UNIVERSITY OF MUMBAI

Bachelor of Engineering
Electronics and Telecommunication Engineering

Third Year Engineering

(Sem. V and Sem. VI), (Rev-2012)

effective from Academic Year 2014 -15

Under

FACULTY OF TECHNOLOGY

(As per Semester Based Credit and Grading System)

From Dean's Desk:

To meet the challenge of ensuring excellence in engineering education, the issue of quality needs to be addressed, debated and taken forward in a systematic manner. Accreditation is the principal means of quality assurance in higher education. The major emphasis of accreditation process is to measure the outcomes of the program that is being accredited. In line with this Faculty of Technology of University of Mumbai has taken a lead in incorporating philosophy of outcome based education in the process of curriculum development.

Faculty of Technology, University of Mumbai, in one of its meeting unanimously resolved that, each Board of Studies shall prepare some Program Educational Objectives (PEO's) and give freedom to affiliated Institutes to add few (PEO's) and course objectives and course outcomes to be clearly defined for each course, so that all faculty members in affiliated institutes understand the depth and approach of course to be taught, which will enhance learner's learning process. It was also resolved that, maximum senior faculty from colleges and experts from industry to be involved while revising the curriculum. I am happy to state that, each Board of studies has adhered to the resolutions passed by Faculty of Technology, and developed curriculum accordingly. In addition to outcome based education, semester based credit and grading system is also introduced to ensure quality of engineering education.
Semester based Credit and Grading System enables a much-required shift in focus from teacher-centric to learner-centric education since the workload estimated is based on the investment of time in learning and not in teaching. It also focuses on continuous evaluation which will enhance the quality of education. University of Mumbai has taken a lead in implementing the system through its affiliated Institutes and Faculty of Technology has devised a transparent credit assignment policy and adopted ten points scale to grade learner's performance. Credit assignment for courses is based on 15 weeks teaching learning process, however content of courses is to be taught in 12-13 weeks and remaining 3-2 weeks to be utilized for revision, guest lectures, coverage of content beyond syllabus etc.
Credit and grading based system was implemented for First Year of Engineering from the academic year 2012-2013. Subsequently this system will be carried forward for Second Year Engineering in the academic year 2013-2014, for Third Year and Final Year Engineering in the academic years 2014-2015 and 2015-2016 respectively.

Dr. S. K. Ukarande
Dean, Faculty of Technology,
Member - Management Council, Senate, Academic Council
University of Mumbai, Mumbai

Preamble:
In the process of change in the curriculum there is a limited scope to have major changes in the fundamental subjects which are mainly part of second year of engineering. The exposure to the latest technology and tools used all over the world is given by properly selecting subjects and their hierarchy in pre-final and final year. Thus this syllabus is made to groom the undergraduate students best suited and competent in all respect with best possible efforts put in by the experts in framing detail contents of individual subjects.

The engineering education in India is expanding in manifolds and the main challenge is the quality education. All the stakeholders are very much concerned about it. To meet this challenge, the issue of quality needs to be addressed, debated and taken forward in a systematic manner.

An engineering program must ensure that its graduates understand the basic concepts of science and mathematics have gone through one engineering field and have acquired skills for life-long learning.

An engineering program must therefore have a mission statement which is in conformity with program objectives and program outcomes that are expected of the educational process. The outcomes of a program must be measureable and must be assessed regularly through proper feedback for improvement of the programme. There must be a quality assurance process in place within the institute to make use of the feedback for improvement of the programme. The curriculum must be constantly refined and updated to ensure that the defined objectives and outcomes are achieved. Students must be encouraged to comment on the objectives and outcomes and the role played by the individual courses in achieving them. In line with this Faculty of Technology, University of Mumbai has taken a lead in incorporating philosophy of outcome based education in the process of curriculum development.

I, the Chairman, Board of Studies in Electronics and Telecommunication Engineering University of Mumbai, am happy to state that, heads of the department and senior faculty from various Institutes took timely and valuable initiative to frame Program Educational Objectives as listed below.

- To provide students with a strong foundation in the mathematical, scientific and engineering fundamentals necessary to formulate, solve and analyze engineering problems and to prepare them for graduate studies.
- To prepare students to demonstrate an ability to identify, formulate and solve electronics and telecommunication engineering problems.
- To prepare students to demonstrate ability to design electrical and electronics systems and conduct experiments, analyze and interpret data.
- To prepare students to demonstrate for successful career in industry to meet needs of Indian and multi-national companies.
- To develop the ability among students to synthesize data and technical concepts from applications to product design.
- To provide opportunity for students to work as part of teams on multidisciplinary projects.
- To promote awareness among students for the life-long learning and to introduce them to professional ethics and codes of professional practice.

These are the suggested and expected main objectives and individual affiliated institute may add further in the list. In addition to Program Educational Objectives, for each course of undergraduate program, objectives and expected outcomes from learner's point of view are

also included in the curriculum to support the philosophy of outcome based education. I believe strongly that small step taken in right direction will definitely help in providing quality education to the stake holders.

At the end, I must extend my gratitude to all the experts who contributed to make curriculum competent at par with latest technological development in the field of Electronics and Telecommunication Engineering.

Dr. Udhav Bhosle
Chairman, Board of Studies in Electronics and Telecommunication Engineering

SEMESTER V

Course Code	Course Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ETC501	Microcontrollers and Applications	04	--	--	04	--	--	04
ETC502	Analog Communication	04	--	--	04	--	--	04
ETC503	Random Signal Analysis	04	--	01	04	--	01	05
ETC504	RF Modeling and Antennas	04	--	--	04	--	--	04
ETC505	Integrated Circuits	04	--	--	04	--	--	04
ETS506	Business Communication and Ethics	--	04 *	--	--	02	--	02
ETL501	Microcontrollers and Applications Laboratory	--	02	--	--	01	--	01
ETL502	Communication Engineering Laboratory I		02			01	--	01
ETL503	Communication Engineering Laboratory II	--	02	--	--	01	--	01
ETL504	Mini Project I	--	02	--	--	01	--	01
Total		**20**	**12**	**01**	**20**	**06**	**01**	**27**

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

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical and Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test 2	Ave. of Test 1 & Test 2					
ETC501	Microcontrollers and Applications	20	20	20	80	--	--	--	100
ETC502	Analog Communication	20	20	20	80	--	--	--	100
ETC503	Random Signal Analysis	20	20	20	80	25	--	--	125
ETC504	RF Modeling and Antennas	20	20	20	80	--	--	--	100
ETC505	Integrated Circuits	20	20	20	80	--	--	--	100
ETS506	Business Communication and Ethics	--	--	--	--	50	--	--	50
ETL501	Microcontrollers and Applications Laboratory	--	--	--	--	25	25	--	50
ETL502	Communication Engineering Laboratory I	--	--	--	--	25	25	--	50
ETL503	Communication Engineering Laboratory II	--	--	--	--	25	25	--	50
ETL504	Mini Project I	--	--	--	--	25	25	--	50
Total		**100**	**100**	**100**	**400**	**175**	**100**	**--**	**775**

SEMESTER VI

Course Code	Course Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ETC601	Digital Communication	04	--		04	--		04
ETC602	Discrete Time Signal Processing	04	--	--	04	--	--	04
ETC603	Computer Communication and Telecom Networks	04	--	--	04	--	--	04
ETC604	Television Engineering	04	--	--	04	--	--	04
ETC605	Operating Systems	04	--	--	04	--	--	04
ETC606	VLSI Design	04	--	--	04	--	--	04
ETL601	Discrete Time Signal Processing Laboratory	--	02	--	--	01	--	01
ETL602	Communication Engineering Laboratory III		02			01	--	01
ETL603	Communication Engineering Laboratory IV	--	02	--	--	01	--	01
ETL604	Mini Project II	--	02	--	--	01	--	01
Total		**24**	**08**	**--**	**24**	**04**	**--**	**28**

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical And Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test 2	Ave. of Test 1 & Test 2					
ETC601	Digital Communication	20	20	20	80	--	--	--	100
ETC602	Discrete Time Signal Processing	20	20	20	80	--	--	--	100
ETC603	Computer Communication and Telecom Networks	20	20	20	80	--	--	--	100
ETC604	Television Engineering	20	20	20	80	--	--	--	100
ETC605	Operating Systems	20	20	20	80	--	--	--	100
ETC606	VLSI Design	20	20	20	80	--	--	--	100
ETL601	Discrete Time Signal Processing Laboratory	--	--	--	--	25	25	--	50
ETL602	Communication Engineering Laboratory III	--	--	--	--	25	25	--	50
ETL603	Communication Engineering Laboratory IV	--	--	--	--	25	25	--	50
ETL604	Mini Project II	--	--	--	--	25	25	--	50
Total		**120**	**120**	**120**	**480**	**100**	**100**	**--**	**800**

Course Code	Course Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/ Practical	Tutorial	Total
ETC501	Microcontroller & Applications	04	--	--	04	--	--	04

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test 2	Ave. Of Test 1 and Test 2					
ETC501	Microcontroller & Applications	20	20	20	80	-	-	-	100

Course Pre –requisite:

- ETC303: Digital electronics
- ETC403: Microprocessor and Peripherals

Course Objectives:

- To develop background knowledge and core expertise of microcontroller.
- To know the importance of different peripheral devices and their interfacing to microcontrollers.
- To know the design aspects of microcontrollers.
- To write assembly language programs of microcontrollers for various applications.

Course Outcomes: At the end of course, a student will be able to

- Draw and describe architecture of 8051 and ARM7 microcontroller.
- Interface various peripheral devices to the microcontrollers.
- Write assembly language program for microcontrollers.
- Design microcontroller based system for various applications.

Module No.	Topics		Hrs.
1.	**8051 Microcontroller**		**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.**		
	2.1	Instruction set	**08**
	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**		**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**	**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	
	4.0	Memory management	
	4.11	ARM7 processor families	
5		**ARM7 Programming**	**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**	**04**
	6.1	Concepts of embedded systems	
	6.2	Optimizing design matrices and common design matrices	
	6.3	Study of embedded systems 1) Digital camera 2) Stepper motor controller	
		Total	**52**

Recommended Books:

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 introduction*", Wiley publication, Third edition 2002.

Internal Assessment (IA):
Two tests must be conducted which should cover at least 80% of syllabus. The average marks of two tests should be considered as final IA marks

End Semester Examination:
1. Question paper will comprise of 6 questions, each of 20 marks.
2. Total 4 questions need to be solved.
3. Question No.1 will be compulsory and based on entire syllabus wherein sub questions for 2 to 5 marks will be asked.
4. Remaining questions will be selected from all the modules.

Course Code	Course Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Practical	Tutorial	Total
ETC502	Analog Communication	04	--	--	04	--	--	04

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test 2	Ave. Of Test 1 and Test 2					
ETC502	Analog Communication	20	20	20	80	-	-	-	100

Course Pre–requisite:-

- ETC302: Analog Electronics-I
- ETC405: Signals and Systems

Course Objective: To teach students

- The fundamentals of basic communication system.
- Various modulation and demodulation techniques used in analog communication, noise handling and multiplexing.
- The working principles of transmitters and receivers used in analog communication systems.

Course Outcomes: After successful completion of the course students will able to

- The different modulation and demodulation techniques used in analog communication.
- Identify and solve basic communication problems, analyze transmitter and receivers.
- Detect the errors that occur due to noise during transmission.
- Compare and contrast advantages and limitations of analog communication systems.

Module No.		Topics	Hrs.
1		**Basics of Communication System**	**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**	**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**	**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, pre-emphasis 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**	**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**	**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**	**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**

Recommended Books:

1. WayneTomasi, "*Electronics Communication Systems*", Pearson education, Fifth edition.
2. Kennedy and Davis, "*Electronics Communication System*", Tata McGraw Hill, Fourth edition.
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. P. Sing and S.D. Sapre, "*Communication Systems: Analog and Digital*", Tata McGraw Hill,Third edition.
6. Simon Haykin, Michel Moher, "*Introduction to Analog and Digital Communication*", Wiley, Second edition.
7. Dennis Roddy and John Coolen, "*Electronic Communication*", Prentice Hall, Third Edition.

Internal Assessment (IA):
Two tests must be conducted which should cover at least 80% of syllabus. The average marks of two tests should be considered as final IA marks

End Semester Examination:
1. Question paper will comprise of 6 questions, each of 20 marks.
2. Total 4 questions need to be solved.
3. Question No.1 will be compulsory and based on entire syllabus wherein sub questions for 2 to 5 marks will be asked.
4. Remaining questions will be selected from all the modules.

Course Code	Course Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Practical	Tutorial	Total
ETC503	Random Signal Analysis	04	--	01	04	--	01	05

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test 2	Ave. Of Test 1 and Test 2					
ETC503	Random Signal Analysis	20	20	20	80	25	-	-	125

Course Pre –requisite:

- ETC 405: Signals and Systems
- ETC 401: Applied Mathematics IV

Course Objective: To teach students

- Random Variables and Random Process
- The design of the systems which involves randomness using mathematical analysis and computer simulations.

Course Outcome : At the end of the course, students will able to

- Apply theory of probability in identifying and solving relevant problems.
- Define and differentiate random variables and vector through the use of cumulative distribution function (CDF), probability density function (PDF), probability mass function (PMF) as well as joint, marginal and conditional CDF, PDF and PMF.
- Show probability and expectation computations using important discrete and continuous random variable types.
- Define and specify random processes and determine whether a given process is stationary or wide sense stationary.
- Determine the response of a linear time invariant system to such a random process.
- Describe basic concepts related to Markov chains and queuing theory and relate it to seal world applications.

Module No.		Overview of Probability Theory and Basics of Random Variables	Hrs.
1	1.1	Sample space, events, set operations, the notion and axioms of probability.	10
	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**	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**	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:**	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**	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, cross-power density spectrum.	
	5.5	Gaussian and Poisson random process	
6		**Markov Chains And Introduction To Queuing Theory**	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**

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*, Tata McGraw Hill, 2004.

Internal Assessment (IA):
Two tests must be conducted which should cover at least 80% of syllabus. The average marks of two tests should be considered as final IA marks

End Semester Examination:
1. Question paper will comprise of 6 questions, each of 20 marks.
2. Total 4 questions need to be solved.
3. Question No.1 will be compulsory and based on entire syllabus wherein sub questions for 2 to 5 marks will be asked.
4. Remaining questions will be selected from all the modules.

Course Code	Course Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/ Practical	Tutorial	Total
ETC504	RF Modeling and Antennas	04	--	--	04	--	--	04

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test 2	Ave. Of Test 1 and Test 2					
ETC504	RF Modeling and Antennas	20	20	20	80	-	-	-	100

Course Pre –requisite: : ETC 404: Wave Theory and Propagation

Course Objective: To teach students

- Design of different types of passive filters used for radio frequency application.
- Radiation phenomena and pattern of various antennas.
- The various characteristics of different types of antennas.

Course Outcome: On Completion of this course Student will be able to

- Analyze and design RF Filters
- Analyze the radiation mechanisms of antennas
- Demonstrate knowledge of antennas in communication systems. Ability to discriminate between antennas on the basis of their electrical performance.
- Discriminate various antennas on the basis of their electrical performance.

Module No.		Topics	Hrs.
1.		**Behavior of Active and Passive Components in RF range**	**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**	**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**	**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**	**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:**	**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**	**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 and limitations	
Total			**52**

Recommended Books:

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.

Internal Assessment (IA):

Two tests must be conducted which should cover at least 80% of syllabus. The average marks of two tests should be considered as final IA marks

End Semester Examination:

1. Question paper will comprise of 6 questions, each of 20 marks.
2. Total 4 questions need to be solved.
3. Question No.1 will be compulsory and based on entire syllabus wherein sub questions for 2 to 5 marks will be asked.
4. Remaining questions will be selected from all the modules

Course Code	Course Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Practical	Tutorial	Total
ETC505	Integrated Circuits	04	--	--	04	--	--	04

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test 2	Avg. of Test 1 and Test 2					
ETC505	Integrated Circuits	20	20	20	80	--	--	--	100

Course Pre-requisite:

- FEC105: Basic Electrical & Electronics Engineering
- ETC302: Analog Electronics-I
- ETC303: Digital Electronics
- ETC402: Analog Electronics-II

Course Objectives: To teach students

- Fundamentals of analog and digital integrated circuits.
- Design methodologies using practical integrated circuits.
- The application areas of integrated circuits.

Course Outcomes: After successful completion of the course student will be able to

- Understand the fundamentals and areas of applications for the Integrated Circuits.
- Analyze important types of integrated circuits of day-to-day requirements.
- Demonstrate the ability to design practical circuits that perform the desired operations.
- Understand the differences among theoretical, practical & simulated results in integrated circuits.
- Choose the appropriate integrated circuit modules to build a given application.

Module No.		Topics	Hrs.
1.		**Review of Operational Amplifier**	04
	1.1	Operational amplifier overview: parameters, open loop and closed loop configurations	
2		**Applications of Operational Amplifier**	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**	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**	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**	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)**	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

Recommended Books:

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

Internal Assessment (IA):

Two tests must be conducted which should cover at least 80% of syllabus. The average marks of two tests should be considered as final IA marks

End Semester Examination:

1. Question paper will comprise of 6 questions, each of 20 marks.
2. Total 4 questions need to be solved.
3. Question No.1 will be compulsory and based on entire syllabus wherein sub questions for 2 to 5 marks will be asked.
4. Remaining questions will be selected from all the modules

Course Code	Course Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Practical	Tutorial	Total
ETS506	Business Communication and Ethics	--	2 + 2	--	--	02	--	02

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test 2	Ave. Of Test 1 and Test 2					
ETS506	Business Communication and Ethics	--	--	--	--	50	--	--	50

Course Pre-requisite : FEC206 Communication Skills

Course Objective :

- To inculcate in students professional and ethical attitude, effective communication skills, teamwork, multidisciplinary approach and an ability to understand engineer's social responsibilities.
- To provide students with an academic environment where they will be aware of the excellence, leadership and lifelong learning needed for a successful professional career.
- To inculcate professional ethics and codes of professional practice and leadership.
- To prepare students for successful careers that meets the global Industrial and Corporate requirement' provide an environment for students to work on Multidisciplinary projects as part of different teams to enhance their team building capabilities like leadership, motivation, teamwork etc.

Expected Outcomes

After completion of this course students will be able to:

- Communicate effectively in both verbal and written form and demonstrate knowledge of professional and ethical responsibilities
- Participate and succeed in Campus placements and competitive examinations like GATE, CET.
- Possess entrepreneurial approach and ability for life-long learning.
- Have education necessary for understanding the impact of engineering solutions on Society and demonstrate awareness of contemporary issues.

Module No.	Unit No.	Topics	Hrs
1.0	**1.0**	**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	
2.0	**2.0**	**Technical Proposals**	**02**
	2.1	Objective of technical proposals	
	2.2	Parts of proposal	
3.0	**3.0**	**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	
4.0	**4.0**	**Meetings and Documentation**	**02**
	4.1	Strategies for conducting effective meetings	
	4.2	Notice	
	4.3	Agenda	
	4.4	Minutes of the meeting	
5.0	**5.0**	**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)	
6.0	**6.0**	**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, 12th edition
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.

Internal Assessment (IA):
There will be no IA written examination

End Semester Examination:
There will be no ESE written examination.

List of assignments:
Term work shall consist of assignments as listed below:

1. Report writing (Synopsis or the first draft of the Report)
2. Technical Proposal (Group activity, document of the proposal
3. Interpersonal Skills (Group activity and Role play)
4. Interpersonal Skills (Documentation in the form of soft copy or hard copy)
5. Meetings and Documentation (Notice, Agenda, Minutes of Mock Meetings)
6. Corporate ethics and etiquettes (case study, Role play)
7. Cover Letter and Resume Printout of the Power Point presentation

The distribution of marks for term work shall be as follows.

1. Assignments - 20 marks
2. Project Report Presentation – 15 marks
3. Group Discussion – 10 marks
4. Attendance - 5 marks

At least total 08 assignments, project report presentation and group discussion covering entire syllabus must be given during the batch wise practical. The assignments and project work should be students' centric and an attempt should be made to make assignments more meaningful, interesting and innovative.

Term work assessment must be based on the overall performance of the student with every assignment / project / group discussion graded from time to time. The average of grades converted in to marks should be taken into account for term work assessment.

Course Code	Course Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Practical	Tutorial	Total
ETL501	Microcontrollers and Applications	--	02	--	--	01	--	01

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical and Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test 2	Ave. Of Test 1 and Test 2					
ETL501	Microcontrollers and Applications	--	--	--	--	25	25	-	50

Term Work:
At least ten experiments covering entire syllabus of ETC501 Microcontrollers and Applications should be set to have well predefined inference and conclusion. The experiments should be student's centric and attempt should be made to make experiments more meaningful, interesting and innovative. Term work assessment must be based on overall performance of the student with every experiment graded. The grade must be converted to marks as per credit and grading system manual, and should be added and averaged. Based on above scheme grading and term work assessment should be done. Practical and oral examination will be based on entire syllabus.

Course Code	Course Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Practical	Tutorial	Total
ETL502	Communication Engineering Laboratory I	--	02	--	--	01	--	01

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical and Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test 2	Ave. Of Test 1 and Test 2					
ETL502	Communication Engineering Laboratory I	--	--	--	--	25	25	-	50

Term Work:
At least ten experiments covering entire syllabus of ETC502: Analog Communication should be set to have well predefined inference and conclusion. The experiments should be student centric and attempt should be made to make experiments more meaningful, interesting and innovative. Term work assessment must be based on over all performance of the student with every experiment graded. The grade must be converted to marks as per credit and grading system manual, and should be added and average. Based on above scheme grading and term work assessment should be done.
Practical and oral examination will be based on entire syllabus.

Course Code	Course Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Practical	Tutorial	Total
ETL503	Communication Engineering Laboratory II	--	02	--	--	01	--	01

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical and Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test 2	Ave. Of Test 1 and Test 2					
ETL503	Communication Engineering Laboratory II	--	--	--	--	25	25	-	50

Term Work:
At least ten experiments covering entire syllabus for ETC 504: RF Modeling and antenna and ETC 505: Integrated circuits should be set to have well predefined inference and conclusion. The experiments should be student's centric and attempt should be made to make experiments more meaningful, interesting and innovative. Term work assessment must be based on overall performance of the student with every experiment graded. The grade must be converted to marks as per credit and grading system manual, and should be added and average. Based on above scheme grading and term work assessment should be done.
Practical and oral examination will be based on entire syllabus.

Course Code	Course Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Practical	Tutorial	Total
ETL504	Mini Project 1	--	02	--	--	01	--	01

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical and Oral	Total
		Internal assessment			End Sem. Exam			
		Test 1	Test 2	Ave. Of Test 1 and Test 2				
ETL504	Mini Project 1	--	--	--	--	25	25	50

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.

Course Code	Course Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Practical	Tutorial	Total
ETC601	Digital Communication	04	--	--	04	--	--	04

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test 2	Ave. Of Test 1 and Test 2					
ETC601	Digital Communication	20	20	20	80	-	-	-	100

Pre-requisite:

- ETC405 Signal and System,
- ETC502 Analog Communication,
- ETC503 Random Signal Analysis

Course Objective:

- Aim is to identify the functions of different components
- Learn about theoretical bounds on the rates of digital communication system and represent a digital signal using several modulation methods
- Draw signal space diagrams, compute spectra of modulated signals and apply redundancy for reliable communication.

Course Outcome: At the end of course, student will be able to :

- Understand the basics of information theory and coding techniques.
- Determine the minimum number of bits per symbol required to represent the source and the maximum rate at which a reliable communication can take place over the channel.
- Describe and determine the performance of different waveform techniques for the generation of digital representation of signals.
- Determine methods to mitigate inter symbol interference in baseband transmission system.
- Describe and determine the performance of different error control coding schemes for the reliable transmission of digital representation of signals and information over the channel.
- Understand various spreading techniques and determine bit error performance of various digital communication systems.

Module No.		Topics	Hrs.
1.		**Information theory and source coding**	6
	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**	6
	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**	5
	3.1	Orthogonality, representation of signals	
	3.2	Maximum likelihood decoding	
	3.3	Correlation receiver, equivalence with matched filter	
4		**Bandpass Modulation and Demodulation**	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), M-ary 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**	10
	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	7
	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**	6
	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**

Recommended Books:

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, First Edition, 2011.
7. M F Mesiya, *"Contempory Communication systems*", Mc-Graw Hill, Singapore, First Edition, 2013.

Internal Assessment (IA):

Two tests must be conducted which should cover at least 80% of syllabus. The average marks of two tests should be considered as final IA marks

End Semester Examination:

1. Question paper will comprise of 6 questions, each of 20 marks.
2. Total 4 questions need to be solved.
3. Question No.1 will be compulsory and based on entire syllabus wherein sub questions for 2 to 5 marks will be asked.
4. Remaining questions will be selected from all the modules

Course Code	Course Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Practical	Tutorial	Total
ETC602	Discrete Time Signal Processing	04	--	--	04	--	--	04

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test 2	Ave. Of Test 1 and Test 2					
ETC602	Discrete Time Signal Processing	20	20	20	80	-	-	-	100

Course Prerequisite: ETC 405: Signals and System

Course Objectives:

- To develop a thorough understanding of the central elements of discrete time signal processing theory and the ability to apply this theory to real-world signal processing applications.
- Use z-transforms and discrete time Fourier transforms to analyze a digital system.
- Understand the discrete Fourier transform (DFT), its applications and its implementation by FFT techniques.
- Design and understand finite & infinite impulse response filters for various applications.
- The course is a prerequisite course for further studying of other multimedia related courses, such as speech processing, image processing, audio and video data compression, pattern recognition, communication systems and so forth.

Course Outcomes: Student will able to

- Formulate engineering problems in terms of DSP tasks
- Apply engineering problem solving strategies to DSP problems
- Design and test signal processing algorithms for various applications
- Recover information from signals
- Design and simulate digital filters

Module No.		Topics	Hrs.
1		**Transform Analysis of Linear Time Invariant System**	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.**	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**	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**	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**	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:**	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

Recommended Books:

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

Internal Assessment (IA):

Two tests must be conducted which should cover at least 80% of syllabus. The average marks of two tests should be considered as final IA marks

End Semester Examination:

1. Question paper will comprise of 6 questions, each of 20 marks.
2. Total 4 questions need to be solved.
3. Question No.1 will be compulsory and based on entire syllabus wherein sub questions for 2 to 5 marks will be asked.
4. Remaining questions will be selected from all the modules

Course Code	Course Name	Teaching Scheme	Credits Assigned					
		Theory	Practical	Tutorial	Theory	TW/ Practical	Tutorial	Total
ETC603	Computer Communication Networks	04	--	--	04	--	--	04

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test 2	Ave. Of Test 1 and Test 2					
ETC603	Computer Communication Networks	20	20	20	80	-	-	-	100

Course pre requisite: ETC 502 Analog Communication

Course Objective:

- To introduce analysis and design of computer and communication networks.
- To understand the network layered architecture and the protocol stack.

Course Outcomes:

Upon completion of the subject, students will be able to:

- Assemble the components of a PC and install one or more network operating systems resulting in a functioning
- Design a small or medium sized computer network including media types, end devices, and interconnecting devices that meets a customer's specific needs.
- Perform basic configurations on routers and Ethernet switches.
- Demonstrate knowledge of programming for network communications
- Learn to simulate computer networks and analyze the simulation results
- Troubleshoot connectivity problems in a host occurring at multiple layers of the OSI model
- Develop knowledge and skills necessary to gain employment as computer network engineer and network administrator.

Module No.		Topics	Hrs.
1.		**Network Architectures, Protocol layers, and their Service Models:**	04
	1.1	OSI-RM model and TCP/IP protocol	
2		**Principles of Network Applications:**	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	3.1	**Reliable and Unreliable Transport-layer protocols:**	10
	3.2	TCP and UDP, Port numbers, Multiplexing and de-multiplexing	
	3.3	Flow control and congestion control. fairness delay, jitter, and loss in packet-switched networks	
	3.4	Bandwidth, throughput, and quality-of-service	
4	4.1	**Network layer Services and Protocols**	10
	4.2	Switching fabric, routing and forwarding, queues and buffering	
	4.3	Virtual-circuit and datagram networks, internet protocol. IPv4 and IPv6 tunneling	
	4.4	Link State and Distance Vector algorithms, Routing in the Internet RIP, OSPF, and BGP	
	4.5	Broadcast and multicast, handling mobility	
5		**Data link layer Services and Protocols:**	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**	08
	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

Recommended Books:

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.

Internal Assessment (IA):

Two tests must be conducted which should cover at least 80% of syllabus. The average marks of two tests should be considered as final IA marks

End Semester Examination:

1. Question paper will comprise of 6 questions, each of 20 marks.
2. Total 4 questions need to be solved.
3 Question No.1 will be compulsory and based on entire syllabus wherein sub questions for 2 to 5 marks will be asked.
4. Remaining questions will be selected from all the modules.

Course Code	Course Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Practical	Tutorial	Total
ETC 604	Television Engineering	04	--	--	04	--	--	04

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test 2	Ave. Of Test 1 and Test 2					
ETC 604	Television Engineering	20	20	20	80	-	-	-	100

Pre requisite : ETC 502 Analog Communication

Course Objective:

- To introduce the basics of picture transmission and reception.
- To become well conversant with new development in video engineering.
- To introduce most latest and revolutionary ideas in the field of digital TV, HDTV, WDTV.

Course outcome: The students will be able to

- Describe and differentiate working principles of latest digital TV, HDTV, WDTV.
- Understand, use and working principles of latest display like LCD, LED, Plasma and large plat panel monitors

Module No.		Topics	Hrs.
1		**Fundamentals of Analog T V system**	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**	
	2.1	Compatibility considerations, Color theory, chromaticity diagram, generation of color TV signals, luminance signal, chrominance signal, frequency interleaving process, color subcarrier frequency.	10
	2.2	NTSC system- transmitter and receiver, PAL system- transmitter and receiver	
		Fundamental Concept of Digital Video	
3	3.1	Digitization, pixel array, scanning notation, viewing distance and angle, aspect ratio, frame rate and refresh rate.	12
	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		**Advanced TV systems**	6
	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)	
5		**High definition televisions**	8
	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**	6
	6.1	Principle, working, advantages and disadvantages of Plasma, LED,LCD	
Total			**52**

Recommended Books:

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

Internal Assessment (IA):

Two tests must be conducted which should cover at least 80% of syllabus. The average marks of two tests should be considered as final IA marks

End Semester Examination:

1. Question paper will comprise of 6 questions, each of 20 marks.
2. Total 4 questions need to be solved.
3: Question No.1 will be compulsory and based on entire syllabus wherein sub questions for 2 to 5 marks will be asked.
4: Remaining questions will be selected from all the modules.

Course Code	Course Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Practical	Tutorial	Total
ETC 605	Operating System	04	--	--	04	--	--	04

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test 2	Ave. Of Test 1 and Test 2					
ETC 605	Operating System	20	20	20	80	-	-	-	100

Course Pre-requisite: Basic concepts of computer systems

Course Objectives:

- To introduce operating system as a resource manager, its evolutions and fundamentals.
- To help student understand concept of process and different process (linear and concurrent) Scheduling policies.
- To help student familiar with memory, file and I/O management policies.

Course Outcomes: On completing this course Student will able to:

- Understand the role of an operating system, its function and issues.
- Compare between different algorithms used for management and scheduling of processes, Memory and input-output operation.
- Appreciate the role of various productivity enhancing tools.

Module No.		Topics	Hrs.
1		**Fundamental of Operating System(OS)**	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**	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**	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.	
4		**Unix Operating System**	06
	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**	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 Scheduling	
	5.6	Advantages of Linux and Unix over Windows	
6		**Real Time Operating System(RTOS)**	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**

Recommended Books:

1. Tanenbaum, "*Modern Operating Systems*", III[rd] Edition, PHI
2. Silberschatz A., Galvin P., and Gagne G, "*Operating Systems Concepts*", VIII[th] Edition Wiley.
3. William Stallings, "*Operating System-Internal & Design Principles*", VI[th] 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 Hill
7. Richard Blum and Christine Bresnahan, "*Linux Command Line & Shell Scripting*", 2nd edition, Wiley

Internal Assessment (IA):

Two tests must be conducted which should cover at least 80% of syllabus. The average marks of two tests should be considered as final IA marks

End Semester Examination:

1. Question paper will comprise of 6 questions, each of 20 marks.
2. Total 4 questions need to be solved.
3. Question No.1 will be compulsory and based on entire syllabus wherein sub questions for 2 to 5 marks will be asked.
4. Remaining questions will be selected from all the modules.

Course Code	Course Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Practical	Tutorial	Total
ETC606	VLSI Design	04	--	--	04	--	--	04

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test 2	Avg. of Test 1 and Test 2					
ETC606	VLSI Design	20	20	20	80	--	--	--	100

Course Pre-requisite:

- ETC303: Digital Electronics
- ETC302: Analog Electronics-I
- ETC402: Analog Electronics-II
- ETC505: Integrated Circuits

Course Objectives:

- To teach fundamentals of VLSI circuit design and implementation using circuit simulators and layout editors.
- To highlight the circuit design issues in the context of VLSI technology.

Course Outcomes: After successful completion of the course student will be able to

- Demonstrate a clear understanding of CMOS fabrication flow and technology scaling.
- Design MOSFET based logic circuit
- Draw layout of a given logic circuit
- Realize logic circuits with different design styles
- Demonstrate an understanding of working principle of operation of different types of memories
- Demonstrate an understanding of working principles of clocking, power reduction and distribution

Module No.		Topics	Hrs.
1		**MOSFET Fabrication and Scaling**	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**	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**	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**	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, Decoder	
5		**Data Path Design**	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 design**	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**

Recommended Books:

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

Internal Assessment (IA):
Two tests must be conducted which should cover at least 80% of syllabus. The average marks of two tests should be considered as final IA marks

End Semester Examination:
1. Question paper will comprise of 6 questions, each of 20 marks.
2. Total 4 questions need to be solved.
3. Question No.1 will be compulsory and based on entire syllabus wherein sub questions for 2 to 5 marks will be asked.
4. Remaining questions will be selected from all the modules.

Course Code	Course Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Practical	Tutorial	Total
ETL601	Discrete Time Signal Processing	--	02	--	--	01	--	01

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical and Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test 2	Ave. Of Test 1 and Test 2					
ETL601	Discrete Time Signal Processing	--	--	--	--	25	25	-	50

Term Work:
At least ten experiments covering entire syllabus of ETC 602:Discrete Time Signal Processing on should be set to have well predefined inference and conclusion. The experiments should be student's centric and attempt should be made to make experiments more meaningful, interesting and innovative. Term work assessment must be based on overall performance of the student with every experiment graded. The grade must be converted to marks as per credit and grading system manual, and should be added and average. Base on above scheme grading and term work assessment should be done.
Practical and oral examination will be based on entire syllabus.

Course Code	Course Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Practical	Tutorial	Total
ETL602	Communication Engineering Laboratory III	--	02	--	--	01	--	01

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical and Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test 2	Ave. Of Test 1 and Test 2					
ETL602	Communication Engineering Laboratory III	--	--	--	--	25	25	-	50

Term Work:
At least ten experiments covering entire syllabus for ETC 601: Digital Communication and ETC 603 Computer Communication and Networks should be set to have well predefined inference and conclusion. The experiments should be student's centric and attempt should be made to make experiments more meaningful, interesting and innovative. Term work assessment must be based on overall performance of the student with every experiment graded. The grade must be converted to marks as per credit and grading system manual, and should be added and average. Base on above scheme grading and term work assessment should be done.
Practical and oral examination will be based on entire syllabus of ETC 601 and ETC 603

Course Code	Course Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Practical	Tutorial	Total
ETL604	Communication Engineering Laboratory IV	--	02	--	--	01	--	01

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical and Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test 2	Ave. Of Test 1 and Test 2					
ETL604	Communication Engineering Laboratory -IV	--	--	--	--	25	25	-	50

Term Work:
At least six experiments covering entire syllabus for ETC 606:VLSI Design and minimum four experiments for ETC 604: Television Engineering. should be set to have well predefined inference and conclusion. The experiments should be student's centric and attempt should be made to make experiments more meaningful, interesting and innovative. Term work assessment must be based on overall performance of the student with every experiment graded. The grade must be converted to marks as per credit and grading system manual, and should be added and average. Base on above scheme grading and term work assessment should be done.
Practical and oral examination will be based on entire syllabus for ETC 606 and ETC 604.

Course Code	Course Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Practical	Tutorial	Total
ETL605	Mini Project II	--	02	--	--	01	--	01

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		Test 1	Test 2	Ave. Of Test 1 and Test 2				
ETL605	Mini Project II	--	--	--	--	25	25	50

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.