Bharatiya Vidya Bhavan's

Sardar Patel Institute of Technology

(Autonomous Institute Affiliated to University of Mumbai)

Bachelor of Engineering/Technology (B.E./B.Tech)
in
Electronics and Telecommunication Engineering

Third Year Engineering
(Sem. V and Sem. VI)
Effective from Academic Year 2017 -18

Sardar Patel Institute of Technology

Bhavan's Campus, Munshi Nagar, Andheri (West), Mumbai-400058-India
(Autonomous Institute Affiliated to University of Mumbai)

Preamble:

Concept of academic autonomy is based on the argument that Institutions can undertake the work expected of them by all stakeholders such as Students, Parents, University, Industry, Society in general, only if they have freedom of choice and action.
We at S.P.I.T. would like to believe that this freedom of choice and action as far as academics is concerned will make us more Proactive in our offerings.

An academic autonomy is as good as its Curricula and execution of it is as well as its faculty. S.P.I.T. is confident of succeeding on both the fronts.

In the first offering we have tried to pro-actively bridge the ever discussed "Industry-academic gap" by way of our SCOPE program. The issue about sensitizing students to social needs is being addressed by special activity based courses. Liberal arts courses have been introduced to enhance functionality of both sides of brain. In all this the professional core has not been overlooked. Thus the curricula are designed to achieve multi dimensional outcomes.

The evaluation mechanism is tuned for assessing the attainment of the designed outcomes and is designed as a fair mechanism.

As our learning cycle begins from July 2017, I wish to place on record that entire S.P.I.T. staff and faculty will work with singular focus and commitment towards the success of this endeavour.

Dr. Prachi Gharpure
Principal, S.P.I.T.

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From the Desk of Dean Academics

Greetings and congratulations to all the students, teaching and supporting staff of Sardar Patel Institute of Technology for getting autonomous status to the institute from the year 2017-18. We look towards autonomy as a great opportunity to design and implement curriculum sensitive to needs of Indian Society and Industries.

In the proposed curriculum we have made an attempt to provide opportunity for students to develop themselves as competent engineering graduates with knowledge, skill and ethical behavior required for global career. Curriculum is designed to provide multiple learning opportunities for students to acquire and demonstrate competencies for rewarding careers. The curriculum model is outcome based that focuses on learning by doing. This is achieved through activity based learning, minor projects, problem solving and innovative styles of pedagogy. Various steps are taken to transform teaching-learning process to make learning a joyful experience for students. Special laboratory based courses are introduced to give more practical exposure to the students.

To create socially responsible citizen curriculum offers courses like Constitution of India, Environmental Studies and Human Health Systems Approach. Also various activity based learning modules like 'Building Automation, Fire Safety and Electronic Security', 'Occupational Safety & Legal Studies for Engineers', 'Technical Presentation Skills', 'Technical Paper and Patent Drafting', 'Engineering Solution for Environmental Problems' and 'Financial Planning, Taxation Policies and Investment' are introduced. For overall development of the learner, various elective courses like Yoga Vidya, Music Appreciation, Dramatics, Industrial and Organizational Psychology, Law for Engineers, French Language, German Language etc. are introduced. To encourage interdisciplinary studies institute level Open Elective courses are offered.

One of the special feature of this curriculum is Skill development programme called SCOPE (Skill Certification for Outcome-Based Professional Education) planned to enhance employability, innovation and research culture in the institute. Every department is offering six domain specific tracks, each track containing six courses. Student will have an opportunity to enroll for more than 140 courses in any of the department of his choice. Some of the courses under SCOPE will be delivered in co-ordination with industries.

We believe that this curriculum will raise the bar of academic standards with the active involvement and cooperation from students, academic and administrative units. Faculty of S.P.I.T. deserves a special appreciation for their relentless efforts in designing curriculum and assessment instruments which will bring transformation in the quality and transparency in assessment of learners.

Looking forward for your active cooperation and constructive feedback to create vibrant and joyful learning environment at Sardar Patel Institute of Technology.

Dr. Surendra Singh Rathod
Professor and Dean Academics

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Message from Head of the Department

The Electronics & Telecommunication Engineering department has highly qualified and professionally skilled faculty members, who regularly conduct training programs in the areas of Network Administration, Communication, Design & Optimization, Network Security, Embedded Systems, Real-time DSP applications, VLSI design and RTOS. The department has signed MoU with companies like Tata Consultancy Services, Sony Ericsson India Ltd to train and significantly improve technical knowledge and skills of students. Department faculties are rigorously involved in R&D activities. The research work is published in reputed international journals like IEEE, IET, AIP, ASP, Elsevier etc. and also in international conferences.

The department is actively involved in research areas ranging from Cyber-physical systems to Computation Engineering. The following is a broad research areas:

- Embedded and Cyber-Physical Systems
- Signal Processing and Control System
- Communication
- RF System and Design
- Networking and Security
- Simulation and Modeling
- Computational Engineering

The department expects graduates **establish** themselves in their **chosen career paths** by utilizing technical, leadership, communication and interpersonal skills, while complying with ethical standards. Graduates through their excellence, contribute towards the next generation of telecommunication by **engaging in Research and Development**. Graduates demonstrate personal growth by pursuing or successfully **completing advanced degrees and professional development courses** in the field of engineering.

Dr. Y. S. Rao
Head of Electronics & Telecom. Engg. Department

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Scheme for B.E./B.Tech Electronics and Telecommunication Engineering					
SEM -V					
Course Code	**Course Name**	**Teaching Scheme (Hrs/week)**			**Credits**
		L	**T**	**P**	**Total**
ETC501	Microcontrollers and Applications	4	--	--	4
ETC502	Analog Communication	4	--	--	4
ETC503	Random Signal Analysis	4	1	--	5
ETC504	RF Modeling and Antennas	4	--	--	4
ETC505	Integrated Circuits	4	--	--	4
ETC506	Business Communication and Ethics	--	--	4*	2
ETL501	Microcontrollers and Applications Laboratory	--	--	2	1
ETL502	Communication Engineering Laboratory-I	--	--	2	1
ETL503	Communication Engineering Laboratory-II	--	--	2	1
ETL504	Mini Project I	--	--	2	1
	Total	20	1	12	27

*** Out of 4 hours, 2 hours class wise theory and 2 hours batch wise practical**

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Scheme for B.E./B.Tech Electronics and Telecommunication Engineering					
SEM -VI					
Course Code	**Course Name**	**Teaching Scheme (Hrs/week)**			**Credits**
		L	**T**	**P**	**Total**
ETC601	Digital Communication	4	--	--	4
ETC602	Discrete Time Signal Processing	4	--	--	4
ETC603	Computer Communication and Telecom Networks	4	--	--	4
ETC604	Television Engineering	4	--	--	4
ETC605	Operating Systems	4	--	--	4
ETC606	VLSI Design	4	--	--	4
ETL601	Discrete Time Signal Processing Laboratory	--	--	2	1
ETL602	Communication Engineering Laboratory- III	--	--	2	1
ETL603	Communication Engineering Laboratory- IV	--	--	2	1
BS604	Mini Project II	--	--	2	1
	Total	24	--	8	28

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SEMESTER - V

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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
ETC501	Microcontroller & Applications	4	-	-	4	-	--	4
		Examination Scheme						
		ISE		MSE		ESE		
		10		30		100 (60% Weightage)		

Pre-requisite Course Codes		ETC303: Digital electronics ETC403: Microprocessor and Peripherals
After successful completion of the course, student will be able to		
Course Outcomes	CO1	Ability to describe the architecture and the software aspects of microcontroller 8051and ARM7.
	CO2	Interface various peripheral devices to the microcontroller 8051.
	CO3	Write assembly language programs for microcontroller 8051 and ARM7.
	CO4	Design microcontroller 8051 based system for various applications.

Module No.	Unit No.	Topics	Ref.	Hrs.
1	**8051 Microcontroller**		1,2	**12**
	1.1	Comparison between Microprocessor and Microcontroller		
	1.2	Features, architecture and pin configurations		
	1.3	CPU timing and machine cycle		
	1.4	Input / Output ports		
	1.5	Memory organization		
	1.6	Counters and timers		
	1.7	Interrupts		
	1.8	Serial data input and output		
2	**8051 Assembly Language Programming.**		1,2	**08**
	2.1	Instruction set		
	2.2	Addressing mode		
	2.3	Assembler directives		
	2.4	**Programs related to:** arithmetic, logical, delay, input, output port, serial communication, and interrupts		
3	**8051 Interfacing and Applications**		1,2	**12**
	3.1	Interfacing of display: LED, LCD, and seven segment display		
	3.2	Keyboard Interfacing		
	3.3	Interfacing of ADC and DAC (0808/09)		

	3.4	Stepper motor and relay		
	3.5	Connection to RS 232 for serial communication		
	3.6	Manual and auto reset		
	3.7	IR based wireless communication system design		
4	**ARM7: A 32-bit Microcontroller**		4	**08**
	4.1	The RISC design philosophy		
	4.2	Concept of Cortex-A, the Cortex-R, and the Cortex-M		
	4.3	Features of ARM Microcontroller		
	4.4	Operating modes		
	4.5	Architecture (ARM core dataflow model)		
	4.6	Registers		
	4.7	Current program status register		
	4.8	Pipeline		
	4.9	Exceptions, interrupt and vector table		
	4.10	Memory management		
	4.11	ARM7 processor families		
5	**ARM7 Programming**		4	**08**
	5.1	Instruction set for data processing, branching, load-store, software interrupt,and program status register		
	5.2	Addressing modes		
	5.3	Programming for ARM7		
6	**Introduction to Embedded Systems**		5,6	**04**
	6.1	Concepts of embedded systems		
	6.2	Optimizing design matrices and common design matrice		
	6.3	Study of embedded systems 1) Digital camera 2) Stepper motor controller.		
			Total	**52**

References

1. M. A. Mazidi, J. G. Mazidi and R. D. Mckinlay, "*The 8051 Microcontroller & Embedded systems*", Pearson Publications, Second Edition 2006.
2. C. Kenneth J. Ayala and D. V. Gadre, "*The 8051 Microcontroller & Embedded system using assembly & 'C*' ", Cengage Learning, Edition 2010.
3. Satish Shah, "*The 8051 Microcontrollers",* Oxford publication first edition 2010.
4. Andrew Sloss, Dominic Symes, and Chris Wright, "*ARM System Developer's Guide*" Morgan Kaufmann Publishers, First Edition 2004.
5. James A. Langbridge, "*Professional Embedded Arm Development*", Wrox, John Wiley Brand& Sons Inc., Edition 2014
6. Frank Vahid& tony Gavages "*Embedded system design – A unified hardware / software*

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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
ETC502	Analog Communication	4	-	--	4	-	--	4
		Examination Scheme						
		ISE		MSE	ESE			
		10		30	100 (60% Weightage)			

Pre-requisite Course Codes		ETC302: Analog Electronics-I ETC405: Signals and Systems
After successful completion of the course, student will be able to		
Course Outcomes	CO1	Demonstrate a clear understanding of different modulation and demodulation techniques using analog communication.
	CO2	Identify and solve basic communication problems, analyze transmitter and receivers.
	CO3	Compare and contrast advantages and limitations of different analog communication systems.
	CO4	Apply sampling theorem to convert analog signals to digital signals while satisfying certain specs.

Module No.	Unit No.	Topics	Ref.	Hrs.
1	**Basics of Communication System**		1,2,6	04
	1.1	Block diagram, electromagnetic spectrum, signal bandwidth and power, types of communication channels		
	1.2	Types of noise, signal to noise ratio, noise figure, and noise temperature		
2	**Amplitude Modulation and Demodulation**		1,2,6	12
	2.1	Basic concept, signal representation, need for modulation		
	2.2	**s**pectrum, waveforms, modulation index, bandwidth, voltage distribution, and power calculation		
	2.3	**DSBFC**: Principles, modulating circuits, low level and high level transmitters **DSB suppressed carrier**:- Multiplier modulator, nonlinear modulator, and switching modulator, **Single Side Band (SSB):-**Principle, Filter method, phase shift method and third method Quadrature amplitude modulation (QAM), Independent sideband (ISB) and Vestigial Side Band (VSB) principles and transmitters		
	2.4	**Amplitude demodulation:** Diode detector, practical diode detector, and square law detector.		
	2.5	Applications of AM and use of VSB in broadcast television		
3	**Angle Modulation and Demodulation**		2,6	14
	3.1	**Frequency modulation (FM):** Basic concept, mathematical		

		analysis, frequency spectrum of FM wave, sensitivity, phase deviation and modulation index, frequency deviation and percent modulated waves, bandwidth requirement of angle modulated waves, deviation ratio, narrow Band FM, and Wide Band FM.		
	3.2	Varactor diode modulator, FET reactance modulator, stabilized reactance modulator-AFC, Direct FM transmitter, indirect FM Transmitter, noise triangle in FM, preemphasis and de-emphasis.		
	3.3	**Phase modulation (PM): P**rinciple and working of Transistor direct PM modulator and relationship and comparison between FM and PM		
	3.4	**FM demodulation:** Balance slope detector, Foster-Seely discriminator, ratio detector, Phase lock loop(PLL) FM demodulator, amplitude limiting and thresholding, comparison between FM demodulators, comparison between AM, FM and PM.		
	3.5	Applications of FM and PM		
4	**Radio Receivers**		2,4	10
	4.1	TRF, Super-heterodyne receiver, receiver parameters, and choice of IF.		
	4.2	AM receiver circuits and analysis, simple AGC, delayed AGC, forward AGC, and communication receiver		
	4.3	FM receiver circuits, comparison with AM receiver		
	4.4	Single and independent sideband (SSB and ISB) receivers		
5	**Sampling Techniques**		2,4	04
	5.1	Theorem for low pass and band pass signals, proof with spectrum, Nyquist criteria		
	5.2	Sampling techniques, aliasing error, and aperture effect		
6	**Pulse Modulation and Demodulation**		1,2,4	08
	6.1	PAM, PWM, PPM generation and detection		
	6.2	Delta modulation, adaptive delta modulation, principle, generation and detection		
	6.3	TDM and FDM basic concepts and block diagram		
	6.4	Applications of pulse communication		
			Total	**52**

References

1. WayneTomasi, "*Electronics Communication Systems*", Pearson education, Fifth edition.
2. Kennedy and Davis, "*Electronics Communication System*", Tata McGraw Hill,4e.
3. B.P. Lathi, Zhi Ding*, "Modern Digital and Analog Communication system*", Oxford University Press, Fourth edition
4. Taub, Schilling and Saha, "*Taub's Principles of Communication systems*", Tata McGraw Hill,Third edition.
5. Simon Haykin, Michel Moher, "*Introduction to Analog and Digital Communication*", Wiley, Second edition.

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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
ETC503	Random Signal Analysis	4	1	--	4	1	--	5
		Examination Scheme						
		ISE		MSE	ESE			
		10		30	100 (60% Weightage)			

Pre-requisite Course Codes		ETC 405: Signals and Systems ETC 401: Applied Mathematics IV
After successful completion of the course, student will be able to		
Course Outcomes	CO1	Prove mathematically and interpret statistical properties that will be used in later semesters in the design and analysis of communication systems
	CO2	Analyze statistical behavior of single and multiple random variables and be able to manipulate them.
	CO3	Students can solve engineering problems using axiomatic probability theory, random variables, and random processes

Module No.	Unit No.	Topics	Ref.	Hrs.
1	**Overview of Probability Theory and Basics of Random Variables**		1,3	10
	1.1	Sample space, events, set operations, the notion and axioms of probability.		
	1.2	Conditional probability**,** Joint probability, Baye's rule, Independence of events,Sequential Experiments.		
	1.3	Notion of random variable.		
	1.4	Continuous random variables, probability density function, probability distribution function, Uniform, Exponential and Gaussian continuous random variables and distributions.		
	1.5	Discrete random variables, probability mass function, probability distribution function, binomial, Poisson and geometric discrete random variables and distributions.		
2	**Operations on One Random Variable**		1,2	07
	2.1	Functions of a random variable and their distribution and density functions.		
	2.2	Expectation, Variance and Moments of random variable.		
	2.3	Transformation of a random variable, Markov, Chebyshev and Chernoff bounds, characteristic functions, moment theorem		
3	**Multiple of Random Variables And Convergence**		1,4	08
	3.1	Vector random variables, Pairs of random variables, Joint CDF, Joint PDF Independence , Conditional CDF and PDF, Conditional		

		Expectation		
	3.2	One function of two random variable, two functions of two random variables; joint moments, joint characteristic function, covariance and correlation-independent,uncorrelated and orthogonal random variables.		
4	**Sequence Of Random Variables And Convergence:**		1,2,4	05
	4.1	Random sequences, Limit theorems; Strong and weak laws of large numbers,		
	4.2	Central limit theorem and its significance		
5	**Random Process**		1,5	10
	5.1	Random process: Definition, realizations, sample paths, discrete and continuous time processes		
	5.2	Probabilistic structure of a Random process; mean, correlation and covariance functions, stationarity of random process.		
	5.3	Ergodicity, Transmission of WSS random process through LTI system		
	5.4	Spectral analysis of random processes, power density spectrum bandwidth, crosspower density spectrum.		
	5.5	Gaussian and Poisson random process		
6	**Markov Chains And Introduction To Queuing Theory**		1,5,	12
	6.1	Markov processes		
	6.2	Discrete Markov chains, The n–step transition probabilities, steady state probabilities.		
	6.3	Introduction to Continuous time Markov chains.		
	6.4	Classifications of states.		
	6.5	Markovian models		
	6.6	Birth and death queuing models		
	6.7	Steady state results		
	6.8	Single and Multiple server Queuing models		
	6.9	Finite source models		
	6.10	Little's formula		
			Total	**52**

References

1. Alberto Leon Garcia, "*Probability And Random Processes For Electrical Engineering*", second edition Low price edition Pearson education.
2. Miller, "Probability And Random Processes-With Applications to Signal Processing and Communication", first edition 2007, Elsevier.
3. Papoulis and S. Unnikrishnan Pillai, "*Probability, Random Variables and Stochastic Processes*," Fourth Edition, McGraw Hill.
4. H. Stark and J. Woods, ``*Probability and Random Processes with Applications to Signal Processing*,'' Third Edition, Pearson Education.
5. Hwei Hsu, "*Probability Random Variable,s Random Process, Schaulm's Outlines*,TMH,2004.

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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
ETC504	RF Modeling and Antennas	4	-	--	4	-	--	4
		Examination Scheme						
		ISE		MSE	ESE			
		10		30	100 (60% Weightage)			

Pre-requisite Course Codes		ETC 404: Wave Theory and Propagation
After successful completion of the course, student will be able to		
Course Outcomes	CO1	Analyze and Design RF Filters
	CO2	Analyze the radiation mechanism and fundamental parameters of Antennas.
	CO3	Able to Demonstrate knowledge of antennas in communication systems.
	CO4	Able to discriminate between antennas on the basis of their electrical performance.
	CO5	Able to design different microstrip Antennas and Antenna Arrays.

Module No.	Unit No.	Topics	Ref.	Hrs.
1	**Behavior of Active and Passive Components in RF range**		1,2	04
	1.1	Frequency Spectrum, hazards of Electromagnetic Radiations, and fundamentals of radio frequency design		
	1.2	High Frequency behavior, equivalent circuit and frequency response of resistor, capacitor, inductor, diode, BJT, and FET		
	1.3	Characteristics, structure and applications of coaxial line, stripline, microstrip line, and coplanar lines		
2	**Filter Design**		1,2,4	12
	2.1	Analysis of infinite periodic structures terminated Periodic structures, k-β diagrams and wave velocities.		
	2.2	**Image Parameter Method:** Image impedances and transfer functions for two port networks, constant-k filter sections, m-derived filter sections, and composite filters		
	2.3	**Insertion Loss Method:** Characterization by power loss ratio, maximally flat, equal ripple, and linear phase low pass filter prototype.		
	2.4	**Filter transformations:** impedances, frequency scaling, and band pass and band stop		
	2.5	Richard's transformation, Kuroda's identity, impedance, and admittance inverters		
3	**Fundamentals of Antenna**		3,4	14
	3.1	Conceptual understanding and radiation mechanism		

	3.2	**Fundamental Parameters of Antennas:** Radiation pattern, radiation power density, radiation intensity , beam width, directivity, antenna efficiency, gain, beam efficiency, bandwidth, input impedance, antenna radiation efficiency, antenna vector effective length and equivalent areas, maximum directivity and maximum effective areas.		
	3.3	Friss transmission equation, antenna temperature		
	3.4	Vector potential *A* for an electric current source *J*, vector potential *F* for an magnetic current source *M*, electric and magnetic fields for electric *J* and Magnetic *M* current sources, and concept of near and far field radiation.		
4	**Wire Antennas**		1,2,3,5	10
	4.1	**Infinitesimal dipole and small dipole:** Radiation field, near field, far field directivity, region separation		
	4.2	**Finite Length dipole**: Basic parameters of half wavelength dipole, folded dipole		
	4.3	Monopole antenna		
	4.4	Ground Effects		
	4.5	Linear elements near or on infinite perfect conductors		
	4.6	**Loop antennas**: Basic parameters		
5	**Antenna Arrays:**		1,3	04
	5.1	Linear arrays, planner arrays, and circular arrays		
	5.2	Array of two isotropic point sources, non-isotropic sources		
	5.3	Principle of pattern multiplication,		
	5.4	Linear arrays of n elements, broadside, radiation pattern, directivity, beam width and null directions, array factor		
	5.5	Antenna analysis using Binomial, Dolph-Tschebyscheff, Yagi Uda antenna		
6	**Special types of antennas**		3	08
	6.1	**Frequency Independent Antennas:** Log periodic and helical antennas **Microstrip Antennas: C**haracteristics, applications and limitations		
	6.2	**Reflector Antennas and Horn Antennas:** Characteristics, applications andlimitations		
			Total	**52**

References

1. David M Pozar, "*Microwave Engineering*", John Wieley and Sons, Inc. Hobokenh, New Jersey, Fourth Edition, 2012
2. Costantine A. Balanis, "*Antenna Theory Analysis And Design*", John Wiley Publication
3. John D. Kraus, " *Antennas*", Tata McGraw Hill publication
4. Annapurna Das and Sisir K Das, "*Microwave Engineering*", Tata McGraw Hill,New Delhi, Second Edition, 2009
5. Reinhold Ludwig and Pavel Bretchko, "*RF Circuit Design*", Pearson Education Asia.

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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
ETC505	Integrated Circuits	4	-	--	4	-	--	4
		Examination Scheme						
		ISE		MSE	ESE			
		10		30	100 (60% Weightage)			

Pre-requisite Course Codes	FEC105: Basic Electrical & Electronics Engineering ETC302: Analog Electronics-I ETC303: Digital Electronics ETC402: Analog Electronics-II	
After successful completion of the course, student will be able to		
Course Outcomes	CO1	Able to understand the areas of applications of the Operational Amplifier.
	CO2	Able to analyze special purpose integrated circuits (IC 555, Regulators etc).
	CO3	Able to select IC and design practical circuits that perform the desired operations (Using Counters and Shift Registers).

Module No.	Unit No.	Topics	Ref.	Hrs.
1	**Review of Operational Amplifier**		1,5,6	04
	1.1	Operational amplifier overview: parameters, open loop and closed loop configurations		
2	**Applications of Operational Amplifier**		1,2,5,6	12
	2.1	**Amplifiers:** Current amplifier, difference amplifier, instrumentation amplifier, and programmable gain amplifier		
	2.2	**Converters:** Current to voltage converters, voltage to current converters,generalized impedance converter, voltage to frequency converter, frequency to voltage converter, logarithmic converters and antilog converters		
	2.3	**Active Filters:** Second order active finite and infinite gain low pass, high pass,band pass and band reject filters		
	2.4	**Sine Wave Oscillators:** RC phase shift oscillator, Wien bridge oscillator, Quadrature oscillator		
3	**Non-Linear Applications of Operational Amplifier**		3,4,6	10
	3.1	**Comparators:** Inverting comparator, non-inverting comparator, zero crossing detector, window detector and level detector		
	3.2	**Schmitt Triggers:** Inverting Schmitt trigger, non-inverting Schmitt trigger, and adjustable threshold levels		
	3.3	**Waveform Generators:** Square wave generator, triangular wave generator, and duty cycle modulation		
	3.4	**Precision Rectifiers:** Half wave, full wave, and applications		
	3.5	Peak detectors, sample and hold circuits		

4	**Special Purpose Integrated Circuits**		1,2,4,5	08
	4.1	**Functional block diagram, working, design and applications:** Timer 555		
	4.2	**Functional block diagram, working and applications:** VCO 566, PLL 565, multiplier 534, waveform generator XR 2206, power amplifier LM380		
5	**Voltage Regulators**		2,3	08
	5.1	Functional block diagram, working and design of three terminal fixed (78XX,79XX series) and three terminal adjustable (LM 317, LM 337) voltage regulators.		
	5.2	Functional block diagram, working and design of general purpose 723 (LVLC,LVHC, HVLC and HVHC) with current limit and current fold-back protection,Switching regulator topologies, Functional block diagram and working of LT1070 monolithic switching regulator		
6	**Counters, Shift Registers and ALU (Logic Diagram and applications)**		1,2,3	10
	6.1	**MSI Counters:** Ripple counters (7490 decade, 7492 modulus-12, 7493 4-bitbinary), synchronous counters (74162 decade, 74163 4-bit binary, 74169 4-bit up/down binary)		
	6.2	**MSI Shift Registers:** 74164 serial input parallel output, 74166 parallel input serial output, 74191 serial input serial output, 74194 universal shift register		
	6.3	**Arithmetic Logic Unit:** 74181 ALU		
			Total	**52**

References

1. Sergio Franco, "*Design with Operational Amplifiers and Analog Integrated Circuits*", Tata McGraw Hill, 3rd Edition
2. John F. Wakerly, "*Digital Design – Principles & Practices*", Pearson Education, 3rd Edition
3. J. Millman and A. Grabel, "*Microelectronics*", Tata McGraw Hill, 2nd Edition.
4. D. Roy Choudhury and S. B. Jain, "*Linear Integrated Circuits*", New Age International Publishers, 4th Edition
5. David A. Bell, "*Operation Amplifiers and Linear Integrated Circuits*", Oxford University Press, Indian Edition
6. Ramakant A. Gayakwad, "*Op-Amps and Linear Integrated Circuits*", Pearson Prentice Hall, 4th Edition
7. R. F. Coughlin and F. F. Driscoll, "*Operation Amplifiers and Linear Integrated Circuits*", Prentice Hall, 6th Edition
8. J. G. Graeme, G. E. Tobey and L. P. Huelsman, "*Operational Amplifiers- Design & Applications*", New York: McGraw-Hill, Burr-Brown Research Corporation

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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
ETS506	Business Communication and Ethics	-	-	4	-	-	2	2
		Examination Scheme						
		ISE		MSE		ESE		
		10		30		100 (60% Weightage)		

Pre-requisite Course Codes		
After successful completion of the course, student will be able to		
Course Outcomes	CO1	Communicate effectively in both verbal and written form and demonstrate knowledge of professional and ethical responsibilities
	CO2	Participate and succeed in Campus placements and competitive examinations like GATE, CET.
	CO3	Possess entrepreneurial approach and ability for life-long learning.
	CO4	Have education necessary for understanding the impact of engineering solutions on Society and demonstrate awareness of contemporary issues.

Module No.	Unit No.	Topics	Ref.	Hrs.
1	**Report Writing**			08
	1.1	Objectives of report writing		
	1.2	Language and style in a report		
	1.3	Types of reports		
	1.4	Formats of reports: Memo, letter, project and survey based		
2	**Technical Proposals**			02
	2.1	Objective of technical proposals		
	2.2	Parts of proposal		
3	**Introduction to Interpersonal Skills**			08
	3.1	Emotional Intelligence		
	3.2	Leadership		
	3.3	Team building		
	3.4	Assertiveness		
	3.5	Conflict Resolution		
	3.6	Negotiation Skills		
	3.7	Motivation		
	3.8	Time Management		
4	**Meetings and Documentation**			02
	4.1	Strategies for conducting effective meetings		

	4.2	Notice		
	4.3	Agenda		
	4.4	Minutes of the meeting		
5	**Introduction to Corporate Ethics and etiquettes**			02
	5.1	Business meeting etiquettes, interview etiquettes, professional and work etiquettes, social skills		
	5.2	Greetings and art of conversation		
	5.3	Dressing and grooming		
	5.4	Dinning etiquette		
	5.5	Ethical codes of conduct in business and corporate activities (Personal ethics, conflicting values, choosing a moral response,the process of making ethical decisions)		
6	**Employment Skills**			06
	6.1	Cover letter		
	6.2	Resume		
	6.3	Group Discussion		
	6.4	Presentation Skills		
	6.5	Interview Skills		
			Total	**28**

Reference Books:

1. Fred Luthans, "*Organisational Behavior" ,* McGraw Hill, edition
2. Lesiker and Petit, "*Report Writing for Business"* , McGraw Hill, edition
3. Huckin and Olsen, "*Technical Writing and Professional Communication",* McGraw Hill
4. Wallace and Masters, "*Personal Development for Life and Work" ,* Thomson Learning, 12thedition
5. Heta Murphy, "*Effective Business Communication",* McGraw Hill, edition
6. R.C Sharma and Krishna Mohan, "*Business Correspondence and Report Writing"*
7. B N Ghosh, "*Managing Soft Skills for Personality Development*", Tata McGraw Hill.Lehman, Dufrene, Sinha, "*BCOM*", Cengage Learning, 2nd edition
8. Bell . Smith,"Management Communication" Wiley India edition, 3rd edition.

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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
ETL501	Microcontroller and Application Laboratory	--	--	2	--	--	1	1
		Examination Scheme						
		ISE		ESE				Total
				Practical		Oral		
		40		10		10		60

Pre-requisite Course Codes	ETC501 **:** Microcontroller and Application	
After successful completion of the course, student will be able to		
Course Outcomes	CO1	Use hardware and software tools for microcontroller 8051 and ARM.
	CO2	Analyze the problem statement and write and execute an assembly language program for 8051/ARM7.
	CO3	Debug an assembly language program for 8051/ARM7.
	CO4	Document the procedure and analyze the result of an experiment.

Exp. No.	Experiment Details	Ref.	Marks
1	Study Arithmetic Instructions of 8051.		5
2	a)Search for a Byte in a array of 10 elements b) Sorting of array elements in asending/desending order		5
3	Timer/Counter Programming for 8051.		5
4	Serial port and Interrupt programming for 8051.		5
5	Interfacing of LED & LCD panel with 8051.		5
6	Interfacing of simple/matrix keypad with 8051.		5
7	Interfacing of sensors with 8051.		5
8	Study Arithmetic Instructions of ARM7.		5
9	Generating software delay for ARM7.		5
10	Interrupt programming for ARM7.		5
11	Interfacing of LCD panel with ARM7.		5
12	Interfacing of sensors with ARM7.		5
***Any 08 Experiments to be performed.**		**Total Marks**	**40**

References

As per recommended by faculty.

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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
ETL502	Communication Engineering Laboratory-I	--	--	2	--	--	1	1
		Examination Scheme						
		ISE		ESE				Total
				Practical		Oral		
		40		10		10		60

Pre-requisite Course Codes	ETC502: Analog Communication	
After successful completion of the course, student will be able to		
Course Outcomes	CO1	Demonstrate a clear understanding of different modulation and demodulation techniques used in analog communication.
	CO2	Able to use basic circuit building blocks to create more advanced circuits.
	CO3	Able to determine fundamental communication system parameters.

Exp. No.	Experiment Details	Ref.	Marks
1	Generation of DSB-FC signal on kit. AM generation and demodulation using IC AD633.		5
2	Generation of SSB-SC signal.		5
3	Generation of PWM signal using IC-741.		5
4	Generation of PPM signal using IC-555.		5
5	Generation of FM signal on Kit. Generation of FM signal using IC-555.		5
6	Study of AM Broadcast receiver.		5
7	Measurement of Sensitivity, Selectivity and Fidelity of Broadcast receiver.		5
8	Generation of Demodulation of PAM signal using Transistor BC547B and IC CD4016.		5
9	AM modulation and demodulation using SCILAB.		5
10	Generation and Detection of PCM.		5
11	Generation of DSB-SC using multiplier IC AD633.		5
*Any 08 Experiments to be performed.		Total Marks	40

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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
ETL503	Communication Engineering Laboratory- II	--	--	2	--	--	1	1
		Examination Scheme						
		ISE		ESE				Total
				Practical		Oral		
		40		10		10		60

Pre-requisite Course Codes	ETC 504: RF Modeling ETC 505: Integrated circuits	
After successful completion of the course, student will be able to		
Course Outcomes	CO1	Ability to program and analyze the experiments in different softwares. (Softwares used: MATLAB, Pspice, IE3D)
	CO2	Ability to perform experiments based on applications of Integrated Circuits.
	CO3	Ability to program and analyze the various concepts.
	CO4	Ability to perform experiments based on applications of Integrated Circuits.
	CO5	To be able to improve their debugging skill.
	CO6	To be able to document the experiment.

Exp. No.	Experiment Details	Ref.	Marks
1	Analyse the High frequency behaviour of Resistance, Inductor and Capacitor using Matlab/Scilab.		5
2	Design and simulate BPF using circuit objects from RF toolbox in Matlab.		5
3	Design and test the performance of integrator and differentiator using Operational Amplifier and trace out the output waveforms for the given inputs.		5
4	Find the Schmitt trigger characteristic by using IC741 and compare theoretical and practical values of the upper threshold voltage and lower threshold voltage.		5
5	Design practical applications of OPAMP a) Instrumentation amplifier b) Zero crossing Detector		5
6	Design Astable Multivibrator using IC555.		5
7	Design Low voltage Regulator using IC 723.		5
8	Design and simulate the Sallen – key second order LPF and HPF frequency response using PSpice.		5
9	Analyse the Radiation pattern and measure its Beamwidth and Bandwidth of different antennas.		5

	a) Half wave Dipole antenna b) Folded Dipole antenna c) Yagi UDA 5 element antenna d) Log- Periodic antenna.		
10	Design and simulate rectangular patch microstrip antenna using IE3D.		**5**
11	Design and simulate microstrip line filter design.		**5**
***Any 08 Experiments to be performed.**		**Total Marks**	**40**

References
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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
ETL504	Mini Project-I	--	--	2	--	--	1	1
		Examination Scheme						
		ISE			ESE			Total
					Practical		Oral	
		Phase-I:10 Phase-II:10 Phase-III:10 Phase-IV:20			--		50	100

Term Work:

The main intention of Mini Project is to make student enable to apply the knowledge and skills learned out of courses studied to solve/implement predefined practical problem. The students undergo various laboratory/tutorial/simulation laboratory/work shop courses in which they do experimentation based on the curriculum requirement. The Mini Project may be beyond the scope of curriculum of courses taken or may be based on the courses but thrust should be on

- Learning additional skills
- Development of ability to define and design the problem and lead to its accomplishment with proper planning
- Learn the behavioral science by working in a group

The group may be maximum **four** (04) students. Each group will be assigned one faculty as a supervisor. The college should keep proper assessment record of progress of the project and at the end of the semester it should be assessed for awarding TW marks. The TW may be examined by approved internal faculty appointed by the head of the institute. The final examination will be based on demonstration in front of internal and external examiner. In the examination each individual student should be assessed for his/her contribution, understanding and knowledge gained about the task completed. The students may use this opportunity to learn different computational techniques as well as some model development. This they can achieve by making proper selection of Mini Projects.

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SEMESTER - VI

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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
ETC601	Digital Communication	4	-	--	4	-	--	4
		Examination Scheme						
		ISE		MSE	ESE			
		10		30	100 (60% Weightage)			

Pre-requisite Course Codes	ETC405 Signal and System, ETC502 Analog Communication, ETC503 Random Signal Analysis	
After successful completion of the course, student will be able to		
Course Outcomes	CO1	Ability to model various entities of digital communication system mathematically
	CO2	Identify and analyse methods of various digital communication sub-blocks and compare their performance.
	CO3	Ability to Perform the time and frequency domain analysis of the signals in a digital communication system.
	CO4	Explain receiver techniques for detection of a signal in AWGN channels.
	CO5	Provide sound evaluation of digital communication applications in terms of their performance

Module No.	Unit No.	Topics	Ref.	Hrs.
1	**Information theory and source coding**		1,2,3	06
	1.1	Block diagram and sub-system description of a digital communication system,measure of information and properties, entropy and it's properties		
	1.2	Source Coding, Shannon's Source Coding Theorem, Shannon-Fano Source Coding,Huffman Source Coding		
	1.3	Differential Entropy, joint and conditional entropy, mutual information and channel capacity, channel coding theorem, channel capacity theorem		
2	**Baseband Modulation and Transmission**		2,4	06
	2.1	Discrete PAM signals and it's power spectra		
	2.2	Inter-symbol interference, Nyquist criterion for zero ISI, sinusoidal roll-off filtering, correlative coding, equalizers, and eye pattern		
3	**Base band Detection**		2,4	05
	3.1	Orthogonality, representation of signals		
	3.2	Maximum likelihood decoding		
	3.3	Correlation receiver, equivalence with matched filter		
4	**Bandpass Modulation and Demodulation**		1,2,4	12

	4.1	Bandpass digital transmitter and receiver model, digital modulation schemes		
	4.2	**Generation, detection, signal space diagram, spectrum, bandwidth efficiency, and probability of error analysis of:** Amplitude Shift Keying (ASK), Frequency Shift Keying (FSK)Modulations, Binary Phase Shift Keying (BPSK) Modulation, Quaternary Phase Shift Keying QPSK), Mary PSK Modulations, Quadrature Amplitude Modulation (QAM), Minimum Shift Keying (MSK)		
	4.3	Comparison between bandwidth and bit rate, applications of digital modulation schemes		
5	**Error Control Systems**		2,5	17
	5.1	Types of error control, error control codes, linear block codes, vector spaces ,vector sub spaces, generator matrix, systematic linear block codes, parity check matrix, syndrome testing ,error correction, and decoder implementation.		
	5.2	**Cyclic codes:** Algebraic structure of cyclic codes, binary cyclic code properties, encoding in systematic form, circuits for dividing polynomials, systematic encoding with shift register and error detection.		
	5.3	**Convolution Codes:** Time domain and transform domain approach, graphical representation, code tree, trellis, state diagram, decoding methods, maximum likelihood decoding, and free distance		
	5.4	Viterbi decoding, hard decision Viterbi decoding , decoding window, soft decision Viterbi decoding, code spectra, recursive systematic codes, code transfer function,and application areas		
6	**Spread Spectrum**		2,5,6	06
	6.1	Spread Spectrum (SS) concept, PN Sequences, Direct Sequence(DS), Frequency Hopping (FH), and Time Hopping		
	6.2	Comparison of Spread Spectrum Methods, SS Communication System, DSSS with Coherent BPSK, Processing Gain, Probability of Error of FHSS Transmitter and FHSS Receiver.		
			Total	**52**

References

1. Sklar B, and Ray P. K., *"Digital Communication: Fundamentals and applications,"* Pearson, Dorling Kindersley (India), Delhi, Second Edition, 2009.
2. Haykin Simon, *"Digital Communication Systems*," John Wiley and Sons, New Delhi, Forth Edition, 2014.
3. H. Taub, D. Schlling, and G. Saha, "*Principles of Communication Systems*," Tata Mc- Graw Hill, New Delhi, Third Edition, 2012.
4. Lathi B P, and Ding Z., "*Modern Digital and Analog Communication Systems*," Oxford University Press, Forth Edition, 2009.
5. T L Singal, "*Analog and Digital Communication*," Tata Mc-Graw Hill, New Delhi, First Edition, 2012.
6. P Ramakrishna Rao, *"Digital Communication*," Tata Mc-Graw Hill, New Delhi, 1e.

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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
ETC602	Discrete Time Signal Processing	4	-	--	4	-	--	4
		Examination Scheme						
		ISE		MSE	ESE			
		10		30	100 (60% Weightage)			

Pre-requisite Course Codes		ETC 405: Signals and System
After successful completion of the course, student will be able to		
Course Outcomes	CO1	Able to compute various Transform Analysis of Linear Time Invariant System.
	CO2	Ability to apply engineering problem solving strategies to DSP problems.
	CO3	Ability to Design and simulate digital filters.
	CO4	Ability to Design and test signal processing algorithms for various applications.
	CO5	Ability to Recover information from signals.

Module No.	Unit No.	Topics	Ref.	Hrs.
1	**Transform Analysis of Linear Time Invariant System**		1,2	04
	1.1	Review of *Z* transform and its properties, response to sinusoidal and complex exponential signals, steady-state response to periodic input signals, response to aperiodic input signals, relationships between the system function and the frequency response function, computation of the frequency response function		
	1.2	LTI systems as frequency-selective filters like; low pass, high pass, band pass, notch, comb, all-Pass filters, and digital resonators.		
	1.3	Invertibility of LTI systems, minimum-phase, maximum-phase, mixed-phase systems		
2	**The Discrete Fourier Transform and Efficient Computation.**		1,2	12
	2.1	Frequency domain sampling and reconstruction of discrete time signals, discrete Fourier transform (DFT), DFT as a linear transformation, properties of the DFT,relationship of the DFT to other transforms		
	2.2	Fast Fourier Transform: Radix-2 and split-radix fast Fourier transform (FFT) algorithms and their applications		
	2.3	Quantization effects in the computation of the DFT		
3	**Design of Digital filters and Implementation**		1,2	12
	3.1	Design of Infinite Impulse Response (IIR) filters using impulse invariant method and bilinear transformation method, Butterworth and Chebyshev filter approximation.		
	3.2	Concepts of Finite Impulse Response (FIR) filter, symmetric and		

		anti symmetric FIR filter, FIR filter design using window method and frequency sampling method.		
	3.3	Realization structures for IIR and FIR filters using direct form structures, cascade, parallel structures, and lattice, ladder structure (only conceptual understanding)		
4	**Multi rate Signal Processing**		1,2,3	08
	4.1	Decimation by a factor *D*, interpolation by I, sampling rate conversion by a rational factor I/D		
	4.2	Polyphase filter structures, interchange of filers and down samplers/up samplers,sampling rate conversion with cascade integrator comb filters, polyphase structures for decimation and interpolation filters, structures for rational sampling rate conversion.		
	4.3	Multistage implementation of sampling rate conversion.		
	4.4	Sampling rate conversion of band pass signals		
	4.5	Sampling rate conversion by an arbitrary factor – arbitrary re-sampling with polyphase interpolators, narrow band filter structures.		
	4.6	Application of Multirate Signal Processing for design of phase shifters, interfacing of digital systems with different sampling rates, implementation of narrowband low pass filters, sub band coding of speech signals.		
5	**Analysis of Finite Word length effects**		1,2	08
	5.1	Quantization process and errors, quantization of fixed-point numbers, quantization of floating-point numbers, analysis of coefficient quantization effects		
	5.2	A/D Conversion Noise Analysis, Analysis of Arithmetic Round-Off Errors and dynamic range scaling		
6	**Applications of Digital Signal processing:**		2,5	08
	6.1	Dual –Tone multi frequency signal detection, spectral analysis of sinusoidal signals, spectral analysis of non stationary signals, and spectral analysis of random signals		
	6.2	Musical sound processing, digital music synthesis, discrete time analytic signal generation.		
	6.3	Trans-multiplexers, oversampling ADC and DAC and sparse antenna array design		
			Total	**52**

References

1. Alan V. Oppenheim and Ronald Schafer, "Discrete Time Signal Processing", Pearson Education
2. J. Proakis, D. G. Manolakis, and D. Sharma, "Digital Signal Processing: Principles, Algorithms and Applications", Pearson Education.
3. P.P. Vaidyanathan, "Multirate Systems and Filter Banks", Pearson.
4. Robert Schilling and Sandra Harris, "Fundamentals of Digital Signal Processing using MATLAB", Cengage Learning.
5. Sanjit K.Mitra, "Digital Signal Processing", McGrawHill education

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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
ETC603	Computer Communication Networks	4	-	--	4	-	--	4
		Examination Scheme						
		ISE	MSE	ESE				
		10	30	100 (60% Weightage)				

Pre-requisite Course Codes		ETC 502 Analog Communication
After successful completion of the course, student will be able to		
Course Outcomes	CO1	Conceptual understanding and functional aspects of computer communication and telecom networks.
	CO2	Design and configure small/medium sized computer network that meets a specific needs for communications.
	CO3	Simulate computer networks and analyze the simulation results including troubleshoot connectivity problem occurring at layers of TCP/IP model.

Module No.	Unit No.	Topics	Ref.	Hrs.
1	**Network Architectures, Protocol layers, and their Service Models:**		4,5	04
	1.1	OSI-RM model and TCP/IP protocol		
2	**Principles of Network Applications:**		4,5	10
	2.1	Application layer protocols such as HTTP, FTP, and SMTP.		
	2.2	Peer-to-Peer File Sharing Protocols and Architectures		
	2.3	ISPs and Domain name systems, Socket API and network socket programming		
3	**Reliable and Unreliable Transport-layer protocols:**		2,3,4	10
	3.1	TCP and UDP, Port numbers, Multiplexing and de-multiplexing		
	3.2	Flow control and congestion control. fairness delay, jitter, and loss in packets witched networks		
	3.3	Bandwidth, throughput, and quality-of-service		
4	**Network layer Services and Protocols**		3,4,5	10
	4.1	Switching fabric, routing and forwarding, queues and buffering		
	4.2	Virtual-circuit and datagram networks, internet protocol. IPv4 and IPv6 tunneling		
	4.3	Link State and Distance Vector algorithms, Routing in the Internet RIP, OSPF, and BGP		
	4.4	Broadcast and multicast, handling mobility		
5	**Data link layer Services and Protocols:**		4,5	10
	5.1	Link-layer and its services, Ethernet, hubs, bridges, and switches		

	5.2	Link-layer addressing, ATM and MPLS		
	5.3	Local area networks and IEEE 802.11 wireless LANs, multiple-access protocols. Random access, efficiency of pure and slotted ALOHA, CSMA, CSMA/CD, and CSMA/CA		
6	**Introduction to Physical-layer Services and Systems**		4,5	8
	6.1	Introduction to physical media, Coax, fiber, twisted pair, DSL, HFC, WiMax, cellular, satellite, and telephone networks, bit transmission, frequency division multiplexing. time division multiplexing		
			Total	**52**

References

1. Andrew Tanenbaum, *"Computer Networks",* PHI New Dehli,
2. Natalia Olifer and Victor Olifer, " Computer Networks", Wiley India,New Delhi
3. J. F. Kurose and K. W. Ross, "*Computer Networking: A Top-Down Approach*", Pearson Publication , 5th Edition, March 2009
4. L.Garcia et al, "*Communication Networks*", McGraw Hill Publication, 2nd Edition
5. B. Forouzan, "*Data Communication and Networking*", McGraw Hill Publication, 5th edition.

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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
ETC 604	Television Engineering	4	-	--	4	-	--	4
		Examination Scheme						
		ISE		MSE	ESE			
		10		30	100 (60% Weightage)			

Pre-requisite Course Codes		ETC 502 Analog Communication
After successful completion of the course, student will be able to		
Course Outcomes	CO1	To understand the working principles of basic TV.
	CO2	To Describe and differentiate latest digital TV, HDTV, WDTV.
	CO3	To differentiate working principles of latest display like LCD, LED, Plasma.

Module No.	Unit No.	Topics	Ref.	Hrs.
1	**Fundamentals of Analog T V system**		1,2,3	10
	1.1	Transmitter and receiver- block diagram approach, interlaced scanning, composite video signal, VSB transmission and reception (CCIR-B standards)		
	1.2	Camera tubes: basic principle ,Vidicon and Image orthicon		
2	**Color T V**		1,2,3	10
	2.1	Compatibility considerations, Color theory, chromaticity diagram, generation of color TV signals, luminance signal, chrominance signal, frequency interleaving process,color subcarrier frequency.		
	2.2	NTSC system- transmitter and receiver, PAL system- transmitter and receiver		
3	**Fundamental Concept of Digital Video**		4	12
	3.1	Digitization, pixel array, scanning notation, viewing distance and angle, aspect ratio, **12** frame rate and refresh rate.		
	3.2	Raster scanning, scan line waveform, interlace, scanning standards.		
	3.3	Sync structure, data rate, linearity, bandwidth and data rate, resolution, luma, color difference coding, chroma sub sampling		
	3.4	Component digital video, composite video	4	
4	**Advanced TV systems**			06
	4.1	Digital video and audio signals		
	4.2	MAC signal, D2-MAC/packet signal, MAC decoding and interfacing, advantages of MAC signal		
	4.3	Direct-to-home TV(DTH)		08
5	**High definition televisions**		5,6	
	5.1	High definition TV systems, HDTV standards and compatibility, resolution and working.		

	5.2	Wide dimensions high definition TV		
	5.3	Standards of wide dimensions HDTV		
	5.4	MUSE system		
6	**Displays**		5,6	06
	6.1	Principle, working, advantages and disadvantages of Plasma, LED,LCD		
			Total	**52**

References

1. Gulati R.R, " *Monochrome and Color Television*," Wiley Eastern Limited publication.
2. R.G.Gupta , "*Television and Video Engineering*", Tata Mc Graw Hill publication.
3. Dhake A.M, "*Television and Video Engineering*", Tata McGraw Hill publication.
4. Keith Jack, "*Video Demystified*", 4e, , Elsevier
5. Charles Poynton, "*San Francisco, Digital video and HDTV, Algorithms And Interfaces*," Morgan Kaufmann publishers, 2003.
6. Stan Prentiss, *"High Definition TV*", second edition, , Tata McGraw Hill publication

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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
ETC 605	Operating System	4	-	--	4	-	--	4
		Examination Scheme						
		ISE		MSE	ESE			
		10		30	100 (60% Weightage)			

Pre-requisite Course Codes		Basic concepts of computer systems
After successful completion of the course, student will be able to		
Course Outcomes	CO1	Comprehend and describe the role of an operating system, its functions and issues.
	CO2	Compare between different algorithms used for management and scheduling of processes, Memory and input-output operation.
	CO3	Appreciate, compare and contrast the various features of typical operating systems through case study approach.

Module No.	Unit No.	Topics	Ref.	Hrs.
1	**Fundamental of Operating System(OS)**		1,3,6	06
	1.1	Definition, objectives, functions, evolution, services, types, and different views of OS		
	1.2	Operating System as a resource manager, system calls, and shell		
	1.3	Monolithic systems, layered systems, client server model, monolithic kernel and microkernel		
2	**Process Management and Memory Management**		1,3,6	10
	2.1	Process, process creation, process control block, process states, process state transition diagram		
	2.2	Scheduling queues and schedulers, preemptive and non- preemptive scheduling algorithms, types of threads, multithreading models		
	2.3	Race condition, critical section, mutual exclusion, semaphores, monitors		
	2.4	Multiprogramming with fixed and variable partitions, memory allocation strategies		
	2.5	Logical and physical address space, paging and segmentation		
	2.6	Concept, performance of demand paging, page replacement algorithms.		
	2.7	Deadlock Problem, deadlock characterization, deadlock prevention and deadlock avoidance deadlock detection and recovery		
3	**File Management and Input Output Management**		1,3,6	10
	3.1	File Naming, File Structure, File Types, File Access, File		

		Attributes, File Operations,Memory Mapped Files, Implementing Files, contiguous allocation, linked list allocation, indexed allocations, Inode		
	3.2	Single level directory system, Two level directory system, Hierarchical Directory System		
	3.3	Principles of Input/output H/W: I/O Devices, Device Controllers, Direct Memory Access.		
	3.4	Principles of Input/output S/W: Goals Of I/O S/W, Interrupt Handler, Device Driver, Device Independent I/O Software		
	3.5	Disks : RAID levels, Disks Arm Scheduling Algorithms		
	3.6	Management of free blocks.		06
4	**Unix Operating System**		2,7	
	4.1	History of UNIX, UNIX Goals, Unix Shell, interfaces to Unix, UNIX utility programs		
	4.2	Traditional UNIX Kernel, Modern UNIX Systems		
	4.3	Unix process management: Concept, Scheduling in Unix		
	4.4	Unix Memory management: Paging, Page replacement strategies		
	4.5	Unix file management: I-node, File allocation, I/O management		
	4.6	Unix Security measures		
5	**Linux Operating System**		2,7	10
	5.1	History, Linux Processes and Thread management		
	5.2	Scheduling in Linux, Linux System calls		
	5.3	Memory management: Virtual memory, Buddy Algorithm, Page replacement policy		
	5.4	Linux File System		
	5.5	I/O management: Disk Schedulin		
	5.6	Advantages of Linux and Unix over Windows		
6	**Real Time Operating System(RTOS)**		1,4	10
	6.1	Introduction, Characteristics of real-time operating systems		
	6.2	Real Time task Scheduling, Modeling Timing constraints, Table-driven scheduling		
	6.3	Cyclic schedulers		
	6.4	Earliest Deadline First (EDF) scheduling		
	6.5	Rate Monotonic Algorithm(RMA)		
			Total	**52**

References

1. Tanenbaum, "*Modern Operating Systems*", IIIrd Edition, PHI
2. Silberschatz A., Galvin P., and Gagne G, "*Operating Systems Concepts*", VIIIth Edition Wiley.
3. William Stallings, "*Operating System-Internal & Design Principles*", VIth Edition, , Pearson
4. Rajib Mall, "*Real-Time Systems: Theory and Practice*," Pearson, 2008.
5. Maurice J. Bach, "*The Design of Unix Operating System*", Prentine Hall
6. Achyut S. Godbole, "*Operating Systems*", 2nd edition, Tata McGraw Hill7. Richard Blum and Christine Bresnahan, "*Linux Command Line & Shell Scripting*", 2nd edition, Wiley.

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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
ETC606	VLSI Design	4	-	--	4	-	--	4
		Examination Scheme						
		ISE		MSE		ESE		
		10		30		100 (60% Weightage)		

Pre-requisite Course Codes	ETC303: Digital Electronics ETC302: Analog Electronics-I ETC402: Analog Electronics-II ETC505: Integrated Circuits
After successful completion of the course, student will be able to	
Course Outcomes	CO1 To evaluate MOSFET fabrication techniques and scaling
	CO2 To evaluate DC and transient analysis of CMOS logic.
	CO3 To illustrate MOS circuit design styles.
	CO4 To evaluate Semiconductor memories.
	CO5 To illustrate Data path design.
	CO6 To illustrate VLSI clocking and system design

Module No.	Unit No.	Topics	Ref.	Hrs.
1	**MOSFET Fabrication and Scaling**		3,5	08
	1.1	**Fabrication:** Fabrication process flow for NMOS and CMOS, CMOS Latch-up		
	1.2	**MOSFET Scaling:** Types of scaling, short channel effects, Level 1 and Level 2 MOSFET Models		
	1.3	**Layout:** Lambda based design rules, MOSFET capacitances		
2	**MOSFET Inverters**		1,3,5	10
	2.1	**Circuit Analysis:** Static and dynamic analysis (Noise, propagation delay and power dissipation) of resistive load and CMOS inverter. Comparison of all types of MOS inverters. Design of CMOS inverters and its layout.		
	2.2	**Logic Circuit Design:** Analysis and design of 2-I/P NAND and NOR using equivalent CMOS inverter.		
3	**MOS Circuit Design Styles**		3,5	10
	3.1	**Design Styles:** Static CMOS, Pass Transistor Logic, Transmission Gate, Pseudo NMOS, Domino, NORA, Zipper, C^2MOS		
	3.2	**Circuit Realization:** SR Latch, JK FF, D FF, 1 Bit Shift Register, MUX, Decoder using above design styles and their layouts		
4	**Semiconductor Memories**		2,4	08

	4.1	**SRAM:** ROM Array, SRAM (operation, design strategy, leakage currents, read/write circuits), DRAM (Operation 3T, 1T, operation modes, leakage currents, refresh operation, Input-Output circuits), Flash (mechanism, NOR flash, NAND flash), layout of SRAM and DRAM		
	4.2	**Peripheral Circuits:** Sense Amplifier, Decode		
5	**Data Path Design**		3,4,5	08
	5.1	**Adder:** Bit adder circuits, Ripple carry adder, CLA adder		
	5.2	**Multipliers and shifter:** Partial-product generation, partial-product accumulation, final addition, Barrel Shifter		
6	**VLSI Clocking and System des**		3,5	08
	6.1	**Clocking:** CMOS clocking styles, Clock generation, stabilization and distribution.		
	6.2	**Low Power CMOS Circuits:** Various components of power dissipation in CMOS, Limits on low power design, low power design through voltage scaling.		
	6.3	**IO pads and Power Distribution:** ESD protection, Input circuits, Output circuits, Simultaneous switching noise, power distribution scheme		
	6.4	**Interconnect:** Interconnect delay model, interconnect scaling and crosstalk.		
			Total	**52**

References

1. Sung-Mo Kang and Yusuf Leblebici, "*CMOS Digital Integrated Circuits Analysis and Design*", Tata McGraw Hill, 3rd Edition, 2012.
2. Jan M. Rabaey, Anantha Chandrakasan and Borivoje Nikolic, "*Digital Integrated Circuits: A Design Perspective*", Pearson Education, 2nd Edition.
3. John P. Uyemura, "*Introduction to VLSI Circuits and Systems*", Wiley, Student Edition, 2013.
4. Neil H. E. Weste, David Harris and Ayan Banerjee, "*CMOS VLSI Design: A Circuits and Systems Perspective*", Pearson Education, 3rd Edition.
5. R. Jacob Baker, "*CMOS Circuit Design, Layout and Simulation*", Wiley, 2nd Edition, 2013

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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
ETL601	Discrete Time Signal Processing	--	--	2	--	--	1	1
		Examination Scheme						
		ISE		ESE				Total
				Practical		Oral		
		40		10		10		60

Pre-requisite Course Codes		ETC 602:Discrete Time Signal Processing
After successful completion of the course, student will be able to		
Course Outcomes	CO1	Explores the Ability to develop programs for various DSP concepts.
	CO2	Explores the Ability to debug programs for various DSP concepts.
	CO3	Ability to Design and analyze the frequency response of digital IIR and FIR filters
	CO4	Ability to analyse the result and document the experiment.

Exp. No.	Experiment Details	Ref.	Marks
1	Signal Manipulation		5
2	Frequency Selective Filter		5
3	Discrete Fourier Transform		5
4	Convolution		5
5	Fast Fourier Transform		5
6	Filtering of long data Sequence using Overlap Add Method		5
7	Filtering of long data Sequence using Overlap Save Method		5
8	Digital Butterworth IIR filter design using Impulse Invariant Method (IIM)		5
9	Digital Butterworth IIR filter design using Bilinear Transformation Method (BLT)		5
10	Linear Phase FIR Filter Design		5
11	Correlation		5
12	Real Time Digital Signal Processing		5
13	Mini Project		5
*Any 08 Experiments to be performed.		Total Marks	40

References

As per recommended by faculty.

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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
ETL602	Communication Engineering Laboratory III	--	--	2	--	--	1	1
		Examination Scheme						
		ISE		ESE			Total	
				Practical		Oral		
		40		10		10	60	

Pre-requisite Course Codes	ETC 601: Digital Communication ETC 603: Computer Communication and Networks	
After successful completion of the course, student will be able to		
Course Outcomes	CO1	Ability to implement various concepts of networking and digital communication.
	CO2	Ability to design/configure/reconfigure sub blocks and components of networking and digital communication.
	CO3	Ability to write and debug software programs

Exp. No.	Experiment Details	Ref.	Marks
1	Binary Amplitude Shift Keying		5
2	Binary Phase Shift Keying		5
3	Binary Frequency Shift Keying		5
4	Hamming code Encoder		5
5	Syndrome Decoder		5
6	Duo binary Encoder		5
7	QAM PSD and Constellation diagram		5
8	Transmission of Convolutionally coded QPSK signal through AWGN channel		5
9	Signal transmission through Raised cosine filter		5
10	BER analysis of BPSK signal		5
11	Transmission of QAM signal using USRP (Demo)		5
12	Understanding of basic Network utilities on Linux OS: ifconfig, ping, telnet, traceroute, nslookup, netstate, whois, curl.		5
13	Socket Programming using Python, Introduction to Packet Tracer		5
14	Design network topology using Packet tracer and verify the communication among verious entities using suitable network utilities		5
15	Designing network topology using DHCP, DNS and HTTP Servers configuration and their verification		5
16	Subnet Design and Router Configuration, RIPv2 Router Configuration and testing through various learning objectives		5
***Any 08 Experiments to be performed.**		**Total Marks**	**40**

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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
ETL603	Communication Engineering Laboratory IV	--	--	2	--	--	1	1
		Examination Scheme						
		ISE		ESE				Total
				Practical		Oral		
		40		10		10		60

Pre-requisite Course Codes	ETC 606:VLSI Design ETC 604: Television Engineering	
After successful completion of the course, student will be able to		
Course Outcomes	CO1	Ability to Realize and design MOSFET based logic circuits with different design styles using circuit simulators and layout editor.
	CO2	Ability to understand the working principles of analog TV, latest display and troubleshooting.
	CO3	To be able to document the experiment.

Exp. No.	Experiment Details	Ref.	Marks
1	To find input and output characteristics of NMOS and PMOS.		5
2	To design and simulate CMOS inverter.		5
3	To design and simulate CMOS logic circuit.		5
4	Design CMOS complex logic circuit.		5
5	Design and simulate T FF, 2:1 MUX.		5
6	Design and simulate PMOS resistive load		5
7	To study block diagram of Monochrome & Colour TV receiver.		5
8	To study RF section through test points & fault simulation step by step.		5
9	To study VIF section through test points & fault simulation step by step.		5
10	To study details of video & chroma section through test points & fault simulation step by step.		5
11	To study details of horizontal and vertical oscillator section & output section through test points & fault simulation step by step.		5
12	To study the detail circuit description of R-G- B Video output Section.		5
13	To study degaussing in colour TV.		5
14	To study LED, LCD and Plazma diplays.		5
***Any 08 Experiments to be performed.**		**Total Marks**	**40**

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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
ETL604	Mini Project II	--	--	2	--	--	1	1
		Examination Scheme						
		Term Work		Practical		Oral		Total
		Phase-I:10 Phase-II:10 Phase-III:10 Phase-IV:20		--		50		100

Term Work:

The main intention of Mini Project is to make student enable to apply the knowledge and skills learned out of courses studied to solve/implement predefined practical problem. The students undergo various laboratory/tutorial/simulation laboratory/work shop courses in which they do experimentation based on the curriculum requirement. The mini Project may be beyond the scope of curriculum of courses taken or may be based on the courses but thrust should be on

- Learning additional skills
- Development of ability to define and design the problem and lead to its accomplishment with proper planning.
- Learn the behavioral science by working in a group

The group may be maximum **four** (04) students. Each group will be assigned one faculty as a supervisor. The college should keep proper assessment record of progress of the project and at the end of the semester it should be assessed for awarding TW marks. The TW may be examined by approved internal faculty appointed by the head of the institute. The final examination will be based on demonstration in front of internal and external examiner. In the examination each individual student should be assessed for his/her contribution, understanding and knowledge gained about the task completed.

The topic of Mini Project I and II may be different and / or may be advancement in the same topic. The students may use this opportunity to learn different computational techniques as well as some model development. This they can achieve by making proper selection of Mini Projects.