Partitioning to Timing Closure"**, Andrew B. Kahng, Jens Lienig, Igor L. Markov, Jin Hu, 1st edition, Springer, 2011 ISBN 978-90-481-9590-9 e-ISBN 978-90-481-9591-6

REFERENCE BOOKS:

1. **"Algorithms for VLSI Design Automation"**, Sabih H. Gerez,ISBN: 9780471984894, 0471984892, 2000.
2. "**Algorithms for VLSI Physical Design Automation"**, N. A. Shervani, 1999. 3rd edition ISBN 0-7923-8393-1
3. **"Handbook of Algorithms for Physical design Automation",** Charles J. alpert, Dinesh p. Mehta, Sachin S. Sapatnekar. ISBN: 9780849372421, 0849372429

C. Course Outcomes

CO #	Course Outcome	Program Outcome Addressed (PO #) with BTL
CO1	To apply the knowledge of graph theory in VLSI Physical Design.	**PO1(L3)**
CO2	To be able to analyze the VLSI Physical Design algorithms.	**PO2 (L3)**
CO3	To be able to apply the VLSI Physical Design algorithms.	**PO1, PO4, PO5 (L2)**
CO4	To be able to analyze the Physical Design for specific constraints.	**PO1, PO4, PO12 (L3)**

D. Course Articulation Matrix (CAM)

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2
#1	**2**												**2**	
#2		**3**												**3**
#3	**1**			**2**	**2**								**1**	
#4	**2**			**2**								**2**	**2**	

Course Plan: Elective-IV			
Course Title: Advanced Wireless Technologies			
Course Code: P18EC823	**Semester : VIII**	**L-T-P-H: 3 – 1– 0-4**	**Credits:03**
Contact Period : Lecture :52 Hrs., Exam: 3Hrs.		**Weightage :CIE:50% SEE:50%**	

A. Course Learning Objectives (CLOs)

This course aims to

1. Analyze the various (4G, 5G) advanced wireless technologies.
2. Describe LTE architecture, users equipment, communication protocols and standardization of LTE.
3. Describe the basic network architectures, equipment, methodologies, specifications and topologies used by 5G wireless technologies.
4. Explain the use case scenarios, design principles, performance parameters, security and safety requirements of advanced wireless technologies.
5. Analyze the working, fundamental techniques and protocols used in device to device (D2D) and machine to machine communication (M2M).
6. Analyze and contrast advanced wireless technologies and wireless devices.

B. Course Content

UNIT – I

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, Evolved Packet Core, Communication Protocols.

Quality of Service, Policy and Charging: Policy and Charging Control, Policy and Charging Control Architecture, Session Management Procedures, Data Transport in the Evolved Packet Core, Charging and Billing.

Text 1:1.1 to 1.6, 2.1 to 2.5, 13.1 to 13.5 **10 Hrs**

Self Learning Component:

1. Study VoLTE Technology.
2. Understand all the IP Multimedia Applications of LTE.

UNIT – II

Orthogonal Frequency Division Multiple Access: Principles of OFDMA, Benefits and Additional Features of OFDMA, Single Carrier Frequency Division Multiple Access.

Multiple Antenna Techniques: Diversity Processing, Spatial Multiplexing,Beamforming.

Random Access: Transmission of Random Access Preambles on the PRACH, Non-Contention-Based Procedure, Contention-Based Procedure.

Text 1: 4.1 to 4.3, 5.1 to 5.3, 9.1 to 9.3 **11 Hrs**

Self Learning Component:

1. Explore the advantages of Multiple Antenna Transmission in LTE.
2. Understand the concept of Cell Acquisition Procedure in LTE.

UNIT – III

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 connecteddevices and Wide requirements, Global initiatives.

5G use cases and system concept: Use cases and requirements, 5G system concepts.

Text 2: 1.1 to 1.4, 2.1 to 2.2 **11 Hrs**

Self Learning Component:

1. Survey the standardization of LTE under ITU-R.
2. Investigate the role of IEEE, in Standardization of 4G.

UNIT – IV

The 5G Architecture: Introduction, High-level requirements for the 5G architecture, Functionalarchitecture and 5G flexibility, Physical architecture and 5G deployment.

Machine-Type Communications: Introduction, Fundamental techniques for MTC, Massive MTC, Ultra-reliable low-latency MTC.

Text 2: 3.1 to 3.4, 4.1 to 4.4 **10 Hrs**

Self Learning Component:

1.Explorenew relaying techniques of 5G.
2. Understand all the key applications of 5G.

UNIT – V

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, Architecture and mobility, Beamforming, Physical layer techniques.

Test 2: 5.1 to 5.4, 6.1 to 6.7 **10 Hrs**

Self Learning Component:

1. Investigate various Spectrum challenges in 5G.
2. Understand 5G spectrum landscape and its requirements.

Note: <u>No questions</u> from SLC component in the Semester End Exam (SEE), it is evaluated only in Continuous Internal Evaluation (CIE)

TEXT BOOK:

1. **"An Introduction to LTE: LTE, LTE-Advanced, SAE, VOLTE and 4G Mobile Communications",** 2nd edition Christopher Cox Director, Chris Cox Communications Ltd, UK, 20l4, ISBN: 978-1-118-81803-9.
2. **"5G mobile and Wireless Communications Technology"**, AfifOsseiran, Ericsson, Jose F. Monserrat, Polytechnic University of Valencia, Patrick Marsch, Nokia Networks. New York: Cambridge University Press, 2016, LCCN 2015045732 | ISBN 9781 107130098 (hardback).

REFERENCE BOOKS:

1. **"LTE for UMTS: Evolution to LTE-Advanced"**, HarriHolma, AnttiToskala. —2"d edition, 2011, ISBN 978-0-470-66000-3.
2. **"Smart Device to Smart Device Communication",**ShahidMumtaz, Jonathan Rodriguez Aveiro, Portugal , Springer Cham Heidelberg New York Dordrecht London, ISBN 978-3-3 19-04962-5.
3. **"Wireless Communications and Networking",** Vijay. K.Garg, Morgan Kaufman Publishers, 2014. ISBN: 978-81-312-1889-1.
4. **"3G Wireless Networks",** Clint Smith. P.E., and Daniel Collins, —2"d edition, Tata McGraw Hill, July 2017. ISBN-13: 978-0070636927.
5. **"Wireless Communications- Principles and Practice",**Theodre .S. Rappaport, 2nd edition, Pearson,20l0. ISBN-13: 978-81-317-3186-4.
6. **"Introduction to Wireless Telecommunications Systems and Networks",** Gary I Mullet,Cengage Learning, 2010. ISBN-13: 978-81-315-0559-5

Video Lecture Reference:

1. https://nptel.ac.in/courses/117/104/117104099/ (By Adithya K Jaganathan, IIT Kanpur)
2. https://www.youtube.com/watch?v=h5Lxn328zlw

C. Course Outcomes

CO #	Course Outcome	Program Outcome Addressed (PO #) with BTL
CO1	To Apply knowledge of digital communication tounderstand modulation techniques and evolution of various wireless technologies	**PO1 (L3)**
CO2	To Analyze network architectures, equipment, methodologies, specifications and topologies used by various wireless technologies.	**PO2 (L3)**
CO3	To Analyze the use case scenarios, design principles, performance parameters, security and safety requirements of advanced wireless technologies.	**PO3 (L2)**
CO4	To Examine the standards and protocols used forcommunication by LTE, 4G and 5Gtechnologies	**PO5 (L2)**
CO5	To Inspect and Contrast various advanced wirelesstechnologies, wireless components and devices.	**PO3 (L4)** **PO4 (L2)**

D. Course Articulation Matrix

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
#1	3												3	
#2		3												3
#3			2											
#4					2									
#5			3	2										

Course Plan: Elective –IV			
Course Title : Biomedical Signal Processing			
Course Code: P18EC824	**Semester : VIII**	**L-T-P-H : 3-1-0-4**	**Credits: 3**
Contact Period : Lecture : 52 Hrs, Exam: 3 Hrs	**Weightage: CIE: 50%**		**SEE: 50%**

A. Course Learning Objectives (CLOs)

This course aims to:

1. Introduce students to the principles of signal processing techniques when applied specifically to biomedical signals, including: ECG, MEG, EEG, SPO2, heart rate etc.
2. Provide the student with a firm grounding in methods and tools for extracting information from digitally acquired biomedical signals.
3. Understand data reduction techniques on Biomedical signals and their utility
4. Elaborately discuss analysis of EEG and ECG signals
5. Understand models related to Event related Potentials
6. Introduce the practical implementation of signal processing techniques to digitally acquired biomedical signals.

B. Course Content

UNIT – I

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, Computer aided diagnosis.

Text 2: 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, 1.5. 10 Hrs

Self Learning Component:

1. Study of Challenges in Biomedical Signal Analysis.
2. Study of instruments and modalities for acquisition of biomedical signals of different origin.

UNIT – II

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, Review of Butterworth filters, Removal of noise using Butterworth filters

Text 2: 3.1-3.4 11 Hrs

Self Learning Component:

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 carotid pulse signal.

UNIT – III

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, Adaptive Noise Canceller.

Text 1:6.1-6.6, 6.6(A)- 6.6(E) 11 Hrs

Self Learning Component:

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 Electrosurgical Interference.

UNIT – IV

EEG and ECG Signal Processing: EEG analysis, Linear Prediction Theory, The Auto regressive Method, Recursive estimation of AR parameters, Special Error measure, Adaptive segmentation, ECG parameters and their Estimation, The Use of Multi – scale Analysis for Parameters Estimation of ECG waveforms,

Text 1:4.4, 4.5, 4.6, 4.7, 4.8, 4.9, 7.4, 7.5. 10 Hrs

Self Learning Component:

1. Study of article "Deep learning for electroencephalogram (EEG) classification tasks: A Review".
2. Study ECG data compression using Wavelet Transform.

UNIT – V

Event Detection: Illustration of the Problem With Case-Studies, Detection of Events and Waves. **Modeling Event Related Potentials**: Exponential modeling, Exponential Parameter estimation, The original Prony Problem, Least Squares Prony Method, The covariance method of Linear Prediction, Prony's Method in the presence of noise.

Text 2: 4.1-4.3.

Text 1: 9.1-9.6. 10 Hrs

Self Learning Component:

1.Clinical application of Prony's Method.

Ref:

https://www.researchgate.net/publication/329193563_Coding_Prony's_method_in_MATLAB_and_applying_it_to_biomedical_signal_filtering.

Note: No questions from SLC component in the Semester End Exam (SEE), it is evaluated only in Continuous Internal Evaluation (CIE)

TEXT BOOKS:

1. **Biomedical Signal Processing: Principles and Techniques** – D.C Reddy –Tata McGraw – Hill Publishing Company Limited – ISBN-13:978-0-07-058388-7.
2. **Biomedical Signal Analysis:** A Case – Study Approach –Rangaraj M Ragayyan– John Wiley & Sons – ISBN-0-471-20811-6.

REFERENCE BOOKS:

1. **Biomedical Signal Processing** –Wills J Tompkins, Prentice Hall of India Pvt Ltd, ISBN – 81 – 203 – 1478 – 6.
2. **Digital Signal Processing: Principles, Algorithms and Applications,** Johan G Proakis and Dimitris G MANOLAKIS - 4th edition, ISBN: 9788131710005, 8131710009.
3. **Digital Signal Processing: A Computer based approach**, Sanjit K Mitra – 2nd editionTata – McGraw Hill Publishing Company Ltd, ISBN: 9781259098581, 1259098583.

ONLINE COURSES AND VIDEO LECTURES:

1. https://nptel.ac.in/courses/108/105/108105101/ (Prof SudiptaMukhopaddhyay, 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

C. Course Outcomes

CO #	Course Outcome	Program Outcome Addressed (PO #) with BTL
CO1	Demonstrate a systematic knowledge of the complex physical and physiological principles that underpin biomedical signals.	**PO1[L1]**
CO2	Demonstrate an advanced understanding of the principles of digital signal processing.	**PO1[L1]**
CO3	Systematically Apply methods to extract relevant information from biomedical signal measurements.	**PO1[L2]**
CO4	Critically Assess the appropriateness of biomedical signal processing techniques for various problems in the field.	**PO2 [L4]**
CO5	Evaluate the effectiveness of techniques applied to biomedical signals against specific benchmarks.	**PO4 [L4]**

D. Course Articulation Matrix

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO12	PSO1	PSO2
#1	**3**												**3**	
#2	**3**												**3**	
#3	**3**												**3**	
#4		**3**												**3**
#5				**2**										

Course Plan: Elective –IV			
Course Title: Stochastic Models and Applications			
Course Code: P18EC825	**Semester : VIII**	**L-T-P-H : 3-1-0-4**	**Credits: 3**
Contact Period : Lecture : 52 Hrs, Exam: 3 Hrs	**Weightage: CIE: 50%**		**SEE: 50%**

A. Course Learning Objectives (CLOs)

This course aims to:

1. Understand the relation between probability and statistics.
2. Elaborate on need for studying stochastic modelling.
3. Apply probability theory in reliability and risk analysis of systems.
4. Provide Ability to classify states of a Markov chain.
5. Discuss Basic probabilistic reasoning skills.

B. Course Content

UNIT – I

Introduction: Axioms of probability; Conditional probability and independence; Random variables; Expected value and variance; Moment- Generating Functions and Laplace Transforms; conditional expectation; Exponential random variables, Limit theorems; Examples: A random graph; The Quicksort and Find algorithms; A self-organizing list model; Random permutations.

Text 1: Chapter 1 & 2 **10 Hrs**

Self-Learning Components:

1. When 10 coins are flipped, the event of interest is the number of heads. Let this number be the random variable. a) Plot the distribution function for this random variable using MATLAB

2. Estimate the Mean of X^2, where X is a Gaussian Random Variable using MATLAB

UNIT – II

Probability Bounds, Approximations, and Computations: Tail probability inequalities; The second moment and conditional expectation inequality; probability bounds via the Importance sampling identity; Poisson random variables and the Poisson paradigm; Compound Poisson random variables.

Text 1: Chapter 3 **11 Hrs**

Self-Learning Components:

1. Using Simulation tool (MATLAB or SCILAB) Compute the pdf of the Poisson distribution with parameter lambda = 4.

2. Study of paper "Nonlinear Poisson regression using neural networks: a simulation study" Nader Fallah ,Hong Gu ,Kazem Mohammad , Seyyed Ali Seyyedsalehi ,KeramatNourijelyani ,Mohammad Reza Eshraghian, Neural Comput&Applic, DOI 10.1007/s00521-009-0277-8

UNIT – III

Markov Chains : Introduction; Chapman-Kologorov Equations; Classification of states; Limiting and stationary probabilities; some applications; Time-Reversible Markov Chains; Markov Chain Monte Carlo methods.

The Probabilistic Method: Introduction; Using probability to prove existence; Obtaining bounds from expectations; The maximum weighted independent set problem: A bound and a random algorithm;

Text 1: Chapter 4 & 5.1 to 5.4 **10 Hrs**

Self-Learning Components:

1. Study of paper based on Markov chain "Analysis of Cognitive Radio Spectrum Access with Optimal Channel Reservation", Xiaorong Zhu, LianfengShen, and Tak-Shing Peter Yum, IEEE COMMUNICATIONS LETTERS, VOL. 11, NO. 4.

2. Study of paper "Uncertainty evaluation using Monte Carlo method with MATLAB,"Han Jie, Chen Huaiyan and Cao Yun, IEEE 2011 10th International Conference on Electronic Measurement & Instruments, 2011, pp. 282-286, doi: 10.1109/ICEMI.2011.6037817.

UNIT – IV

The set covering problem; Antichains; The Lovasz Local lemma; A random algorithm for finding the minimal cut in a graph.

Martingales: Definitions and examples; The martingale stopping theorem; The Hoeffding-Azuma inequality; Sub-martingales.

Text 1: Chapter 5.5 to 6.4 **10 Hrs**

Self-Learning Components:

1. Study of paper "Martingale Theory-Based Optimal Task Allocation in Heterogeneous Vehicular Networks,"byT. Liu, L. Sun, R. Chen, F. Shu, X. Zhou and Z. Han, in IEEE Access, vol. 7, pp. 122354-122366, 2019, doi: 10.1109/ACCESS.2019.2914942.

2. write a program to calculate the Minimal Cut in a graph using any simulation tool

UNIT – V

Poisson Processes, Queuing Theory: The non-stationary Poisson process; The stationary Poisson process; Some Poisson process computations; Classifying the events of a non-stationary Poisson process; Conditional distribution of the arrival times

Queuing Theory: Introduction; Preliminaries; Exponential models; Birth-and-Death exponential queuing systems; The backwards approach in exponential queues; A closed queuing network; An open queuing network; The M/G/1 queue; Priority queues.

Text 1: Chapter 7.1 to 8.9 **11 Hrs**

Self Learning Components:

1. Application of Weighted Fair queuing (WFQ) in Packet Voice Transmission.

2. Simulate a non stationary Poisson process using MATLAB

Note: <u>No questions</u> from SLC component in the Semester End Exam (SEE), it is evaluated only in Continuous Internal Evaluation (CIE)

TEXT BOOK:

1. **"Probability Models for Computer Science"**, Sheldon M. Ross, Elsevier, 2002. ISBN: 9780125980517.

REFERENCE BOOKS:

1. **Stochastic Models Analysis and Applications**, B. R. Bhat, New Age International, 2000, ISBN 81-224-1228-9.
2. **Probability and Random Processes with Applications to Signal Processing and Communications**, Scott L. Miller, Donald G. Childers, Elsevier, 2004, ISBN: 978-0-12-386981-4.

ONLINE COURSES AND VIDEO LECTURES:

1. https://nptel.ac.in/courses/110/104/110104024/ (By Dr Raghu NandanSengupta, IIT Kanpur)

C. Course Outcomes

CO #	Course Outcome	Program Outcome Addressed (PO #) with BTL
CO1	To Apply the knowledge of basic concepts in probability theory	**PO1 (L1)**
CO2	To Understand Poisson processes and models	**PO1 (L2)**
CO3	To Analyse essential stochastic modeling tools including Martingales, Markov chains and queuing theory.	**PO2 (L2)**
CO4	To Formulate and solve problems which involve setting up stochastic models.	**PO3 (L1,L3)**
CO5	To Discuss Case study of Birth and Death exponential queuing	**P03 (L3)**

D. Course Articulation Matrix

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2
#1	**3**												**3**	
#2	**2**												**2**	
#3		**2**												**2**
#4			**2**											
#5			**2**											