Syllabus

(With effect from 2015-2016 Academic year)

ಪಠ್ಯಕ್ರಮ

(ಶೈಕ್ಷಣಿಕವರ್ಷ 2015–16)

VII & VIII Semester

Bachelor Degree

in

Electronics and Communication Engineering

Out Come Based Education with Choice Based Credit System

ಫಲಿತಾಂಶ ಆಧಾರಿತ ಶಿಕ್ಷಣ ಹಾಗೂ ಐಚ್ಛಿಕ ವಿಷಯಾಧಾರಿತ ಗಳಿಕೆ ಪದ್ಧತಿ

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)

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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

Dr. Umesh D R
Deputy Dean (Academic)
Associate Professor,
Dept. of Computer Science & Engg

Dr.P S Puttaswamy
Dean (Academic)
Professor,
Dept. of Electrical & Electronics Engg..

Department of Electronics and Communication Engineering

About the department:

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 fulfil their obligation in terms of **social responsibility**.

Mission

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

Program Educational objectives (PEOs)

The Bachelor of Engineering (BE) program in ECE during four year term, aims at:

PEO1: Graduates to exhibit knowledge in mathematics, engineering fundamentals applied to Electronics and Communication Engineering for professional achievement in industry, research and academia

PEO2: Graduates to identify, analyse and apply engineering concepts for design of Electronics and Communication Engineering systems and demonstrate multidisciplinary expertise to handle societal needs and meet contemporary requirements

PEO3: Graduates to perform with leadership qualities, team spirit, management skills, attitude and ethics need for successful career, sustained learning and entrepreneurship.

Program 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:

1. 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.
2. 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. (ECE)				
Sl No.	Course Code	Course Title	Teaching Dept.	Hours Pattern L:T:P:H	Total Credit	Examination Marks		
						CIE	SEE	Total
1.	P15EC71	Analog CMOS VLSI Design (CC-1))	ECE	4:0:0:4	4	50	50	100
2.	P15EC72	Digital Image Processing(CC-2))	ECE	4:0:0:4	4	50	50	100
3.	P15EC73	Embedded and Real Time Systems(CC-3))	ECE	4:0:0:4	4	50	50	100
4.	P15EC74	Elective-IV	ECE	4:0:0:4	3	50	50	100
5.	P15EC75	Open Elective-I	ECE	4:0:0:4	3	50	50	100
6.	P15ECL76	Analog and Digital VLSI Design Laboratory	ECE	0:0:3:3	1.5	50	50	100
7.	P15ECL77	Computer Communication & Protocol laboratory	ECE	0:0:3:3	1.5	50	50	100
8.	P15EC78	Project Work Phase – I	ECE	0:0:4:2	2	--	50	50
				Total	23	350	400	750

List of Electives					
Elective – 4			Open Elective – 1		
Sl. No.	**Course Code**	**Course Title**	**Sl. No.**	**Course Code**	**Course Title**
1.	P15EC741	Wireless sensor networks & Technology	1.	P15EC751	Wireless Communication systems
2.	P15EC742	Digital Control Systems	2.	P15EC752	Microcontroller and Applications
3.	P15EC743	Low power VLSI design	3.	P15EC753	Digital signal processing and Applications
4.	P15EC744	Avionics	4.	P15EC754	Biometrics

Scheme of Teaching and Examination				VIII Semester B.E. (ECE)				
Sl No.	Course Code	Course Title	Teaching Dept.	Hours Pattern L:T:P:H	Total Credit	Examination Marks		
						CIE	SEE	Total
1.	P15EC81	Wireless Communication Technologies(CC-1)	ECE	4:0:0:4	3	50	50	100
2.	P15EC82	Elective-V	ECE	4:0:0:4	3	50	50	100
3.	P15EC83	Elective-VI	ECE	4:0:0:4	3	50	50	100
4.	P15EC84	Open Elective-II	ECE	4:0:0:4	3	50	50	100
5.	P15EC85	Project Work Phase - II	ECE	0:0:16:16	8	50	100	150
6.	P15EC86	Internship	ECE	0:0:2:2	2	50	--	50
				Total	22	300	300	600

List of Electives								
Elective – 5			Elective – 6			Open Elective - 2		
Sl. No.	**Course Code**	**Course Title**	**Sl. No.**	**Course Code**	**Course title**	**Sl. No.**	**Course Code**	**Course title**
1.	P15EC821	Satellite Communication	1.	P15EC831	Advanced Wireless Technologies	1.	P15EC841	Wireless Sensor Networks
2.	P15EC822	Time-Frequency Analysis	2.	P15EC832	Bio Medical Signal Processing	2.	P15EC842	Embedded Systems
3.	P15EC823	Neural Networks & Machine Learning	3.	P15EC833	MEMS	3.	P15EC843	Internet of Things and Applications
4.	P15EC824	Algorithms for VLSI Physical Design Automation	4.	P15EC834	Stochastic Models and Applications	4.	P15EC844	Data Acquisition and Instrumentation

A. Course Plan- Core			
Course Title : **Analog CMOS VLSI Design**			
Course Code: **P15EC71**	Semester : **VII**	L-T-P: 4 – 0 - 0	Credits: 4
Contact Period : Lecture :52 Hr, Exam: 3Hr	Weight age: CIE:50% SEE:50%		

B. Course Learning Objectives (CLOs)

This course aims to

1. Analyze the analog CMOS integrated circuits.
2. Describe the basic MOS device physics and models.
3. Describe the small signal and large signal analysis of amplifiers.
4. Explain the working of various single stage MOS amplifiers.
5. Describe the operation of differential amplifier and different types of Current mirrors and their applications.
6. Design the Operational amplifiers circuits for specific applications.
7. Design and develop the different types of oscillators.
8. Analyse and design the Phase Locked Loops and its applications.

C. Course Content

UNIT – I

Basic MOS Device Physics: General Considerations, MOS I/V Characteristics, Second–Order Effects, MOS Device Models.

Single– Stage Amplifiers: Basic Concepts, Common–Source Stage, Source Follower, Common–Gate Stage, Cascode Stage.

Text 1: 2.1 to 2.4 and 3.1 to 3.5 **11 Hrs**

UNIT – II

Differential Amplifiers: Single– Ended and Differential Operation, Basic Differential Pair, Common–Mode Response, Differential Pair with MOS Loads, Gilbert Cell.

Passive and Active Current Mirrors: Basic Current Mirrors, Cascode Current Mirrors, Active Current Mirrors,

Text 1: 4.1 to 4.5 and 5.1 to 5.3 **11Hrs**

UNIT – III

Operational Amplifiers: General considerations, One stage op-amp, Two stage op-amp, Gain Boosting, Comparison, Common Mode feedback, Input Range limitations, Slew rate, Power supply rejection, Noise in Op-amps.

Text 1: 9.1 to 9.9 **10 Hrs**

UNIT – IV

Oscillators: General Considerations, Ring Oscillators, LC Oscillators, Voltage–Controlled Oscillators, Mathematical Model of VCOs.

Text 1: 14.1 to 14.5 **10 Hrs**

UNIT – V

Phase– Locked Loops: Simple PLL, Charge– Pump PLLs and Non–ideal Effects in PLLs, Delay–Locked Loops and Applications.

Text 1: 15.1 to 15.5 **10 Hrs**

TEXT BOOK:

1. **"Design of Analog CMOS Integrated Circuits",** Behzad Razavi, Tata McGraw Hill, Edition, 2008. ISBN 0-07-238032-2

REFERENCE BOOKS:

1. **"CMOS Analog Circuit Design"**, Phillip E. Allen, Douglas R. Holberg, Oxford University Press, 3rd Edition 2011, ISBN: 9780199765072
2. **"CMOS Circuit Design, Layout and Simulation"**, R. Jacob Baker, Harry W. Li, David E. Boyce, Prentice Hall of India, 1st Edition 2005, ISBN-13: 978-0780334168 ISBN-10: 0780334167

D. Course Outcome

CO #	Course Outcome	Program Outcome Addressed (PO #) with BTL
CO1	To **apply** the knowledge of mathematics to understand the MOS devices and analog CMOS circuits	**PO1, L2**
CO2	To **analyze** different Analog CMOS VLSI circuits (Amplifiers, Op-amps, Oscillators, PLL)	**PO2, L4**
CO3	To **develop** analog CMOS circuits for different parameters.	**PO1, L4**
CO4	To **design** the analog CMOS circuits for the given specifications.	**PO3, L5**
CO5	To model the analog CMOS circuits using modern tools.	**PO5,PO9**

E. 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					**3**				**2**					

A. Course Plan - Core			
Course Title: **Digital Image Processing**			
Course Code: **P15EC72**	Semester: **VII**	L – T – P : 4 – 0 - 0	Credits: 4
Contact Period - Lecture: 52 Hrs.; Exam:3 Hrs.	Weightage: CIE: 50%; SEE: 100%		

B. Course Learning Objectives (CLOs)

This course aims to

1. Provide the knowledge about basic concepts of human eye and visualization.
2. Describe the block schematic of a digital image processing system
3. Outline the areas of applications of image processing.
4. Gain the knowledge of image enhancement.
5. Study the basic FFT and their applications for image processing.
6. Apply the knowledge for image segmentation and analysis.
7. Gain the knowledge of noise models and image restoration.
8. Design the filters for colour image processing.
9. Gain the exposure to image compression concepts and algorithms.

C. Course Content

UNIT – I

Digital Image Fundamentals: Digital Image Restoration, fundamental Steps in Image Processing, Image processing Application, Overview of Digital Imaging Processing, Physical Aspects of Image Acquisition, Biological Aspects of Image Acquisition, Sampling and Quantization.

Text 1: 1.4, 1.7,1.8,2.1,2.2,2.3,2.5 **10Hrs**

UNIT – II

Image Enhancement: Image Enhancement in Spatial domain, Histogram-Based Techniques, Image Smoothing Spatial Filter, Image Sharpening Spatial Filters.

Image Enhancement in Frequency Domain: Image smoothing frequency domain filtering, Image sharpening frequency domain filtering.

Text 1: 5.3, 5.4,5.6,5.6.2,5.7.1,5.8.1,5.8.2,5.9.4 **11 Hrs**

UNIT – III

Image Restoration: Image Degradation Model, Noise modeling, Image Restoration in Presence of Noise, Periodic Noise and Band Pass and Band Reject Filtering, Image Restoration Techniques.

Text 1: 6.4,6.5,6.5.1,6.7,6.8,6.9,6.9.3,6.9.4 **11 Hrs**

UNIT – IV

Image Segmentation: Detection of discontinuities, Edge Detection, Principle of Region Growing.

Morphological Image Processing: Morphological Operators (Dilation and Erosion), opening and closing, Basic Morphological algorithms.

Text 1: 9.3,9.4,9.4.1,9.4.3,9.4.6,9.8 and 11.2,11.2.1,11.2.2,11.2.4,11.6,11.6.3,11.6.4 10 Hrs

UNIT – V

Colour Image Processing: Introduction, colour models, pseudo colour Image processing, Full colour processing, colour transformations.

Image Compression: Image Compression Models, Compression Algorithm and Its Types.

Text 1: 10.1,10.3,10.5,10.6,10.6.1 and 7.1,7.2 **10Hrs**

TEXT BOOK:

1. "**Digital Image Processing**" S.Sridhar Oxford University Press, 2016, 2nd edition. ISBN 10: 0199459355 ISBN 13: 9780199459353

REFERENCE BOOKS:

1. **"Digital Image Processing"**, Rafael C. Gonzalez and Richard E. Woods Pearson Education, 2001, 2nd edition. ISBN: 9788131726952, 8131726959
2. **"Fundamentals of Digital Image Processing"**, Anil K. Jain, Pearson Edition, 2001. ISBN: 9788120309296, 8120309294
3. **"Digital Image Processing"** S. Jayaraman and others. ISBN: 9780070144798, 0070144796

D. Course Outcome

CO #	Course Outcome	Program Outcome Addressed (PO #) with BTL
CO1	**Apply** basic mathematical and signal processing knowledge to understand different image processing stages.	PO1-L4
CO2	**Analyse** images in the spatial/frequency domain using various methods.	PO2-L4
CO3	**Analyse** an image through image enhancement & segmentation.	PO2-L4
CO4	**Apply** knowledge of signal processing in image restoration, colour and morphological processing	PO1-L4
CO5	**Develop** algorithms to perform image processing using modern tool in a group and acquire team playing skills	PO3-PO5-PO9-PO10-L5

E. 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	PS O3
#1	**3**													**3**	
#2		**3**													**3**
#3		**3**													**3**
#4	**3**													**3**	
#5			**2**		**2**				**2**	**2**					**3**

A. Course Plan – Core			
Course Title: **Embedded and Real Time Systems**			
Course Code: **P15EC73**	Semester: **VII**	L – T – P : **4 – 0 - 0**	Credits: 4
Contact Period-Lecture: 52Hrs.; Exam:3 Hrs.	Weightage: CIE: 50%;		SEE: 50%

B. Course Learning Objective (CLO's)

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 concepts of real time operating system based embedded systems.
6. Provide the knowledge of Task synchronization and communication.
7. Describe the Design and Development of Embedded Firmware.
8. Outline the recent trends and overview of Embedded Real Time Systems.

C. 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.

The 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 and 2.1 to 2.7 **11 Hrs**

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, Introduction to Unified Modeling Language, Hardware Software Trade-offs.

Text 1: 3.1 to3.2, 4.1 to 4.2 and 7.1 to 7.4 **10 Hrs**

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, How to Choose an RTOS (Only conceptual understanding, no programming implementation).

Text 1: 10.1 to 10.10 **11Hrs**

UNIT – IV

Embedded Firmware Design and Development: Embedded Firmware Design Approaches, Embedded Firmware Development Languages.

The Embedded System Development Environment: The Integrated Development Environment (keil microvision 3 for illustration only), Types of Files Generated on Cross

compilation, Disassembler/Decompiler, Simulators, Emulators and Debugging, Target Hardware Debugging, Boundary Scan.

Text1: 9.1 to 9.2, 13.1 to 13.6 **11 Hrs**

UNIT – V

Trends in the Embedded Industry: Processor Trends in Embedded Systems**,** Embedded OS Trends**,** Development Language Tools**,** Open Standards, Framework and Alliances**,** Bottlenecks.

Overview of Embedded/Real-Time Operating Systems: Off-the –Shelf Operating Systems**,** Embedded Operating Systems**,** Real-Time Operating Systems**,** Handheld Operating Systems

Text 1: 16.1 to 16.5 Texts 2: 8.1 to 8.4 **10Hrs**

TEXT BOOK:

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

2. "Embedded/ Real Time Systems: Concept, Design and Programming" Dr. K V K K Prasad, Dreamtech press Publisher.

REFERENCE BOOKS:

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

D. Course Outcome

CO #	Course Outcome	Program Outcome Addressed (PO #) with BTL
CO1	**Apply** the knowledge of Microcontrollers to understand & explain the concepts of Embedded systems.	**PO1 (L1,L2)**
CO2	**Analyse** and understand the different issues involved in embedded system development using real time operating systems.	**PO2 (L2)**
CO3	**Design** and **Develop** a domain specific Embedded system applications.	**PO3 (L5)**
CO4	**Discuss** recent trends and overview in the Design of Embedded systems.	**PO3 (L3)**

E. Course Articulation Matrix (CAM)

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

A. Course Plan – Program Elective			
Course Title: **Wireless Sensor Networks & Technology**			
Course Code: **P15EC741**	Semester: **VII**	L – T – P : 4 – 1 - 0	Credits: 3
Contact Period - Lecture: 52 Hrs.; Exam: 3 Hrs.	Weightage: CIE: 50 %; SEE:50%		

B. 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. Understand the utility-cost-based approach to distributed sensor network management.
9. Provide an overview of few sensor node hardware platforms.
10. Provide an overview of node level simulators such as ns-2 and TOSSIM.

C. Course Content

UNIT – I

Overview of Wireless Sensor Networks: Characteristic requirements – ToS, QoS, fault tolerance, lifetime, scalability, wide range densities, programmability, maintainability. Required mechanisms–multihop, energy efficient, auto configuration, collaboration, data centric, locality, exploit trade–off.Unique constraints and challenges of sensor networks. Emerging technologies for wireless sensor networks. Advantages of sensor networks–energy advantage–detection advantage. Sensor network applications– Tracking chemical plumes– smart transportation. Collaborative processing and key definitions of sensor networks.

Text 1: 1.4, 1.6 Text 2: 1.1 to 1.5 **10 Hrs**

UNIT – II

Architectures: Hardware components– sensor node overview– controller– memory, communication device– sensors and actuators– power supply of sensor nodes, Energy consumption of sensor nodes–operation status with different power consumption– microcontroller energy consumption–memory, energy consumption– radio transceivers– computation and communication– power consumption, OS–Embedded OS– Programming Paradigms– Protocol Stack– Energy and Power Management, OS and execution environments– Case study– Tiny OS and nesC, Network architecture – Sensor network scenarios– types of sources and sinks – single hop Vs multi hop – multiple sources and sinks – mobility, Optimization goals and figures of merit – Qos – energy efficiency – scalability – robustness, Gateway – Need – WSN to Internet – Internet to WSN – WSN tunneling.

Text 1: 2.1.1, 2.1.3 ,2.1.4 , 2.2 to 2.4 ,3.1, 3.2 , 3.5 **11 Hrs**

UNIT – III

Networking Sensors: Communication protocols– physical layer and transceiver design in WSN: energy usage profile– choice of modulation scheme, Communication protocols– physical layer and transceiver design in WSN: dynamic modulation scaling– antenna, MAC

protocol– low duty cycle protocols and wake up concepts: mediation device protocol, Wakeup radio concepts, Naming and addressing–Address and name management in WSN, Assessment of MAC addresses – distributed assignment of network wide addresses, Routing protocols– Energy efficient – overview and ex., unicast protocols, multipath unicast routing, Geographic routing– position based routing– Geocasting

Text 1: 4.3,5.2.2 , 5.2.3 ,7.2,7.3, 11.3, 11.5 .1 **10 Hrs**

UNIT – IV

Infrastructure Establishment: Technology control– motivation and basic ideas– options and aspects of topology – controlling topology in flat networks – power control, Clustering – hierarchical networks by clustering – clusters– connecting clusters – rotating cluster heads, multi hop clusters– multilayer of clustering– passive clustering, Time synchronization – Need – properties– protocol– LTS – TPSN – RBS – HRTS, Clocks and Communication delays – Interval methods –reference broadcasts, Localization and positioning– properties– approaches – lateration problem – Single Hop localization, positioning in multi hop environment, Localization and localization services– ranging techniques – range based localization algorithms – location services, Sensor tasking and control – Task driven sensing – roles of sensor nodes and utilities– Information based sensor tasking, joint routing and information aggregation.

Text 1: 10.1,10.2,,10.4, 8.1 to 8.3 , 9.1 to 9.5

Text 2: 4.1to 4.4 , 5.1 to 5.4 **11 Hrs**

UNIT – V

Sensor Network Platforms and Tools: Sensor node hardware – Barkeley motes, 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, Programming behind individual nodes: collaboration groups – state – centric programming (PIECES), multi target tracking problem.

Text 2: 7.1 to 7.5 **10 Hrs**

TEXT BOOKS:

1.“Protocols and Architectures for Wireless Sensor Networks”, Holger Karl & AndressWillig, John Willey, 2005. ISBN-13 978-0-470-09510-2

2.“Wireless Sensor Networks–An Information Processing Approach”, Feng Zhao & Leonidas.J. Guibas, Elsevier, 2007. ISBN: 978-1-55860-914-3

REFERENCE BOOKS:

1.**“Wireless Sensor Networks Technology, Protocols and Applications”**, KazemSohraby, Daniel Minoli, &TaiebZnati, John Wiley, 2007.

2.**“Wireless Sensor Network Designs”**, Anna Hac, John Wiley, 2003.

3.**“Wireless Sensor Network”,** Kazemshraby, Daniel Minoli, TaiebZnati, Wiley.

D. 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(Nework simulators,tiny OS,etc)	**PO1,PO5[L4]**

E. Course Articulation Matrix (CAM)

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

A. Course Plan - Program Elective			
Course Title: **Digital Control Systems**			
Course Code: **P15EC742**	Semester: **VII**	L – T – P : 4 – 0 - 0	Credits: 3
Contact Period - Lecture: 52 Hrs.; Exam:3 Hrs.	Weightage: CIE: 50%; SEE: 100%		

B. Course Learning Objectives (CLOs)

This Course aims to:

1. Provide the basic knowledge of digital control systems and the control problem
2. Discuss the analysis of discrete-time systems using Z-transform
3. Explain the mathematical model of sampled-data control systems
4. Describe the construction of state variable models of open-loop and closed-loop systems
5. Provide the understanding of the concept of stability and classical design techniques such as root locus, Bode plots
6. Discuss the pole assignment techniques to design digital control systems
7. Explain the concept of observability and controllability
8. Describe the concept of PID Controller, PI Control of Air-Fuel ratio, Antilock Brake and Traction-Control Systems, Optimal Active suspension control

C. Course Content

UNIT 1

Introduction: Digital Control System, The control problem, Satellite model, Servomotor system model, Temperature control model, Discrete Time systems, transform methods, state variables, other state variable formulations, transfer functions, solution of the state equations

Sampling and reconstruction: Introduction, Sampled data control, The ideal sampler, Evaluation of $E^*(S)$, Results from the Fourier transform, Properties of $E^*(S)$, Data Reconstruction

Text 1:1.1-1.6, 2.1,2.1,2.2,2.3,2.8,2.9,2.10,2.11,3.1-3.7 **11Hrs**

UNIT – II

Open -Loop Discrete Time Systems: Introduction, The Relationship between E(S) and $E^*(S)$, The Pulse transfer function, Open loop system containing Digital Filters, Modified Z-transform, Systems with Time Delays, State variable models, review of continuous state variables, Discrete state equations

Closed Loop Systems: Introduction, Preliminary concepts, derivation procedure, state variable models

Text 1: 4.1-4.6,4.8-4.10,5.1-5.4 **10Hrs**

UNIT – III

Stability Analysis Techniques: Introduction, Stability , Bilinear Transformation, The Routh-Hurwitz criterion, Jury's Stability Test, Root Locus, Nyquist Criterion, The Bode Diagram, Interpretation of the frequency response, Closed loop frequency response

Text 1:7.1-7.10 **10Hrs**

UNIT – IV

Pole-Assignment Design and State estimation: Introduction, Pole Assignment, State Estimation, Reduced-order Observers, Current Observers, Controllability and Observability, system with inputs

Text 1: 9.1-9.7 **10Hrs**

UNIT – V

Digital Controller Design: Introduction, Control system Specifications, Compensation, Phase-Lag Compensation, Phase-Lead Compensation, Phase-Lead Design Procedure, PID Controllers and its design, PI Control of Air-Fuel ratio, Antilock Brake and Traction-Control Systems, Optimal Active suspension control

Text 1: 8.1-8.6,8.9,8.10 Text 2: 6.1,6.2, 13.1-13.3,16.1-16.3 **11Hrs**

TEXT BOOKS:

1. **"Digital Control Systems , Analysis and Design** ", Charles L Philips, H Troy Nagle, 3rd Edition, McGraw Hill. ISBN:0-13-309832-X
2. **"Automotive Control Systems** ", A Galip Ulsoy,Huei Peng, Melih Cakmakci, Cambridge University Press, 2012, ISBN 10: 110701011X / ISBN 13: 9781107010116

REFERENCE BOOKS:

1. **"Discrete-Time Control Systems"**, Katsuhiko Ogata, 2nd Edition. ISBN: 9789332549661, 9332549664
2. **"Digital Control and State Variable Methods "**, M Gopal, 3rd Edition, Tata McGraw Hill, ISBN: 9780071333276, 0071333274
3. **"Digital Control of Dynamic Systems"**, Gene F Franklin, J David Powell, Michael Workman, 3rd Edition , Ellis-Kagle Press,2006, ISBN: 9780071333276, 0071333274

D. Course Outcome

CO#	Course Outcome	Program Outcome with BTL
CO1	**Analyze** the discrete-time systems using Z-transforms	**PO2,L4**
CO2	**Analyze** the Open-loop and closed-loop control systems as both transfer function and state variable models	**PO2,L4**
CO3	**Design** the digital controllers using tools such as root locus, Bode plots	**PO3,L5**
CO4	**Design** the observers and controllers using pole assignment techniques	**PO3,L5**
CO5	**Implement t**he controllers for automotives using MATLAB/SIMULINK	**PO5**

E. Course Articulation Matrix (CAM)

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

A. Course Plan- Program Elective			
Course Title: **Low Power VLSI Design**			
Course Code: **P15EC743**	Semester: **VII**	L – T – P : 4 – 0 - 0	Credits: 3
Contact Period - Lecture: 52 Hrs.; Exam:3 Hrs.	Weightage: CIE: 50%; SEE: 100%		

B. Course Learning Objectives (CLOs):

This Course aims to:

1. Provide the basic knowledge of low power VLSI design.
2. Explain the various sources of power dissipation in MOSFET.
3. Discuss the design, physics and limitations of low–power MOSFET.
4. Describe the synthesis for low–power using Algorithm level transforms and Logic Level optimization for low–power.
5. Explain the circuit level synthesis.
6. Explain the design and testing of low–voltage CMOS circuits.
7. Analyze Low-Power Static RAM Architectures.
8. Describe the various techniques of low–energy computing using energy recovery.
9. Explain the sources of software power dissipation.

C. Course Content

UNIT-I

Low Power CMOS VLSI Design: Introduction, Sources of power dissipation, designing for low power.

Physics of power dissipation in CMOS FET Devices: Introduction, Physics of power dissipation in MOSFET devices – MIS Structure, Long channel MOSFET, Sub–micron MOSFET, Gate induced Drain leakage, Power dissipation in CMOS – Short circuit dissipation, Dynamic dissipation, Load capacitance. Low power design limits – Principles of low power design, Hierarchy of limits, fundamental limits, Material limits, Device limits, Circuit limits, System limits, Practical limits, Quasi-Adiabatic Microelectronics.

Text 1: 1.1 to 1.3, 2.1 to 2.4 **11 Hrs**

UNIT-II

Synthesis for Low Power: Behavioral Level Transforms – Algorithm level transforms for low Power, Power–constrained Least – squares optimization for adaptive and non–adaptive filters, Circuit activity driven architectural transformations, Architectural driven voltage scaling, Power optimization using operation reduction, Power optimization using operation substitution, Pre–computation – Based optimization for Low Power, Logic Level optimization for low power – FSM and Combinational logic synthesis, Technology Mapping.

Text 1: 4.1 and 4.2 **10 Hrs**

UNIT – III

Circuit Level – Circuit level transforms, CMOS Gates, Transistor Sizing.

Design and Test of Low–Voltage CMOS Circuits: Introduction, Circuit Design style, Leakage current in Deep sub–micron transistors, Deep Sub micrometer device design issues, Key to minimizing short channel effect, Low voltage circuit design techniques, Testing deep sub micrometer IC's with elevated intrinsic leakage, Multiple supply voltages.

Text 1: 4.3, 5.1 to 5.8 **10 Hrs**

UNIT – IV

Low-Power Static RAM Architectures: Introduction, Organization of a static RAM, MOS Static RAM memory cell - The 4T SRAM Cell, The 6T SRAM Cell, SRAM Cell operation, Banked Organization of SRAMs- Divided word line architecture, Reducing Voltage Swings on Bit Lines- Pulsed Word Lines, Self-Timing the RAM Core, Precharge Voltage for Bit Lines, Reducing Power in the write driver circuits, Reducing Power in the Sense Amplifier circuits, Method for achieving low core voltages from a single supply.

Low–Energy Computing Using Energy Recovery Techniques: Energy dissipation in transistor channel using an RC model, Energy recovery circuit design, Designs with partially reversible logic- Designs with reversible logic, Simple charge recovery logic modified from static CMOS circuits, Adiabatic Dynamic Logic, Energy recovery SRAM Core, Supply clock generation.

Text 1: 6.1 to 6.8, 7.1, 7.2, 7.3 to 7.3.4 and 7.4 **11 Hrs**

UNIT – V

Software Design for Low Power: Introduction, Sources of software power dissipation, Software power estimation, Software power optimization.

Text 1: 8.1 to 8.4 **10 Hrs**

TEXT BOOK:

1. "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."Practical Low Power Digital VLSI Design", Gary K. Yeap, Kluwer Academic Publisher, 2002. ISBN:0-7923-8009-6

2."Low Power Design Methodologies", Pedram Rabaey, Kluwer Academic Publishers, 1997. ISBN 978-1-4615-2307-9

D. 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** the low power circuits for RAM architecture.	PO3(L5)
CO5	**Discuss** issues of power estimation and optimization in software design.	PO1(L2)

E. Course Articulation Matrix (CAM)

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

A. Course Plan - Program Elective			
Course Title :Avionics			
Course Code: **P15EC744**	Semester : **VII**	L-T-P: 4 – 0 – 0	Credits: 3
Contact Period: Lecture:52 Hr, Exam: 3Hr		Weight age:CIE:50% SEE:50%	

B. Course Learning Objectives (CLOs)

This course aims to

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

C. 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 Systems Engineering Concept Map-Systems Definition - Role of Quality and T&E in Systems Development, Integrating the Hard and Soft Aspects of System Design, Setting Up SE Activity for a Project.

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

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, Boeing 777 Implementation, Interrelationship of Flight Control, Guidance and Flight Management.

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

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.

Text 2: 5.1-5.10. **11Hrs**

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

Text 2: 10.1-10.9. **10Hrs**

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.

Text 2: 12.1-12.7. **10Hrs**

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 & Sons Ltd (2009), ISBN:978-0-470-05996-8.

REFERENCES:

1. **"Systems Engineering"** by Erik Aslaksen and Rod Belcher.
2. **"Design and Development of an Aircraft Systems**" by Ian Moir and Allan Seabridge. ISBN: 9788126560301, 8126560304
3. **"Introduction to Systems Engineering"** by Andrew P. Sage and James E. Armstrong.

D. Course Outcome

CO #	Course Outcome	Program Outcome Addressed (PO #) with BTL
CO1	To **understand** system engineering on the basics of engineering knowledge.	**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)**

E. 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**													
#3	**2**	**2**											**2**	**2**
#4			**2**											**2**
#5		**2**												**2**

A. Course Plan – Open Elective			
Course Title : **Wireless Communication Systems**			
Course Code: **P15EC751**	Semester : **VII**	L-T-P: 4 – 0 - 0	Credits: 3
Contact Period : Lecture :52 Hr, Exam: 3Hr		Weight age: CIE:50% SEE:50%	

B. 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. Analyse different channel allocation techniques.
4. Describe handoff, roaming and control channels.
5. Understand the GSM reference architecture.
6. Discuss the concept of PSTN and wireless networks.

C. Course Content

UNIT-I

Principles of Wireless Communication: History of wireless communication, Introduction, Mobile communications: basic concepts, definition of terms used, basic cellular system architecture and call procedure, cordless phones, paging systems, introduction to hands off and roaming.

Text1: Chapter 1 **10 Hrs**

UNIT-II

Cellular System Design Fundamentals: Introduction, wireless network topologies, advantages and disadvantages of Ad-hoc and infrastructure network, cell concept and frequency reuse, advantages of small cells, interference coverage and capacity expansion techniques in cellular systems. Cell -splitting, sectoring, signal to interference ratio calculation.

Text 1: 4.1 - 4.10 **10 Hrs**

UNIT-III

Network Planning: channel assignment strategies and capacity expansion, fixed channel allocation (FCA), Dynamic channel allocation (DCA), Handoffs and roaming strategies, Umbrella cell approach, Different generations of wireless networks, first generation basic cellular radio network, AMPS control channels and call handling, PCS second generation CTS , EIA/TIA interim standard 54(IS-54) & USDC control channels migration from AMPS to IS -95 systems.

Text 1 : 4.11 – 4.15, 5.2-5.8 **11 Hrs**

UNIT-IV

Global #ystem for Mobile Communication: GSM reference architecture, protocol architecture of GSM, mobility management mechanism, handoff, feedback maho- strategy, security requirements, GPRS network services, GPRS transmission plane protocol reference model,Short messaging services (SMS), CDMA for wireless, CDMA digital cellular standards (IS-95). .

Text 1 : 5.9 - 5.18,5.20-5.21 **11 Hrs**

UNIT-V

PSTN & Wireless Networks: Difference between wireless and fixed telephone networks, routing protocols in wireless networks, circuit switching and packet switching, packet switching network, Cellular Digital Packet Data[CDPD], Advanced Radio Data Information System[ARDIS], Ram Mobile Data[RMD].

Wireless Geo-location and Intelligent cell concepts: architecture, intelligent cell concept in building communication processing –gain intelligent cells, spectrum allocation, spectrum efficiency

Text 1: 3.6 to 3.10, 7.2 -7.9 **10 Hrs**

TEXT BOOK:

1**. "Wireless and Mobile Communication"** by Sanjeev Kumar, New age International Publishers-2010 Edition. ISBN(10):81-224-2354-X, ISBN(13):978-81-224-2354-9

REFERENCE BOOK:

1. **"Mobile Cellular Telecommunication",** Lee W.C.Y, Mc Graw Hill, 2002. ISBN: 9780071436861, 0071436863

2. **"Wide Band Wireless Digital Communications**", Andreas F Molisch(Pearson,2001, ISBN: 9788131709108, 8131709108

3.**"Wireless Communication and Networking",** Jon W Mark, Weihua, Zhunang Pearson,2nd edition,2008.

D. Course Outcome

CO #	Course Outcome	Program Outcome Addressed (PO #) with BTL
CO1	**Apply** signal processing for wireless mobile communication to understand basic principles of wireless communication.	**PO1, [L2]**
CO2	**Analyze** various methodologies to improve the cellular capacity.	**PO2, [L3]**
CO3	**Apply** communication system to interpret multiple access techniques and interference reduction techniques in wireless mobile communication.	**PO1, [L2]**
CO4	**Apply** fundamentals of cellular communication system to understand handoff and roaming strategies.	**PO1, [L3]**
CO5	**Design** a cellular system for various parameters like capacity, interference, handoff etc.	**PO3, [L4]**

E. Course Articulation Matrix (CAM)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PS02
CO1	**2**												**2**	
CO2		**3**												**3**
CO3	**3**												**3**	
CO4	**3**												**3**	
CO5			**2**											**2**

A. Course Plan – Open Elective			
Course Title: **Microcontroller and Applications**			
Course Code: **P15EC752**	Semester: **VII**	L – T – P : 4 – 0 - 0	Credits: 3
Contact Period - Lecture: 52 Hrs.; Exam:3 Hrs.	Weightage: CIE: 50%; SEE: 50%		

B. Course Learning Objectives

This course aims to

1. Provide the basic knowledge of Embedded systems.
2. Outline the architecture of MSP430.
3. Make use of the instruction sets for writing programs.
4. Summarize the operation of different timers.
5. Discuss the interrupts and low power applications of MSP430

C. Course content

UNIT – I

Introduction to Microcontrollers and MSP430 Architecture: Definition of Embedded Systems, Approaches to Embedded Systems, Small Microcontrollers, Anatomy of a Typical Small Microcontroller, Memory, Software. The Outside View—Pin-Out, the Inside View—Functional Block Diagram, Memory, Central Processing Unit, Memory-Mapped Input and Output, Clock Generator, Exceptions: Interrupts and Resets.

Text1: 1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7. 11Hrs

UNIT – II

Addressing Modes and Instruction set: Central Processing Unit, Addressing Modes, Constant Generator and Emulated Instructions, Instruction set, Examples, Reflections on the CPU and Instruction Set, Resets, Clock system.

Text 1: 5.1, 5.2, 5.3, 5.4, 5.5, 5.6, 5.7, 5.8. 11Hrs

UNIT – III

Interrupts and Low-Power Modes: Functions and Subroutines, Subroutine, Storage for Local Variables, Passing Parameters to a Subroutine and Returning a Result, Interrupts, Interrupt Service Routines, Issues Associated with Interrupts, Low-Power Modes of Operation.

Text 1: 6.1, 6.2, 6.3, 6.4, 6.6, 6.7, 6.8, 6.9, 6.10. 10Hrs

UNIT – IV

Timers and Mixed Signal System: Timer_A, Measurement in the Capture Mode, Output in the Continuous Mode, Output in the Up Mode: Edge-Aligned Pulse-Width Modulation, Output in the Up/Down Mode: Centered Pulse-Width Modulation, Operation of Timer_A in the Sampling Mode, Comparator _A, Analog-to-digital Conversion: General Issues, Analog-to-digital Conversion: Successive Approximation ADC, The ADC 10 Successive.-Approximation ADC.

Text 1: 8.3, 8.4, 8.5, 8.6, 8.7, 8.8, 9.1, 9.2, 9.3, 9.4. 10 Hrs

UNIT – V

Digital Input-Output and Serial Communication: Parallel Ports, Lighting LEDs, Flashing LEDs, Read Input from a Switch, Toggle the LED state by pressing the push button, LCD interfacing. Basic Operation Of the ADC10 Asynchronous Serial Communication, Communications Peripheral in MSP430, Serial Peripheral Interface, Asynchronous communication with USCI_A.

Text 1: Selected topics from Ch4 & Ch7, Ch9-9.5, Ch10-10.1, 10.2 10Hrs

Self learning components

Study of assembly language/ c-programming tools with programming exercises

TEXT BOOKS:

1.John Davies, "**MSP430 Microcontrollers Basics**", Newnes (Elsevier Science), 2008. ISBN: 978-0-7506-8276-3

REFERENCES:

1. Chris Nagy, "**Embedded System Design Using TI MSP430 Series",** Newnes Publication, Elsevier, 2003, ISBN: 9780750676236, 075067623X

2. User Guide from Texas Instrumentation.

D. Course Outcome

CO #	Course Outcome	Program Outcome Addressed (PO #) with BTL
CO1	**Analyze** the Embedded System and Architecture of MSP430	**PO2,L4**
CO2	**Develop** the programs using various instruction sets of MSP430	**PO3,L5**
CO3	**Explain** and use the Interrupts and write subroutines of MSP430.	**PO2,L2**
CO4	**Use** in built Timers and Counters with different modes of operation	**PO2,L2**
CO5	**Describe** the low power applications of MSP430	**PO2,L2**

E. Course Articulation Matrix (CAM)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1		**2**												**2**
CO2			**3**											
CO3		**3**												**3**
CO4		**3**												**3**
CO5		**3**												**3**

A. Course Plan – Open Elective			
Course Title: **Digital Signal Processing and Applications**			
Course Code: **P15EC753**	Semester**: VII**	L – T – P : 4 – 0 - 0	Credits: 3
Contact Period - Lecture: 52 Hrs.; Exam:3 Hrs.	Weightage: CIE: 50%; SEE: 100%		

B. Course Learning Objectives (CLOs):

This Course aims to;

1. Provide the knowledge of DFT/ IDFT and its various properties.
2. Explain the different Fast–Fourier–Transform (FFT) algorithms along with its applications.
3. Provide the design procedure of IIR filters and FIR filters using different techniques.
4. Provide the design of IIR filters from analog filters using different methods.
5. Provide implementation scheme of IIR and FIR filters using different methods.
6. Provide exposure to different applications of DSP

UNIT-I

Introduction: Overview of Digital Signal Processing, A Brief Introduction to MATLAB, Applications of Digital Signal Processing, Discrete-time Signals, Discrete Systems, Convolution, Difference Equations.

Text 1: 1.1, 1.2, 1.3, 1.4, 2.1, 2.2, 2.3, 2.4, 2.5 **10Hrs**

UNIT-II

The Z-Transform And The Discrete-Time Fourier Analysis: The Bilateral z-Transform, Important Properties of the z-Transform, Inversion of the z-Transform, System Representation in the Z-Domain, Solutions of the Difference Equations, Problems, The Discrete-time Fourier Transform (DTFT), The Properties of the DTFT, The Frequency Domain Representation of LTI Systems, Sampling and Reconstruction of Analog Signals.

Text 1: 4.1, 4.2, 4.3, 4.4, 4.5, 4.6, 3.1, 3.2, 3.3, 3.4, 3.5 **11Hrs**

UNIT-III

The Discrete Fourier Transform [DFT]: The Discrete Fourier Series, Sampling and Reconstruction in the z-Domain, The Discrete Fourier Transform, Properties of the Discrete Fourier Transform, Linear Convolution Using the DFT, The Fast Fourier Transform.

Text 1: 5.1, 5.2, 5.3, 5.4, 5.5, 5.6, 5.7 **10Hrs**

UNIT-IV

Implementation of Discrete-Time filters: Basic Elements, IIR Filter Structures, FIR Filter Structures, Lattice Filter Structures, Overview of Finite-Precision Numerical Effects, Representation of Numbers, The Process of Quantization and Error Characterizations, Quantization of Filter Coefficients.

Text 1: 6.1, 6.2, 6.3, 6.4, 6.5, 6.6, 6.7, 6.8, 6.9 **11Hrs**

UNIT-V

Applications of DSP: LMS Algorithm for Coefficient Adjustment, System Identification of System Modelling, Suppression of Narrowband Interference in a Wideband Signal, Adaptive Line Enhancement, Adaptive Channel Equalization, Pulse-Code Modulation, Differential PCM (DPCM), Adaptive PCM and DPCM (ADPCM), Delta Modulation (DM), Linear Predictive Coding (LPC) of Speech, Dual-tone Multifrequency (DTMF) Signals, Binary Digital Communications, Spread-Spectrum Communications.

Text 1: 11.1, 11.2, 11.3, 11.4, 11.5, 12.1, 12.2, 12.3, 12.4, 12.5, 12,6, 12.7, 12.8 **10Hrs**

TEXT BOOK:

1. Vinay K. Ingle, Ingle and John G. Proakis **"Digital Signal Processing Using MATLAB"**, Third Edition - Publisher, Global Engineering: Christopher M. Shortt 2012. ISBN-13:978-1-111-42737-5 ISBN-10:1-111-42737-2

REFERENCE BOOKS:

1. Johan G Proakis and Dimitris G MANOLAKIS "**Digital Signal Processing: Principles, Algorithms and Applications"** 4th Edition. ISBN: 9788131710005, 8131710009

2.Sanjit K Mitra **"Digital Signal Processing: A Computer based approach",** 2nd Edition Tata – McGraw Hill Publishing. ISBN: 9781259098581, 1259098583

D. Course Outcome

CO #	Course Outcome	Program Outcome Addressed (PO #) with BTL
CO1	**Understand** importance of discrete time signal properties and its applications	**PO1, L2**
CO2	Various transforms to mathematically **analyze** discrete-time signals/systems in frequency domain.	**PO2, L3**
CO3	**Implement** discrete-time systems using various structures	**PO3,L4**
CO4	**Understand** role of DSP in various applications	**PO1, L2**
CO5	Use **Modern tool** Matlab to understand different DSP algorithms and definitions	**PO5, L4**

E. 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		**3**												**3**
#3			**2**											**2**
#4	**3**						**3**						**3**	
#5							**2**							

A. Course Plan – Open Elective		
Course Title: **Biometrics**		
Course Code: **P15EC754**	Semester: **VII**	L – T – P : **4 – 0 - 0**
Contact Period - Lecture:52Hrs.;Exam: 3Hrs.	Weightage: CIE: 50% SEE: 50%	

B. Course Learning Objectives (CLOs):

This Course aims to;

1. Provide the basic knowledge on biometrics and its modality.
2. Analyze the handwritten character recognition and its experimental results.
3. Describe the concept of face biometrics.
4. Outline the concept of retina and iris biometrics.
5. Illustrate the concept of vein and fingerprint biometrics.
6. Interpret biometric hand gesture recognition for Indian sign language.
7. Discover the privacy issues and concerns related to biometrics.
8. Discuss biometric cryptography and multimodal biometrics.
9. Explain the importance of watermarking techniques in biometrics.
10. Summarize the scope and future of biometrics and its standards.

C. Course Content

UNIT – I

Introduction: What is Biometrics? History of biometrics**,** Types of biometric traits**,** General architecture of biometric system, Basic working of biometric matching (Templates)**,** Biometric system error and performance measures, Design of biometric systems**,** Applications of biometrics, Benefits of biometrics versus Traditional authentication methods.

Text1: 1.1-1.9 **10Hrs**

Handwritten Character Recognition: Introduction**,** Character recognition**,** System overview**,** Feature extraction for character recognition**,** Neural network for handwritten Character recognition, Multilayer neural network for handwritten character recognition**,** Devanagari numeral recognition**,** Isolated handwritten devanagari character recognition using fourier descriptor and hidden**,** Experimental results.

Text 1: 2.1-2.9 **11 Hrs**

UNIT – II

Face Biometrics: Introduction**,** Background of face recognition**,** Design of face recognition system**,** Neural network for face recognition**,** Face detection in video sequences**,** Challenges in face biometrics**,** Face recognition methods**,** Advantages and disadvantages.

Text1: 3.1-3.8

Retina and Iris Biometrics: Introduction**,** Performance of biometrics**,** Design of retina biometrics, Design of iris recognition system**,** Iris segmentation method**,** Determination of iris region**,** Experimental results of iris localization**,** Applications of iris biometrics**,** Advantages and disadvantages.

Text1: 4.1-4.9 **10 Hrs**

UNIT – III

Vein and Fingerprint Biometrics: Introduction**,** Biometrics using vein pattern of palm**,** Fingerprint biometrics, Fingerprint recognition system, Minutiae extraction**,** Fingerprint indexing**,** Experimental results**,** Advantages and disadvantages.

Text1: 5.1 -5.8

Biometric Hand Gesture Recognition for Indian Sign Language: Introduction**,** Basics of hand geometry**,** Sign language, Indian sign language (ISL), SIFT algorithm, A practical approach, Advantages and disadvantages.

Text1: 6.1-6.7 **10 Hrs**

UNIT – IV

Privacy Enhancement Using Biometrics: Introduction**,** Privacy concerns associated with biometric deployments, Identity and privacy, Privacy concerns, Biometrics with privacy enhancement**,** Comparison of various biometrics in terms of privacy, Soft Biometrics.

Text1: 7.1-7.7

Biometric Cryptography and Multimodal Biometrics: Introduction to biometric cryptography, General purpose cryptosystem, Modern cryptography and attacks, Symmetric key ciphers, Cryptographic algorithms, Introduction to multimodal biometrics, Basic architecture of multimodal biometrics, Multimodal biometrics using face and ear, Characteristics and advantages of multimodal biometrics, AADHAAR: An application of multimodal biometrics.

Text1:8.1-8.10 **10Hrs**

UNIT – V

Watermarking Techniques: Introduction**,** Data hiding methods**,** Basic framework of watermarking**,** Classification of watermarking**,** Applications of watermarking**,** Attacks on watermarks, Performance evaluation**,** Characteristics of watermarks, General watermarking process**,** Image watermarking techniques**,** Watermarking algorithm.

Text 1: 9.1-9.11

Biometrics Scope and Future: Scope and future market of biometrics, Biometric technologies**,** Applications of biometrics**,** Biometrics and information technology infrastructure**,** Role of biometrics in enterprise security**,** Role of biometrics in border security**,** Smart card technology and biometrics**,** Radio frequency identification (RFID) biometrics, DNA biometrics**,** Comparative study of various biometric techniques.

Text1: 10.1-10.10

Biometric Standards: Introduction**,** Standard development organizations**,** Application programming interface (API), Information security and biometric standards, Biometric template interoperability.

Text1: 12.1-12.5 **11Hrs**

TEXTBOOK:

1. **"Biometrics: Concepts and Applications"**, G.R.Sinha, SandeepB.Patil, Wiley, 2013 edition. ISBN: 13: 978-81-265-3865-2

REFERENCES:

1. Samir Nanavati, Michael Thieme, Raj Nanavati, **"Biometrics – Identity Verification in a Networked World"**, Wiley-dreamtech India Pvt Ltd, New Delhi, 2003. .ISBN: 978-0-471-09945-1
1. Paul Reid, **"Biometrics for Network Security"**, Pearson Education, New Delhi, 2004. ISBN 10: 8131716007
2. John R Vacca, **"Biometric Technologies and Verification Systems"**, Elsevier Inc, 2007. ISBN: 9780750679671
3. Anil K Jain, Patrick Flynn, Arun A Ross, **"Handbook of Biometrics"**, Springer, 2008. ISBN 978-0-387-71041-9

D. Course Outcome

CO #	Course Outcome	Program Outcome Addressed (PO #) with BTL
CO1	**Explain** the basics of biometric modalities and features of the biometrics.	**PO1, [L2]**
CO2	**Apply** the various morphological operations for feature extraction in various biometrics	**PO2, [L2]**
CO3	**Analyze** the use of various biometrics.	**PO3, [L4]**
CO4	**Summarize** the privacy issues & concerns related to biometric cryptography	**PO3, [L5]**

E. 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		**2**												**2**
#3				**2**										**2**
#4		**2**												**2**
#5														

A. Course Plan		
Course Title: **Analog VLSI Design and Digital VLSI Design Laboratory**		
Course Code: **P15ECL76**	Semester: **VII**	L – T – P : 0 – 0 - 4
Contact Period - Lecture: 52 Hrs.; Exam:3 Hrs.	Weightage: CIE: 50%; SEE: 100%	

B. Course Learning Objectives (CLOs)

This course will enable students to:

1. Explore the CAD tool and understand the flow of the Full Custom IC design cycle.
2. Learn DRC, LVS and Parasitic Extraction of the various designs.
3. Design and simulate the various basic CMOS analog circuits and use them in higher circuits like data converters using design abstraction concepts.
4. Design and simulate the various basic CMOS digital circuits and use them in higher circuits like adders and shift registers using design abstraction concepts.
5. Understand simulation and synthesis of digital design.
6. Analyze the ASIC Design flow.
7. Design and Verify an inverter, Buffer, Transmission gate and Basic/universal gates using verilog code.
8. Design and Verify different types of adder using Verilog code.
9. Design and Verify universal shift register using verilog code.

C. Course Content:

A. Analog VLSI Design

Analog Design Flow:

The design flow must consist of the following:

a. Draw the schematic and verify the following
   - DC Analysis
   - Transient Analysis

b. Draw the Layout and verify the DRC, ERC, and LVS.

c. Check for LVS.

d. Extract RC and Back annotate the same and verify the Design

1. Design an Inverter gate with given specification.
2. Design an NAND and NOR gate with given specification
3. Design the following circuits, in different styles, for the given specification
   i) Common source amplifier, ii) Common Drain amplifier.
4. Design a Single Stage Differential Amplifier for given specifications.
5. Design an OPAMP for given specifications using Differential Amplifier.
6. Design a simple 8-bit ADC converter using any one of the tools given above.

B. Digital VLSI Design

ASIC-Digital Design / FPGA Digital Design

1. Develop Verilog Code for the n inverter, Buffer and their Test Bench for verification,
2. Develop Verilog Code for the Transmission gate and their Test Bench for verification,
3. Design and Develop Verilog code for 4/8-bit Carry Ripple Adder
4. Design and Develop Verilog code for 4/8-bit Carry Look Ahead adder
5. Develop Verilog Code for Radix-4 Booth Multiplication.
6. Develop Verilog code for 4/8-bit Universal Shift Register.

D. Course Outcome (CO)

CO #	Course Outcome	Program Outcome Addressed (PO #) with BTL
CO1	**Apply** the knowledge of the digital system to design of the schematic and layout in cadence tools.	**PO1, L1**
CO2	**Interpret** concepts of DC Analysis, AC Analysis and Transient Analysis in analog circuits.	**PO4, L4**
CO3	**Design** and **simulate** basic CMOS circuits like inverter, common source amplifier and differential amplifiers.	**PO3,L5**
CO4	**Analyze** the ASIC flow and FPGA Digital Design.	**PO2,L4**
CO5	**Develop** 4/8-bit Carry Ripple Adder, Carry Look Ahead adder and Booth Multiplication using Verilog code.	**PO3,L5**

E. 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												2	
#2				2										
#3			2											2
#4		3												2
#5			2		3									2

A. Course Plan			
Course Title: **Computer Communication and Protocol Laboratory**			
Course Code: **P15ECL77**	Semester: **VII**	L – T – P : 0 – 0 - 4	Credits:1.5
Contact Period - Lecture: 52 Hrs.; Exam:3 Hrs.	Weightage: CIE: 50%; SEE: 100%		

B. Course Learning Objectives (CLOs)

This course will enable students to:

1. Understand the HDLC frame formats
2. Analyze the concepts of graph theory. Ex: Shortest path algorithm, minimum spanning tree.
3. Understand the basic concepts of cyclic codes, and explain how cyclic redundancy check works.
4. Understand the importance of encryption and decryption through ciphering techniques.
5. Understand and design network topology using NS2.
6. Understand the scenario and study the performance of various network protocols through simulation.
7. Understand the concept of Routing algorithm to find the shortest path
8. Understand the congestion control techniques.

C. Course Content

Sl No	List of Experiments:
	C program
1	a) For the given data, write a program in C to simulate bit stuffing in HDLC frame and also display the bit stuffed frame.
	b) For the given data, write a program in C to simulate character stuffing in HDLC frame and also display the bit stuffed frame.
2	Write a program in C to simulate the shortest path algorithm for the given network in the graph form. (The number of nodes should be greater than 6).
3	Write a program in C to simulate the minimum spanning tree using suitable algorithm for the given network in the graph form. (The number of nodes should be greater than 4).
4	For the given data, use CRC-CCITT polynomial to obtain a CRC code. Verify the program for the cases (i) Without error (ii) With the introduction of error.
5	Write a program in C to encrypt a given message using Substitution and Transposition cipher method and decrypt it.
	USING NS2 / NS3 SIMULATOR
6	Implement prescribed number of nodes (point – to – point network) with duplex links between them. Set the queue size, vary the bandwidth and find the number of packets dropped.
7	Implement an Ethernet LAN using n nodes and set multiple traffic nodes and plot congestion window for different source / destination.
8	Stop-and-Wait Protocol: Conduct an experiment to provide reliable data transfer between two nodes over an unreliable network using the Stop-and-Wait Protocol.
9	Sliding Window Protocol-Selective Repeat: Conduct an experiment to provide reliable

	data transfer between two nodes over an unreliable network using the Sliding Window Protocol-Selective Repeat.
10	Test DSR and DSDV routing protocols over wired network and compare the performance
11	Carrier Sense Multiple Access (CSMA): Conduct an experiment to implement the CSMA protocol for packet communication between a number of nodes connected to a common bus.
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

Open ended experiments :

1. Implement and study the performance of GSM on NS2/NS3 (Using MAC layer) or equivalent Environment.
2. Implement and study the performance of CDMA on NS2/NS3 (Using stack called Call net) or equivalent environment.
3. Write a program for simple RSA algorithm to encrypt and decrypt the data

D. Course Outcome (CO)

CO #	Course Outcome	Program Outcome Addressed (PO #) with BTL
CO1	**Apply** the knowledge gained for real implementation of the computer network scenarios	**PO1, L1**
CO2	**Interpret** the different agents and their applications like TCP, FTP over TCP, UDP, CBR and CBR over UDP etc.	**PO4, L4**
CO3	**Design** and **simulate** basic concepts of link layer properties including error detection.	**PO3,PO5,L5**
CO4	**Analyze** the installation error of NS2/NS3, identifying and solving the installation error.	**PO2,L4**
CO5	**Develop** programs to work with a congestion control algorithm and public key encryption system.	**PO3,L5**

E. 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**	
#2				**2**										
#3			**2**		**3**									**2**
#4		**3**												**2**
#5			**2**											**2**

A. Course Plan – Core			
Course Title : **Wireless Communication Technologies**			
Course Code: **P15EC81**	Semester : **VIII**	L-T-P: 4 – 0 – 0	Credits: 3
Contact Period : Lecture :52 Hr, Exam: 3Hr	Weight age: CIE:50% SEE:50%		

B. 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 analyze different multiple access techniques.
5. Describe different wireless systems and standards.
6. Understand VoIP- its architecture and challenges.

C. Course Content

UNIT-I

Introduction to Wireless Communication Systems: Evolution of Mobile Radio Communications, Mobile Radiotelephony in the U.S, Mobile Radio Systems around the world, Examples of Wireless Communication Systems, Trends in cellular radio and Personal communications

Modern Wireless Communication Systems: Second generation (2G) cellular networks, Third generation (3G) wireless networks, Wireless local loop (WLL) and LMDS, Wireless Local Area Networks(WLANs), Bluetooth and Personal Area Networks (PANs)

Text1: 1.1-1.5, 2.1-2.5 **11 Hrs**

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**

UNIT-III

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 **10 Hrs**

UNIT-IV

Wireless Systems and Standards: AMPS and ETACS, United States Digital Cellular (IS-54 and IS-136), Global System for Mobile(GSM)

Text 1: 11.1-11.3 **10 Hrs**

UNIT-V

Voice over IP (VOIP) Technology: Why VoIP?, The basics of IP Transport, VoIP Challenges, H.323, The Session Initiation Protocol (SIP), Distributed Architecture and Media Gateway Control, VoIP and SS7, VoIP Quality of Service.

Text 2: 10.1-10.8 **11 Hrs**

TEXT BOOK:

1. Theodre .S. Rappaport, **"Wireless Communications- Principles and Practice"**, Pearson, 2nd Edition, 2010. ISBN-13: 978-81-317-3186-4
2. Clint Smith,P.E and Daniel Collins, **"3G Wireless Networks"**, Mc Graw Hill Education, 2nd Edition, 2013. ISBN-13 : 978-0-07-063692-7

REFERENCE BOOKS:

1. Vijay. K.Garg, **"Wireless Communications and Networking"**, Morgan Kaufman Publishers, 2014. ISBN: 978-81-312-1889-1
2. Gary. J. Mullet, **"Introduction to Wireless Telecommunications Systems and Networks"**, Cengage Learning, 2010. ISBN-13: 978-81-315-0559-5
3. William. C. Y. Lee, **"Wireless and Cellular Communications"**, Mc-Graw Hill, 2005. ISBN:978-00-714-3686-1

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 methodologies to improve the cellular capacity.	**PO2, L3**
CO3	**Apply** communication system to interpret multiple access techniques and interference reduction techniques in wireless mobile communication.	**PO1, L2**
CO4	**Apply** fundamentals of cellular communication system to understand handoff, roaming strategies and various wireless systems and standards	**PO1, L3**
CO5	**Design** a cellular system for various parameters like capacity, interference, handoff etc.	**PO3, 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

A. Course Plan – Program Elective			
Course Title: **Satellite Communication**			
Course Code: **P15EC821**	Semester: **VIII**	L – T – P : 4 – 0 - 0	Credits: 3
Contact Period - Lecture: 52 Hrs.; Exam:3 Hrs.		Weightage: CIE: 50%; SEE: 50%	

B. Course Learning Objectives

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 and 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.

C. 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, launching orbits.

Text 1: 1.1 to 1.3, 2.1 to 2.8, 2.8.1, 2.8.2, 2.9, 2.9.1 to 2.9.4, 3.1 to 3.8 **11 Hrs**

UNIT – II

The Space Segment: Introduction, power supply, attitude control, Spinning satellite stabilization, momentum wheel stabilization, station keeping, thermal control, TT&C 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 **11Hrs**

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, code–division multiple access, direct–sequence spread spectrum, the code signal c(t), acquisition and tracking, spectrum spreading dispreading, CDMA throughput.

Text 1: 14.1 to 14.7, 14.7.1 to 14.7.4, 14.10, 14.10.1 to 14.10.5 **10Hrs**

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: 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, 15.5, 15.9 to 15.13 **10 Hrs**

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), orb–comm, iridium.

Text 1: 16.1 to 16.14, 17.1 to 17.7 **10 Hrs**

TEXT BOOK:

1. "Satellite Communications", Dennis Roddy, 4th Edition, Special Indian Edition 2009, 11th reprint 2013 McGraw–HillISBN13:978-0-07-007785-0 ISBN 10:0-07-007785-1

REFERENCE BOOKS:

1."Satellite Communications", Timothy Pratt, Charles Bostian and Jeremy Allnutt, 2nd Edition, John Wiley & Sons, 2010. ISBN:9788126508334,

2."Satellite Communications Systems Engineering", W.L.Pitchand, H.L. Suyderhoud, R.A. Nelson, 2nd edition, Pearson education.2007. ISBN:9788131702420

3."Satellite Communications", Anil K.Maini, VarshaAgrawal, 3rd Edition, Wiley India Pvt.Ltd, Reprint, 2012. ISBN:9788126520718.

D. 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 and other 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 communications link.	**PO1(L3)**
CO5	**Understand** the analog and digital technologies used for satellite communications networks.	**PO1, PO2, PO5(L2)**

E. Course Articulation Matrix (CAM)

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
#1	3												3	
#2	3												3	
#3			2											
#4				3										
#5	3	2			1								3	2

A. Course Plan – Program Elective			
Course Title :Time and Frequency Analysis			
Course Code: **P15EC822**	Semester : **VII**	L-T-P: 4 – 0 - 0	Credits: 3
Contact Period : Lecture :52 Hr, Exam: 3Hr		Weight age:CIE:50% SEE:50%	

B. Course Learning Objectives (CLOs)

This course aims to

1. Understand some of the properties of signals.
2. Learn behaviour of signals over different environment.
3. Understand probability as a part of signal behaviour.
4. Implement different mathematical operations to non-stationary signals.
5. Design different systems to avoid interferences in a communication channels.
6. Analyse marginal properties of different signals.

C. Course Content

UNIT I

Time and Frequency Description of Signals: Time description of Signals, Frequency description of Signals, Bandwidth equations, AM and FM contributions to the bandwidth, Duration and Meantime in terms of the spectrum, Classification of signals. **Instantaneous Frequency and the Complex Signal:** Reasons for the complex signal, The analytic signal, Physical interpretation of the analytic signal, Instantaneous Frequency, Density of instantaneous frequency.

Text 1: 1.1-1.3, 1.5-1.7, 1.11, 2.1-2.3, 2.5, 2.7, 2.8. 11Hrs

UNIT II

The Uncertainty Principle: Introduction, The Uncertainty Principle, Proof of the Uncertainty Principle, The Uncertainty Principle for the Short-Time Fourier Transform. **Densities and Characteristic Functions:** Introduction, One Dimensional Densities, One Dimensional Characteristic Functions, Two Dimensional Densities, Relation Between Local and Global Averages, Distribution of a New Variable, **The Need for Time-Frequency Analysis:** Introduction, Simple Analytic Examples, Real Signals, Why Spectra Change.

Text 1: 3.1-3.4, 4.1-4.4, 4.6, 4.7, 5.1-5.4. 10Hrs

UNIT III

Fundamentals of Time - Frequency Distribution (TFD): Global Averages, Local Average, Time and Frequency Shift Invariance, Linear Scaling, Weak and Strong Finite Support, Uncertainty Principle. **Short Time Fourier Transform**: Introduction, The Short-Time Fourier Transform and Spectrogram, General Properties, Global Quantities, Local Averages, Narrowing and Broadening the Window, Group Delay, Examples, Wigner distribution, generalized TFD and prosperities of these distributions. **Global Averages:** Local Averages, Examples, The Wigner Distribution of the Sum of Two Signals, Comparison of the Wigner Distribution with the Spectrogram.

Text 1: 6.1-6.7, 7.1-7.8, 8.1-8.7, 8.11. 11Hrs

UNIT IV

General Approach and the Kernel Method: Introduction, General Class, The Kernel Method, Basic Properties Related to the Kerrfel, Global Averages, Local Averages. **Generation of TFD:** Introduction, Characteristic Function Method, Evaluation of the Characteristic Function, The General Class, Averages, The Moment Method, **Kernel design for reduced interference in TFD:** Introduction, Reduced Interference Distributions.

Text 1: 9.1-9.6, 10.1-10.6, 11.1, 11.2. 10Hrs

UNIT V

Positive Distributions Satisfying the Marginals: Introduction, Positive Distributions, The Method of Loughlin, Pitton, and Atlas, **Density of a Single Variable:** Introduction, Density of a Single Variable, Mean Values, Bandwidth, Arbitrary Starring Representation, **Joint Representations for Arbitrary Variables:** Introduction, Marginal, Characteristic Function, Operator Method, Methods of Evaluation, General Class for Arbitrary Variables, Transformation Between Distributions, Local Autocorrelation, Instantaneous Values, Local Values for Arbitrary Variable Pairs, The Covariance, Generalization of the Short-Time Fourier Transform, Unitary Transformation, Inverse Frequency.

Text 1: 14.1-14.3, 16.1-16.5, 7.1-7.3. **10Hrs**

TEXT BOOK:

1. Leon Cohen, "**Time-Frequency Analysis"**, Prentice-Hall PTR, Upper Saddle River, 1995, ISBN: 0-13-594532-1.

REFERENCE BOOKS:

1. S. Mallat, **A Wavelet Tour of Signal Processing** - The sparse way, Elsevier, Third Edition, 2009. ISBN: 9788131222904, 813122290X
2. D. Gabor, **"Theory of Communication"**, Proceedings of IEE, pp. 429-457, 1946
3. M. Vetterli, J. Kovacevic, and V. K. Goyal, **"Fourier and Wavelet Signal Processing".** Book site:http://fourierandwavelets.org/terms.php

D. Course Outcome

CO #	Course Outcome	Program Outcome Addressed (PO #) with BTL
CO1	To **understand** different properties of signals through basics of communication and signal processing.	**PO1(L1)**
CO2	To **apply** the knowledge of signal processing to analyze different signal characteristics.	**PO1(L2)**
CO3	To **analyze** non stationary signals arising in various real-world contexts	**PO2(L3)**
CO4	To **evaluate** distributions and transformations over the marginal properties of different signals.	**PO2(L3)**
CO5	To **design** systems to decline interferences in signal communication	**PO3(L5)**

E.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**												**2**
#5			**2**											**2**

A. Course Plan – Program Elective			
Course Title: **Neural Networks and Machine Learning**			
Course Code: **P15EC823**	Semester: **VIII**	L – T – P : 4 – 0 - 0	Credits: 3
Contact Period - Lecture: 52 Hrs.; Exam:3 Hrs.	Weightage: CIE: 50%; SEE: 100%		

B. Course Learning Objectives

This course aims to:

11. Provide an insight to analogy of Human brain and Neural Networks.
12. Illustrate Relation Between the Perceptron and Bayes Classifier.
13. Provide details about model building through Regression.
14. Explains Relationship Between RLSE and MAP Estimation.
15. Provides detailed functioning of Least-Mean-Square Algorithm.
16. Describe Pattern Classification Virtues and Limitations of the LMS Algorithm,
17. Examine mathematical aspects of Multilayer Perceptrons
18. Compare Back-Propagation Learning, Supervised Learning.
19. Provide an overview of Kernel Methods and Radial-Basis Function Networks.
20. Provide details about the Support Vector Machines.

C. Course contents

UNIT – I

Introduction: What is a Neural Network, The Human Brain, Models of a Neuron, Neural Networks Viewed As Directed Graphs, Feedback Network Architectures, Knowledge Representation, Learning Processes, Learning Tasks.

Rosenblatt's Perceptron: Introduction, Perceptron, The Perceptron Convergence Theorem, Relation Between the Perceptron and Bayes Classifier for a Gaussian Environment, Computer Experiment: Pattern Classification, The Batch Perceptron Algorithm.

Text 1: Introduction1, 1.1 to 1.6 **10Hrs**

UNIT – II

Model Building through Regression: Introduction, Linear Regression Model: Preliminary Considerations, Maximum a Posteriori Estimation of the Parameter Vector, Relationship Between Regularized Least-Squares Estimation and MAP Estimation, Computer Experiment: Pattern Classification The Minimum-Description-Length Principle, Finite Sample-Size Considerations, The Instrumental-Variables Method.

Text 1: 2.1 to 2.8 **10Hrs**

UNIT – III

The Least-Mean-Square Algorithm: Introduction, Filtering Structure of the LMS Algorithm, Unconstrained Optimization: a Review, The Wiener Filter, The Least-Mean-Square Algorithm, Markov Model Portraying the Deviation of the LMS Algorithm from the Wiener Filter, The Langevin Equation: Characterization of Brownian Motion, Kushner's Direct-Averaging Method, Statistical LMS Learning Theory for Small Learning-Rate Parameter, Computer Experiment I: Linear Prediction, Computer Experiment II: Pattern Classification Virtues and Limitations of the LMS Algorithm, Learning-Rate Annealing Schedules.

Text 1: 3.1 to 3.13 **11Hrs**

UNIT – IV

Multilayer Perceptrons: Introduction, Some Preliminaries, Batch Learning and On-Line Learning, The Back-Propagation Algorithm, XOR Problem, Heuristics for Making the Back-Propagation Algorithm Perform Better, Computer Experiment: Pattern Classification, Back Propagation and Differentiation, The Hessian and Its Role in On-Line Learning, Optimal Annealing and Adaptive Control of the Learning Rate, Generalization, Approximations of

Functions, Cross-Validation, Complexity Regularization and Network Pruning, Virtues and Limitations of Back-Propagation Learning, Supervised Learning Viewed as an Optimization Problem, Convolutional Networks, Nonlinear Filtering, Small-Scale Versus Large-Scale Learning Problems.

Text 1: 4.1 to 4.19 **11Hrs**

UNIT – V

Kernel Methods and Radial-Basis Function Networks: Introduction, Cover's Theorem on the Separability of Patterns, The Interpolation Problem, Radial-Basis-Function Networks, K-Means Clustering, Recursive Least-Squares Estimation of the Weight Vector, Hybrid Learning Procedure for RBF Networks, Computer Experiment: Pattern Classification, Interpretations of the Gaussian Hidden Units, Kernel Regression and Its Relation to RBF Networks,

Support Vector Machines: Introduction, Optimal Hyperplane for Linearly Separable Patterns, Optimal Hyperplane for Nonseparable Patterns, The Support Vector Machine Viewed as a Kernel Machine, Design of Support Vector Machines, XOR Problem, Computer Experiment: Pattern Classification, Regression: Robustness Considerations, Optimal Solution of the Linear Regression Problem, The Representer Theorem and Related Issues.

Text 1: 5.1 to 5.10 , 6.1 to 6.10 **10Hrs**

TEXT BOOK:

1. **"Neural Networks and Learning Machines",** Third Edition by Simon Haykin, Pearson.
   2008 ISBN-13: 978-0-13-147139-9 ISBN-10: 0-13-147139-2

REFERENCE BOOK:

1. **"Artificial Neural Networks"** by B. Yegnanarayana Prentice-Hall of India Private Limited.
   2005 ISBN-81-203-1253-8

D. Course Outcomes

CO #	Course Outcome	Program Outcome Addressed (PO #) with BTL
CO1	**Summarize** the working of Neuralnets and Learning Algorithms	**PO2(L2)**
CO2	**Model** the systems using Linear Regression with RMSE and MAP	**PO3(L2)**
CO3	**Apply and Choose appropriate** learning methods to the given application.	**PO3(L3)**
CO4	**Design** Neural nets with appropriate structures and learning method.	**PO3(L1)**
CO5	**Understand** and I**nterpret** functioning and algorithms used in Machine learning.	**PO1, PO4(L2)**

E. 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	PSO 2
#1		**2**											**2**	
#2			**2**											**2**
#3			**2**											
#4			**2**											**2**
#5	**2**			**2**									**2**	**2**

A. Course Plan – Program Elective			
Course Title : **Algorithms for VLSI Physical Design Automation**			
Course Code: **P15EC824**	Semester : **VIII**	L-T-P: 4 – 0 – 0	Credits: 3
Contact Period : Lecture :52 Hr, Exam: 3Hr		Weight age: CIE:50% SEE:50%	

B. Course Learning Objectives (CLOs)

This course aims to

1. Study various physical design methods in VLSI
2. Describe the fabrication process and its impacts on physical design.
3. Describe the concept behind the VLSI design rules and routing techniques.
4. Explain various algorithms techniques in physical design.
5. Outline the concept of compaction algorithm.
6. Discuss the physical design automation of FPGA

C. Course Content

UNIT I

VLSI Physical Design Automation: VLSI Design Cycle, New Trends in VLSI Design Cycle, Physical Design Cycle, Design Styles, System Packaging Styles.

Design and Fabrication of VLSI Devices: Fabrication Materials, Transistor fundamentals, Fabrication of VLSI Circuits, Design Rules, Layout of Basic Devices.

Text 1: 1.1 to 1.6, 2.1 to 2.5 **11Hrs**

UNIT II

Fabrication process and its impact on Physical Design: Scaling methods, Status of Fabrication process, issues related to the fabrication process (Except – Aggressive projections for the process, other process innovation).

Data Structures and Basic Algorithms: Basic Terminology, complexity issues and NP-hardness, Basic Algorithms, Basic Data structures.

Text 1: 3.1 to 3.4, 4.1 to 4.4 **11Hrs**

UNIT III

Partitioning: Problem formulation, classification of partitioning algorithms, group migration algorithms, simulated annealing and evolution.

Floor planning and pin assignment: Floor planning, Chip planning, Pin Assignment.

Placement: Problem formulation, Classification of Placement algorithms, simulation based placement Algorithms.

Text 1: 5.1 to 5.4, 6.1 to 6.3, 7.1 to 7.3 **10Hrs**

UNIT IV

Global Routing: Problem formulation, Classification of Global Routing, Maze Routing Algorithms, Shortest path based algorithms, Integer programming based approach.

Compaction: Problem formulation, Classification of Compaction algorithms, one dimensional Compaction, Two dimensional Compaction, Hierarchical Compaction, Recent trends in compaction.

Text 1 : 8.1 to 8.3, 8.5, 8.7 , 12.1 to 12.3, 12.5 to 12.7 **10Hrs**

UNIT V

Clock and Power Routing: clock Routing, clocking schemes, design consideration for the clocking system, problem formulation, clock routing algorithms, skew and delay reduction by pin assignment, multiple clock routing, power and ground routing.

Physical Design automation of FPGAs: FPGA technologies, Physical Design cycle for FPGAs, Partitioning, and Routing.

Text 1: 11.1, 11.2, 13.1 to 13.4 **10Hrs**

TEXT BOOK:

1. **"Algorithms for VLSI Physical Design Automation"**, N. A. Shervani, 1999. 3rd Edition ISBN 0-7923-8393-1

REFERENCE BOOKS:

1."Algorithms for VLSI Design Automation", Sabih H. Gerez, 2000. ISBN: 9780471984894, 0471984892

2.**"Handbook of Algorithms for Physical design Automation",** Charles J. alpert, Dinesh p. Mehta, Sachin S. Sapatnekar. ISBN: 9780849372421, 0849372429

D. Course Outcome

CO #	Course Outcome	Program Outcome Addressed (PO #) with BTL
CO1	To **Apply** the basic knowledge of physics, logic design, HDL and MOS Transistor theory in various stages of physical design of VLSI circuits.	**PO1, L2**
CO2	To **Understand** compaction theory and fabrication process on physical design.	**PO1, L1**
CO3	To **Analyze** and **compare** different algorithms in physical design of VLSI circuits.	**PO2, L4**
CO4	To **Analyze** and optimize various logical networks.	**PO2, L4**
CO5	To **Construct** physical layout for a given scenario.	**PO3,L5**

E. Course Articulation Matrix (CAM)

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

A. Course Plan – Program Elective			
Course Title : **Advanced Wireless Technologies**			
Course Code: **P15EC831**	Semester : **VIII**	L-T-P: 4 – 0 - 0	Credits: 3
Contact Period : Lecture :52 Hr, Exam: 3Hr		Weight age: CIE:50% SEE:50%	

B. Course Learning Objectives (CLOs)

This course aims to

1. Analyze the various (4G,5G) advanced wireless technologies.
2. Describe LTE architecture, users equipments, communication protocols and standardization of LTE.
3. Describe the basic network architectures, equipments, 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. Analyse the working, fundamental techniques and protocols used by device to device (D2D), machine to machine communication (M2M).
6. Analyse and contrast advanced wireless technologies, wireless devices.

C. Course Content

UNIT-I

An introduction to LTE, LTE-advanced, 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, The 3GPP Specifications for LTE

LTE SAE and VoLTE: High-Level Architecture of LTE, User Equipment, Evolved UMTS Terrestrial Radio Access Network, Evolved Packet Core Communication Protocols, The IP Multimedia Subsystem, VoLTE, Rich Communication Services.

Text 2:1.1-1.6, 2.1 to 2.5, 22.1 **10Hrs**

UNIT-II

LTE Standardization: Overview of 3GPP Releases and Process,LTE Targets , LTE Standardization Phases. **Introduction to OFDMA and SC-FDMA and to MIMO in LTE** Introduction, LTE Multiple Access Background, OFDMA Basics, SC-FDMA Basics, MIMO Basics.

LTE Physical Layer: Introduction , Transport Channels and their Mapping to the Physical Channels, Modulation, Uplink User Data Transmission, Downlink User Data Transmission. **Text 1: : 2.1-2.4, 4.1-4.5, 5.1-5.5** **10Hrs**

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 connected devices and wide requirements, Global initiatives, Standardization activities

5G use cases and system concept: Use cases and requirements, 5G system concept- Concept overview ,Extreme mobile broadband, Massive machine-type communication, Ultra-reliable machine-type communication, Dynamic radio access network ,Lean system control plane, Localized contents and traffic flows , Spectrum toolbox.

Text 3 1.1-1.5, 2.1-2.2 **11Hrs**

UNIT-IV

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

Spectrum: Spectrum for 4G, Spectrum challenges in 5G, 5G spectrum landscape and requirements, Spectrum access modes and sharing scenarios, 5G spectrum technologies.

Text 3: 3.1-3.4, 12.1-12.4 **10 Hrs**

UNIT-V

Machine-type communications: Introduction, Fundamental techniques for MTC- Data and control for short packets Non-orthogonal access protocols, Massive MTC-Design principles, Technology components , Summary of mMTC features, , Ultra-reliable low-latency MTC

Device-to-device (D2D) From 4G to 5G , D2D standardization: 4G LTE D2D , 5G: research challenges, Radio resource management for mobile broadband, RRM techniques for mobile broadband D2D, Multi-hop D2D communications for proximity and emergency services-National security and public safety requirements in 3GPP and METIS , Device discovery without and with network assistance, Network-assisted multi-hop D2D communications , Radio resource management for multi-hop D2D, Performance of D2D communications in the proximity communications scenario , Multi-operator D2D communication

Text 3:4.1-4.5, 5.1-5.5 **11Hrs**

TEXT BOOKS:

1. **LTE for UMTS : Evolution to LTE-Advanced** / edited by Harri Holma, Antti Toskala. – Second Edition, 2011, ISBN 978-0-470-66000-3.
2. "**An Introduction to LTE LTE, LTE-Advanced, SAE, VOLTE and 4G Mobile Communications**" Second Edition Christopher Cox Director, Chris Cox Communications Ltd, UK,2014.
3. **"5G mobile and Wireless Communications Technology"** Afif Osseiran, Ericsson, Jose F. Monserrat, Polytechnic University of Valencia, Patrick Marsch, Nokia Networks. New York : Cambridge University Press, 2016. LCCN 2015045732 | ISBN 9781107130098 (hardback)

REFERENCE BOOKS:

1. **"Smart Device to Smart Device Communication"** Shahid Mumtaz, Jonathan Rodriguez , Aveiro, Portugal , Springer Cham Heidelberg New York Dordrecht London, ISBN 978-3-319-04962-5
2. Vijay. K.Garg, **"Wireless Communications and Networking"**, Morgan Kaufman Publishers, 2014. ISBN: 978-81-312-1889-1
3. Clint Smith. P.E., and Daniel Collins, **—3G Wireless Networks‖**, 2nd Edition, Tata McGraw Hill, July 2017. ISBN-13: 978-0070636927
4. Theodre .S. Rappaport, **"Wireless Communications- Principles and Practice"**, Pearson, 2nd Edition, 2010. ISBN-13: 978-81-317-3186-4
5. Gary. J. Mullet, **"Introduction to Wireless Telecommunications Systems and Networks"**, Cengage Learning, 2010. ISBN-13: 978-81-315-0559-5

D. Course Outcome

CO #	Course Outcome	Program Outcome Addressed (PO #) with BTL
CO1	To **Apply** knowledge of digital communication to understand modulation techniques and evolution of various wireless technologies	**PO1 [L3]**
CO2	To **Analyze** network architectures, equipments, methodologies, specifications and topologies used by various wireless technologies.	**PO2 [L3]**
CO3	To **Analyse** 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 for communication by LTE, 4G and 5Gtechnologies	**PO5[L2]**
CO5	To **Inspect** and **contrast** various advanced wireless technologies, wireless components and devices.	**PO3 [L4],PO4[L2]**

E. 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
#4					2									2
#5			3	2										2

A. Course Plan – Program Elective			
Course Title: **Biomedical Signal Processing**			
Course Code: **P15EC832**	Semester: **VIII**	L – T – P : 4 – 0 - 0	Credits: 3
Contact Period - Lecture:52Hrs.;Exam: 3Hrs.		Weightage: CIE: 50% SEE: 50%	

B. Course Learning Objectives (CLOs):

This Course aims to:

1. To 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. Introduce the practical implementation of signal processing techniques to digitally acquired biomedical signals.

C. Course Content

UNIT - I

Introduction: The nature of Biomedical Signals, The Brain and its potentials, the Electrophysiological Origin of Brainwaves, The EEG signal and its characteristics, Basic Electrocardiography, Origin of the ECG, ECG Data Acquisition, ECGLead system, Examples of other Biomedical Signals, objectives of Biomedical Signal analysis, Difficulties in Biomedicalsignal analysis, computer – aided diagnosis, Types of noise, Illustration of noise effects.

Text 2:1.1,4.1,4.2,4.3,7.1,7.2,7.3, 3.1, 3.2.2, 3.2.3, 3.2.4, 3.2.5, 3.2.7 11Hrs

UNIT – II

Time Domain and Frequency Domain Filtering – : Time domain filters, Frequency – Domain Filters, Review of Butterworth filters, Removal of noise using Butterworth filters

Text 2: 3.3, 3.4 10Hrs

UNIT -III

Adaptive Filtering and Data Reduction Techniques : A review of Weiner Filtering Problem, Principle of an Adaptive filter, The steepest Descent Algorithm, TheWindrow – Hoff Least – Mean – square Adaptive algorithm, Adaptive Noise Canceller.Case studies, Direct Data Compression Techniques, Direct ECG data compression Techniques, Transformation Compression Techniques, Other Data Compression Techniques, Compression of Data Compression Techniques

Text 1:6.1, 6.2, 6.3, 6.4, 6.5, 6.6, 8.1, 8.2, 8.3,8.4,8.5 11Hrs

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, Arrthmia Analysis Monitoring, Long – term continuous Monitoring.

Text 1:4.4, 4.5, 4.6, 4.7, 4.8, 4.9, 7.4, 7.5, 7.6, 7.7 **10Hrs**

UNIT – V

Modeling Event related Potentials: Exponential modeling, Exponential Parameter estimation, The original Prony Problem. Least Squares Prony Methods, The covariance method of Linear Prediction, Prony's Method in the presenceof noise, Clinical application of Prony's Method.

Text 1: 9.1, 9.2, 9.3, 9.4, 9.5, 9.6, 9.7 **10Hrs**

Text Books:

1. D.C Reddy – **Biomedical Signal Processing: Principles and Techniques** – TataMcGraw – Hill Publishing CompanyLimited – ISBN-13:978-0-07-058388-7 (chapters 4, 6, 7, 8, 9)
2. Rangaraj M Ragayyan – **Biomedical Signal Analysis:** A Case – Study Approach – John Wiley & Sons – ISBN-0-471-20811-6 (chapters 1 & 3)

Reference Books:

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

D. Course Outcome

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**

E. 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	**3**												**3**	
#3	**3**												**3**	
#4		**3**												**3**
#5				**2**										

A. Course Plan – Program Elective			
Course Title :**Microelectromechanical Systems**			
Course Code: **P15EC833**	Semester : **VIII**	L-T-P: 4 – 0 - 0	Credits: 3
Contact Period : Lecture :52 Hr, Exam: 3Hr		Weight age:CIE:50% SEE:50%	

B. Course Learning Objectives (CLOs)

This course aims to

1. Gain the physical knowledge underlying the operation principles of Microelectromechanical systems.
2. Be familiar with the different MEMS fabrication techniques.
3. Understand the operation of micro devices.
4. Gain the knowledge of integration and packaging of MEMS.
5. Discuss few micro sensors and actuators.

C. Course Content

UNIT – I

MEMS: Microfabrications for MEMS, microsensing for MEMS

MEMS materials and fabrication techniques: Metals, semiconductors, thin films for MEMS and their deposition techniques, bulk micromachining forsilicon-based MEMS, silicon surface micromachining

Text 1: 1.3, 1.5, 2.1, 2.2, 2.3, 2.5, 2.6 **10Hrs**

UNIT – II

RF MEMS switches and micro relays: Switch parameters, Actuation mechanisms for MEMS devices - Electrostatic switching.

MEMS inductors and capacitors: Introduction, MEMS/micromachined passive elements: pros and cons, MEMS inductors – Self-inductance and mutual inductance, micromachined inductors, Folded inductors, variable inductors. MEMS capacitors – MEMS gap tuning capacitors.

Text 1: 3.2, 3.5.1, 4.1, 4.2, 4.3.1, 4.3.2, 4.3.6, 4.3.8, 4.4.1 **10Hrs**

UNIT – III

Micromachined RF filters: Introduction, micromechanical filters, Surface acoustic wave filters, bulk acoustic wave filters, micromachined filters for millimeterwave frequencies.

Micromachined phase shifters: Introduction, types of phase shif tersand their limitations, MEMS phase shifters - Switched delay line phase shifters, Distributed MEMS phase shifters, Ferroelectric phase shifters - Distributed parallel plate capacitors, Inter digital capacitor phase shifters.

Text 1: 5.1, 5.3, 5.4, 5.5, 5.6, 6.1, 6.2, 6.3.1, 6.3.2, 6.4.1, 6.4.3 **10Hrs**

UNIT – IV

Micromachined transmission lines and components: Introduction, micromachined transmission lines, Design, fabrication and measurement.

Micromachined antennas: Introduction, Overview of microstrip antennas, micromachining techniques to improve antenna performance, micromachining as a fabrication process for small antennas, micromachined reconfigurableantennas.

Text 1: 7.1, 7.2, 7.3, 8.1, 8.2, 8.3, 8.4, 8.5 **11Hrs**

UNIT – V

Integration and packaging for RF MEMS devices: Introduction, Role of MEMS packages, Types of MEMS packages, Flip-chip assembly, multichip module packaging, RF MEMS packaging: reliability issues, Thermal issues.

Introduction to microsystems: Why miniaturization, microsystems versus MEMS, Why microfabrication, smart materials, structures and systems, integrated microsystems.

Micro sensors and actuators: Silicon capacitive accelerometer, piezoresistive pressure sensor, conductometric gas sensor, electrostatic comb drive, magnetic microrelay, portable blood analyzer, piezoelectric inkjet print head, Micromirror array for video projection.

Text 1: 9.1, 9.2, 9.3, 9.4, 9.5, 9.6, 9.7
Text 2: 1.1, 1.2, 1.3, 1.4, 1.5, 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8 **11Hrs**

TEXT BOOKS:

1. V K Varadan, K J Vinoy, K. A. Jose, **"RF MEMS and their Applications",** John Wiley, 2003. ISBN:9780470843086
2. G. K. Ananthasuresh, K. J. Vinoy, S. Gopalakrishnan, K. N. Bhat, V. K. Aatre, **"Micro and Smart Systems",** Wiley India, 2010. ISBN:9788126527151

REFERENCE BOOKS:

1. T R Hsu, **"MEMS and Microsystems Design and Manufacturing",** Tata McGraw Hill, 2nd Edition, 2008. ISBN:9780071130516
2. Chang Liu, **"Foundations of MEMS",** Pearson International Edition, 2006. ISBN:9780132497367
3. S. D. Senturia, **"Micro System Design",** Springer International Edition, 2001. ISBN:9780306476013

D.Course Outcome

CO #	Course Outcome	Program Outcome Addressed (PO #) with BTL
CO1	**Apply** the knowledge of physics to understand operation principles of MEMS and its fabrication	**PO1 (L3)**
CO2	**Analyze** the operation of MEMS devices	**PO2(L4)**
CO3	**Design** the solutions for various MEMS devices	**PO3(L5)**
CO4	**Examine** micromachined devices such as filters, phase shifters, transmission lines and antennas	**PO2(L4)**
CO5	**Inspect** different MEMS sensors and actuators	**PO1,PO2 (L4)**

E.Course Articulation Matrix (CAM)

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
#1	**3**												**3**	
#2	**2**	**3**											**2**	**3**
#3	**2**		**3**										**2**	
#4		**3**												**3**
#5	**2**	**2**											**2**	**2**

A. Course Plan – Program Elective			
Course Title: **Stochastic Models and Applications**			
Course Code: **P15EC834**	Semester : **VIII**	L-T-P: 4 – 0 - 0	Credits: 3
Contact Period : Lecture :52 Hr, Exam: 3Hr	Weight age: CIE:50% SEE:50%		

B. Course Learning Objectives (CLOs)

This course aims to

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

C. 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**

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 **11Hrs**

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**

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**

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 **11Hrs**

TEXT BOOK:

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

REFERENCE BOOKS:

1.B. R. Bhat: **Stochastic Models Analysis and Applications**, New Age International, 2000, ISBN 81-224-1228-9

2. Scott L. Miller, Donald G. Childers: **Probability and Random Processes with Applications to Signal Processing and Communications**, Elsevier, 2004, ISBN: 978-0-12-386981-4

D. Course Outcome

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 Markov chains and queuing theory.	**PO2 [L2]**
CO4	To **Formulate** and solve problems which involve setting up stochastic models.	**PO3 [L1,L3]**

E.Course Articulation Matrix (CAM)

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

A. Course Plan- Open Elective			
Course Title: **Wireless Sensor Networks**			
Course Code:**P15EC841**	Semester: **VIII**	L – T – P : 4– 0 - 0	Credits: 3
Contact Period - Lecture:52Hrs.;Exam: 3Hrs.		Weightage: CIE: 50% SEE: 50%	

B. Course Learning Objectives (CLOs):

This Course aims to:

1. Provide an understanding of common wireless sensor node architectures.
2. Understand multi hop communication
3. Discuss various applications of wireless sensor architectures.
4. Describe current technology trends for the implementation and deployment of wireless sensor networks.
5. Discuss the general issues of sensor network design
6. Understand different types of wireless sensor network
7. Provide an overview of challenges and design constraints involved in Wireless sensor network
8. Provide an overview of different types of WSN.
9. Understand Localization with respect to WSN.
10. Understand different requirements of wireless communication

C .Course Content

UNIT – I

Overview of Wireless Sensor Networks: Introduction: Sensor Mote Platform-Low-End Platform, High-End Platform, Standardization Efforts, Software. WSN Architecture and Protocol Stack: Physical Layer, Data Link Layer, Network Layer, Transport Layer, Application Layer. **WSN Applications-** Military Applications, Environmental Applications, Health Applications, Home Applications

Text 1 : chapter 1 and chapter 2 **10Hrs**

UNIT – II

WSN Design Constraints and Challenges: Hardware Constraints, Fault Tolerance, Scalability, Production costs, WSN Topology- Pre-deployment and Deployment Phase , Post-deployment Phase, Re-deployment Phase of additional nodes, Transmission Media, Power Consumption- Sensing, Data Processing, Communication. Grand Challenges: Integration of Sensor Network and the Internet, Real-Time and Multimedia Communication, Protocol Stack, Synchronization and Localization, WSNs in Challenging environments

Text 1: 3.1 -3.7 , 18.1-18.5 **10 Hrs**

UNIT – III

Wireless Multimedia Sensor Networks: Design Challenges, Network Architecture- Single Tier Architectures, Multi-tier Architecture, Coverage, Multimedia Sensor Hardware- Audio Sensors, Low Resolution Video Sensors, Medium-Resolution Video Sensors, Examples of Deployed Multimedia Sensor Networks, Physical Layer(TH-IR-UWB, MC-UWB, Distance Measurement through UWB), MAC layer (FRASH,RICH,MIMO TECHNOLOGY), Error Control, Network Layer(MMSPEED), Transport Layer- Multihop buffering and Adaptation, Error Robust Image Transport, Application Layer- Traffic Management and Admission Control, Multimedia Encoding Techniques, Still image Encoding, Cross-Layer Design.

Text 1: 15.1 -15.10 **11 Hrs**

UNIT – IV

Wireless Underwater Sensor Networks: Design Challenges- Terrestrial Sensor Networks vs. Underwater Sensor Networks, Real-Time Networking vs. Delay-Tolerant Networking,

Underwater Sensor Network Components, Communication Architecture, The 2-D UWSNs, The 3-D UWSNs ,Sensor Networks with AUVs , Basics of Underwater Acoustic Propagation, Physical Layer, MAC Layer , Network Layer, Transport Layer, Application Layer, Cross-Layer Design.

Text 1: 16.1 -16.10 **11 Hrs**

UNIT – V

Wireless Underground Sensor Networks : Applications, Design Challenges in Underground Wireless Sensor network, Network Architecture-WUSNs in soil, WUSNs in mines and Tunnels, Underground Wireless Channel for EM waves- Underground Channel Properties, Effect of Soil Properties on the Underground Channel ,Soil Dielectric Constant, Underground Signal Propagation ,Reflection from Ground Surface ,Multi-path Fading and Bit Error Rate , Underground Wireless Channel for Magnetic Induction- MI Channel Model, MI Waveguide, Characteristics of MI Waves and MI Waveguide in Soil , Wireless Communication in Mines and Road/Subway Tunnels

Text 1: 17.1 -17.6 **10Hrs**

TEXT BOOKS:

1. "Wireless Sensor Networks", Ian F. Akyildiz , Mehmet Can Vuran, John Willey, 2010 ISBN : 978-0-470-03601-3

REFERENCE BOOKS:

1. "Protocols and Architectures for Wireless Sensor Networks", Holger Karl & AndressWillig, John Willey, 2005, ISBN: 9788126533695, 8126533692

2.**"Wireless sensor networks–An information processing Approach**",Feng Zhao & Leonidas.J. Guibas, Elsevier, 2007, ISBN: 9781558609143, 1558609148

3. "Wireless sensor networks technology, protocols and Applications", KazemSohraby, Daniel Minoli, & TaiebZnati, John Wiley, 2007, ISBN: 9788126527304, 8126527307

4. **"Wireless Sensor Network Designs"**,Anna Hac, John Wiley, 2003, ISBN: 9783639276282, 3639276280

D.Course Outcome

CO #	Course Outcome	Program Outcome Addressed (PO #) with BTL
CO1	**Apply** fundamentals of Computer communication networks to understand characteristics of different types of Wireless sensor networks	**PO1 [L3]**
CO2	**Identify** challenges and design Constraints involved in different types of Wireless sensor network	**PO1,PO2[L3]**
CO3	**Analyze** different Sensors for Wireless sensor network	**PO2 [L3]**
CO4	**Analyze** different Cross Layer design strategies and its effect on performance	**PO2 [L2]**
CO5	**Analyze** different wireless channels for Electromagnetic wave propagation	**PO2[L2]**

E.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	PO12	PS O1	PS O2
#1	**3**												**3**	
#2	**2**	**2**												**2**
#3		**2**												**2**
#4		**2**												**2**
#5		**2**												**2**

A. Course Plan – Open Elective			
Course Title: **Embedded Systems**			
Course Code: **P15EC842**	Semester: **VIII**	L – T – P : 4 – 0 - 0	Credits: 3
Contact Period - Lecture: 52 Hrs.; Exam:3 Hrs.	Weightage: CIE: 50%; SEE: 100%		

B.Course Learning Objectives (CLO's)

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 concepts of real time operating system based embedded systems.
7. Describe the Design and Development of Embedded Firmware.

C.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.

Text1:1.1 to 1.7, 2.1 to 2.6 10Hrs

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, Introduction to Unified Modeling Language, Hardware Software Trade-offs.

Text1: 3.1, 3.2, 4.1, 4.2, 7.1 to 7.4 11Hrs

UNIT III

Embedded Firmware Design and Development: Embedded Firmware Design Approaches, Embedded Firmware Development Languages

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,

Text 1: 9.1, 9.2, 10.1 to 10.9 10 Hrs

UNIT IV

The Embedded System Development Environment: The Integrated Development Environment (keil microvision 3 for illustration only), Types of Files Generated on Cross compilation, Disassembler/Decompiler, Simulators, Emulators and Debugging, Target Hardware Debugging, Boundary Scan.

Text1: 13.1 to 13.6 10 Hrs

UNIT V

The Embedded Product Development Life Cycle (EDLC): what is EDLC, why EDLC, Objectives of EDLC, Different phases of EDLC, EDLC Approaches (Modeling the EDLC)

Trends in the Embedded Industry: Processor Trends in Embedded System, Embedded OS Trends, Development Language Trends, Open Standards, Frameworks and Alliances, Bottlenecks.

Text1: 15.1 to 15.5, 16.1 to 16.5 **11 Hrs**

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

D.Course Outcomes (COs):

CO#	Course Outcomes	Program Outcome Addressed(PO#) with BTL
CO1	**Apply** the knowledge of Microcontrollers to understand & explain the concepts of Embedded systems.	**PO1 (L1,L2)**
CO2	**Analyse** and understand the different issues involved in embedded system development using real time operating systems.	**PO2 (L2)**
CO3	**Design** and **Develop** domain specific Embedded system applications.	**PO3 (L5)**
CO4	**Discuss** recent trends and overview in the Design of Embedded systems.	**PO3 (L3)**

E.Course Articulation Matrix (CAM)

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

A. Course Plan- Open Elective			
Course Title: **Internet of Things and Applications**			
Course Code: **P15EC843**	Semester: **VIII**	L – T – P : 4 – 0 - 0	Credits: 3
Contact Period - Lecture: 52 Hrs.; Exam:3 Hrs.		Weightage: CIE: 50%; SEE: 50%	

B. Course Learning Objectives (CLO's)

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. Explain the Standard of the IOT
5. To learn about the IOT Platforms design Methodology and logical design of IOT system using Python
6. To develop IOT applications using Raspberry Pi and apply Cloud services for IOT systems

C.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, Internet of things application examples: Overview, Smart metering /Advanced metering infrastructure, e-health/ Body area networks, City Automation, Automotive Applications, Home Automation, Smart Cards, Tracking.

Text 1: 1.1, 1.2, 1.3, 1.4, 1.5

Text 2: 3.1, 3.2, 3.3, 3.4, 3.5, 3.6, 3.7, 3.8. **11 Hrs**

UNIT-II

Fundamental IOT Mechanism and Key Technologies: Identification of IOT objects and services, structural aspects of the IOT, Key IOT Technologies, Evolving IOT standards overview and approaches, IETF IPv6 routing protocol for RPL Roll, Constrained application protocol, Representational state transfer, ETSI M2M, Third generation partnership Project service requirement for machine type communication, CENE\EC, IETF IPv6 over lower power WPAN, Zigbee IP(ZIP), IPSO(IP in smart object).

Text 2: 4.1, 4.2, 4.3, 5.1, 5.2, 5.3, 5.4, 5.5, 5.6, 5.7, 5.8, 5.9, 5.10. **10Hrs**

UNIT -III

Layer ½ Connectivity: Wireless technologies for the IOT, WPAN technologies for IOT/M2M, Cellular and mobile network technologies for IOT/M2M. Layer3 Connectivity, IPv6 technologies for the IOT: Overview and Motivations, Address Capabilities, IPv6 protocol Overview, IPv6 Tunelling, Ipsec in IPV6 Header Compression Schemes, Quality of service in IPv6, Migration Strategies to IPv6.

Text 2: 6.1, 6.2, 7.1, 7.2, 7.3, 7.4, 7.5, 7.6, 7.7. **10Hrs**

UNIT-IV

IOT Platforms Design Methodology: Introduction, IOT design methodology, Case Study on IOT System for Weather Monitoring, Motivation for using Python, 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: 5.1, 5.2, 5.3, 5.4, 6.1, 6.3, 6.4, 6.5, 6.6, 6.7, 6.8, 6.9, 6.10. 10Hrs

UNIT-V

IOT physical devices and Endpoints: What is an IOT device, Raspberry Pi, About the board, Linux on Raspberry Pi, Raspberry Pi interfaces.

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. Case Studies illustrating IOT design: Home Automation.

Text 1: 7.1, 7.2, 7.3, 7.4, 7.5, 8.1, 8.2, 8.3, 8.4, 9.1, 9.2. 11 Hrs

TEXT BOOK:

1. **A Hands-on Approach,** Arshdeep Bahga and Vijay Madisetti, Internet of Things, Universities Press, 2015. , ISBN:978-81-7371-954-7.
2. **Daniel Minoli, Building the Internet of Things with IPv6 and MIPv6**:The Evolving World of M2M Communications, Wiley, 2013 ISBN:9781118473474.

REFERENCE BOOK:

1. Michael Miller, **The Internet of Things**, First Edition, Pearson, 2015.
2. Claire Rowland, Elizabeth Goodman et.al., Designing Connected Products, First Edition, O'Reilly, 2015
3. Matt Richardson & Shawn Wallace, "**Getting Started with Raspberry Pi"**, O'Reilly (SPD), 2014
4. Michael McRoberts "**Beginning Arduino" ,** Technology in action 2nd edition.

D.Course Outcomes (COs):

CO#	Course Outcomes	Program Outcome Addressed(PO#) with BTL
CO1	**Understands** the essentials of IOT	**PO1(L3)**
CO2	**Analyze** the Concept of Web services to access/control IOT devices	**PO2(L4)**
CO3	**Examine** the design methodology of IOT and logical design using Python	**PO1,PO2(L3)**
CO4	**Develop** a Portable IOT using Raspberry PI	**PO2(L4),PO3(L4)**
CO5	**Identify** Physical devices required to deploy on IOT application and connect to the cloud for real time scenarios.	**PO2(L4)**

E. 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	PSO 1	PSO 2
#1	3												3	
#2		2												2
#3	2	3											3	2
#4		2	2											3
#5		3											2	

A. Course Plan – Open Elective			
Course Title : **Data Acquisition and Instrumentation**			
Course Code: **P15EC844**	Semester : **VIII**	L-T-P: 4 – 0 - 0	Credits: 3
Contact Period : Lecture :52 Hr, Exam: 3Hr		Weight age: CIE:50% SEE:50%	

B. Course Learning Objectives (CLOs)

This course aims to

1. Discuss the concepts of signal conditioning and data acquisition system
2. Compare the different types of electrical transducers with examples
3. Explain the different types of measurement errors– gross error, systematic error, instrumental error, Environmental error and Observational error
4. Differentiate between the DC and AC voltmeters
5. Analyze different types of digital voltmeter
6. Analyze the operation of ADC and different types of digital instruments.
7. Describe the operation of instrumentation amplifier and its applications.
8. Analyze the operation of different types of recorders.

C. 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

Text 1: 17.1 to 17.7 **10 Hrs**

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 **11Hrs**

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, AC Voltmeter Using Rectifiers, AC Voltmeter Using Half Wave Rectifier, AC Voltmeter Using Full Wave Rectifier, Peak Responding Voltmeter, True RMS Voltmeter.

Text 1: 1.1 to 1.7, 4.1 to 4.6, 4.12 to 4.14, 4.17, 4.18 **11 Hrs**

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 Tachometer, Digital pH Meter.

Text 1: 5.1 to 5.9, 5.11, 6.1 – 6.3, 6.9, 6.10 **10 Hrs**

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**

TEXT BOOKS:

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

REFERENCE BOOKS:

1. David A. Bell, **"Electronic Instrumentation and Measurements",** Oxford University Press, 3e, 2015
2. Cooper, Helfrick, **"Modern Electronic Instrumentation and Measuring Techniques"**, Prentice Hall of India.

D. Course Outcome

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	Ability to **analyze** the working principle of various electronic instruments.	**PO2, L4**
CO5	Ability to **design** a system for the desired specification in electronic instrumentation.	**PO3, L3**

E. 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	PSO 1	PSO 2
#1	**3**												**3**	
#2	**3**												**3**	
#3	**3**	**2**											**3**	**2**
#4		**3**												**3**
#5			**2**											**2**