RAMAIAH
Institute of Technology

CURRICULUM

for the Academic year 2021 – 2022

ELECTRONICS AND TELECOMMUNICATION ENGINEERING

V & VI SEMESTER B.E

RAMAIAH INSTITUTE OF TECHNOLOGY
(Autonomous Institute, Affiliated to VTU)
Bangalore – 560054.

About the Institute:

Dr. M. S. Ramaiah a philanthropist, founded 'Gokula Education Foundation' in 1962 with an objective of serving the society. M S Ramaiah Institute of Technology (MSRIT) was established under the aegis of this foundation in the same year, creating a landmark in technical education in India. MSRIT offers 17 UG programs and 15 PG programs. All these programs are approved by AICTE. All eligible UG and PG programs are accredited by National Board of Accreditation (NBA). The institute is accredited with **'A^{+}' grade by NAAC in March 2021** for 5 years. University Grants Commission (UGC) & Visvesvaraya Technological University (VTU) have conferred Autonomous Status to MSRIT for both UG and PG Programs since 2007. The institute is a participant to the Technical Education Quality Improvement Program (TEQIP), an initiative of the Government of India. The institute has 380 competent faculty out of which 60% are doctorates. Some of the distinguished features of MSRIT are: State of the art laboratories, individual computing facility for all faculty members, all research departments active with sponsored funded projects and more than 300 scholars pursuing Ph.D. To promote research culture, the institute has established Centre of Excellence for Imaging Technologies, Centre for Advanced Materials Technology, Centre for Antennas and Radio Frequency systems (CARFS), Center for Cyber Physical Systems & Schneider Centre of Excellence. **M S Ramaiah Institute of Technology has obtained "Scimago Institutions Rankings" All India Rank 65 & world ranking 578 for the year 2020.**

The Entrepreneurship Development Cell (EDC) and Section 8 company "Ramaiah Evolute" have been set up on campus to incubate startups. **M S Ramaiah Institute of Technology secured All India Rank 8th for the year 2020 for Atal Ranking of Institutions on Innovation Achievements (ARIIA), by MoE, Govt. of India.** MSRIT has a strong Placement and Training department with a committed team, a good Mentoring/Proctorial system, a fully equipped Sports department, large air-conditioned library with good collection of book volumes and subscription to International and National Journals. The Digital Library subscribes to online e-journals from Elsevier Science Direct, IEEE, Taylor & Francis, Springer Link, etc. MSRIT is a member of DELNET, CMTI and VTU E-Library Consortium. MSRIT has a modern auditorium and several hi-tech conference halls with video conferencing facilities. The institute has excellent hostel facilities for boys and girls. MSRIT Alumni have distinguished themselves by occupying high positions in India and abroad and are in touch with the institute through an active Alumni Association. **As per the National Institutional Ranking Framework (NIRF), MoE, Government of India, M S Ramaiah Institute of Technology has achieved 65th rank among 1143 top Engineering institutions of India for the year 2021 and is 1st amongst the Engineering colleges affiliated to VTU, Karnataka.**

About the department:

The Department of Electronics &Telecommunication Engineering (Formerly known as Department of Telecommunication Engineering) was established in 1996 to address the increasing demand for professionals with expertise in communication and networking technology in India. The Department has state of the art laboratories, equipment's, resources and committed faculty having best of the academic and industry recognition. The Department started a **M.Tech program in Digital Communication in the year 2004**. The Department also started a **Research Centre** in the year 2012 and currently has 12 Research Scholars carrying out their Research. Department has collaborations with some of the leading industries like **Ansys, Rohde & Schwarz, JV Micronics, Nokia, Huawei Technologies, Intel, Samsung,** and with leading national and international universities like **Bradley University, IIT-M**, enabling the department to focus on R&D, and thus providing new avenues for PG/UG students for placement and higher studies. Both UG and PG Programs are accredited by the **National Board of Accreditation**. There are **5 Funded Research projects** (Industry and Government) ongoing in the department involving students to carry out innovative projects. Many professional activities are organized regularly to the students under various professional societies like IEEE Sensor Council, IEEE Communication Society, IEEE Antenna and Propagation Society and IETE Bangalore.

The department of ETE has established the Centre of Excellence – **Centre for Antennas and Radio Frequency Systems (CARFS)** Jointly with ECE department on 24th March 2021 to engage in advanced Research leading to innovation in the areas of Antennas & RF Systems. The CARFS has the State of the art Facilities to collaborate with Researchers in other Institutions across the Country and World in various projects.

VISION OF THE INSTITUTE

To be an Institution of International Eminence, renowned for imparting quality technical education, cutting edge research and innovation to meet global socio-economic needs

MISSION OF THE INSTITUTE

RIT shall meet the global socio-economic needs through

- Imparting quality technical education by nurturing a conducive learning environment through continuous improvement and customization
- Establishing research clusters in emerging areas in collaboration with globally reputed organizations
- Establishing innovative skills development, techno-entrepreneurial activities and consultancy for socio-economic needs

QUALITY POLICY

We at Ramaiah Institute of Technology strive to deliver comprehensive, continually enhanced, global quality technical and management education through an established Quality Management System complemented by the synergistic interaction of the stake holders concerned

VISION OF THE DEPARTMENT

To provide an ambience for the students to excel in studies, research and innovation, focusing on meeting global socio-economic needs from a Telecommunication Engineering perspective

MISSION OF THE DEPARTMENT

- Providing high quality technical education to create world class Telecommunication engineers.
- Creating an ambience for skill development, research and entrepreneurial activities to meet socio-economic needs

PROGRAM EDUCATIONAL OBJECTIVES (PEOs):

PEO1: Graduates will excel in professional careers in Industry, Academic, Research and Development that meet the needs of Organizations.

PEO2: Graduates will be able to analyze real life problems and be able to suggest solutions to design complex engineering systems that are technically sound, economically feasible and socially acceptable.

PE03: Graduates will exhibit all-round education that includes communication skills, the ability |to function well in a team, an appreciation for ethical behavior and the ability to engage in lifelong learning.

PROGRAM OUTCOMES (POs):

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6: The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7: Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11: Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12: Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES (PSOs):

PSO1: Identify, analyze, formulate, design and demonstrate applications relevant to telecommunication engineering using electronic devices**.**

PSO2: Use current technology and modern tools to address solutions for telecommunication products by taking into account safety, healthy and environmental requirements.

PSO3: Apply project management tools to solve Telecommunication systems by exhibiting teamwork and lifelong learning.

Curriculum Course Credits Distribution

Batch 2019- 2023

Course Category/Semester	1	2	3	4	5	6	7	8	Total credits
Humanities, Social Sciences and Management (HSMC)		2			3		3		8
Basic Sciences (BSC)	9	8	4	4					25
Engineering Sciences (ESC)	11	10							21
Professional courses (PCC)-core			21	21	15	11	10		78
Professional Courses (PEC)-Elective					3	6	6		15
Other Open Elective Courses (OEC)					3	3			6
Project work (PROJ)/Internship (IN)						4	1	17	22
Total	20	20	25	25	24	24	20	17	175

SCHEME OF TEACHING

V SEMESTER

Sl. No.	Course Code	Course Name	Category	Credits				Contact Hours
				L	T	P	Total	
1.	ET51	Digital Signal Processing	PCC	3	1	0	4	5
2.	ET52	Communication Systems 1	PCC	3	1	0	4	5
3.	ET53	Embedded System Design	PCC	4	0	0	4	4
4.	ET54	Intellectual Property Rights	HSMC	3	0	0	3	3
5.	ETE551 /552/553	Professional Elective-1	PEC	3	0	0	3	3
6.	ETOE01	Open Elective – 1	OEC	3	0	0	3	3
7.	ETL56	Digital Signal Processing Lab	PCC	0	0	1	1	2
8.	ETL57	Communication Systems-1 Lab	PCC	0	0	1	1	2
9.	ETL58	Embedded System Design Lab	PCC	0	0	1	1	2
Total				**19**	**2**	**3**	**24**	**29**

Note: Minimum of 2 subject should have a tutorial component of 1 credit

List of Electives

ETE551	Internet of Things
ETE552	Operating Systems
ETE553	Mobile Communication Systems

Open elective offered by the Department

ETOE01 - Fuzzy logic systems and Applications

SCHEME OF TEACHING

VI SEMESTER

Sl. No.	Course Code	Course Name	Category	Credits				Contact Hours
				L	T	P	Total	
1.	ET61	Communication Systems 2	PCC	3	1	0	4	5
2.	ET62	Computer Communication Networks	PCC	3	1	0	4	5
3.	ETE631/ 632/633	Professional Elective-2	PEC	3	0	0	3	3
4.	ETE641/ 642/643	Professional Elective-3	PEC	3	0	0	3	3
5.	ETOE02	Open Elective -2	OEC	3	0	0	3	3
6.	ET65	Mini Project/ Professional Elective/ NPTEL Course	PROJ/PEC	*	*	*	4	*
7.	ETL66	Communication Systems-2 Lab	PCC	0	0	1	1	2
8.	ETL67	Computer Communication Networks Lab	PCC	0	0	1	1	2
9.	ETL68	DSP Systems Lab	PCC	0	0	1	1	2
Total				**15***	**2***	**3***	**24**	**25 + ***

Note: * depends on choice between Mini Project/ Professional Elective/NPTEL Course
Minimum of 2 subject should have a tutorial component of 1 credit

List of Electives

ETE631	Machine Learning	ETE641	Wireless Sensor Networks
ETE632	Digital System Design using Verilog	ETE642	Embedded Networks and Protocols
ETE633	DSP Algorithms and Applications	ETE643	Satellite Communication
ET65	Neural Networks and Fuzzy Logic		

Open elective offered by the Department

ETOE02 Communication Systems and Networks

V Semester

DIGITAL SIGNAL PROCESSING

Course Code: ET51 **Credit: 3:1:0**
Course coordinator: Dr B K Sujatha **Contact Hours: 42+28**

Course Content

UNIT 1

Discrete Fourier Transforms: Definition of DFT and its inverse, Properties of DFT: linearity, time shift, frequency shift, symmetry for real sequences, complex conjugate, circular folding, multiplication, circular correlation, inner product, or parseval's relation, linear filtering using DFT, signal segmentation method: overlap add, overlap save methods.

UNIT 2

Fast Fourier Transforms: FFT algorithms: direct computation of DFT, need for efficient computation of DFT (FFT algorithms), radix 2 FFT algorithms for computation of DFT, IDFT, decimation in time, decimation in frequency algorithms, Chirp Z transforms, Goertzel algorithm, relationship between DFT and other transforms. Frequency analysis of signals using DFT

UNIT 3

IIR Filters: Frequency domain specification of IIR filters, frequency transformations, magnitude response and frequency response of Butterworth filters, and its properties, determination of filter order and transfer function of Butterworth filters. Magnitude frequency response of Chebyshev filters, and its properties, determination of filter order and transfer function of Chebyshev filters. Design of Butterworth and Chebyshev filters, Structure of digital filters, BLT and its properties, Backward difference method, numerical solutions for differential equations, Impulse Invariant transforms, Matched Z transforms, Design of analog filter using Digital filter.

UNIT 4

FIR Filters: Need for FIR filters, Symmetry and Anti symmetry conditions for linear phase, design of FIR filters using -Rectangular, Hamming, Harming, Blackman, Bartlet and Kaiser windows, FIR filter design using frequency sampling technique.

UNIT 5

Realization of IIR & FIR Filters: Direct form I and Direct form II realization of an IIR filter, Cascade realization of an IIR filter, Parallel realization of an IIR filter, Direct form I realization of FIR filter, Realization of FIR filter with linear phase, Lattice realization of FIR filter.

TEXT BOOKS

1. Proakis & Monalakis, "Digital signal processing - Principles Algorithms & Applications", Pearson education, 4th Edition, New Delhi, 2007.

REFERENCES

1. Oppenheim & Schaffer, "Discrete Time Signal Processing", PHI, 2003.
2. S. K. Mitra, "Digital Signal Processing", Tata Mc-Graw Hill, 2nd Edition, 2004.
3. Dr. D. Ganesh Rao, Vineeta P Gejji, "Digital Signal Processing", 3rd Edition, Centage learning Publications.

COURSE OUTCOMES(COs):

At the end of the course, students will be able to

1. Acquire the basic knowledge of signal processing and apply this to the solution of complex engineering problems using DFT, IDFT & FFT concept**. (PO 1, 2, 3, 4, 5, 9, 12) (PSO 1, 2)**
2. Design of standard IIR digital filters like Butterworth and Chebyshev using bilinear transformation method for low pass, high pass, bandpass, band stop applications. **(PO 1, 2, 3, 4, 5, 8, 9, 12) (PSO 1, 2)**
3. Design FIR filters to meet specific magnitude and phase requirements using different window techniques **(PO 1, 2, 3, 4, 5, 8, 9) (PSO 1, 2)**
4. Evaluate IIR and FIR filters using direct forms, cascade and parallel forms & lattice structures. **(PO 1, 2, 3, 4, 5, 8, 9, 10) (PSO 1, 2)**
5. Design and filter Implementation of different IIR and FIR filters and their realization using MATLAB **(PO 1, 2, 3, 4, 5, 8, 9) (PSO 1, 2)**

COMMUNICATION SYSTEMS - 1

Course Code: ET52 **Credit:3: 1: 0**

Course coordinator: Dr Parimala P **Contact Hours: 42+28**

Course Content

UNIT 1

Amplitude Modulation: Introduction to AM: Time domain description, Frequency domain description. Generation of AM wave: Square law modulator, switching modulator. Detection of AM waves: Square law detector, envelope detector; Frequency domain ad time domain description of DSBSC, Generation of DSBSC waves, ring modulator, coherent detection of DSBSC modulated waves.

Single Side-Band Modulation: Hilbert transform and its properties, canonical representation of band pass signals, SSB modulation, frequency domain and time domain description of SSBSC wave, Generation and detection of SSB waves. Frequency and time domain description of VSB wave, Generation and detection of VSB modulated wave.

UNIT 2

Angle Modulation (FM): Generation of FM waves: indirect FM and direct FM, frequency discrimination method, phase locked loop, non linear model of phase locked loop, linear model of the phase locked loop, non linear effect in FM systems.

Noise Basics And Noise In Continuous Wave Modulation Systems: Introduction to noise shot noise, thermal noise, white noise, noise equivalent bandwidth, noise figure, noise equivalent noise temperature, Cascade connection of two port network. Receiver model, Noise in AM receivers, Noise in FM receivers, pre-emphasis and de-emphasis in FM.

UNIT 3

Signal Sampling: Basic signal processing operations in Digital communication, Sampling Principles, Sampling Theorem, Practical aspects of sampling and signal recovery, PAM, TDM.

Waveform Coding Techniques: PCM block diagram, Different quantization techniques, SNR in PCM Robust quantization, DPCM, DM, Adaptive DM.

UNIT 4

Base-Band Shaping for Data Transmission: Line Codes and their power spectra.

Inter symbol interference: Introduction, Nyquist criterion for distortionless base-band binary transmission, correlative coding, duo binary coding, Eye pattern.

UNIT 5

Random Process:

Random Variables: Several Random Variables, Statistical averages: Function of Random Variables, moments, mean correlation and covariance function, principles of autocorrelation function, cross correlation functions, central limit theorem, properties of Gaussian process.

TEXT BOOKS

1. Simon Haykin, "Communication Systems" 3rd edition John Wiley, 2010.
2. Simon Haykins, "An Introduction to analog and Digital communications", John Wiley, 2010.

REFERENCES

1. B.P Lathi, "Modern Digital and Analog Communication Systems", 3rd edition 2011, Oxford University press.
2. Harold P.E Stern Samy and A Mahmoud, "Communication Systems", Pearson Education, 2009.
3. Singh and Spare, "Communication Systems: Analog and Digital", TMH 2nd edition, 2009

COURSE OUTCOMES (COs):

At the end of the course, students will be able to

1. Understand the concepts of various Analog modulation, Waveform Coding and Detection techniques. **(PO1, 2, 3, 4, 6, 7,9, 12) (PSO1, 2, 3)**
2. Apply and solve problems on Analog modulation, Waveform Coding and Random Process **(PO1, 2, 3, 4, 6,7, 9, 12) (PSO1, 2, 3)**
3. Analyze Analog modulation techniques, Noise in Continuous Wave Modulation Systems and Signal Sampling **(PO1, 2, 3, 4, 6,7, 9, 12) (PSO1, 2, 3)**
4. Analyze the Base-Band Shaping for Data Transmission, Detection, random process and its relevance in communication **(PO1, 2, 3, 4, 6,7, 9, 12) (PSO1, 2, 3)**
5. Design of analog and digital modulators and demodulators in communication systems **(PO1, 2, 3, 4, 6,7, 9, 12) (PSO1, 2, 3)**

EMBEDDED SYSTEM DESIGN

Course Code: ET53 **Credit: 4:0: 0**
Course coordinator: Dr S G Shivaprasad Yadav **Contact Hours: 56**

Course Content

UNIT 1

Embedded Systems: Introduction, Complex Systems and Microprocessors, Embedding Computers, Characteristics of Embedded Computing Applications, The Physics of Software, Challenges in Embedded Computing System Design, Performance in Embedded Computing, The Embedded System Design Process, Requirements, Specification, Architecture Design, Designing Hardware and Software Components, System Integration, Formalisms for System Design, Structural Description, Behavioral Description, Concept of Real time Systems, Model Train Controller, Requirements, DCC, Conceptual Specification, Detailed Specifications

UNIT 2

ARM Cortex M-series Processors Fundamentals and Instruction set: Introduction to ARM Embedded Systems, Introduction to ARM Cortex-M series Processor, Architecture versions, Instruction Set Development, The Thumb-2 Instruction Set Architecture (ISA), Cortex-M series Processor Applications, Overview of the Cortex-M3 and M4, Fundamentals, Registers, Special Registers, Operation Modes, The Built-In Nested Vectored Interrupt Controller, Exceptions and Interrupts, Vector Tables, Stack Memory Operations, Instruction Sets - Assembly Basics, Instruction set descriptions, useful instructions in Cortex M3 and M4, Barrel shifter, Accessing special instructions and special registers in programming

UNIT 3

ARM Cortex-M series Memory Systems, Implementation, Exceptions and NVIC: Memory System features overview, Memory Map, Memory access attributes, Memory access permission, Bit-Band operations, Unaligned transfers, Exclusive access, Endian mode, The Pipeline, Detailed Block Diagram, Bus Interfaces on the Cortex-M4, External Private Peripheral Bus, Debug Access Port Bus, Typical Connections, Reset Signals, Exception types, Definition of priorities, Vector Tables, Interrupt Inputs and Pending behavior, Fault exceptions, supervisor call and spendable service call, NVIC and Interrupt Control, Basic Interrupt Configuration, Interrupt Enable and Clear Enable, Interrupt Pending and Clear Pending, Example Procedures of Setting Up an Interrupt, Software Interrupts, the SYSTICK timer.

UNIT 4

ARM Cortex M-series Programming, Memory Protection Unit and other features:

Cortex-M3 Programming - Using Assembly, Using C, The Interface Between Assembly and C, A Typical Development Flow, Producing Outputs, Using Data Memory, Using Exclusive Access for Semaphores, Using Bit Band for Semaphores, Working with Bit Field Extract and Table Branch, Running a System with Two Separate Stacks, Double-Word Stack Alignment, Non-base Thread Enable, Performance Considerations, Lockup Situations, Overview of Memory Protection Unit, MPU Registers, Setting Up the MPU, The SYSTICK Timer, Power Management, Multiprocessor communication, Self-Reset control.

UNIT 5

Real Time Operating System: Fundamentals of RTOS, Features, characteristics of RTOS, Real Time Kernel and its Types, Tasks, Task states, State Transition Diagram, Tasks, Task Control Block (TCB), Multitasking, Context Switching, Foreground-Background Systems, Real Time Task Scheduling, Need and problems of shared data, Semaphores, Types of semaphores, Problems with semaphores, Deadlock, Priority Inversion and overcoming techniques, Inter-task communication - Message queues, Pipes, Signals, Overview of different types of RTOS - Features of VXWorks, Mucos.

TEXT BOOKS

1. Wayne Wolf, “Computers as Components Principles of Embedded Computer System Design”, Second Edition, Elsevier, 2008.
2. Joseph Yiu, “The Definitive Guide to the ARM Cortex-M3 and M4 processors”, Newnes Publications, 3rd edition, 2013
3. David E. Simon, “An Embedded Software Primer”, Addison- Wesley, 1999
4. Rajkamal, “Embedded Systems: Architecture, Programming and Design, Tata McGraw Hill, New Delhi, 2003.

REFERENCE BOOKS

1. Frank Vahid / Tony Givargis “Embedded System Design A Unified Hardware/Software Introduction” 1st Edition, John Wiley & Sons, 2002.
2. Dr. K.V. K. K.Prasad “Embedded Real Time Systems: Concepts Design and Programming”, Dreamtech Press New Delhi, 2003.
3. Arnold S.Berger, “Embedded System Design: An Introduction to Processes, Tools and techniques”, CMP Book, Dec 200l.
4. Andrew N. Sloss, Dominic Symes and Chris Wright, “ARM System Developer's Guide”, Morgan Kaufamnn (Elsevier Inc.), 2004

COURSE OUTCOMES (COs):

1. Describe the differences between the general computing system and the embedded system, characteristics, challenges, embedded design process, their applications and need for RTOS in embedded systems. **(PO 1, 2, 3, 4, 6, 7, 11, 12) (PSO 1, 2, 3)**
2. Evaluate the requirements of programming embedded systems, related hardware-software architectures, operating modes and tool chain for ARM Cortex microcontroller based embedded systems. **(PO 1, 2, 3, 4, 5, 7, 11, 12) (PSO 1, 2, 3)**
3. Analyse the memory management capability, Interrupts, Bus Implementation, Exceptions and various peripherals of ARM Cortex Microcontrollers. **(PO 1, 2, 3, 4, 11, 12) (PSO 1 and 3)**
4. Analyse and develop programs for ARM Cortex based embedded systems enabling the features of Memory protection, performance considerations, power management and multiprocessor communication. **(PO 1, 2, 3, 4, 5, 6, 7, 11, 12) (PSO 1, 2, 3)**
5. Ability to design an embedded system or process to meet the desired needs within realistic constraints using the design process and optimizing it exploring the role of RTOS **(PO 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12) (PSO 1, 2, 3)**

INTELLECTUAL PROPERTY RIGHTS

Course Code: ET54 **Credit: 3:0:0**
Course coordinator: Venu K N **Contact Hours: 42**

Course Content

Syllabus

UNIT 1

Patent system: Types of intellectual property rights, Introduction to patents, application for patent, publication and examination of application, representation and opposition, secrecy of inventions, grant of patens and right of patentee, amendment of applications and specifications, restoration of lased patents, surrender and revocation of patents,

UNIT 2

Patent registration and introduction to trademarks: Register of patents, working of patents, compulsory licenses and revocation, use of inventions for government purposes, infringement of patents and remedies, Introduction, register of trademarks and trademarks registry, conditions of registration of trademarks, procedure for registration, effect of registration, infringement and passing off, protection of trademarks through international registration,

UNIT 3

Use of trademarks and introduction to copyright: assignment and transmission, use of trademarks and registered users rectification and correction of register, collective marks and certification trademarks, appellate board. Introduction, subject matter of copyright, ownership of copyright, economic rights of copyright owners, Authors moral rights, term of copyright,

UNIT 4

Assignment of copyrights and semiconductor integrated circuits layout design: Assignment of copyright and licenses, role of copyright societies in the administration of copyright, performer's rights, broadcast reproduction rights, international copyright, infringement of copyright, permitted acts in relation, copyright and remedies for infringement of copyright, semiconductor integrated circuits layout design

UNIT 5

Geographical indications and licensing intellectual property right: Introduction, the register and conditions of registration, registration of Geographical indication, effect of registration, rectification and correctness of the register offences, penalties and procedure infringement and passing off, licensing intellectual property rights.

TEXT BOOKS

1. V.K.Ahuja, " Law relating to Intellectual Property Rights", third edition, LexisNexis publication -2017
2. Dr. B.L Wadhera, Intellectual Property Law hand book, Universal law publishing com. Ltd- 2002.

REFERENCE BOOKS

1. P. Narayanan," Intellectual property law" third edition Eastern Law House-2017
2. Dr. S.R. Myneni," Law of intellectual property, 7th edition Asia law house -2017

COURSE OUTCOMES (COs):

1. Understanding the importance of patenting process in Indian and other countries and its impact on nation building and prosperity **(PO6,8,9, 10, 12) (PSO2, 3)**
2. Interpret the steps involved in filing a patent, copyright and trade mark and their role in safeguarding individual Intellectual rights. (**PO6, 8,9, 10, 12) (PSO 2,3)**
3. Interpret the importance of intellectual property rights applied to electronics domain and steps involved in the revocation of a patent, copyright and trademark (**PO1,6, 8, 10, 12) (PSO1, 2, 3)**
4. Importance of understanding amendments to patent, copyright and trademarks **(PO1, 6, 8, 10, 12) (PSO1, 2,3)**
5. Understanding infringements with respect to patented product, copy right and trade mark and role of geographical indicators **(PO1, 6, 8,10,12) (PSO1,2,3)**

DIGITAL SIGNAL PROCESSING LAB

Course Code: ETL 56 **Credit: 0: 0: 1**
Course coordinator: Venu K N **Contact Hours: 28**

Course Content

A. LIST OF EXPERIMENTS USING MATLAB

1. Verification of sampling theorem.
2. Impulse response of a given system
3. Linear convolution of two given sequences.
4. Circular convolution of two given sequences
5. Autocorrelation of a given sequence and verification of its properties.
6. Cross correlation of given sequences and verification of its properties.
7. Solving a given difference equation.
8. Computation of N point DFT of a given sequence and to plot magnitude and phase spectrum.
9. Linear and Circular convolution of two sequences using DFT and IDFT.
10. Design and implementation of FIR filter to meet given specifications.
11. Design and implementation of IIR filter to meet given specifications.

B. LIST OF EXPERIMENTS USING DSP PROCESSOR

1. Computation of DFT and FFT of a given sequence
2. Realization of an FIR and IIR filter to meet given specifications.
3. Demonstrating the capabilities of filtering by adding and removal of noise

TEXT BOOKS

1. Proakis & Manolakis, "Digital signal processing - Principles Algorithms & Applications", Pearson education, 4th Edition, New Delhi, 2007.

REFERENCE BOOKS

1. Oppenheim & Schafer, "Discrete Time Signal Processing", PHI, 2003.
2. S. K. Mitra, "Digital Signal Processing", Tata Mc-Graw Hill, 2nd Edition, 2004.
3. D. Ganesh Rao and Vineeta P Gejji, "Digital Signal Processing", 2nd Edition, Sanguine Technical Publications Pearson, 2012.

COURSE OUTCOMES (COs):

1. Understand the DSP concepts like Sampling theorem, convolution, DFT and IDFT (**PO 1, 2, 4, 5, 9) (PSO 1, 2, 3)**
2. Understand the concepts of correlation and solution for a difference equation using Matlab**. (PO 1, 2, 4, 5, 9) (PSO 1, 2, 3)**
3. Design of FIR filter by using different methods**. (PO 1, 2, 4, 5, 9) (PSO 1,2,3)**
4. Design IIR filter by using different methods**. (PO 1, 2, 4, 5, 9, 10, 11, 12) (PSO 1, 2, 3)**
5. Design of FIR and IIR filters and implementation through DSP Processor**. (PO 1, 2, 4, 5, 9, 10, 11, 12) (PSO 1, 2, 3)**

COMMUNICATION SYSTEMS- 1 LAB

Course Code: ETL 57 **Credit: 0: 0: 1**
Course coordinator: Dr Parimala P. **Contact Hours: 28**

Course Content

LIST OF EXPERIMENTS

1. Amplitude modulation using transistor (generation and detection).
2. DSBSC using a ring modulator.
3. Pre-emphasis and De-emphasis
4. Frequency modulation using 8038/2206
5. Pulse amplitude modulation and detection
6. Pulse Width Modulation and detection
7. Pulse Position Modulation and detection.
8. Precision rectifiers – both half wave and full wave
9. Transistor mixer
10. Verification of Sampling Theorem, Natural Sampling and flat Top Sampling
11. Time Division Multiplexing.
12. Delta Modulation and Demodulation.
13. Pulse Code Modulation and Demodulation using codec chip 44233.
14. Adaptive Delta Modulation and Demodulation.

TEXT BOOKS

1. Simon Haykin, "Communication Systems" 3rd edition, John Wiley, reprint 2015.
2. Simon Haykin, "An Introduction to Analog and Digital communications", John Wiley, reprint 2013.

REFERENCE BOOKS

1. B. P Lathi "Modern Digital and Analog Communication Systems", Oxford University press 3rd edition 2005
2. Harold P.E Stern Samy and A Mahmod, "Communication Systems", Pearson Education 2004.
3. Singh and Spare, "Communication Systems: Analog & Digital", TMH 2nd edition 2007.
4. S Chandrashekariah, "Analog Communication" TMH publications 2010.

COURSE OUTCOMES (COs):

1. Design and evaluation of analog modulation circuits for AM, DSBSC and FM. **(PO1, 2, 3, 4, 5, 8, 9, 10, 11, 12) (PSO 1, 2, 3)**
2. Design and evaluation of PAM, PWM PPM and PCM modulation. **(PO1, 2, 3, 4, 5, 8, 9, 10, 11, 12) (PSO 1, 2, 3)**
3. Design and evaluation of Pre-emphasis, De-emphasis, Transistor mixer and precision rectifiers. **(PO1, 2, 3, 4, 5, 8, 9, 10, 11, 12) (PSO 1, 2, 3)**
4. Design and verification of sampling theorem for natural and flat Top Samples. **(PO1, 2, 3, 4, 5, 8, 9, 10, 11, 12) (PSO 1, 2, 3)**
5. Design and evaluation of Time Division Multiplexing, delta and adaptive modulation techniques **(PO1, 2, 3, 4, 5, 8, 9, 10, 11, 12) (PSO 1, 2, 3)**

EMBEDDED SYSTEM DESIGN LAB

Course Code: ETL58 **Credit: 0: 0: 1**
Course coordinator: Dr S G Shivaprasad Yadav **Contact Hours: 28**

Course Content

List of Programs using Cortex M-series Boards

1. Program for Addition and subtraction of N numbers
2. Program to demonstrate Data transfer
3. Program for swapping the data
4. Program to compute the factorial of a given number
5. Arrange a given set of data in ascending order and descending order
6. Embedded C programs using Keil simulator like port toggling, delays
7. GPIO Programming for interfacing LED
8. Program for interfacing LCD
9. Program for interfacing Keypad
10. Program for Interrupts
11. Program for Interfacing for ADC/
12. Program for Interfacing for DAC
13. Interfacing of stepper Motors
14. Program for Interfacing for DC Motors

TEXT BOOKS

1. Joseph Yiu, "The Definitive Guide to the ARM Cortex-M3 and M4", Newnes Publications, 2013
2. David E. Simon, "An Embedded Software Primer", Addison- Wesley, 2001
3. Rajkamal, "Embedded Systems: Architecture, Programming and Design", Tata McGraw Hill, New Delhi, 2009.

REFERENCE BOOKS

1. Arnold S.Berger, "Embedded System Design: An Introduction to Processes, Tools and techniques", CMP Book, Dec 200l.
2. Andrew N. Sloss, Dominic Symes and Chris Wright, "ARM System Developers Guide", Morgan Kaufamnn (Elsevier Inc.), 2004.

COURSE OUTCOMES (COs):

1. Proficiency in the usage of tools for embedded systems programming and debugging. **(PO1, 2, 3, 4, 5, 6, 9, 10, 11, 12) (PSO 1, 2, 3)**
2. Develop “Assembly” and "C" programs for ARM Cortex M-series microcontrollers for various tasks such as data transfer, arithmetic and logical operations using Keil IDE **(PO1, 2, 3, 4, 5, 6, 7, 9, 10, 11, 12) (PSO 1, 2, 3)**
3. Develop “Assembly” and "C" programs to configure various peripherals such as GPIO, timers, serial communication, and interrupts. (**PO1, 2, 3, 4, 5, 6, 7, 9, 10, 11, 12) (PSO 1, 2, 3)**
4. Ability to design embedded systems, component or a process including hardware/software interfaces for devices like LCD displays, motors, keyboards, analog sensors and speakers. (**PO1, 2, 3, 4, 5, 6, 7, 9, 10, 11, 12) (PSO 1, 2, 3)**
5. Demonstrate technical ability to build interdisciplinary microcontroller based systems and proficiency to document the work in a technical record/report involving teamwork **(PO1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12) (PSO 1, 2, 3)**

VI Semester

COMMUNICATION SYSTEMS - 2

Course Code: ET61 **Credit: 3: 1: 0**
Course coordinator: Dr Parimala P **Contact Hours: 42+28**

Course Content

UNIT 1

Detection and Estimation: Model of DCS, Gram-Schmidt Orthogonalization procedure. Geometric interpretation of Signals, response of bank of correlators to noisy input, Detection of known signals in noise, correlation receiver, matched filter receiver, detection of signals with unknown phase in noise.

UNIT 2

Information Theory and Source coding: Introduction, Measure of information, Average information content of symbols in long independent sequences, Average information content of symbols in long dependent sequences, Markov's statistical model for information source, problems on Entropy and information rate of zero memory sources and mark-off source

Source Coding: Encoding of the source output, Source coding Theorem, Shannon's encoding algorithm, Huffman coding problems on Shannon coding, Shannon-Fano coding, Huffman coding

UNIT 3

Communication Channels: Communication Channel, Discrete communication Channel, Discrete memory less Channels, Mutual information, Channel Capacity. Channel coding theorem, Types of Discrete communication channels, problems on Continuous Channel, Differential entropy and mutual information for continuous ensembles, Channel capacity Theorem. Continuous channels

UNIT 4

Digital Modulation Techniques: Digital Modulation formats, Coherent binary modulation techniques, Coherent quadrature modulation techniques, Non-coherent binary modulation techniques.

Error Control Coding: Introduction, Types of errors, examples, Types of codes Linear Block Codes: Matrix description, Error detection and correction, Standard arrays and table look up for decoding.

UNIT 5

Binary cycle codes: Algebraic structures of cyclic codes, Properties of cyclic codes, Matrix representation of generator and parity check matrix, Encoding using a (n-k) bit shift register, Syndrome calculation.

Convolution codes: Encoder for convolution codes, Encoding using Time domain approach (two methods), Encoding using Transform domain approach, state diagrams and code tree of convolutional codes, problems on design of Expurgated binary cyclic code, Trellis code, convolutional codes

TEXT BOOKS

1. K. Sam Shanmugam, "Digital and Analog Communication systems", John Wiley, 2012
2. Simon Haykin, "Digital communication", John Wiley, 2013

REFERENCES

1. Ranjan Bose, "ITC and Cryptography", TMH, II edition, 2007
2. Glover and Grant, "Digital Communications", Pearson Edition, 2nd Edition, 2008
3. Bernard Sklar, "Digital Communications", Pearson education, 2009

COURSE OUTCOMES (COs):

1. Understand the basics of detection and estimation of signals, source and channel coding and decoding of discrete symbols. **(PO1,2,3,12) (PSO1)**
2. Apply the concept of Gram-Schmidt orthogonalization procedures to signals and different encoding algorithms at source and channel **(PO 1, 2, 3, 4, 5, 9,10,11,12) (PSO 1, 2, 3)**
3. Analyze correlation filters, matched filter response for noisy signals, entropy of independent & dependent sources, source coding efficiency and channel coding efficiency **(PO 1, 2, 3, 4, 5, 9,10,11,12) (PSO 1, 2,3)**
4. Analyze the performance of continuous channels and different digital modulation techniques **(PO 1, 2, 3, 4, 5, 9,10,11,12) (PSO 1, 2, 3)**
5. Evaluate receiver designs, Source codes, discrete and continuous channels, Block codes and convolutional codes for error detection and correction **capacity (PO 1, 2, 3, 4, 5, 9,10,11,12) (PSO 1, 2, 3)**

COMPUTER COMMUNICATION NETWORKS

Course Code: ET62 **Credit: 3: 1: 0**
Course coordinator: Venu.K.N **Contact Hours: 42+28**

Course Content

UNIT 1

Networks and Layering: Layered tasks, OSI Model, Introduction to data communication, networks, the internet, layered tasks, OSI model, layers in the OSI model, TCP/ IP protocol suite,, Addressing, analog and digital signals, transmission impairment, data rate limits, performance, transmission modes, digital to analog conversion and analog to analog conversion, bandwidth utilization, multiplexing and spreading, Data link control: Framing, Flow and error control, Protocols, Noiseless channels and noisy channels,

UNIT 2

Data Link Layer: Random access, Controlled access, Channelization. Wired LAN, Ethernet, IEEE standards, Standard Ethernet, gigabit Ethernet, Wireless LAN IEEE 802.11.

UNIT 3

Connecting LANS: Connecting LANs, Backbone and Virtual LANs, Connecting devices, back bone Networks, Virtual LANs, Cellular telephony, Frame relay, ATM, Network Layer, Logical addressing, Ipv4 addresses, Ipv6 addresses, Ipv4 and Ipv6,

UNIT 4

Network Layer: Address mapping, ICMP, IGMP, delivery, forwarding and routing

UNIT 5

Transport layer: Process to process delivery, user data gram protocol, TCP, congestion, congestion control, techniques to improve QOS, domain name space, domain name space, distribution of name space, DNS in the internet, resolution, DNS messages

TEXT BOOKS

1. B Forouzan, “Data communication and networking”, 4th edition, TMH, 2009

REFERENCE BOOKS

1. Leon-Garcia and Widjaja, “Communication Networks”, MGH, 2nd edition, 2012.
2. Andrew.s. Tannenbaum, “Computer Networks”, 4th edition, Pearson Education, 2010
3. William Stallings, “Data and Computer Communication”, PHI, 2012.

COURSE OUTCOMES (COs):

1. Understand the importance of OSI and TCP layers and to interpret the concepts behind working of computer communication networks **(PO1,2,3,5,7) (PSO1,2)**
2. Interpret concepts behind the working of different protocols used at different layers **(PO1, 2,3, 8, 9) (PSO 1,2,3)**
3. Design of different types of topologies and to understand the working of different wired and wireless communication networks **(PO 1, 2, 3, 4, 10,12) (PSO 1,3)**
4. Understand different data format in different types of network and the interpret their Working (**PO 1, 2, 3, 4,11,12) (PSO 1,3)**
5. Importance of security in a network, understanding their working and their application in different scenarios **(PO1,2,3,4,6,12) (PSO1,2,3)**

MINI PROJECT / PROFESSIONAL ELECTIVE/ NPTEL COURSE

Course Code: ET65
Credit: 4

MINI PROJECT:

Students of 6th semester will take up Mini-Project among the three domain of expertise:

1. **Group A: Networks and Systems**
2. **Group B: Embedded Systems**
3. **Group C: Communication and Signal Processing**

Students will complete the technical mini project under the guidance of the faculty member in the department. The quality of the work will be judged in three presentations, where the panel consists of the guide and other faculty members in the project domain.

Subject code	Subject	No. of Hrs/Week		Duration of exam	Marks		Total marks	Credits
		Lecture	Practical/ Field work		IA	Exam		
TC65	Mini-project	-	8	3 hours	50	50	100	0:0:4

Course Outcomes (COs):

1. Ability to review the literature and identify a suitable problem by analyzing the requirements based on current trends and societal needs in the domain of interest and arrive at the specifications. **(POs 1, 2, 4, 6, 7, 9, 12) (PSO 1, 2, 3)**
2. Ability to identify the methodology for implementing the project by visualizing the Hardware and Software. **(POs 1, 2, 3, 4, 7, 11) (PSO 1, 2, 3)**
3. Design and Implementation of identified Problem using appropriate tools and techniques in the area of telecommunication/ multidisciplinary areas. **(POs 1, 2, 3, 4, 5, 6, 7, 9) (PSO 1, 2, 3)**
4. Validate the achieved results and demonstrate good project defense, presentation skills, leadership and punctuality as a team/individual. **(POs 8, 9, 10, 11) (PSO 3)**
5. Ability to write the thesis following ethical values and attempt to publish the work in quality conferences/journals supporting lifelong learning abilities. **(POs 8, 9, 10, 12) (PSO 3)**

Professional Elective

NEURAL NETWORKS AND FUZZY LOGIC

Course Code: ET65 **Credit: 4: 0: 0**
Course coordinator: Ramya H R **Contact Hours: 56**

Course Content

UNIT 1

Introduction: Basic building blocks of ANN, ANN terminologies, comparison between Artificial & Biological neural networks, Learning Rules, Network Architectures, Fundamental Models of ANN, Neural Net for Pattern Classification- Hebb Net, Perceptron, Adaline Network, Back propagation network- Architecture, training algorithm.

UNIT 2

Feed Forward and Feedback Networks: Discrete Hopfield network –architecture, training algorithm and energy analysis, Radial Basis Function network -Architecture, training algorithm. Associative neural network- Hetero associative neural net architecture and Auto associative net architecture, Learning vector quantizer-Architecture, training algorithm, Brain state networks- training algorithm, Support Vector Machines- training algorithm.

UNIT 3

Applications of Neural Networks: Implementation of Hebb net, McCulloch-Pitts net, Perceptron Networks and ADALINE networks, Hopfield network, Radial Basis Function network, Associative neural network, Learning vector quantizer, Brain state networks and Support Vector Machines using MATLAB.

UNIT 4

Fuzzy Set Theory: Fuzzy vs crisp sets, crisp sets, Operations on crisp sets, properties of crisp sets, partition and covering. Membership function, Basic fuzzy set operations, properties of Fuzzy sets, Crisp relations and Fuzzy relations. Fuzzy Inference Systems - Mamdani Fuzzy Models - Sugeno Fuzzy Models –

UNIT 5

Fuzzy systems: Crisp logic: Laws of propositional logic, inference in propositional logic. Predicate logic: Interpretations of predicate logic formula, inference in predicate logic. Fuzzy logic: Fuzzy Quantifiers, Fuzzy inference. Fuzzy rule based system, Defuzzification. Applications: Greg Viot's Fuzzy cruise controller, Air conditioner controller.

TEXT BOOKS

1. S. Rajasekaran, G.A. Vijayalakshmi Pai, "Neural Networks, Fuzzy logic and Genetic algorithms", PHI, 2011.
2. Timothy Ross, "Fuzzy Logic with Engineering Applications", John Wiley and Sons, 2010.
3. S. N. Sivanandam, S. Sumathi and S N Deepa, "Introduction to Soft computing using Matlab 6.0", Tata McGraw Hill, 2016.

REFERENCES

1. Jacek M. Zurada, "Introduction to Artificial Neural Systems", Jaico Publishing House.
2. Laurene Fausett, "Fundamentals of Neural Networks, Architectures, Algorithms, and Applications", Pearson Education, 2004
3. B. Kosko, "Neural Networks and Fuzzy systems", Prentice Hall, 1992.

COURSE OUTCOMES (COs):

1. Understand the basic concepts of neural network and fuzzy logic. **(PO1, PO2, PO5,PO9,PO11) (PSO 1, 2, 3)**
2. Apply the concepts of Hebb rule, perceptron learning rule for feedforward and feedback networks and fuzzy logic operations for fuzzy systems**. (PO1, PO2, PO3, PO5,PO9,PO11) (PSO 1, 2, 3)**
3. Illustrate neural network algorithms and fuzzy logic for Fuzzy Inference Systems. **(PO1, PO2, PO3, PO4,PO5,PO9,PO11) (PSO 1, 2, 3)**
4. Compare the difference between neural networks and fuzzy logic controller **(PO1, PO2, PO3, PO4,PO5,PO9,PO11) (PSO 1, 2, 3)**
5. Apply neural network and fuzzy set operations for different applications and understand hybrid fuzzy controllers. **(PO1, PO2, PO3, PO4, PO5,PO8,PO9,PO11) (PSO 1, 2, 3)**

NPTEL Course:

Student can take any NPTEL course relevant to the specialization of the branch where the 4 credits can be obtained after meeting the Certification requirements. Evaluation is based on the involvement of the student in the course and the grades obtained.

COMMUNICATION SYSTEMS-2 LAB

Course Code: ETL66 **Credit: 0:0:1**
Course coordinator: Dr Parimala P **Contact Hours: 28**

Course Content

LIST OF EXPERIMENTS

1. Amplitude Shift Keying Modulation and Demodulation.
2. Frequency Shift Keying Modulation and Demodulation using IC4051.
3. Phase Shift Keying Modulation and Demodulation using IC4051.
4. Pulse Code Modulation and Demodulation using codec chip 44233.
5. Differential Phase Shift Keying Modulation and Demodulation using kit.
6. Quadrature Phase Shift Keying Modulation and Demodulation using kit.
7. Time Division Multiplexing using IC7493 and IC4051
8. Simulation of ASK and FSK Using Simulink (MATLAB)
9. Simulation of Shannon encoding algorithm (Matlab or C-programming)
10. Simulation of Shannon Fano encoding algorithm (Matlab or C-programming)
11. Simulation of Huffman encoding (Matlab or C-programming)
12. Simulation of Linear block codes (Matlab or C-programming)
13. Simulation of Binary cyclic codes (Matlab or C-programming)
14. Simulation of Convolutional codes (Matlab or C-programming).

TEXT BOOKS

1. Simon Haykin, “Digital Communication”, John Wiley, 2012.

REFERENCE BOOKS

1. Haribhat and Ganesh Rao, “Digital Communications”, Sanguine Technical Publishers, 2009
2. Simon Haykin, “An Introduction to Analog and Digital Communication”, John Wiley, 2009.
3. Bernard Sklar, “Digital Communications”, Pearson education, 2009

COURSE OUTCOMES (COs):

1. Design and evaluation of Digital modulation techniques (**PO1, 2, 3, 4, 5, 8, 9, 10, 11, 12) (PSO 1, 2, 3)**
2. Design and evaluation of PCM,Time Division Multiplexing using IC7493 and IC4051 **(PO1, 2, 3, 4, 5, 8, 9, 10, 11, 12) (PSO 1, 2, 3)**

3. Design and evaluation of source coding techniques **(PO1, 2, 3, 4, 5, 8, 9, 10, 11, 12) (PSO 1, 2, 3)**
4. Design and evaluation of Linear block codes **(PO1, 2, 3, 4, 5, 8, 9, 10, 11, 12) (PSO 1, 2, 3)**
5. Design and evaluation of cyclic codes and convolution codes. **(PO1, 2, 3, 4, 5, 8, 9, 10, 11, 12) (PSO 1, 2, 3)**

COMPUTER COMMUNICATION NETWORKS LAB

Course Code: ETL67 **Credit: 0: 0: 1**
Course coordinator: Venu K N **Contact Hours: 28**

Course Content

List of experiments

1. Simple programs in C
2. Programming on Bit Stuffing
3. Programming on Bit De-stuffing
4. Programming on Character Stuffing
5. Programming on Character De-stuffing
6. Encryption and Decryption using Substitution method
7. Encryption and Decryption using Transposition method
8. Shortest Path Algorithm -Dijkstra's routing algorithm
9. Error control using CRC-CCITT
10. RSA Algorithm
11. Implementation of LAN using Packet tracer
12. Implementation of Connecting LANs by bridge
13. Implementation of IP hierarchical network
14. Implementation of home automation using packet tracer

TEXT BOOKS

1. B Forouzan, "Data communication and networking", 4th edition, TMH, 2009.

REFERENCE BOOKS

1. Nobuo Funabiki, "Wireless Mesh Networks, Publisher: InTech, ISBN 978-953-307-519-8, January 14, 2011.
2. Yan Zhang, Jijun Luo and Honglin Hu, "Wireless Mesh Networking Architectures, Protocols and Standards", Auerbach Publications, ISBN 10: 0-8493-7399-9, 2007.

COURSE OUTCOMES (COs):

1. Understand and analyze various mechanisms carried out at physical and data link layers (**PO1, 2, 4, 5, 7, 8, 9, 10, 11, 12) (PSO 1, 2, 3)**
2. Analyze various mechanisms followed in network layer **(PO1, 2, 4, 5, 7, 9, 10, 11, 12) (PSO 1, 2, 3)**
3. Detect error during transmission and error correction and analyze the same **(PO1, 2,3,7,8,9 10,11,12) (PSO 1,2, 3)**
4. Model network on the simulator and analyze it for various parameters **(PO1, 2, 3, 5,7,8, 9, 10,11,12) (PSO 1,2, 3)**
5. Analyze various algorithms using the simulator **(PO1, 2 3,4, 5, 8,9,10,11 12) (PSO 1, 2, 3)**

DSP SYSTEMS LAB

Course Code: ETL68 **Credit: 0: 0: 1**
Course coordinator: Dr. S G Shivaprasad Yadav **Contact Hours: 28**

Course Content

Experiments using OMAPl138 (6748 LCDK) DSP (TMS320C6748):

Part A

Non-Real Time Experiments with C6748 DSK:

1. Solution of Differential Equations, Generation of random signal and sine wave and to compute and plot Power Density Spectrum
2. To Verify Linear and circular Convolution
3. To find 8Point FFT (DIF), DFT and IDFT of Given Samples
4. Interpolation and Decimation Filters
5. FIR and IIR Filter implementation
6. Adaptive Filter implementation
7. MAC operation using various addressing modes (assembly programming).

Part B

Real Time Experiments with C6748 DSK using Audio CODEC: Audio Processing and Image Processing

1. Audio Processing with Audio loop back. Delayed Audio Loop Back, Echoed Audio
2. Waveform generation using Audio CODEC and Storing Audio Signals in External Memory
3. Applying DCT/IDCT on image
4. Pixel operations on images
5. Applying Filters to Image, Smoothing, Sharpening, Threshold and Sobel edge
6. Demo on Image Capturing and processing using USB Camber
7. Demo on Video Capturing and displaying in VGA monitor

TEXT BOOKS:

1. Donald Reay, “Digital Signal Processing and Applications with the OMAP - L138”, March 2012
2. Thad B. Welch, Cameron H.G. Wright and Michael G. Morrow, “Real-Time Digital Signal Processing from MATLAB to C with the TMS320C6x DSPs”, Third Edition, Jan 2017
3. Alan V. Oppenheim and Ronald W. Schafer, “Discrete-Time Signal Processing”, 3rd edition (2011) by “TMS320C6748 DSP” Technical Reference Manual, September 2016

COURSE OUTCOMES (COs):

1. Proficiency in the usage of tools for DSP systems programming and debugging. **(PO1, 2, 3, 4, 5, 6, 7, 9, 10, 11, 12) (PSO 1, 2, 3)**
2. Develop “Assembly” and "C" programs for TMS320 C6748 DSK for various Real time and non-real time experiments using CCS IDE **(PO1, 2, 3, 4, 5, 6, 7, 9, 10, 11, 12) (PSO 1, 2, 3)**
3. An ability to design the Filters for various embedded DSP Applications using TMS320 C6748 DSP processor along with time and frequency domain analysis (**PO1, 2, 3, 4, 5, 6, 7, 9, 10, 11, 12) (PSO 1, 2, 3)**
4. Ability to design Embedded DSP applications including hardware/software interfaces and various Input/output devices (**PO1, 2, 3, 4, 5, 6, 7, 9, 10, 11, 12) (PSO 1, 2, 3)**
5. Demonstrate technical ability to build interdisciplinary DSP based systems and proficiency to document the work in a technical record/report involving teamwork **(PO1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12) (PSO 1, 2, 3)**

ELECTIVE SYLLABUS

GROUP A: NETWORKS AND SYSTEMS

INTERNET OF THINGS

Course Code: ETE551 **Credit: 3: 0: 0**
Course coordinator: Dr K R Shobha **Contact Hours: 42**

Course Content

UNIT 1

Introduction & Concepts: Definition and Characteristics of IoT, Things in IoT, IoT Protocols {OCF, OneM2M), IoT Functional Blocks, IoT Communication Models, IoT Communication APIs, IoT Enabling Technologies, IoT Levels and Deployment Templates IoT and M2M, SDN and NFV for IoT,

UNIT 2

Developing Internet of Things: IoT Platform Design Methodology, Specifications: Requirements, Process, Domain, Information, Services, Level, Functional, Operational, Integration, Application Development

Python Language: Data Types & Data Structures, Control Flow, Functions, Modules, Packages, File Handling, Date & Time Operations, Classes, Python Packages of Interest for IoT

UNIT 3

IoT Physical Devices and End Points: Basic Building Blocks of an IoT Device, Raspberry Pi, Linux on Raspberry Pi, Raspberry Pi Interfaces: Serial, SPI, and I2C

Programming Raspberry Pi with Python: Basic programs for interfacing sensors, creating data logs and sending alerts to users, client server programming.

UNIT 4

Cloud and Data Analytics: Introduction to cloud storage Models and Communication APIs, and Data Analytics: Introduction to SmartThings, AWS Python **Web Application Framework** Web Services for IoT, Data Analytics for IoT, Real-Time Data Analysis, Tools for IoT

UNIT 5

IoT Case Studies and PLC basics: Home Automation: Smart Lighting, Elderly care Home Intrusion Detection; Cities: Smart Parking Environment: Agriculture – Smart Irrigation, basic of PLC

TEXT BOOK

1. Arshdeep Bahga, Vijay Madisetti, "Internet of Things: A Hands-on Approach", Universities Press, 2015

REFERENCE BOOKS

1. Ovidiu Vermesan, Peter Friess, "Internet of Things-From Research and Innovation to Market Deployment", River Publishers Series in Communication, 2013.
2. http://www.internet-of-things-research.eu/pdf/ IERC_Cluster_Book_2014_Ch.3_SRIA_WEB.pdf
3. Adrian McEwen, Hakim Cassimally, "Designing the Internet of Things", Wiley Publication,2013
4. Introduction to Internet of Things - Course – Nptel https:// onlinecourses.nptel.ac.in /noc18_cs08/

COURSE OUTCOMES (COs):

1. Student will be able to understand the fundamentals and applications of Internet of Things**. (PO 1, 2, 4, 6, 9, 12) (PSO 1, 2, 3)**
2. Student will get exposure to the aspects of communication and protocols associated with IoT**. (PO 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12) (PSO 1, 2, 3)**
3. Students will be able to know the methodologies and tools involved in the design of IoT **(PO 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12) (PSO 1, 2, 3)**
4. Students will be able to understand aspects of hardware and software associated with the development of IoT **(PO 1, 2, 3, 5, 6, 8, 9, 10, 11, 12) (PSO 1, 2, 3)**
5. Students will get exposure to the basics of cloud based aggregation and analysis of shared data **(PO 1, 2, 3, 6, 12) (PSO 1, 2, 3)**

MACHINE LEARNING

Course Code: ETE631 **Credit: 3: 0: 0**
Course coordinator: Dr K R Shobha **Contact Hours: 42**

Course Content

UNIT 1

Introduction: What is machine learning? Examples of machine learning applications, key terminologies, key tasks of machine learning, choosing right algorithms, steps in developing machine learning applications, why Python, getting started with numpy, Classifying with k-Nearest Neighbors: Classifying with distance measurements Examples

UNIT 2

Splitting Datasets One Feature at a Time: decision trees: Tree construction, plotting trees in Python with Matplotlib annotations, Testing and storing the classifier, Examples Classifying with probability theory: naïve Bayes: classifying with Bayesian decision theory, Conditional probability, Classifying with conditional probabilities, Document classification with naïve Bayes, Classifying text with Python, Examples

UNIT 3

Logistic Regression: Classification with logistic regression and the sigmoid function: a tractable step function, Using optimization to find the best regression coefficients, Examples Support vector machines: Separating data with the maximum margin, finding the maximum margin, efficient optimization with the SMO algorithm, speeding up optimization with the full Platt SMO, Using kernels for more complex data, Example

UNIT 4

Predicting Numeric Values: Regression: Finding best-fit lines with linear regression, locally weighted linear regression, shrinking coefficients to understand our data, the bias/variance tradeoff, Examples

Tree-Based Regression: Locally modeling complex data, Building trees with continuous and discrete features, Using CART for regression, Building the tree, executing the code, Tree pruning, Model trees, Examples

UNIT 5

Grouping Unlabeled Items Using K-Means Clustering: The k-means clustering algorithm, Improving cluster performance with post processing, Bisecting k-means, Examples Using **Principal Component Analysis to Simplify Data:** Dimensionality reduction techniques, Principal component analysis, moving coordinate axes, Performing PCA in NumPy, Example

TEXT BOOKS

1. Peter Harrington, “Machine Learning in Action”, Manning Publications, 2012, ISBN 9781617290183

REFERENCE BOOKS

1. Ethem Alpaydin, "Introduction to Machine Learning" 3rd Edition, PHI Pvt. Ltd-New Delhi,2015
2. Christopher Bishop, "Pattern Recognition and Machine Learning", CBS Publishers & Distributors, New Delhi, 2010
3. Tom M Mitchell, “Machine Learning”, McGraw-Hill, Inc. New York, NY, USA 2017.
4. Introduction to Machine Learning - Course – Nptel https:// onlinecourses.nptel.ac.in/ noc17_cs26

COURSE OUTCOMES (COs):

At the end of the course, a student should be able to

1. Identify the concepts of machine learning and specify solutions using python. **(PO 1, 2, 5, 6, 8, 9, 11, 12) (PSO 1, 2, 3)**
2. Design and develop solutions for classification problems using different approaches **(PO 1, 2, 3, 4, 5, 6, 8, 9, 10, 11, 12) (PSO 1, 2, 3)**
3. Design and develop solutions for finding best parameters to classify data **(PO 1, 2, 3, 4, 5, 6, 8, 9, 10, 11, 12) (PSO 1, 2, 3)**
4. Design and develop approaches for predicting numeric values **(PO 1, 2, 3, 4, 5, 6, 8, 9, 10, 11, 12) (PSO 1, 2, 3)**
5. Apply dimensionality reduction techniques and develop clustering methods as well as approaches to simplify data **(PO 1, 2, 3, 4, 5, 6, 8, 9, 10, 11, 12) (PSO 1, 2, 3)**

WIRELESS SENSOR NETWORKS

Course Code: ETE641 **Credit: 3: 0: 0**
Course coordinator: Dr Parimala P **Contact Hours: 42**

Course contents

UNIT 1

Introduction to basics of Sensor Networks: Definitions and Background, Challenges and Constraints, Applications, Node Architecture and available Operating Systems. Single-Node Architecture - Hardware Components, Energy Consumption of Sensor Nodes , Operating Systems and Execution Environments, Network Architecture Sensor Network Scenarios, Optimization Goals and Figures of Merit, Gateway Concepts.

UNIT 2

Medium Access Control: Overview, Characteristics of MAC Protocols in Sensor Networks, Contention-Free MAC Protocols, Contention-Based MAC Protocols. Hybrid MAC Protocols

UNIT 3

Network Layer: Routing Metrics, Flooding and Gossiping, Data-Centric Routing, Proactive Routing, On-Demand Routing, Hierarchical Routing, Location-Based Routing, QoS-Based Routing Protocols.

UNIT 4

Power Management: Local Power Management Aspects, Dynamic Power Management, Conceptual Architecture

Time Synchronization: Clocks and the Synchronization Problem, Time Synchronization in Wireless Sensor Networks, Basics of Time Synchronization, Time Synchronization Protocols

UNIT 5

Localization: Ranging Techniques, Range-Based Localization, Range-Free Localization, Event-Driven Localization

TEXT BOOKS

1. Waltenegus Dargie and Christian Poellabauer , “Fundamentals Of Wireless Sensor Networks Theory And Practice “, John Wiley Publication, 2010 .
2. Holger Karl, Andreas willig “Protocol and Architecture for Wireless Sensor Networks”, John wiley publication, 2007.

REFERENCES:

1. Feng zhao, Leonidas guibas, “Wireless Sensor Networks: an information processing approach – Elsevier publication, 2004.

COURSE OUTCOMES (COs):

1. Classify WSN architectures, MAC protocols, routing protocols, power managements, localization. **(PO1,2,6,7,12) (PSO1,3)**
2. Understand the various blocks of wireless sensor networks, MAC layer, Network layer, Power management and localization need in WSN**.(PO1,2,3,5,6,7,10,12, PSO-1,3)**
3. Analyze the units of wireless sensor networks, functionality of MAC layer, Network layer, Power management and localization need in WSN.**(PO1,2,3,5,6,7,10,12, PSO-1,3)**
4. Apply different architectures of WSN, MAC layer and network layer protocols , power management and localization techniques under different scenarios of WSN.**(PO1,2,3,5,6,7,10,12, PSO-1,3)**
5. Evaluate different architectures, MAC protocols, routing protocols, power management types and localization techniques**.(PO1,2,3,5,6,7,10,12, PSO-1,3)**

GROUP B: EMBEDDED SYSTEMS

OPERATING SYSTEMS

Course Code: ETE552 **Credit: 3: 0: 0**
Course coordinator: S J Krishna Prasad **Contact Hours: 42**

Course contents

UNIT 1

Introduction Overview and structure of Operating systems:
Introduction, Abstract views & goals of operating systems. Operations of operating systems, Input/output, Memory, Process management Memory hierarchy & protection Interrupts, Interrupt processing & System call Computing environments and Classes of operating systems. Operation & structure of OS, OS with monolithic structure & Layered design. Virtual machine operating systems, Kernel based & Microkernel based operating systems.

UNIT 2

Introduction to Process and Process scheduling: Process concepts, Operation on process, sharing, synchronization between processes, OS view of processes. Process control block. Scheduling principles, Non preemptive scheduling policies Preemptive Scheduling policies, Issues in real time scheduling.

UNIT 3

Process, threads and synchronization Process state transitions & its activities. Events, Threads and its Variants, Multithreaded programming, Processes in UNIX. Inter process communication, Race conditions.

UNIT 4

Memory management
Memory hierarchy, Execution of programs Memory allocation model Reuse of memory, Memory allocators. Contiguous and noncontiguous allocators, Paging and segmentation.
Virtual memory Virtual memory basics Demand paging and paging preliminaries Page replacement, paging hardware, Virtual memory handler, and Page replacement policies

UNIT 5

Distributed operating system: features of distributed operating system, nodes of distributed operating system, integrating operation nodes of a distributed operating system, reliable inter process communication, distributed computation paradigm.

TEXT BOOKS

1. D M Dhamdhere, "Operating systems, A concept based approach" TMH, 2nd Edition, 2006.
2. Andrew S.Tanenbaum, "Modern operating systems", PHI learning, Third edition, 2011

REFERENCE BOOKS

1. Silberschatz and Galvin, "Operating systems concepts", John Wiley, 9th edition, 2012
2. William Stallings, "Operating systems- Internals and Design principles" Pearson Education, 6th edition, 2009
3. Harvey M. Deitel and Paul J. Deitel "Operating System", Pearson, Third edition 2014
4. Pradeep K Sinha "Distributed operating systems concepts and design", Prentice Hall of India, New Delhi ,2010

COURSE OUTCOMES (COs):

1. Examine basics, structure, process and memory management concepts of operating systems **(PO1,2,3,5,11,12) (PSO1,2,3).**
2. Analyze process, process synchronization and Input output software design aspects of operating systems **(PO1,2,3,4,5,11,12) (PSO1,2,3**).
3. Analyze process, threads, race conditions and critical section of operating systems and remote access of process in distributed operating systems **(PO1,2,3,4,5,11) (PSO1,2,3).**
4. Analyze performance of physical and virtual memory and process management issues **(PO1,2,3,4,5,11,12) (PSO1,2,3).**
5. Analyze distributed operating system development/ deployment and its relation to standard operating systems **(PO1,2,4,5,7,8,11,12) (PSO1,2,3).**

DIGITAL SYSTEM DESIGN USING VERILOG

Course Code: ETE632 **Credit: 3: 0: 0**
Course coordinator: Dr. Umesharaddy **Contact Hours: 42**

Course Content

UNIT 1

Introduction and Methodology: Digital Systems and Embedded Systems, Binary representation and Circuit Elements, Real-World Circuits, Models, Design Methodology.

Combinational Basics: Boolean Functions and Boolean Algebra, Binary Coding, Combinational Components and Circuits, Verification of Combinational Circuits.

UNIT 2

Number Basics: Unsigned and Signed Integers, Fixed and Floating-point Numbers.
Sequential Basics: Storage elements, Counters, Sequential Data paths and Control, Clocked Synchronous Timing Methodology.

UNIT 3

Memories: Concepts, Memory Types, Error Detection and Correction. Implementation Fabrics: ICs, PLDs, Packaging and Circuit Boards, Interconnection and Signal Integrity.
Processor Basics: Embedded Computer Organization, Instruction and Data, Interfacing with memory.

UNIT 4

I/O interfacing: I/O devices, I/O controllers, Parallel Buses, Serial Transmission, I/O software.

UNIT 5

Accelerators, Design Methodology: Accelerators: Concepts, case study, Verification of accelerators.
Design Methodology: Design flow, Design optimization, Design for test.

TEXT BOOKS:

1. Peter J Ashenden: "Digital Design: An embedded system approach using verilog",1st Edition, Elsevier, 2010, ISBN: 9780123695277.

REFERENCE BOOKS:

1. Samir Palnitkar: "Verilog HDL", 2nd Edition, Pearson, New Delhi, 2003, ISBN: 978-0132599702
2. Stephen Brown and Zvonko Vranesic, "Fundamentals of Digital logic with VERILOG design", TMH, 2013

COURSE OUTCOMES (COs):

1. Analyze and verify various logical circuits. **(PO1, 2, 5) (PSO1, 2)**
2. Discussing the abstraction levels used in Verilog to implement the logical circuits. **(PO1, 2, 5) (PSO1, 2)**
3. Analyze the appropriate usage of instructions and data types. **(PO1, 3, 6) (PSO1, 2)**
4. Analyze various I/O interfacings and software. **(PO1, 2, 8, 9) (PSO1, 2, 3)**
5. Describe and verify accelerators and design methodologies. **(PO1, 3, 4, 10, 11) (PSO1, 2, 3)**

EMBEDDED NETWORKS AND PROTOCOLS

Course Code: ETE642 **Credit: 3: 0: 0**
Course coordinator: Dr S G Shivaprasad Yadav **Contact Hours: 42**

Course Content

UNIT 1

CAN bus: Concept of bus access and arbitration, Error Processing and Management, Increase your word power, Patents, License and certification.

CAN PROTOCOL: ISO 11898-1 Errors: Their intrinsic properties, detection and processing, the rest of the Frame-CAN 2.OB.

UNIT 2

CAN Physical Layer: Introduction, CAN bit, Nominal Bit Time-CAN and Signal Propagation-Bit Synchronization, Network Speed.

Medium, Implementation and Physical Layers of CAN: The range of media and types of coupling to the network, high speed CAN, optical Media, Electro Magnetic Media.

UNIT 3

Components, Applications and Tools for CAN: CAN Components, application, application layer and development tools for CAN.

Flex Ray: Some general remarks, event triggered and time triggered aspects, TT CAN-towards high speed, X-by- wire and redundant Systems-Flex Ray.

UNIT 4

LIN: Introduction, Basic concept of LIN 2.0 Protocol, Cost and Market, Conformity of LIN, examples.

Fail –Safe SBC- Gateways: The Strategy and principles of Re-use, Demo board gateways managing the application layers.

Safe by Wire: Safe –by-wire plus-Some Words of Technology.

UNIT 5

Audio –Video Buses: I2C Bus, D2B (Domestic digital) BUS, MOST (Media oriented systems transport) bus-IEEE BUS OR 'Firewire'.

RF Communication: Radio –frequency communication, Internal Radio-frequency communication, External –Wireless Networks

TEXTBOOKS

1. Dominique Paret, “Multiplexed Networks for Embedded Systems-CAN, LIN, Flexray, Safe-by-Wire”, John Wiley & Sons Ltd, Paris, 2009
2. Jan Axelson, “Embedded Ethernet and Internet Complete”, Penram publications, Madison, 2008

REFERENCE BOOKS

1. Glaf P. Feiffer, Andrew Ayre and Christian Keyold, "Embedded networking with CAN and CAN open", Embedded System Academy, California, 2008
2. Gregory J. Pottie and William J.Kaiser, "Principles of Embedded Networked Systems Design", 2nd edition, Cambridge University press, NewYork, 2009

COURSE OUTCOMES (COs):

1. Understand the need of embedded network protocols, its various applications, and features to meet the emerging application requirements **(PO1, 2, 3, 4, 6, 7, 11, 12) (PSO 1, 2, 3)**
2. Analyze the various implementation and physical layer details of CAN protocol **(PO1, 2, 3, 4, 12) (PSO 1, 3)**
3. Evaluate the various components, functionalities, applications and tools of CAN, LIN and Flexray protocols **(PO1, 2, 3, 4, 12) (PSO 1, 3)**
4. Analyze the general principles of LIN, Fail-Safe SBC gateways and Safe by wire protocols **(PO1, 2, 3, 4, 12) (PSO 1, 3)**
5. Analyze the features and operations of audio - video buses, RF communication and their inter relation with various networks protocols in the design of embedded systems **(PO1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12) (PSO 1, 2, 3)**

MOBILE COMMUNICATION SYSTEMS

Course Code: ETE553 **Credit: 3: 0: 0**
Course coordinator: Dr Parimala P **Contact Hours: 42**

Course Contents

UNIT 1

Introduction to Mobile communication: Developments of cellular telecommunications-1G,2G,3G,4G, Cellular mobile Telephony architecture, Functions of switching systems, Cellular radio system design, frequency assignment and Frequency reuse channels, concept of Cell splitting.

UNIT 2

Tele Traffic model and Queuing theory: Introduction, Unit of traffic, Congestion, Traffic measurement, Lost call systems, Queuing Systems, Mathematical model, types of switching systems, Signaling methods, Telephone network organization.

UNIT 3

Multiple access schemes and Digital switching: Multiple access schemes in mobile communication-TDMA, FDMA, CDMA, Random multiple access. Handover and Hand off algorithms,

Evolution of digital switching systems, Stored program control switching systems, Building blocks of a digital switching system, Space and time switching, Simple call processing, Hardware architecture.

UNIT 4

Digital Switching System Software: Introduction, Scope, Basic software architecture, Operating systems, Database Management, Concept of generic program, Software architecture for level 1 control, Software architecture for level 2 control, Software architecture for level 3 control. Digital switching system software classification, Call models, Connect sequence, Software linkages during call.

UNIT 5

Practical Cellular Mobile systems: Introduction to Packet switching, Connectionless and connection-oriented modes, Packet switching in networks, X.25 vs. Frame Relay, Packet-switched networks, early networks, X.25 era, Internet era, satellite phone, Numbering plan, charging call.

TEXT BOOKS

1. Rappaport, "Wireless Communications: Principles and Practice", 2nd Edition,2010
2. J E Flood, "Telecommunication and Switching, Traffic and Networks", Pearson Education, 2015
3. Syed R, "Digital Switching Systems", TMH Edition, 2017.

REFERENCE BOOKS

1. P Gnanasivam, "Telecommunication switching and networks" PHI learning Pvt ltd, 2015
2. John C Bellamy, "Digital Telephony" Wiley India 3rd Edition, 2016
3. Thyagarajan Vishwanathan, "Telecommunication Switching", PHI learning Pvt ltd, 2016
4. Stephen W Gibson, "Cellular Mobile Radio Telephones", Prentice Hall of India, 2015

COURSE OUTCOMES (COs):

1. Classification and application of Mobile Communication system **(PO1, 2, 3) (PSO 1, 2)**
2. Understand the basics blocks of Mobile communication and Digital switching.
3. Analyze frequency allocations, different traffic models,multi access schemes and digital switching **(PO1, 2, 3, 4) (PSO 1, 2)**
4. Design cellular system with different traffic models, different access schemes and swithing systems. **(PO1, 2, 3, 4) (PSO 1, 2)**
5. Evaluate mobile communication system, traffic **(PO1, 2, 3, 9) (PSO 1, 3)**

DSP ALGORITHMS AND APPLICATIONS

Course Code: ETE633 **Credit: 3: 0: 0**
Course coordinator: Dr S G Shivaprasad Yadav **Contact Hours: 42**

Course contents

UNIT 1

Introduction and architectures for programmable Digital Signal Processors: Introduction, Digital Signal-Processing System and Applications, Data representations and Arithmetic, Fixed point versus Floating point formats, Finite word length effects – Input Quantization, Coefficient quantization, overflow and solutions, rounding and truncation, Basic Architectural features, DSP computational building blocks, Bus Architecture and Memory, Data Addressing capabilities, Address generation unit, Programmability and Program execution, Speed issues, Hardware and Software Interrupts

UNIT 2

Architecture and Instruction set of the TMS320C6X Processor: Introduction, TMS320C6x architecture, Functional units, Fetch and execute packets, Pipelining, Registers, Linear and circular addressing modes, Instruction Set, Assembler Directives, Programming examples in C/Assembly and Linear Assembly, Timers, Interrupts, Multichannel Buffered Serial Ports, Direct Memory Access, Memory Considerations, Fixed- and Floating-Point Format, Code Improvement, Constraints

UNIT 3

FIR and IIR Filters: Finite-Impulse Response Filters, Filter characteristics, Filter structures, Filter Designs, Finite-Word length effects, Implementation of FIR filters, Infinite-Impulse Response Filters, Filter characteristics, Filter structures, stability of IIR filters, Finite-Word length effects, Implementation of IIR filters, Interpolation Filters and Decimation Filters

UNIT 4

Fast Fourier Transforms and Adaptive Filters: FFT, computational load of DFT and IDFT, properties of Twiddle factors, FFT algorithms, Decimation-in-Time Radix-2 FFT, Decimation-in-Frequency Radix-2 FFT, Other Radix and Mixed-Radix FFT algorithms, Inverse Fast Fourier Transform, Implementation considerations

Adaptive Filters: Introduction to adaptive filters, Adaptive filter structures and algorithms, Filter structures, Adaptive algorithms, Properties of adaptive filters and Applications.

UNIT 5

DSP Applications: Applications of Programmable DSP Devices: DSP-based Bio-Telemetry Receiver, A Speech Processing system, An Image processing system, A Position control system for a Hard Disk drive, DSP-based power meter, Collision Avoidance and Adaptive Cruise Control, Lane Departure.

TEXT BOOKS:

1. Rulph Chassaing and Donald Reay, "DSP and Applications with the TMS320C6713 and TMS320C6416 DSK" 2nd Edition, John Wiley Publications, 2008
2. Avatar Singh and S Srinivasan, "Digital Signal Processing", Thomson Learning, 2004
3. Sen M Kuo and Woon-Seng S Gan, "Digital Signal Processors, Architectures, Implementations and Applications", Pearson Prentice Hall, 2008

REFERENCE BOOKS:

1. B Venkataramani and M Bhaskar, "Digital Signal Processors", TMH, 2002.
2. V. Udayshankara, "Modern DSP", PHI Publication, 2nd Edition, 2012

COURSE OUTCOMES (COs):

1. Understand the need, features, characteristics, architectural features and applications of DSP processors **(PO 1, 2, 3, 4, 6, 7, 11, 12) (PSO 1, 2, 3)**
2. Evaluate the requirements of programming DSP applications, related hardware-software architectures and tool chain for DSP Processor (TMS320C6x) **(PO 1, 2, 3, 4, 5, 11, 12) (PSO 1, 2, 3)**
3. Analyze Memory management capability, Interrupts and various peripherals of DSP Processor. **(PO 1, 2, 3, 4, 12) (PSO 1, 3)**
4. An ability to design the Filters for various embedded DSP Applications along with time and frequency domain analysis **(PO 1, 2, 3, 4, 5, 6, 11, 12) (PSO 1, 2, 3)**
5. Ability to analyze and implement the DSP applications to meet the desired needs using the various architectural units of DSP processor. **(PO 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12) (PSO 1, 2, 3)**

SATELLITE COMMUNICATION

Course Code: ETE643 **Credit: 3: 0: 0**
Course coordinator: Nisha S L **Contact Hours:42**

Course Content

UNIT 1

Introduction & Orbital Mechanics: Introduction, Kepler's Law, Orbital elements, Orbital perturbations, Look angles, Geostationary Geosynchronous Orbits, Launches and launch vehicles.

UNIT 2

Space Segment: Power supply, Attitude and Control system, Altitude measurement using GPS module and Arduino, Telemetry, Tracking and Command Subsystems (TT&C), Transponders, antenna subsystem, equipment reliability.

UNIT 3

Satellite Link Design: Basic transmission theory, System noise, Uplink, Concept of saturation of TWTA, Downlink, Combined uplink and downlink C/N ratio, Intermodulation noise.

UNIT 4

Satellite Access: Satellite access, single access, pre-assigned FDMA, SCPC (spade system), TDMA, on board signal processing satellite switched TDMA, and CDMA.

UNIT 5

Satellite Services:
Introduction: Satellite mobile services, Direct broadcast satellite television and radio, VSATs, Radarsat, GPS system and GPS based navigation,
Case study on ISRO missions: MOM and Chandrayan.

TEXT BOOKS

1. Dennis Roody, "Satellite Communication" 5th edition, MGH,reprint 2015.
2. Timothy Pratt, Charles Bostian and Teremy Allnut, "Satellite Communication", John Wiley 2nd Edition, reprint 2012.

REFERENCE BOOKS

1. Ha T T, "Digital Satellite Communication", McGrawHill, reprint 2014.
2. Richharia M, "Satellite Communication Systems", Macmillan Press Ltd, reprint 2012.

COURSE OUTCOMES (COs):

1. Recognize the need for satellite communication. **(PO 1, 2, 4, 6, 7, 10, 12) (PSO 1, 2, 3)**
2. Apply and Solve problems on Kepler's laws and satellite link budget **(PO 1, 2, 4, 6, 7, 10, 12) (PSO 1, 2, 3)**
3. Analyze the concepts of orbital Mechanics, Look angles, Launches, launch vehicles and equipment reliability. **(PO 1, 2,3, 4, 6, 7, 8, 9, 10,11, 12) (PSO 1, 2, 3)**
4. Analyze various satellite subsystems and satellite link **(PO 1, 2,3, 4, 6, 7, 8, 9, 10,11, 12) (PSO 1, 2, 3)**
5. Examine the different Satellite Access technologies and satellite services for practical applications. **(PO 1, 2,3, 4, 6, 7, 8, 9, 10,11, 12) (PSO 1, 2, 3)**

OPEN ELECTIVES
(Offered to the students of other branches)

FUZZY LOGIC SYSTEMS AND APPLICATIONS

Course Code: ETOE01 **Credit: 3: 0:0**
Course coordinator: Dr Ramya H R **Contact Hours: 42**

Course Content

UNIT 1

Introduction: Introduction to Fuzzy Logic, Classical Sets and Fuzzy Sets, Examples. Fuzzy Sets: Fuzzy Set Operations, Properties of Fuzzy Sets, Examples. Classical and Fuzzy Relations, Fuzzy Cartesian Product and Composition, Tolerance and Equivalence Relations, Crisp Relation, Fuzzy Relation

UNIT 2

Membership Functions and Defuzzification: Membership Functions: Introduction, Features of Membership Function, Classification of Fuzzy Sets, Fuzzification Membership Value Assignments Intuition. Defuzzification: Introduction. Lambda Cuts for Fuzzy Sets. Lambda Cuts for Fuzzy Relations, Defuzzification Methods, Solved Examples

UNIT 3

Fuzzy Rule-Based System: Introduction, Formation of Rules, Decomposition of Rules, Aggregation of Fuzzy Rules Fuzzy Inference System. Fuzzy Inference Methods. Mamdani's Fuzzy Inference Method. Takagi–Sugeno Fuzzy Method (TS Method) Comparison Between Sugeno and Mamdani Method .Advantages of Sugeno and Mamdani Method ,Examples.

UNIT 4

Fuzzy Decision Making: Introduction, Fuzzy Ordering, Individual Decision Making, Multi-Person Decision Making. Multi-Objective Decision Making. Fuzzy Bayesian Decision Method. Applications of Fuzzy Logic. Fuzzy Logic in Power Plants. Fuzzy Logic Supervisory Control for Coal Power Plant.

UNIT 5

Fuzzy Logic Applications: Adaptive Fuzzy Partition in Data Base Mining, Fuzzy Image Processing, Fuzzy Logic-Based Anesthetic Depth Control. Analysis of Environmental Data for Traffic Control Using Fuzzy Logic. Antilock-Braking System and Vehicle Speed Estimation Using Fuzzy Logic. . A Fuzzy Expert System Design for Diagnosis of Prostate Cancer.

TEXT BOOKS:

1. Timothy Ross, "Fuzzy Logic with Engineering Applications", John Wiley and Sons
2. S. N. Sivanandam, S. Sumathi and S N Deepa, "Introduction to Fuzzy logic using Matlab 6.0", Tata McGraw Hill, 2016
3. Rajasekaran, G.A. Vijayalakshmi Pai, "Neural Networks, Fuzzy logic and Genetic algorithms", PHI, 2011.

COURSE OUTCOMES (COs):

1. Understand the basic concepts of Fuzzy Logic operations, Membership Functions, Rule-Based System and relations of classical crisp logic and fuzzy logic for basic applications **(PO1, PO2,PO3,PO11)(PSO1,2)**
2. Understand the implementation of fuzzy logic operations, membership functions and defuzzification process and rule based systems of fuzzy logic systems.**(PO1, PO2, PO3, PO4,PO9,PO11) (PSO1,2,3)**
3. Illustrate the fuzzy rule based Systems, Mamdani and TS method and decision making system. **(PO1, PO2, PO3, PO4, PO9, PO11) (PSO1,2,3)**
4. Understand the concepts of fuzzy decision making systems Compare the performance of different fuzzy decision making systems for fuzzy logic systems **(PO1, PO2, PO3, PO4,PO9, PO11) (PSO1,2,3)**
5. Apply fuzzy logic operations, Membership Functions, Rule-Based System and relations of classical crisp logic and fuzzy logic for different applications. **(PO1, PO2, PO3, PO4,PO9,PO11) (PSO1,2,3)**

COMMUNICATION SYSTEMS AND NETWORKS

Course Code: ETOE02 **Credit: 3: 0: 0**
Course coordinator: Arvind Kumar G **Contact Hours: 42**

Course Content

UNIT 1

Introduction to Communication Systems: Introduction to Communication Systems, Elements of a communication system, Modulation and its necessity, Types of Modulation, Binary Data Transmission, Multiplexing techniques.

UNIT 2

Introduction to Computer Networks: Data Communication, Networks, Protocols and Standards, Topology, Categories of Networks, OSI & TCP/IP Protocol suites

UNIT 3

Optical Fiber Communication: Motivation for optical communications, advantages of optical fibers key elements of optical fiber communication link. Total Internal Reflection, fiber types, Attenuation in fibers

UNIT 4

Wireless Communication: An Overview of Wireless System, First- and Second-Generation Cellular Systems, Wireless Network Architecture and Operation: The Cell concept, Cellular advantage, Cellular Hierarchy, Cell Fundamentals, Re-use Number, Capacity expansion Techniques - Cell splitting, Cell Sectoring

UNIT 5

Wireless Sensor Networks and its Applications: Background and Application of Sensor Network, Basic sensor network Architectural Elements. Application of Wireless Sensor Networks: Range of application, Examples of category II WSN application, Examples of category I WSN applications.

TEXT BOOKS

1. Simon Haykins, “An Introduction to analog and Digital communications”, John Wiley, 2010
2. Andrew S. Tanembaum, “Computer Networks”, 4th edition, Pearson Education, 2003.
3. Gerd Keiser, “Optical Fiber Communications”, TMGrH, 4th edition, 2010 reprint
4. Gary J. Mullett and Thomson Delmar, “Wireless Telecommunications Systems and Networks”, Learning, 2006
5. KazemSohraby, Daniel Minoli and TaiebZnati, “Wireless Sensor Networks: Technology, Protocols, and Applications”, John Wiley Publication, 2007.

COURSE OUTCOMES (COs):

1. Understand the basic concepts of Communication Systems. **(PO 1, 2, 3, 4, 5, 9, 10, 11, 12) (PSO 1,3)**
2. Understand the need of networking and wired and wireless networks**. (PO 1, 2, 3, 4, 5, 9, 10, 11, 12) (PSO 1,3)**
3. Employ various operational techniques of coaxial cables and optical fibers to build optical Communication Systems. **(PO1, 2, 3, 4, 5, 9, 10, 11, 12) (PSO 1, 3)**
4. Procure the idea of wireless communication, and Study cellular technology. **(PO 1, 2, 3, 4, 5, 9, 10, 11, 12) (PSO 1, 3)**
5. Understanding the basics of Sensor Networks and developing IOT based systems. **(PO 1, 2, 3, 4, 5, 9, 10, 11, 12) (PSO 1, 3)**