RAMAIAH
Institute of Technology

CURRICULUM

for the Academic year 2019 – 2020

TELECOMMUNICATION ENGINEERING

V & VI SEMESTER B.E

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

About the Institute:

Ramaiah Institute of Technology (RIT) (formerly known as M. S. Ramaiah Institute of Technology) is a self-financing institution established in Bangalore in the year 1962 by the industrialist and philanthropist, Late Dr. M S Ramaiah. The institute is accredited with "A" grade by NAAC in 2014 and all engineering departments offering bachelor degree programs have been accredited by NBA. RIT is one of the few institutes with prescribed faculty student ratio and achieves excellent academic results. The institute was a participant of the Technical Education Quality Improvement Program (TEQIP), an initiative of the Government of India. All the departments have competent faculty, with 100% of them being postgraduates or doctorates. Some of the distinguished features of RIT are: State of the art laboratories, individual computing facility to all faculty members. All research departments are active with sponsored projects and more than 304 scholars are pursuing PhD. The Centre for Advanced Training and Continuing Education (CATCE), and Entrepreneurship Development Cell (EDC) have been set up on campus. RIT 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 over 1,35,427 books with subscription to more than 300 International and National Journals. The Digital Library subscribes to several online e-journals like IEEE, JET etc. RIT is a member of DELNET, and AICTE INDEST Consortium. RIT has a modern auditorium, several hi-tech conference halls and all are air-conditioned with video conferencing facilities. It has excellent hostel facilities for boys and girls. RIT Alumni have distinguished themselves by occupying high positions in India and abroad and are in touch with the institute through an active Alumni Association. RIT obtained Academic Autonomy for all its UG and PG programs in the year 2007. As per the National Institutional Ranking Framework, MHRD, Government of India, Ramaiah Institute of Technology has achieved 64th rank in 2019 among the top 100 engineering colleges across India.

About the Department:

The 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 has a ***Research Centre*** with 15 students, which was started in the year 2012. Department has collaborations with some of the leading industries like., ***Nokia, Honeywell, Intel, ARM-Nuvoton, Ericsson, Samsung, ABB*** and with leading national and international universities like ***Stanford 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. Department is accredited by the ***National Board of Accreditation under AICTE***. There are ***5 Funded Research projects*** (Industry and Government) ongoing in the department involving students to carry out innovative projects. The IEEE Sensor Council focuses on many IEEE student activities.

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

MSRIT 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 MS 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 highly conducive ambience for the students to achieve all round growth and excel in studies and research to become the most successful engineers

MISSION OF THE DEPARTMENT

- Telecommunication Engineering Department endeavor upon providing high quality technical education to meet the ever growing challenges in the emerging industry and social needs.
- To provide all-round personality development with social responsibility emphasizing on quality, standards, research and innovation for students and faculty

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 environmental requirements

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

Curriculum Course Credits Distribution
Batch 2017- 2021

Semester	Humanities & Social Sciences (HSS)	Basic Sciences / Lab (BS)	Engineering Sciences/ Lab (ES)	Professional Courses- Core (Hard core, soft core, Lab) (PC-C)	Professional Courses - Electives (PC-E)	Other Electives (OE)	Project Work (PW)	Internship/ other activities (IS/ECA)	Total semester load
First	02	09	14	-	-	-	-	-	25
Second	02	09	14	-	-	-	-	-	25
Third	-	04	-	21	-	-	-	-	25
Fourth	-	04	-	21	-	-	-	-	25
Fifth	-	-	-	21	4	-	-	-	25
Sixth	-	-	-	15	4	-	6	-	25
Seventh	-	-	-	14	12	-	-	-	26
Eighth	-	-	-	-	-	4	18	2	24
Total	04	26	28	92	20	4	24	2	200

SCHEME OF TEACHING
V SEMESTER

Sl. No.	Course Code	Course Name	Category	Credits					Contact Hours
				L	T	P	S	Total	
1.	TC51	Digital Signal Processing	PC_C	3	1	0	0	4	5
2.	TC52	Analog Communication	PC_C	4	0	0	0	4	4
3.	TC53	Microwave and Antenna Engineering	PC_C	3	0	0	1	4	3
4.	TC54	Information theory and coding	PC_C	3	1	0	0	4	5
5.	TC55	Intellectual Property rights and Entrepreneurship	PC_C	2	0	0	0	2	2
6.	TCE--	Departmental elective	PC_E	3	0	0	1	4	3
7.	TCL56	Digital Signal Processing Lab	PC_C	0	0	1	0	1	2
8.	TCL57	Analog Communication lab	PC_C	0	0	1	0	1	2
9.	TCL58	Microwave and Antenna Lab	PC_C	0	0	1	0	1	2
			Total	**18**	**2**	**3**	**2**	**25**	**28**

SCHEME OF TEACHING
VI SEMESTER

Sl. No.	Course Code	Course Name	Category	Credits					Contact Hours
				L	T	P	S	Total	
1.	TC61	Digital Communication	PC_C	3	1	0	0	4	5
2.	TC62	Computer Communication Networks	PC_C	3	0	0	1	4	3
3.	TC63	Embedded System Design	PC_C	4	0	0	0	4	4
4.	TC64	Mini Project	PC_C	0	0	6	0	6	12
5.	TCE--	Departmental elective	PC_E	3	0	0	1	4	3
6.	TCL65	Digital Communication Lab	PC_C	0	0	1	0	1	2
7.	TCL66	Computer Communication Networks Lab	PC_C	0	0	1	0	1	2
8.	TCL67	Embedded System Design Lab	PC_C	0	0	1	0	1	2
Total				**13**	**1**	**9**	**2**	**25**	**33**

List of electives

Semester	Group 1 Networks and Systems	Group 2 Embedded Systems	Group 3 Communication and Signal Processing
5th Semester	Internet of Things TCE11	OOPS and Data Structures TCE21	Digital Switching Systems TCE31
6th Semester	Machine Learning TCE12	Operating Systems TCE22	Satellite Communication TCE32
7th Semester	Wireless Mesh Networks TCE13	Embedded Networks and Protocols TCE23	Software Defined Radio TCE33
7th Semester	Neural Networks and Fuzzy Logic TCE14	Applications of Sensing and Analysis TCE24	Multimedia Communication TCE34
7th Semester	Network Security TCE15	MEMS TCE25	DSP algorithms and applications TCE35
8th Semester	-	Automotive Electronics TCE26	Wavelets and Applications TCE36

V Semester

DIGITAL SIGNAL PROCESSING

Course Code: TC51 **Credit: 3: 1: 0: 0**
Course Coordinator: Dr. B K Sujatha **Contact Hours: 42 + 28**
Prerequisites : Signals and Systems (TC 45)

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, 4thEdition, 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. Recognition of need for and an ability to engage in life-long learning and ethical responsibility. **(PO 1, 2, 3, 4, 5, 8, 9, 10, 11, 12) (PSO 2, 3)**

ANALOG COMMUNICATION

Course Code: TC52 **Credit: 4:0 :0: 0**
Course Coordinator: Dr. Satish Tunga **Contact Hours: 56**
Prerequisites : Basic Electronics (EC 101/201), Signals and Systems (TC45)

Course Content:

UNIT 1

Amplitude Modulation and Double Sideband Suppressed Carrier 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, envelop detector, DSBSC, Time domain description, frequency domain representation. Generation of DSBSC wave, balanced modulator, ring modulator. Coherent detection of DSBSC modulated waves COSTAS LOOP, Quadrature carrier multiplexing.

UNIT 2

Single Side-Band Modulation: Hilbert transform, properties of Hilbert transform, pre-envelope, 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 of VSB modulated wave, envelope detection of VSB wave plus carrier, Comparison of amplitude modulation techniques. Frequency translation, Frequency division multiplexing. Application: Radio broadcasting, AM Radio.

UNIT 3

Angle Modulation:
Basic Definitions, FM Narrowband, FM wideband, transmission bandwidth of FM waves, Generation of FM waves, Indirect and direct method of FM Generation, Demodulation of FM waves, FM stereo multiplexing, phase locked loop, nonlinear model of the phase locked loop, Linear method of PLL, nonlinear effects in FM systems.

UNIT 4

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.
Noise in continuous wave modulation systems : Introduction, receiver "modes, noise in DSBSC receiver, noise in SSB receivers, noise in AM receivers, Threshold effect, noise in FM receivers, FM threshold effect, Pre-emphasis and De-emphasis in FM.

UNIT 5

Random Process:

Random Variables: Several Random Variables, Statistical averages: Function of Random Variables, moments, mean correlation and covariance function, principles of auto-correlation 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. Describe and analyze the standard amplitude modulation and DSBSC modulated wave. **(PO1, 2, 3, 4, 5, 9, 11) (PSO1, 2)**
2. Analyze SSBSC modulation and different applications of various types of modulation **(PO1, 2, 3, 4, 5, 11, 12) (PSO1, 2)**
3. Analyze and design the application of FM and PM **(PO1, 2, 3, 5, 11, 12) (PSO1, 2)**
4. Formulate the CW modulation systems with respect to figure of merit **(PO1, 2, 3, 4, 11) (PSO 1 ,3)**
5. Discuss and evaluate the random process and its relevance in communication **(PO1, 2, 3, 4, 5, 9, 11) (PSO1, 2)**

MICROWAVE AND ANTENNA ENGINEERING

Course Code: TC 53 **Credit:3:0:0: 1**
Course Coordinator: Dr. Swetha Amit **Contact Hours: 42**
Prerequisites : Engineering Electromagnetic Theory (TC35), Engineering Maths – IV (TC41)

Course Content:

UNIT 1

Introduction to Microwaves: History of Microwaves, Microwave Frequency bands, Applications of Microwaves, Concept of Mode, Characteristics of TEM, TE and TM Modes, TE_{10} dominant mode. Rectangular Waveguide: T junctions, H plane, E plane and Magic Tee junctions, Scattering Parameters.
Self-study: Microwave Systems, design of waveguides at any given frequency bands.

UNIT 2

Passive And Active Microwave Devices: Planar Transmission line: Stripline, Microstrip Line, Microwave Passive components: Directional Coupler with S-parameters, ring resonator, Isolator. Microwave Semiconductor Devices: Gallium arsenide Devices, RF Filter, Amplifier and RF mixer
Self-study: Microwave applications in Radar Systems, RFID, and GPS

UNIT 3

Microwave Propagation: Sky Wave Propagation: Structure of the ionosphere, Critical frequency, Maximum usable frequency, Skip distance, OWF, Effect of Earth‘s magnetic field. Space Wave Propagation: Reflection from ground for vertically and horizontally polarized waves, Reflection characteristics of earth, Duct propagation. Ground Wave Propagation: Attenuation characteristics for ground wave propagation, Calculation of field strength at a distance, Illustrative Problems.
Self-study: Importance of radiation resistance to EM wave radiated, challenges of satellite communication with involvement of ionosphere, near field communication challenges

UNIT4

Antenna And Its Array : Introduction to Antenna basics, current distribution on a thin wire antenna, Radiation pattern, Beam area and beam solid angle, Radiation intensity, directivity, Antenna aperture, Friis Transmission formula, Antenna field zones. Introduction to Arrays: broadside and end fire array, Hansen and Woodyard array. Introduction to short electric dipoles: Expression for far field Electric and Magnetic components, Radiation resistance of a short dipole.
Self-study: Impact of mutual coupling in array, Study of phased array and its importance.

UNIT 5

Antenna Types: Horn antenna, Helical antenna, Yagi-Uda antenna, Corner reflectors, Parabolic reflectors, Lens antenna, MIMO antennas, Fractal antenna, Smart antenna, antennas for satellite, antennas for ground penetrating radars, Embedded antennas, Ultra wide band antennas, Slot antennas. Illustrative problems to design the above said antennas. Planar Antennas: Salient features, Advantages and limitations, rectangular micro strip antenna, feeding techniques.

Self-study: Design a Microwave Planar Antenna in HFSS

TEXT BOOKS

1. David M Pozar, "Microwave Engineering", 4th edition, Wiley Publication, 2014.
2. John D Kraus, Ronald J. Marhefka and Ahmed S Khan, "Antenna and Wave Propagation", Fourth edition, Mc Graw Hill Publication, 2010.
3. K.D. Prasad, Satya Prakashan, "Antennas and Wave Propagation", Tech. India Publications, New Delhi, 2010.
4. John Volakis, "Antenna Engineering Handbook", 4th Edition, McGraw Hill Publications, 2013

REFERENCES

1. Samuel Y Liao, "Microwave Devices and Circuits", 3rd edition, Pearson Publication, 2013.
2. Annapurna Das and Sisir K Das, "Microwave Engineering", McGraw-Hill, 2010.
3. C. A Balanis, "Antenna Theory Analysis and Design", Third edition John Wiley, 2012.

COURSE OUTCOMES (COs):

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

1. Acquire the basic knowledge of waveguides and analyze the performance of microwave passive devices. **(PO1, 2, 3, 4, 5, 9, 11, 12) (PSO 1, 2, 3)**
2. Analyze the working of passive devices and microwave diodes. **(PO1, 2, 3, 4, 5, 9, 11, 12) (PSO 1, 2, 3)**
3. Discuss the basic concept of unguided medium, its significance in wireless communication to understand the propagation methods. **(PO 1, 2, 3, 4, 5, 10, 12) (PSO 1, 2)**
4. Analyze the specifications for antenna design to describe the array of antennas, point sources, isotropic and non-isotropic sources and conditions to increase the directivity of array antennas. **(PO 1, 2, 3, 4, 5, 10, 12) (PSO 1, 2, 3)**
5. Analyze antenna types to understand its importance in designing practical antennas. **(PO 1, 2, 3, 4, 5, 10, 12) (PSO 1, 2, 3)**

INFORMATION THEORY AND CODING

Course Code: TC 54 **Credit: 3:1:0: 0**
Course Coordinator: Dr. Parimala P **Contact Hours: 42 + 28**
Prerequisites: Engineering Mathematics III (TC31)

Course Content:

UNIT 1

Introduction to Information Theory: 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

UNIT2

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

UNIT3

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.

UNIT4

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. Reed-Solomon codes, Burst error correcting codes, Random error correcting codes, problems on Numerical on LBC design

UNIT5

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

COURSE OUTCOMES (COs)

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

1. Acquire the basic knowledge the measuring of information, entropy of independent & dependent sources**. (PO1, 2, 5, 9) (PSO 1, 2)**
2. Compare and analyze different types of source codes along with its efficiency **(PO1, 2, 3, 5, 9, 12) (PSO 1, 3)**
3. Analyze discrete and continuous channels**. (PO2, 3, 5, 9) (PSO1, 2)**
4. Evaluate Block codes for error detection and correction **(PO1, 2, 3, 4, 5, 9, 10) (PSO 1, 2, 3)**
5. Design and evaluate Binary cyclic codes and Convolutional codes **(PO1, 2, 3, 4, 5, 9, 10, 12) (PSO 1, 2, 3)**

INTELLECTUAL PROPERTY RIGHTS AND ENTREPRENEURSHIP

Course Code: TC 55 **Credit: 2:0:0: 0**
Course Coordinator: Akshata S Kori **Contact Hours: 28**
Prerequisites: Nil

Course Content:

UNIT 1

Basic Principles of IP Laws: Introduction, Evolution of the patent system in UK, US and India, Basis for protection, Invention, Criteria for patentability, Non- patentable inventions.

UNIT 2

Patents: principles underlying the patent law in India, submission of application, Filing provisional and complete specification, Term of the patent, compulsory license. Forms of transfer of Patent rights, Construction of claims and infringement, patents held to be infringed, patents held to be not infringed. Case study on Basmathi rice, Turmeric powder, Micro-organisms and all Indian contradictory Patents.

UNIT 3

Copy Right and Trademark: Requirement of copyright, rights conferred by copy right, terms of copy right, license of copy right. Trademark, procedure of registration of trademarks, rights conferred by registration of trademarks, infringement of trade mark and action against infringement.

UNIT 4

Management: Nature and Characteristics of Management, Scope and Functional Areas of Management, Roles of Management, Levels of Management, Planning importance of Plans, Decision Making, Six Sigma, Staffing, Directing And Controlling: Leadership Styles, Motivation Theories, Essentials of a sound Control System.

UNIT 5

Entrepreneurship: Entrepreneur, Meaning of Entrepreneur, Evolution of the Concept, Functions of an Entrepreneur, Types of Entrepreneur, Intrapreneur - an Emerging Class, Role of Entrepreneurs in Economic Development; Case study on Entrepreneurs in India.
Preparation of Project: Project Identification, Project Report, Guidelines by Planning Commission for Project Report; Network Analysis.

TEXT BOOKS

1. Dr. B.L Wadhera, “Intellectual Property Law hand book”, Universal law publishing com. Ltd-2012.
2. P. C. Tripathi and P.N.Reddy, “Principles of Management”, Tata McGraw Hill, 2010.

REFERENCES

1. Vasant Desai "Dynamics of Entrepreneurial Development & Management" Himalaya Publishing House, 2013.
2. Poornima M Charantimath, "Entrepreneurship Development & Small Business Enterprises", Pearson Education, 2011.

COURSE OUTCOMES (COs)

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

1. Understand the basic concepts of IRP and its need. **(PO 6, 8, 10, 12) (PSO 2, 3)**
2. Analyze the patent law in India and the registration flowchart to apply for patent. **(PO6, 8, 10, 12) (PSO 2, 3)**
3. Appraise the prominence for copyright and trademarks. **(PO 6, 8, 10, 12) (PSO 2, 3)**
4. Impart the knowledge of management and its functions. **(PO 6, 8, 10, 12) (PSO 2, 3)**
5. Recognize the role of Entrepreneurship and the steps for preparation of project. **(PO 6, 8, 10, 12) (PSO 2, 3)**

DIGITAL SIGNAL PROCESSING LAB

Course Code: TCL 56 **Credit: 0: 0: 1: 0**
Course Coordinator: Dr. S G Shivaprasad Yadav **Contact Hours: 28**
Prerequisites: Signals and Systems (TC45)

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, 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

12. Computation of DFT and FFT of a given sequence
13. Realization of an FIR and IIR filter to meet given specifications.
14. 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)**

ANALOG COMMUNICATION LAB

Course Code: TCL 57 **Credit: 0: 0: 1: 0**
Course Coordinator: Dr. Parimala P. **Contact Hours: 28**
Prerequisites: Analog Communication (TC52)

Course Content:

LIST OF EXPERIMENTS

1. Second order active wide and narrow band Pass Butterworth filters.
2. Second order active wide and narrow Bandstop Butterworth Filters.
3. DSBSC using ring modulator.
4. Pre-emphasis and De-emphasis
5. Frequency modulation using 8038/2206
6. Class-C tuned amplifier
7. Amplitude modulation using transistor (generation and detection)
8. Pulse amplitude modulation and detection
9. Pulse Width Modulation and detection
10. Pulse Position Modulation and detection.
11. Precision rectifiers – both half wave and full wave
12. Transistor mixer
13. Frequency synthesis using PLL.
14. Generation of AM/DSBSC (Balanced Modulator) using IC1496

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 of second order Butterworth filters. **(PO1, 2, 3, 4, 5, 8, 9, 10, 11, 12) (PSO 1, 2, 3)**
2. Design of Pre-emphasis, De-emphasis and precision rectifiers. **(PO1, 2, 3, 4, 5, 8, 9, 10, 11, 12) (PSO 1, 2, 3)**
3. Design of Class-C tuned amplifier and Transistor mixer. **(PO1, 2, 3, 4, 5, 8, 9, 10, 11, 12) (PSO 1, 2, 3)**
4. Design of analog modulation circuits for AM, DSBSC, FM PAM, PWM and PPM**. (PO1, 2, 3, 4, 5, 8, 9, 10, 11, 12) (PSO 1, 2, 3)**
5. Design frequency synthesis using PLL. **(PO1, 2, 3, 4, 5, 8, 9, 10, 11, 12) (PSO 1, 2, 3)**

MICROWAVE AND ANTENNA LAB

Course Code: TCL 58 **Credit: 0: 0: 1: 0**
Course Coordinator: Dr. Swetha Amit **Contact Hours: 28**
Prerequisites: Engineering Electromagnetics (TC35), Microwaves and Antenna Engineering (TC53)

Course Content:

LIST OF EXPERIMENTS:

1. Determination of transit time, electronic tuning range and electronic tuning sensitivity of reflex klystron.
2. Measurement of VSWR, guide wavelength, operating frequency and impedance.
3. Determination of coupling coefficient, power division and insertion loss of a magic tee
4. Determination of coupling factor, insertion loss and directivity of a multi-hole directional coupler.
5. Measurement of directivity, half-power beam width and gain of rectangular horn antenna and parabolic antenna.
6. Study of resonance in a micro strip ring resonator and determination of dielectric constant of substrate.
7. Measurement of power division & isolation characteristics of 3dB power divider.
8. Determination of coupling and isolation characteristics of micro strip branch line and backward couplers.
9. Determination of directivity and half power beam width of dipole and Yagi-Uda antennas.
10. Design and simulate E plane and H plane Tee using HFSS.
11. Design and simulate magic Tee using HFSS.
12. Design and simulate Rectangular Patch antenna with quarter wave transformer using HFSS.
13. Design and simulate dipole Antenna with Balun using HFSS.
14. Design and simulate frequency independent antenna using HFSS.

TEXT BOOKS

1. Liao, "Microwave Devices and circuits", Pearson Education, 3rd edition, 2012
2. David M Pozar, "Microwave Engineering", John Wiley, 4th edition, 2012

REFERENCE BOOKS

1. John D Kraus, Ronald J. Marhefka and Ahmed S Khan, "Antenna and Wave Propagation", Fourth edition, Mc Graw Hill Publication, 2010.
2. John Volakis, "Antenna Engineering Handbook", IV Edition, McGraw Hill Publications, 2010.

COURSE OUTCOMES (COs):

1. Evaluate the characteristics of waveguide, working of klystron oscillator and GUNN diode. **(PO1, 2, 3, 4, 12) (PSO 1, 3)**
2. Analyze the working of passive and active microwave devices**. (PO1, 2, 3, 4, 10) (PSO 1, 3)**
3. Analyze the antenna characteristics with antenna test bench **(PO 1, 2, 3, 4, 5, 10, 11, 12) (PSO 1, 2, 3)**
4. Design antenna and microwave components using HFSS simulation software. **(PO1, 2, 3, 4, 5, 8, 9, 10, 12) (PSO 1, 2, 3)**
5. Evaluate the working of Antennas using HFSS. **(PO 1, 2, 3, 4, 11) (PSO 1, 2, 3)**

VI Semester

DIGITAL COMMUNICATION

Course Code: TC61 **Credit: 3: 1: 0: 0**
Course Coordinator: Akshata S K **Contact Hours: 42 + 28**
Prerequisites: Signals & Systems (TC45) and Analog Communication (TC52)

Course Content:

UNIT 1

Sampling Process: Sampling theorem, Quadrature sampling of Band pass signals, Practical aspects of sampling and signal recovery, PAM and TDM.

UNIT 2

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

UNIT 3

Baseband Shaping for Data Transmission: Discrete PAM signals, power spectra of discrete PAM signals, ISI, Nyquist's criterion for distortion less base-band binary transmission, correlative coding, eye pattern, base-band M-ary PAM systems.

UNIT 4

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 5

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

Spread Spectrum Modulation: Pseudo noise sequence spread spectrum, coherent binary PSK, frequency hop spread spectrum, applications.

TEXT BOOKS

1. Simon Haykin, “Digital Communication”, John Wiley, 2009.

REFERENCE BOOKS

1. Haribhat and Ganesh Rao, “Digital Communications”, Cengage Learning India Pvt Ltd, 2017
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 analyze Sampling technique and TDM. **(PO 1, 2, 4, 5, 8, 9, 10, 11, 12) (PSO 1, 2, 3)**
2. Analyze and design of PCM, DPCM and DM System **(PO 1, 2, 3, 4, 5, 10, 11) (PSO 1, 2, 3)**
3. Analyze ISI and different methods to overcome the same. **(PO 1,2,3,5,11,12) (PSO 1, 2, 3)**
4. Able to understand the concept of Gram-Schmidt orthogonalization procedures applied to signals and the concept of detection and estimation **(PO 1, 2, 3, 4, 5, 9,10,11,12) (PSO 1, 2, 3)**
5. Able to understand the concept of different digital modulation techniques including the Spread Spectrum modulation technique **(PO 1, 2, 3, 4,7,8, 9, 11,12) (PSO 1, 2, 3)**

COMPUTER COMMUNICAITON NETWORKS

Course Code: TC62 **Credit: 3:0: 0: 1**
Course Coordinator: Venu K. N. **Contact Hours: 42**
Prerequisites: Analog Communication (TC52), Network analysis (TC34) and Data structures using C (TC36-1)

Course Content:

UNIT 1

Networks and Layering: Layered tasks, OSI Model, Layers in OSI model, TCP/ IP Suite, Addressing, Physical Layer and Media, Data and Signals, Bandwidth utilization, Transmission Media, Data link control: Framing, Flow and error control, Protocols, Noiseless channels and noisy channels, HDLC. Overview of network security
Self-Study: Analog and digital signals, Analog and digital transmission, Transmission impairment, Data rate limits, Digital to analog conversion, line coding schemes, Analog to digital conversion, Transmission modes

UNIT 2

Data Link Layer: Random access, Controlled access, Channelization. Wired LAN, Ethernet, IEEE standards, Standard Ethernet, Wireless LAN IEEE 802.11.
Self-Study: Channelization, FDMA, TDMA, CDMA, Addressing mechanism

UNIT 3

Connecting LANS: Connecting LANs, Backbone and Virtual LANs, Connecting devices, back bone Networks, Virtual LANs. Network Layer, Logical addressing, Ipv4 addresses, Ipv6 addresses, Ipv4 and Ipv6
Self-Study: Cellular telephony, Satellite networks

UNIT 4

Network Layer: Delivery, Forwarding, Unicast Routing Protocols, Multicast Routing protocols.
Self-Study: SONET/SDH, Address mapping, mapping logical to physical address: ARP, Mapping physical to logical address: RARP, BOOTP, DHCP

UNIT 5

Transport and Application layers: Transport layer Process to process Delivery, UDP, TCP, application layer, Domain Name System, Resolution, HTTP
Self-Study: ICMP and IGMP operation, Congestion control, Quality of service, Techniques to improve QOS, RSVP, Symmetric and asymmetric key encryption and DES

TEXT BOOKS

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

REFERENCE BOOKS

1. Leon-Garcia & Widjaja, "Communication Networks", MGH, 2nd edition, 2012.
2. Andrew. S. Tanenbaum, "Computer Networks", 4th edition, Pearson Education, 2010.
3. William Stallings, "Data and Computer Communication", PHI, 2012.

COURSE OUTCOMES (COs):

1. Understand the different networks, its topologies, components, protocols and the different layers of the OSI and TCP/IP model to ensure the error free transmission of data **(PO1, 2, 3, 4, 6, 7, 8, 9, 11, 12)(PSO 1, 2, 3)**
2. Analyze the various access techniques, protocols and standards of Data Link Layer **(PO1, 2, 4, 7) (PSO 1, 2)**
3. Design subnet masks and addresses to fulfill networking requirements having learnt the different internetworking devices **(PO1, 2, 3, 4, 11, 12) (PSO 1, 3)**
4. Apply various routing algorithms over a network to provide an optimal path from source to destination. **(PO1, 2, 3, 4) (PSO 1)**
5. Analyze the features and operations of various Transport and Application layer protocols (PO1, **2, 3, 4, 6, 7, 8, 9, 11, 12) (PSO 1, 2, 3)**

EMBEDDED SYSTEM DESIGN

Course Code: TC63 **Credit: 4:0: 0: 0**
Course Coordinator: Dr. S. G. Shivaprasad Yadav **Contact Hours: 56**
Prerequisites: Microcontrollers (TC42), Digital Circuit Design (TC33)

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 pendable 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. Understand the importance, features, characteristics, design process and applications of embedded systems. **(PO 1, 2, 3, 5, 6, 7, 8, 9, 11, 12) (PSO 1, 3)**
2. Understand the architectural features, registers, operation modes and Instruction set of ARM Cortex M-series microcontrollers**. (PO 1, 2, 3, 4, 7, 11, 12) (PSO 1, 2, 3)**
3. Understand the features of Memory Systems, Bus Implementation, Exceptions and NVIC of ARM Cortex M-series processor. **(PO 1, 2, 3, 4, 9, 11, 12) (PSO 1, 3)**
4. Understand the programming features of ARM Cortex M series and role of Memory protection unit**. (PO 1, 2, 3, 4) (PSO 1)**
5. Analyze the RTOS Concepts, need, features, functionalities, problems of RTOS. (**PO 1, 2, 3, 7, 9) (PSO 1, 3)**

MINI PROJECT

Course Code: TC64 **Credit: 0:0: 6: 0**
Course Coordinators: Dr. Swetha Amit/ Kusuma S M **Contact Hours: 168**

Course Content:

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 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		
TC64	Mini-project	-	12	3 hours	50	50	100	0:0:6:0

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)**

DIGITAL COMMUNICATION LAB

Course Code: TCL65 **Credit: 0:0:1: 0**
Course Coordinators: Nisha SL **Contact Hours: 28**
Prerequisites: Digital Communication (TC61)

Course Content:

LIST OF EXPERIMENTS:

1. Verification of Sampling Theorem.
    1. Natural Sampling.
    2. Flat Top Sampling.
2. Time Division Multiplexing.
3. Delta Modulation and Demodulation.
4. Amplitude Shift Keying Modulation and Demodulation.
5. Frequency Shift Keying Modulation and Demodulation using IC4051.
6. Phase Shift Keying Modulation and Demodulation using IC4051.
7. Pulse Code Modulation and Demodulation using codec chip 44233.
8. Differential Phase Shift Keying Modulation and Demodulation using kit.
9. Quadrature Phase Shift Keying Modulation and Demodulation using kit.
10. Simulation of Amplitude shift keying Using Simulink (MATLAB).
11. Simulation of Phase Shift Keying Using Simulink (MATLAB).
12. Simulation of Frequency Shift Keying Using Simulink (MATLAB
13. Simulation of Quadrature Phase Shift Keying Using Simulink (MATLAB).
14. Simulation of Differential Phase Shift Keying Using Simulink (MATLAB).

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. Sampling Theorem verified, designed, tested and evaluated.**(PO1, 2, 3, 4, 5, 8, 9, 10, 11, 12) (PSO 1, 2, 3)**
2. Time Division Multiplexing using IC7493 and IC4051 are designed tested and evaluated. **(PO1, 2, 3, 4, 5, 8, 9, 10, 11, 12) (PSO 1, 2, 3)**
3. Modulation and demodulation circuits of ASK, PSK and FSK are designed, tested and evaluated using hardware and software. **(PO1, 2, 3, 4, 5, 8, 9, 10, 11, 12) (PSO 1, 2, 3)**
4. Modulation and demodulation circuits of DPSK and QPSK are designed, tested and evaluated using hardware and software. **(PO1, 2, 3, 4, 5, 8, 9, 10, 11, 12) (PSO 1, 2, 3)**
5. Delta modulation and Pulse Code Modulation and Detection using CODEC chip are designed, tested and evaluated. **(PO1, 2, 3, 4, 5, 8, 9, 10, 11, 12) (PSO 1, 2, 3)**

COMPUTER COMMUNICATION NETWORKS LAB

Course Code: TCL66 **Credit: 0: 0: 1: 0**
Course Coordinator: Venu K. N. **Contact Hours: 28**
Prerequisites: Computer Communication Networks (TC62)

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)**

EMBEDDED SYSTEM DESIGN LAB

Course Code: TCL67 **Credit: 0: 0: 1: 0**
Course Coordinator: Dr. S. G. Shivaprasad Yadav **Contact Hours: 28**
Prerequisites: Microcontrollers (TC42), Analog circuit design (TC33)

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. Develop “Assembly” and "C" programs for ARM Cortex M-series microcontrollers for various tasks like data transfer, arithmetic and logical operations **(PO1, 2, 3, 4, 5, 8, 9, 10, 11, 12) (PSO 1, 2, 3)**
2. Develop applications to configure the interrupts, factorial of a number, ascending, and descending operations. **(PO1, 2, 3, 4, 5, 8, 9, 10, 11, 12) (PSO 1, 2, 3)**
3. Develop Applications to configure various peripherals such as timers, serial communication, and interrupts using Keil IDE **(PO1, 2, 3, 4, 5, 8, 9, 10, 11, 12) (PSO 1,2, 3)**
4. Demonstrate the interfacing of ARM Cortex M-series microcontroller with external interfaces like ADC, DAC, Motors, Keypad using Keil IDE **(PO1, 2, 3, 4, 5, 8, 9, 10, 11, 12) (PSO 1, 2, 3)**
5. Demonstrate teamwork while building interdisciplinary microcontroller based systems and proficiency to document their work in a technical record/report **(PO1, 2, 3, 4, 5, 8, 9, 10, 11, 12) (PSO 1, 3)**

ELECTIVE SYLLABUS

GROUP 1: NETWORKS AND SYSTEMS

INTERNET OF THINGS

Course Code: TCE11 **Credit: 3: 0: 1: 0**
Course Coordinator: Dr. K. R. Shobha **Contact Hours: 42 + 28**
Prerequisites: Digital Circuit Design (TC33), Microcontroller (TC42), Fundamentals of Computing (CS201)

Course Content:

UNIT 1

Introduction & Concepts: Definition and Characteristics of IoT, Things in IoT, IoT Protocols, 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, IoT System Management with NETCONFIG-YANG

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: Controlling LED, Interfacing Switch, Interfacing Light Sensor

UNIT 4

Cloud and Data Analytics: Introduction to cloud storage Models and Communication APIs, Python **Web Application Framework –** Django, Web Services for IoT, SkyNet Messaging Platform Data Analytics for IoT, Apache: Hadoop, Oozie, Storm, Real-Time Data Analysis, Tools for IoT

UNIT 5

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

Laboratory Experiments

Experiments related to following concepts will be done

1. Client server communication
2. Loading of data collected to data base
3. Loading of data collected form sensor to cloud
4. Connecting sensors to RPI for IoT system design
5. Experiments using Schneider Labs on programming a switch for different appliance controls like fan, A/C etc., Monitoring different physical parameters with Sensors for home and Building automation

TEXT BOOK

1. Arshdeep Bahga and 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 aggregation and analysis of shared data **(PO 1, 2, 3, 6, 12) (PSO 1, 2, 3)**

MACHINE LEARNING

Course Code: TCE12 **Credit: 3: 0: 0: 1**
Course Coordinator: Dr. K. R. Shobha **Contact Hours: 42**
Prerequisite: Engineering Mathematics III (TC31), Engineering Mathematics IV (TC41)

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

Self-Study:

- Matplotlib, NumPy

Implementation of programs in python for

- K-Nearest Neighbors (unit 1)
- Naïve Bayes (unit 2)
- Logistic Regression (unit 3)
- Support Vector Machines (unit 3)
- Forecasting numeric values with regression (unit 4)
- Forecasting numeric values with tree based regression (unit 4)
- K Means Clustering (unit 5)
- Simplification of data using PCA (unit 5)

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:

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 MESH NETWORKS

Course Code: TCE13 **Credit : 3:0:0:1**
Course Coordinator: Venu K N **Contact Hours: 42**
Prerequisites: Computer Communication Networks (TC62)

Course Content:

UNIT 1

Fundamentals of Mesh Networks: The role of mesh in future networks, working, Physical layer, Medium access control Routing, Transport, and applications

UNIT 2

Mesh Susceptibility and mesh quality of service: Interference types, Susceptibility to interference-PHY and MAC, dedicated mesh routing and transport approaches, coexistence approaches, summary to susceptibility and coexistence approaches, quality of service levels required, and quality of service summary

UNIT 3

Mesh pit falls to avoid and routing in wireless mesh network: Summary of pitfalls to avoid, introduction to routing in wireless mesh networks, special properties of wireless mesh networks, general concepts of routing protocols, routing metrics, routing protocols, joint routing and channel assignment

UNIT 4

Implementations of Mesh Networks and security in wireless mesh: User side mesh applications, Network side or backhaul mesh applications, Joint user and network side mesh applications, Wireless cities, Community Internet, Vehicular ad hoc network. Security technology overview, mesh usage scenarios, mesh security issues

UNIT 5

Wireless sensor networks as Mesh networks and load balancing in wireless mesh networks: WSN sensors, WSN power sources, Wireless sensor technologies and applications, Differentiating RFID, mesh and sensor networks, Differentiating 802.15.x, ZigBee and 6LoWPAN, taxonomy of WSNs: structure System architecture in sensor networks, Unstructured WSNs, Structured WSNs, External routing and transport options, introduction to load balancing, gateway Gate way load balancing in wireless mesh networks, Center loading in wireless mesh networks

Self-Study Topics:

1. Mesh overview and terminology
2. Key mesh issues
3. Fundamentals of mesh topology, overview
4. Could customers self-generate capacity in a mesh?
5. Improving quality of service by adding network infrastructure
6. Cellular multihop or WLAN hotspot extension

7. Wireless cities
8. WSN system requirements
9. Classic IP- address based routing and transport
10. WSN approaches –other routing mechanisms
11. New routing metric for multi radio wireless mesh networks
12. Performance issues and their causes in WMN
13. Practical mesh networking issues
14. Antenna steering

TEXT BOOKS:

1. Steve Methley, "Essentials of Wireless Mesh Networking", Cambridge University Press, First published in 2009, ISBN 978-0-521-87680-3
2. Yan Zhang, Jijun Luo and Honglin Hu "Wireless Mesh Networking, architecture, protocols and standards", Aurebach Publications

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 the basics of wireless mesh networks **(PO1,2,3,4,5,8,9,10,11,12) (PSO01,3)**
2. Analyze the performance of wireless mesh networks at different layers of networks **(PO1,2,3,4,5,11,12) (PSO1,3)**
3. Apply quality of service in mesh networks **(PO1,2,3,4,7,9,10,11,12) (PSO1,3)**
4. Develop applications using Mesh networks **(PO1,2,3,4,11,12) (PSO1,3)**
5. Appreciate the usage of mesh networks in wireless sensor network **(PO1,2,3,4,5,8,9,10,11,12) (PSO1,2,3)**

NEURAL NETWORKS AND FUZZY LOGIC

Course Code: TCE14 **Credit: 3: 0: 0: 1**
Course coordinator: H R Ramya **Contact Hours: 42**
Prerequisites: Engineering Mathematics III (TC31), Engineering Mathematics IV (TC41)

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, Madaline Networks examples, Back propagation network- Architecture, training algorithm.
Self-Study Topic: Adaptive linear neuron Multilayer Perceptron Model

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,, Boltzmann machines- training algorithm, Support Vector Machines- training algorithm.
Self-Study Topic: Unsupervised learning networks: Kohonen self-organizing feature maps, LVQ – CP networks, ART network.

UNIT 3

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.
Self-Study Topic: Fuzzy Inference Systems - Mamdani Fuzzy Models - Sugeno Fuzzy Models - Tsukamoto Fuzzy Models - Input Space Partitioning and Fuzzy Modeling.

UNIT 4

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.
Self-Study Topic: Advances in GA and its applications, Differences & similarities between GA & other traditional method

UNIT 5

Applications: Pattern classification using Hebb net and McCulloch-Pitts net, Pattern recognition using Perceptron Networks, Process identification, control, fault diagnosis and load forecasting, Implementation of all fuzzy operations on both discrete and continuous fuzzy sets, Defuzzification, Fuzzy inference system.

Self-Study Topic: Soft computing based hybrid fuzzy controllers

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. Generate logic functions like AND, OR, XOR using learning rules. **(PO 1, 6, 12) (PSO 1, 2, 3)**
2. Apply Hebb rule and perceptron learning rule for pattern classification problem**.(PO1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 12) (PSO 1, 2, 3)**
3. Understand character recognition and data compression using back propagation Network. **(PO1, 2, 3, 5, 6, 8, 9, 10, 11, 12) (PSO 1, 2, 3)**
4. Apply the rules of fuzzy logic for fuzzy controller. **((PO1, 2, 3, 5, 6, 8, 9, 10, 11, 12) (PSO1, 2, 3)**
5. Apply fuzzy set operations and defuzzification for control system applications. **(PO1, 2, 3, 5, 6, 8, 9, 10, 11, 12) (PSO1, 2, 3)**

NETWORK SECURITY

Course Code: TCE15 **Credit: 4: 0: 0: 0**
Course coordinator: Arvind Kumar G **Contact Hours: 56**
Prerequisites: Computer Communication Networks (TC62)

Course Content:

UNIT 1

Symmetric Ciphers: Symmetric Cipher Model, Substitution Techniques, Transposition Techniques, traditional block cipher structure, the data encryption standard (DES). A DES example, the strength of DES, AES structure, AES transformation function

UNIT 2

Block Cipher operation: block cipher design principles, multiple encryption and triple DES, Electronic Code Book (ECB), Cipher block chaining mode (CBC), Cipher feedback mode (CFM)

UNIT 3

Public key cryptography: Principles of Public-Key Cryptosystems, The RSA Algorithm, Key management, Diffie-Hellman Key Exchange, Elliptic Curve Arithmetic

UNIT 4

Message Authentication and Hash Functions: Authentication requirements, Authentication functions, Message authentication codes, Hash functions, Security of hash functions and MAC's, Problems.
Digital Signature and Authentication Protocol: Digital signature, Authentication protocols

UNIT 5

Electronic Mail Security: Pretty good privacy, S/MIME, Data compression using ZIP, Radix-64conversion, PGP random number generator.
IP Security: Overview, IP security architecture, Authentication header, ESP (encapsulating security payload), Security associations, Key management, Problems).

TEXT BOOKS

1. William Stallings, "Cryptography and Network Security", Pearson Education, 6th edition, 2014

REFERENCE BOOKS

1. Behrouz A. Forouzan, "Cryptography and Network Security", TMH, 2014
2. Atul Kahate, "Cryptography and Network security", TMH, 2014

COURSE OUTCOMES (COs):

1. Analyze the basic concepts of network security to predict and classify attacks on a network **(PO1, 2, 3, 5, 7) (PSO 1, 2)**
2. Illustrate the process for hiding the information with cryptographic algorithms **(PO1, 2, 3, 8, 9, 10) (PSO 1, 3)**
3. Understand different key management distribution mechanisms **(PO1, PO2, PO3, PO5, PO7) (PSO 1, 2)**
4. Analyze security issues in IP and wireless networks **(PO1, 2, 3, 4) (PSO1)**
5. Analyze the mechanisms of implementing user authentication and intruder detection **(PO1, 2, 4, 5, 6, 7) (PSO 1, 2)**

GROUP 2: EMBEDDED SYSTEMS

OOPS AND DATA STRUCTURE

Course Code: TCE21 **Credit: 3: 0: 0: 1**
Course Coordinator: Venu K N **Contact Hours: 42**
Prerequisites: Fundamentals of computing (CS201)

Course Content:

UNIT-1

Introduction to C++ programming: Why do we need object oriented programming, characteristics of object oriented language, Loops and decisions: Relational operators, loops, decisions, logical operators, precedence summary? structures, enumerations, functions, Class and object : objects as data types, specifying a Class, member function, nesting of member function, static member function, private member function, constructors & destructors, arrays as class member data, arrays as objects, unary and binary operator overloading, overloaded Constructors, function overloading.

UNIT-2

Class inheritance: Inheritance, Derived class & Base class, Overriding member functions, Scope resolution, levels of inheritance, Multiple, Multilevel, Hierarchical, Hybrid Inheritance, Address and pointers, the address-of operator &, pointers and arrays, pointers and c-type strings pointers and functions memory management new and delete Pointers to objects.

UNIT-3

Virtual functions and templates: Virtual functions, Friend function, pure virtual functions, Templates: Introduction, Function Templates, Class Templates, Exceptional Handling: Introduction, C++ Style Solution, and Limitation of Exception Handling, Stream classes, stream errors, disk file I/O with streams, file pointers, error handling in file I/O, file I/O with member functions, overloading the extraction and insertion operators, memory as stream object, command line arguments.

UNIT-4

STL and recursion: Reason for handling multifile programs, interfile communication, introduction to the STL, algorithms, sequence containers, iterators, specialized iterators, associate containers, storing user-defined objects, function objects. Recursion, problem solving using recursion, backtracking.

UNIT-5

Data structure using C++: Linked list, ordered linked list, implementation of stack as arrays, linked list implementation of a stack, linked implementation of queues, bubble sort, selection sort, insertion sort, merge sort, quick sort, heap sort, shell sort, sequential search, binary search, hashing

Self-study topics:

Unit-1

1. Program to illustrate inline function
2. Program to illustrate recursive function
3. Program to illustrate function overloading
4. Program to illustrate function with reference arguments
5. Program to illustrate static data and static member function
6. Program to overload prefix and postfix operator overloading
7. Program to overload binary operator overloading
8. Program to illustrate the concept of constructor overloading

Unit-2

1. Program to illustrate concept of inheritance
2. Program to illustrate concept of multiple inheritance
3. Program to illustrate concept of multilevel inheritance
4. Program to illustrate concept of hybrid inheritance
5. Program to illustrate pointer concepts

Unit-3

1. Program to illustrate friend function
2. Program to illustrate THIS pointer
3. Program to illustrate virtual function
4. Program to illustrate template functions
5. Program to illustrate template class

Unit-4

1. Program to illustrate the concepts of recursion
2. Program to illustrate STL concepts
3. Program to illustrate file handling
4. Program to illustrate interfile communication

Unit-5

1. Program to implement stack using array
2. Program to implement queue using array
3. Program to implement stack using linked list
4. Program to implement queue using linked list
5. Program to illustrate bubble sort
6. Program to illustrate insertion sort
7. Program to illustrate quick sort
8. Program to illustrate linear search
9. Program to illustrate binary search

TEXT BOOKS

1. Robert Lafore, "Object Oriented programming with C++", 4th edition, Galgotia Publications, 2010.
2. E Balaguruswamy, "Object Oriented programming with C++", 4th Edition, TMH 2011.
3. D. S, Malik, "Data structure using C++", Tata Mcgraw Hill addition
4. John R, Hubbard, "Data structures with C++", Tata Mcgraw Hill addition

REFERENCE BOOKS

1. Herbert Schildt, "C++ - The Complete Reference", 4th Edition, TMH, 2013.

COURSE OUTCOMES (COs):

1. Understand and analyze the importance of classes and objects and different applications of operator overloading **(PO1, 2, 3, 4, 5, 7) (PSO 1, 2)**
2. Analyze and understand inheritance concepts **(PO1, 2, 8, 9, 10, 11, 12) (PSO 1, 3)**
3. Analyze virtual functions, templates and functions **(PO1, 2, 3, 4, 7, 9) (PSO 1, 2, 3)**
4. Analyze multifile program and STL concepts **(PO1, 2, 8, 9, 10) (PSO1, 3)**
5. Analyze and implement sorting algorithms and linked list **(PO1, 2, 3, 4, 5, 7) (PSO 1, 2)**

OPERATING SYSTEMS

Course Code: TCE22 **Credit: 3: 0: 0: 1**
Course coordinator: S. J. Krishna Prasad **Contact Hours: 42**
Prerequisites: Microcontrollers (TC42), Digital Circuit Design (TC33)

Course Content:

UNIT 1

Introduction And Overview Of Operating Systems: Introduction, Abstract views & goals of operating systems. Operations of operating systems, Resource and its allocation Security, & protection issues. Memory hierarchy & protection The I/O subsystem, Interrupts, Interrupt processing & System call Computing environments and Classes of operating systems. Batch processing systems, Multiprogramming systems, Time sharing systems, Real time OS, Distributed operating systems.

UNIT 2

Structure Of Operating Systems: Operation & structure of OS, OS with monolithic structure & Layered design. Virtual machine operating systems, Kernel based & Microkernel based operating systems. **Introduction to process:** Process concepts, Operation on process, sharing, synchronization between processes, OS view of processes, Process control block.

UNIT 3

Process, Threads and Synchronization: Process state transitions & its activities. Events, Threads and its Variants, Multithreaded programming, Processes in UNIX & Threads in Solaris. Inter-process communication, Race condition, Critical section, mutual exclusion, Producer consumer problems and semaphore solution

Process Scheduling: Scheduling principles, Non preemptive scheduling policies, Preemptive Scheduling policies, Issues in real time scheduling.

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, address translation, Virtual memory handler, and Page replacement policies.

UNIT 5

File Systems: File systems and IOCS, Fundamental of file organizations & access methods, File protection and UNIX file system. File system implementation and directory implementation **(Self-Study)**

Input/output: Principles of I/O hardware, I/O devices & its controller's, Memory mapped I/O and DMA, Principles Of I/O software, Programmed, interrupt driven, DMA types, I/O Software layers, Interrupt handlers, Device drivers, Device independent I/O software.

Self-study Topics:

1. The program demonstrates how to create a new process using fork system call (Unit-2)
2. The program demonstrates how to create a thread and passing value from thread (Unit-3)
3. Implement the multi-threaded application to create two child threads with normal priority (Unit-3)
4. Simulate the following CPU scheduling algorithms a) FCFS b) Round Robin (Unit-3)
5. A program to simulate FIFO and LRU Page Replacement Algorithm (Unit-4)
6. A program to transfer file among two computers(Unit-5)
7. Demonstration of Keyboard driver interfacing technique with Linux Kernel (Unit-5)

TEXT BOOK

1. D M Dhamdhere, "Operating systems, A concept based approach", TMH, 2nd Edition, 2011.
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, 2010

COURSE OUTCOMES (COs):

1. Examine role of operating systems, its modern design trends aspects **(PO1, 3, 11) (PSO 1, 3)**
2. Analyze process, and OS structural design aspects**. (PO2, 3, 11) (PSO 1, 3)**
3. Analyze process scheduling, threads, and their synchronization and implementation issues. **(PO2, 4) (PSO 1)**
4. Analyze performance of memory management techniques & virtual memory management & deployment issues. **(PO4, 5) (PSO 1, 2)**
5. Analyze techniques of file management, standard I/O devices & their deployment issues. **(PO4, 5) (PSO 1, 2)**

GROUP 1: NETWORKS AND SYSTEMS

EMBEDDED NETWORK AND PROTOCOLS

Course Code: TCE23 **Credit: 3: 0: 0: 1**
Course Coordinator: Dr. S.G. Shivaprasad Yadav **Contact Hours: 42**
Prerequisite Courses: Microcontrollers (TC42), Embedded System Design (TC63)

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.
Self-study component: Historical context of CAN and applications

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.
Self-study component: Pollution and EMC Conformity of CAN

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.
Self-study component: Historical context and Applications of Flexray

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.
Self-Study Component: History–Safe –by-wire plus

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
Self-study component: Historical context and Applications of RF communication

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 network protocols, its applications, CAN bus features and CAN protocol to meet the emerging application requirements **(PO1, 2, 3, 4, 5, 9, 10, 11, 12) (PSO 1, 3)**
2. Analyze the various implementation and physical layer details of CAN protocol **(PO1, 2, 3, 4, 12) (PSO 1, 3)**
3. Analyze the various components, Application and tools for CAN and Flexray protocol **(PO1, 2, 3, 4) (PSO 1, 3)**
4. Analyze the general principles of LIN protocol, Fail-Safe SBC gateways and Safe by wire protocol**(PO1, 2, 3, 5) (PSO 1, 3)**
5. Analyze the features and operations of common audio - video buses and RF communication **(PO1, 2, 3, 4, 5, 8, 9, 10, 11, 12) (PSO 1, 2, 3)**

APPLICATIONS OF SENSING AND ANALYSIS

Course Code: TCE24 **Credit: 3: 0: 0: 1**

Course Coordinator: Dr. Viswanath Talasila **Contact Hours: 42**

Pre-requisites: Systems Modeling and Control (TC44)
Digital Signal Processing (TC51)

Course Content:

UNIT - 1

Systems and Modeling in the Biomechanics of Human Movement: Biomechanics of movement – in sports and medicine, Brief mechanics of the musculo skeleton (specific example of the upper limb) and simple (state space) mathematical models, Measurement of Movement using inertial sensors

UNIT-2

Algebra and Signal Processing in Music: Introduction to the mathematics of music – from basic algebra to Fourier series; Pingala's Recursive Combinatorial Sequence Generation, the Hemachandra-Fibonacci poetic meters and the first Error-Correcting Codes, Capture of finger movement and mapping to musical notes

UNIT-3

Embedded Systems Design for measurement of movement and music: Development of a complete embedded system to measure a complete gait cycle, choice of processors/ microcontrollers, selection of sampling rates, Choice and placement of sensors, Architecture of the embedded system, Embedded programming to measure movement (in gait and while playing music), For inertial sensing and For image processing

UNIT-4

Communication of Movement: Body Area Networks: Basic Theory of Body Area Networks (IEEE 802.15.6), Communication Bands in BAN, Antenna Systems for BAN, Interoperability and Security Issues

UNIT-5

System Integration: Hardware Integration, Software Integration, Interface testing, System testing, Stress testing, High level architecture of system integration

Self-Study Component:

Students will be expected to present a report by setting up a detailed state space model capturing specific dynamical behavior in the movement of the upper limb; an FFT technique used in music signal processing, an embedded systems architecture to capture movement and a report on BAN using BLE communication.

1. Camera based systems to measure the gait of a person; specifically focusing on the specifications of the cameras (Unit-1)
2. Force platform systems used to measure the forces applied (by the feet) during a gait. The focus should be on the 3D aspects of force measurement (Unit-2)
3. Use of inertial sensors in embedded systems for gait measurements. (Unit- 3)
4. Use of BLE in Body Area Networks (Unit- 4)

TEXT BOOKS

1. Duane Knudson, Fundamentals of Biomechanics, Springer, Second Edition, 2007
2. The Sound of Numbers, Rachel Wells Hall, Math Horizons, May 31, 2008, http://people.sju.edu/~rhall/proposal.pdf
3. Math for Poets and Drummers; Rachel Wells Hall, Report from the Dept. Of Mathematics and Computer Science, Saint Josephs University, May 31, 2008, http://people.sju.edu/~rhall/Rhythms/P

REFERENCE BOOKS/MATERIAL

1. Some mathematical tools for music making, Miller Puckette, Conference on Art+Math, Boulder Colorado, 2005. http://msp.ucsd.edu/Publications/artmath-reprint.pdf
2. Fourier Analysis and Applications to Sound Processing, University of Oslo, Mathematics in Natural Sciences, 2017,
3. http://www.uio.no/studier/emner/matnat/math/MAT-INF2360/v12/part1.pdf
4. Wireless Body Area Networks – a survey; S Movassaghi et. al., IEEE Communication Surveys and Tutorials, Vol 16, 2014
5. MAC Protocols for Wireless BANs, B Touijer, YB Maissa and S Mouline, Wireless Communications and Mobile Computing Conference, 2017
6. Communication Protocols for BANs, LETI, 2012, http://www.capdigital.com/wp-content/uploads/2012/11/Atelier_Wear-a-BAN_Presentation_CEA-pdf.pdf
7. Overview of the System Integration Process, NDDOT, 2008, https://www.dot.nd.gov/divisions/maintenance/docs/OverviewOfSEA.pdf.
8. Northrop Grumann, Best Practices for System Integration, https://indiastorage.blob.core.usgovcloudapi.net/ndia/2011/system/13007_HouserThursday.pdf

COURSE OUTCOMES (COs):

1. The state space systems approach can be used to model the Biomechanics of human movement **(PO1, 2, 3, 4, 6; PSO 1, 2)**
2. Engineering mathematics and signal processing can be used to analyze music and creation of music **(PO1, 2, 3, 4, 5, 6, 9, 10, 12; PSO 1, 2, 3)**
3. Embedded systems theory can be used to measure and analyze human movement and music **(PO1, 2, 3, 4, 5; PSO 1, 2)**
4. Communication systems, in the form of Body Area Networks, can be used to sense and communicate vital information about body parameters in real time **(PO 1, 2, 3, 4, 5, 6, 9, 10; PSO 1, 2, 3)**
5. Some basics of System integration provides a holistic view of how different technologies are brought together into a single working system **(PO1, 2, 3, 4, 9, 10, 12; PSO: 1, 2, 3)**

MEMS

Course Code: TCE11 **Credit: 4: 0: 0: 0**
Course Co-coordinator: H. R. Ramya **Contact Hours: 56**
Pre-requisites: Micro Electronics (TC43)

Course Content:

UNIT 1

Introduction to MEMS: Historical background of Micro Electro Mechanical Systems, Feynman's vision, multi-disciplinary aspects, basic technologies, application areas, scaling laws in miniaturization, scaling in geometry, electrostatics, electromagnetics, electricity and heat transfer.

UNIT 2

Micro Systems – Principles: Transduction principles in MEMS Sensors: Various sensing mechanisms, Actuators: different actuation mechanisms - silicon capacitive accelerometer, piezo-resistive pressure sensor, blood analyzer, conductometric gas sensor, silicon micro-mirror arrays, piezo-electric based inkjet print head, electrostatic comb-driver, Smart phone applications, Smart buildings

UNIT 3

Materials and Micro manufacturing: Semiconducting materials, Silicon, Silicon dioxide, Silicon Nitride, Quartz, Poly silicon, Polymers, Materials for wafer processing, Packaging materials Silicon wafer processing, lithography, thin-film deposition, etching (wet and dry), wafer-bonding, Silicon micromachining: surface, bulk, LIGA process, Wafer bonding process.

UNIT 4

Electrical and Electronics Aspects: Electrostatics, Coupled electro mechanics, stability and Pull-in phenomenon, Practical signal conditioning circuits for microsystems, RF MEMS: Switches, varactor, tuned filters, Application circuits based on microcontrollers for pressure sensor, Accelerometer.

UNIT 5

Integration and Packaging of Micro electromechanical Systems: Integration of microelectronics and micro devices at wafer and chip levels, Microelectronic packaging: wire and ball bonding, flip chip, Microsystem packaging examples, Testing of Micro sensors, Qualification of MEMS devices.

TEXT BOOKS

1. G. K. Anantha suresh, K. J. Vinoy, S. Gopalakrishnan, K. N. Bhat and V. K. Aatre, "Micro and Smart Systems", Wiley India, First edition, 2010
2. T R Hsu, "MEMS and Microsystems Design and Manufacturing", Tata McGraw Hill, 2nd Edition, 2008

REFERENCE BOOKS

1. Chang Liu, “Foundations of MEMS”, Pearson International Edition, 2012
2. S D Senturia, “Microsystem Design”, Springer International Edition, 2004

COURSE OUTCOMES (COs):

1. Understand the multidisciplinary and scaling aspects of Micro systems. **(PO1, 2, 3, 4, 8, 10) (PSO3)**
2. Analyze the various transduction mechanisms and applications of MEMS. **(PO 1, 2, 3, 4, 8, 9, 10, 11) (PSO3)**
3. Understand the various fabrication processes of MEMS devices. **(PO, 2, 9, 10, 12) (PSO3)**
4. Analyze the electronics aspects of MEMS systems. **(PO1, 2, 8, 10, 11, 12) (PSO3)**
5. Describe various packaging methods for MEMS devices. **(PO, 2, 9, 10, 12) (PSO3)**

AUTOMOTIVE ELECTRONICS

Course Code: TCE26 **Credit: 3: 0: 0: 1**
Course Coordinator: Dr. S. G. Shivaprasad Yadav **Contact Hours: 42**
Prerequisite Courses: Basic Electronics (EC101), Microcontrollers (TC42) Embedded System Design (TC63)

Course Content:

UNIT-1

Automotive Fundamentals Overview: Four Stroke Cycle, Engine Control, Ignition System, Spark plug, Spark pulse generation, Ignition Timing, Drive Train, Transmission, Brakes, Battery.
Self-study component: Steering and Starting System.

UNIT-2

Electronics Fundamentals: Semiconductor Devices, Operational Amplifiers, Analog Computers, Digital Circuits, Logic Circuits (Combinational and Sequential), Integrated Circuits, Microprocessor.
Self-study component: Application case studies using microcontrollers

UNIT-3

Electronic Engine Control: Motivation for Electronic Engine Control, Concept of an Electronic Engine Control Engine parameters, variables, Engine Performance terms.
Self-study component: Electronic Fuel Control System.

UNIT-4

Sensors: Oxygen (O2/EGO) Sensors, Engine Crankshaft Angular Position (CKP) Sensor, Magnetic Reluctance Position Sensor, Engine Speed Sensor, Ignition Timing Sensor, Hall effect Position Sensor, Optical Crankshaft Position Sensor, Manifold Absolute Pressure (MAP) Sensor - Strain gauge and Capacitor capsule, Engine Coolant Temperature (ECT) Sensor, Intake Air Temperature (IAT) Sensor, Knock Sensor, Airflow rate sensor, Throttle angle sensor Actuators – Fuel Metering Actuator
Self-study component: Fuel Injector, Ignition Actuator and EGR Actuator

UNIT-5

Vehicle Motion Control: Electronic suspension system, Antilock Brake System (ABS), Electronic Steering Control Future Automotive Electronic Systems – Alternative Fuel Engines, Electrical and Hybrid vehicles. Collision Avoidance Radar warning Systems, Low tire pressure warning system
Self-study component: Radio navigation, Advanced Driver Information System

TEXT BOOKS

1. William B. Ribbens, "Understanding Automotive Electronics", 6th Edition, SAMS/Elsevier Publishing, 2013.

REFERENCE BOOKS

1. Ronald K Jurgen: "Automotive Electronics Handbook", 2nd Edition, McGraw-Hill, 2001
2. James D Halderman, "Automotive electricity and Electronics", PHI Publication, 2012
3. Terence Rybak and Mark Stefika, "Automotive Electromagnetic Compatibility (EMC)", Springer, 2014
4. Allan Bonnick, "Automotive Computer Controlled Systems, Diagnostic Tools and Techniques", Elsevier Science, 2010
5. Uwe Kieneke and Lars Nielsen, "Automotive Control Systems Engine, Driveline and Vehicle", 2nd Edition, Springer Verlag, 2008

COURSE OUTCOMES (COs):

1. Apply the knowledge of engineering and science to analyze the performance of Electronic Engine Control, working of sensors and actuators **(PO1, 2, 3, 4, 5, 9, 10,11,12) (PSO 1,2, 3)**
2. Analyze the vehicle level Electronic Control for automotive subsystems. **(PO1, 2, 3, 4, 5, 9, 10, 11, 12) (PSO 1, 2, 3)**
3. Understand and make choices of hardware and software in the design and implementation of a high-end Electronic Control Unit for automotive applications **(PO1, 2, 3, 4, 5, 9, 10, 11, 12) (PSO 1, 3)**
4. Understand various communication systems and protocols used in networking for automotive applications **(PO1, 2, 3, 4, 5, 9, 10, 11, 12) (PSO 1, 3)**
5. Gain insight about building future automotive subsystems that contributes to the safety and health of the society using block diagram approach **(PO1, 2, 3, 4, 5, 9, 10, 11, 12) (PSO 1, 2, 3)**

GROUP 3: COMMUNICATION AND SIGNAL PROCESSING

DIGITAL SWITCHING SYSTEMS

Course Code: TCE31 **Credit: 3: 0: 0: 1**
Course coordinator: Dr. Parimala. P **Contact Hours: 42**
Prerequisite: Analog Communication (TC51)

Course Content:

UNIT 1

Introduction: Developments of telecommunications, Network structure, Digital transmission, FDM, TDM, PDH and SDH, Message switching, Circuit switching, Functions of switching systems, Electronic switching.
Self-study: Signaling methods, Telephone network organization, Numbering plan, charging

UNIT 2

Telecommunication Traffic measurement: Introduction, Unit of traffic, Congestion, Traffic measurement, Lost call systems, Queuing Systems
Self-study: Mathematical model, types of switching systems

UNIT 3

Time Division Switching: Introduction, space and time switching, Time switching networks
Digital switching system: Purpose of analysis, Basic central office linkages, Outside plant venous inside plant, Switching system hierarchy, Evolution of digital switching systems, Stored program control switching systems, Digital switching system fundamentals, Building blocks of a digital switching system, Simple call processing
Self-study: Synchronization, 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.
Self-study: Software maintenance, Interface of a typical digital switching system central office, System outage and its impact on digital switching system reliability, Call features, Feature flow diagram.

UNIT 5

Packet switching: Introduction, Connectionless and connection-oriented modes, Packet switching in networks, X.25 vs. Frame Relay, Packet-switched networks, early networks, X.25 era, Internet era

Mobile switching: The cellular concept, analog and digital network elements, Hand-off in digital cells
Self-study: channel allocation, satellite phone

TEXT BOOKS

1. J E Flood, "Telecommunication and Switching, Traffic and Networks", Pearson Education, 2015
2. 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. Classify Telecommunication Switching and evolution of DSS System **(PO1, 2, 3) (PSO 1, 2)**
2. Analyze telecommunication traffic of different models **(PO1, 2, 3, 4) (PSO 1, 2)**
3. Analyze Time Division Switching networks and digital switching systems. **(PO1, 2, 3, 4) (PSO 1, 2)**
4. Analyze and apply Digital switching software to telephonic call. **(PO1, 2, 3, 9) (PSO 1, 3)**
5. Apply the concept of Packet switching and mobile switching. **(PO1, 2, 3, 9, 11) (PSO 1, 3)**

SATELLITE COMMUNICATION

Course Code: TCE32 **Credit: 3: 0: 0: 1**
Course Coordinator: Nisha S L **Contact Hours: 42**
Prerequisites: Digital communication (TC61)
Microwaves and Antenna Engineering (TC53)

Course Content:

UNIT 1

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

Self-Study:

- Interface between GPS module and Arduino to read the geographical coordinates of a place with the help of the signals received from a number of satellites orbiting the earth.
- Orbital elements and parameters using GPS module and Arduino

UNIT 2

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

Self-Study:

- Altitude measurement using GPS module and Arduino.
- Arduino GPS tracking System
- GPS-Based Satellite Tracking System.

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, Measurement of uplink and downlink frequency using GPS module and Arduino and System design example.

Self-Study:

- Measurement of Range using GPS module and Arduino.
- Measurement of Velocity using GPS module and Arduino
- Measurement of uplink and downlink frequency using GPS module and Arduino.

UNIT 4

Satellite Access: Satellite access, single access, pre-assigned FDMA, SCPC (spade system), TDMA, Measurement of Delay using GPS module and Arduino, on board signal processing satellite switched TDMA, and CDMA.

Self-Study:

- Measurement of Delay using GPS module and Arduino.
- Arduino GPS Clock.

UNIT 5

Satellite Services:

Introduction: Satellite mobile services, Direct broadcast satellite television and radio, VSATs, Radarsat, GPS system; GPS based navigation, Orbcomm and Intelesat.

Self-Study:

- GPS based navigation.
- Real time GPS tracker with integrated Google Maps.
- Measurement of HDOP and VDOP using GPS

TEXT BOOKS

1. Dennis Roody, "Satellite Communication" 5th edition, MGH,reprint 2015.

REFERENCE BOOKS

1. Timothy Pratt, Charles Bostian and Teremy Allnut, "Satellite Communication", John Wiley 2nd Edition, reprint 2012.
2. Ha T T, "Digital Satellite Communication", McGrawHill, reprint 2014.
3. Richharia M, "Satellite Communication Systems", Macmillan Press Ltd, reprint 2012.

COURSE OUTCOMES (COs):

1. Recognize the need of Kepler's laws of orbital mechanism and perturbations. **(PO 1, 2, 4, 6, 7, 10, 12)(PSO 1, 2, 3)**
2. Distinguish the different subsystems of the satellite. **(PO 1, 2, 4, 6, 7, 10, 12) (PSO 1, 2, 3)**
3. Design of satellite link budget. **(PO 1, 2, 3, 4, 6, 7, 10, 12) (PSO 1, 2, 3)**
4. Examine the different satellite access technologies. **(PO 2, 4, 6, 7, 10, 12) (PSO 1, 2, 3)**
5. Analyze the different satellite services for practical applications. **(PO 2, 4, 6, 7, 10, 12) (PSO 1, 2, 3)**

SOFTWARE DEFINED RADIO

Course Code: TCE33 **Credit: 3: 0: 0: 1**
Course Coordinator: Dr. Umesharaddy **Contact Hours: 42**
Prerequisite: Digital Circuit Design (TC33)

Course Content:

Unit 1

Introduction: Introduction to ASICs and FPGAs, Digital design flow using FPGAs, CAD tools, Memory, PLDs: Realization of combinational and sequential circuits using PROM, PLA and PAL.

Unit 2

Software Models: Data types and operators – switch Level Modeling-Gate Level Modeling – Data Flow Modeling – Behavioral Modeling-structural modeling –Design of combinational logic and sequential logic circuits-Design of Memory module and Finite state machines-test benches.

Unit 3

FPGA Based Systems: Introduction-basic concepts-Digital design with FPGAs-FPGA based system design, FPGA Fabrics.

CPLD AND FPGA Architecture: Xilinx CPLD architectures, Xilinx FPGA architectures, Configurable logic blocks, I/O blocks, programmable interconnects, programming technologies.

Unit 4

Software Radio: Block Diagram of Software Radio –Numerically controlled oscillator – Digital Up converters / Down Converters – Sampling schemes-Coherent Modulator and Demodulator - Incoherent Demodulation – digital approach for I and Q generation- Filter design(CIC) - baseband processing techniques.

Unit 5

System Design: Design of Digital signal processing blocks- FFT, IFFT, FIR filters – crest factor reduction, digital pre distortion blocks- Turbo coders -OFDM modulators/demodulators, Network security-AES encryption- decryption modules.

Self-Study:

1. Behavioral, Structural, and Data flow modeling using verilog HDL.(Unit-1)
2. Mixed type and switch level modeling using verilog HDL.(Unit-2)
3. Behavioral description for stepper/DC motor ADC/DAC using verilog HDL.(Unit-3)
4. IIR/FIR Filter design using verilog HDL.(Unit-4)
5. Implementation of Modulator and Demodulator using verilog HDL.(Unit-5)
6. Behavioral description for data encryption and decryption using verilog HDL.(Unit-5)

TEXT BOOKS

1. Bob Zeidman, "Designing with CPLDs and FPGAs", CMP, 2002.
2. Samir Palnitkar, "Verilog HDL: A Guide to Digital Design and Synthesis", Prentice Hall, 2003.
3. Wayne Wolf, "FPGA based system design", Reprint 2005, Pearson Education.
4. Jeffrey H Reed, "Software Radio: A Modern Approach to Radio Engineering", Prentice Hall, 2002.

REFERENCES

1. Mitra S K, "Digital Signal Processing", Tata McGraw Hill, 2005.
2. Uwe Meyer Baese, "Digital Signal Processing with Field Programmable Gate Arrays", Springer, 2007.
3. Stephen Brown, "Fundamentals of Digital Logic with Verilog Design", Tata McGraw-Hill

COURSE OUTCOMES (COs):

1. Describe Digital design flow using PLDs and FPGAs.**(PO1, 2, 3, 5, 6, 12) (PSO 1, 2, 3)**
2. Define, classify, compare and design different types of descriptions using Verilog HDL. **(PO1, 2, 3, 5,12) (PSO 1, 3)**
3. Design, describe, distinguish, illustrate and evaluate complex digital circuits using FPGA and CPLD Architecture. Analyze the basic CLBs in FPGA. **(PO1, 2, 3, 5, 6, 12) (PSO 1, 2, 3)**
4. Describe and design Software Defined Radio.**(PO1, 2, 4, 5, 6, 7, 12) (PSO 1, 2, 3)**
5. Construct and implement different types of filters used in MODEM using FPGA **(PO1, 2, 3, 4, 5, 6, 12) (PSO 1, 2, 3)**

MULTIMEDIA COMMUNICATION

Course Code: TCE34 **Credit : 3:0:0:1**
Course Coordinator: Venu. K. N. **Contact Hours: 42**
Prerequisites: Digital Communication (TC61)

Course Content:

UNIT 1

Multimedia Communications: Introduction, multimedia information representation, multimedia networks, multimedia applications, media types.
Self-Study topic: network QoS application QoS

UNIT 2

Multimedia Information Representation: Text, images, audio and video, Text and image compression, text compression,
Self-Study Topic: image compression.

UNIT 3

Audio and Video Compression: Audio and video compression, audio compression, video compression, video compression principles, video compression standards: H.261, H.263, P1.323, MPEG 1, MPEG 2.
Self-Study topic: coding formats for text, speech, image and video.

UNIT 4

Standards for Multimedia Communications: Standards relative to interactive applications over the internet, standards for entertainment applications, error detection methods, transmission systems, PSTN modems,
Self-study Topic: switching systems and signaling systems.

UNIT 5

Broadband ATM Networks, Entertainment Networks and high Speed Modems: Introduction, cell format and switching principles, switch characteristics, protocol architecture, ATM LANs, Cable TV networks, satellite television networks, terrestrial television networks
Self-study Topic: high speed PSTN access technologies

TEXT BOOKS:

1. Fred Halsall, "Multimedia Communications: Applications, Networks, Protocols and Standards" , Pearson Education, Asia, Second Indian reprint 2002

REFERENCE BOOKS:

1. Nalin K. Sharda, "Multimedia Information Networking", PHI, 2003
2. Prabhat K. Andleigh, Kiran Thakrar, "Multimedia Systems Design", PHI, 2004.

COURSE OUTCOMES (COs):

1. Gain knowledge on different types of media **(PO1, 2, 3, 4,7) (PSO1,2)**
2. Representation of media and compression principles of text and images **(PO1, 2,3) (PSO1)**
3. Understand how audio and video are been compressed **(PO1, 2, 3, 4, 5,12)**
4. Gain knowledge about standards of multimedia communication and interactive applications **(PO1,2,3,4) (PSO1)**
5. Understand the working of broadband ATM networks **(PO1, 2, 3, 4, 6) (PSO1,2)**

DSP ALGORITHMS AND APPLICATIONS

Course Code: TCE11 **Credit: 4: 0: 0: 0**
Course Coordinator: Dr. S G Shivaprasad Yadav **Contact Hours: 56**
Prerequisites : Digital Signal Processing (TC51)

Course Content:

UNIT 1

Introduction to basic features of Digital Signal Processing Devices: Introduction, A Digital Signal-Processing System, Digital Filters, Decimation and Interpolation. Basic Architectural features, DSP computational building blocks, Bus Architecture and Memory, Address generation unit, Speed issues.

UNIT 2

Introduction to Basic DSP Algorithms and its Implementation using Basic DSP processor: The Q-notation, FIR filters, IIR Filters, Interpolation Filters, Decimation Filters, 2-D Signal Processing, FFT implementation.

UNIT 3

ARCHITECTURE OF TMS320C6X PROCESSOR: Introduction, TMS320C6x architecture, Functional units, Fetch and execute packets, Pipelining, Registers, Linear and circular addressing modes, Interrupts

UNIT 4

TMS320C6x INSTRUCTIONS, MEMORY CONSIDERATIONS and Adaptive Filters: Introduction to different types of C6x Instruction sets with examples, Assembly Code Format, Assembler directives

Memory Considerations: Data Allocation and Alignment, Program Directives, Memory Models, Fixed- And Floating-Point Format, Code improvement constraints,

Adaptive Filters: Introduction to adaptive filters Adaptive structures, Algorithms and implementation

UNIT 5

DSP Applications: Applications of Programmable DSP Devices: DSP-based biotelemetry Receiver, A Speech Processing system, An Image processing system, A position Control system for a Hard disk drive, DSP-Based Power Meter

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

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. Describe the Basic Principles of DSP and Basic Architectural features of DSP devices. **(PO 1, 2, 3, 8) (PSO1, 2)**
2. Analyze the implementation of DSP algorithms using basic DSP processor (**PO1, 2, 3, 4, 5, 8) (PSO 1, 2)**
3. Interpret the architectural details of TMS320C67xx processor **(PO1, 2, 3, 4, 5, 8. 9, 12) (PSO 1, 2, 3)**
4. Analyze Addressing modes, instruction sets and the memory considerations of TMS320C67xx processor and design of adaptive filters **(PO 1, 2, 3, 4, 5, 8) (PSO 1, 2, 3)**
5. Interpret the applications of DSP Devices. (**PO 1, 2, 3, 4, 5, 8, 9, 10, 11, 12) (PSO 1, 2, 3)**

WAVELETS AND APPLICATIONS

Course Code: TCE36 **Credit: 3: 0: 0: 1**
Course Coordinator: Dr. Parimala. P **Contact Hours: 42**
Prerequisite: Digital Signal Processing (TC51)

Course Content:

UNIT 1

Introduction: Continuous wavelet transforms, Properties, Inverse transform, Examples of mother wavelets, Analytic wavelet transform.
Self-Study: Implementation of mother wavelets using Mat software.

UNIT 2

Introduction to Discrete Wavelet Transform: MRA, A wavelet basis for MRA, Digital filtering interpretation, Examples of orthogonal basis –generating wavelets, interpreting orthonormal MRAs for discrete time signals.
Self-Study: Implementation of feature extraction.

UNIT 3

Bi-orthogonal Wavelets: Bi-orthogonal wavelet bases, Filtering relationship for bi-orthogonal filters, Examples of bi-orthogonal scaling functions and wavelets, two dimensional wavelets, Multidimensional wavelets and wavelet packets.
Self-Study: Implementation of classification of data using wavelets.

UNIT 4

Wavelet transform and data compression: Transform coding, DTWT for image compression, Audio compression and video coding 61
Self-Study: Implementation of Image compression using wavelet transforms.

UNIT 5

Applications of Wavelet Transforms: De-noising, Biomedical applications, Applications in communication system, Edge detection and object isolation, Image fusion.
Self-Study: Application of wavelets in bio-medical signals.

TEXT BOOKS

1. Raghuveer M. Rao, Ajit S. Bopardikar, “Wavelet Transforms: Introduction to Theory & Applications”, Pearson Education Asia, New Delhi, 2003
2. Agostino Abbate, Casimer M. DeCusatis and Pankaj K. Das, “Wavelets and Subbands Fundamentals and Applications”, Pearson Education Asia, New Delhi, 2008

REFERENCE BOOKS

1. K. P. Soman and K.L. Ramchandran, "Insight into Wavelets from theory to practice", Eastern Economy Edition, 2008
2. Stephane G. Mallat, "A Wavelet Tour of Signal Processing", Academic Press, Second Edition, 1999.

COURSE OUTCOMES (COs):

1. Describe scaling functions, continuous wavelet transform and different wavelet functions. **(PO 1, 2, 3, 4, 5,10,12)(PSO 1, 2)**
2. Differentiate continuous wavelet and discrete wavelet transforms and analyze multi-resolution analysis**. (PO 1, 2, 3, 4, 5, 10, 12) (PSO 1, 2)**
3. Develop bi-orthogonal wavelet basis function and apply to two dimensional signals. **(PO 1, 2, 3, 4, 5, 10, 12) (PSO 1, 2)**
4. Apply wavelet transform for image and audio compression. **(PO 1, 2, 3, 4, 5, 10, 12) (PSO 1, 2)**
5. Employ wavelet transforms for de-noising, speckle removal, object detection and data communication **(PO 1, 2, 3, 4, 5, 10, 12) (PSO 1, 2, 3)**