UNIVERSITY OF MUMBAI

Bachelor of Engineering

Electronics & Telecommunication Engineering
(Second Year – Sem. III & IV), Revised course
(REV- 2012) from Academic Year 2012 -13.

Under

FACULTY OF TECHNOLOGY

(As per Semester Based Credit and Grading System)

Preamble:

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 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:

The engineering education in India in general is expanding in manifolds. Now, the challenge is to ensure its quality to the stakeholders along with the expansion. To meet this challenge, 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 and reflects the fact that in achieving recognition, the institution or program of study is committed and open to external review to meet certain minimum specified standards. The major emphasis of this accreditation process is to measure the outcomes of the program that is being accredited. Program outcomes are essentially a range of skills and knowledge that a student will have at the time of graduation from the program. An engineering program must ensure that its graduates understand the basic concepts of science and mathematics, have gone through one engineering field in dept of appreciate and use its methodologies of analyses and design, 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 of University of Mumbai has taken a lead in incorporating philosophy of outcome based education in the process of curriculum development.

I, as Chairman, Board of Studies in Electronics and Telecommunication Engineering University of Mumbai, happy to state here that, Program Educational Objectives were finalized in a meeting where more than 20 members from different Institutes were attended, who were either Heads or their representatives of Electronics and Telecommunication Engineering Department. The Program Educational Objectives finalized for undergraduate program in Electronics and Telecommunication Engineering are 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.

In addition to above more program educational objectives of their own may be added by affiliated Institutes.

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.

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

Programme structure B.E.(Electronics & Telecommunication)
S.E. (Electronics & Telecommunication) Sem III

Sub Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ETS301	Applied Mathematics III	04	--	01	04	--	01	05
ETC302	Analog Electronics I	04	--	--	04	--	--	04
ETC303	Digital Electronics	04	--	--	04	--	--	04
ETC304	Circuits and Transmission Lines	04	--	--	04	--	--	04
ETC305	Electronic Instruments and Measurements	04	--	--	04	--	--	04
ETS306	Object Oriented Programming Methodology	--	--	--	--	--	--	--
ETL301	Analog Electronics I Laboratory	--	02	--	--	01	--	01
ETL302	Digital Electronics Laboratory	--	02	--	--	01	--	01
ETL303	Circuits and Measurements Laboratory	--	02	--	--	01	--	01
ETSL304	Object Oriented Programming Methodology Laboratory	--	*04	--	--	01	--	01
Total		20	10	01	20	04	01	25

*-Out of four hours, 2 hours theory shall be taught to entire class followed by 2 hrs. practical in batches.

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical and Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test 2	Avg. of Test 1 & Test 2					
ETS301	Applied Mathematics III	20	20	20	80	25	--	--	125
ETC302	Analog Electronics I	20	20	20	80	--	--	--	100
ETC303	Digital Electronics	20	20	20	80	--	--	--	100
ETC304	Circuits and Transmission Lines	20	20	20	80	--	--	--	100
ETC305	Electronic Instruments and Measurements	20	20	20	80	--	--	--	100
ETS306	Object Oriented Programming Methodology	--	--	--	--	--	--	--	--
ETL301	Analog Electronics I Laboratory	--	--	--	--	25	25	--	50
ETL302	Digital Electronics Laboratory	--	--	--	--	25	25	--	50
ETL303	Circuits and Measurements Laboratory	--	--	--	--	25	--	--	25
ETSL304	Object Oriented Programming Methodology Laboratory	--	--	--	--	25	50	--	75
Total		--	--	100	400	125	100	--	725

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ETS 301	Applied Mathematics III	04	--	01	04	-	01	05

Subject Code	Subject 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					
ETS 301	Applied Mathematics III	20	20	20	80	25	--	--	125

Course pre-requisite:
FES 101: Applied Mathematics I
FES 201: Applied Mathematics II

Course objectives:

- To provide students with a sound foundation in Mathematics and prepare them for graduate studies in Electronics and Telecommunication Engg.
- To provide students with mathematics fundamental necessary to formulate, solve and analyze engg. problems.
- To provide opportunity for students to work as part of teams on multi disciplinary projects.

Course outcomes:

- Students will demonstrate basic knowledge of Laplace Transform. Fourier series, Bessel Functions, Vector Algebra and Complex Variable.
- Students will demonstrate an ability to identify formulate and solve electronics and telecommunication Engg. problem using Applied Mathematics.
- Students will show the understanding of impact of Engg. Mathematics on Telecom Engg.
- Students who can participate and succeed in competitive exams like GATE, GRE.

Module No.	Unit No.	Topics	Hrs.
1. 0		**Laplace Transform**	**12**
	1.1	**Laplace Transform (LT) of Standard Functions:** Definition. unilateral and bilateral Laplace Transform, LT of *sin(at), cos(at),* e^{at}, t^n , *sinh(at), cosh(at), erf(t),* Heavi-side unit step, dirac-delta function, LT of periodic function	
	1.2	**Properties of Laplace Transform:** Linearity, first shifting theorem, second shifting theorem, multiplication by t^n , division by t , Laplace Transform of derivatives and integrals, change of scale, convolution theorem, initial and final value theorem, Parsavel's identity	
	1.3	**Inverse Laplace Transform:** Partial fraction method, long division method, residue method	
	1.4	**Applications of Laplace Transform:** Solution of ordinary differential equations	
2.0		**Fourier Series**	**10**
	2.1	**Introduction:** Definition, Dirichlet's conditions, Euler's formulae	
	2.2	**Fourier Series of Functions:** Exponential, trigonometric functions, even and odd functions, half range sine and cosine series	
	2.3	Complex form of Fourier series, orthogonal and orthonormal set of functions, Fourier integral representation	
3.0		**Bessel Functions**	**08**
	3.1	**Solution of Bessel Differential Equation:** Series method, recurrence relation, properties of Bessel function of order +1/2 and -1/2	
	3.2	Generating function, orthogonality property	
	3.3	Bessel Fourier series of functions	
4.0		**Vector Algebra**	**12**
	4.1	**Scalar and Vector Product**: Scalar and vector product of three and four vectors and their properties	
	4.2	**Vector Differentiation:** Gradient of scalar point function, divergence and curl of vector point function	
	4.3	**Properties:** Solenoidal and irrotational vector fields, conservative vector field	
	4.4	**Vector Integral:** Line integral, Green's theorem in a plane, Gauss' divergence theorem, Stokes' theorem	
5.0		**Complex Variable**	**10**
	5.1	**Analytic Function:** Necessary and sufficient conditions, Cauchy Reiman equation in polar form	
	5.2	Harmonic function, orthogonal trajectories	
	5.3	**Mapping:** Conformal mapping, bilinear transformations, cross ratio, fixed points, bilinear transformation of straight lines and circles	
		Total	**52**

Text books:

1. P. N. Wartikar and J. N. Wartikar, *"A Text Book of Applied Mathematic",* Vol. I & II, Vidyarthi Griha Prakashan
2. A. Datta, *"Mathematical Methods in Science and Engineering",* 2012
3. B.S. Grewal, *"Higher Engineering Mathematics",* Khanna Publication

Reference Books:

1. B. S. Tyagi, *"Functions of a Complex Variable,"* Kedarnath Ram Nath Publication
2. B. V. Ramana, *"Higher Engineering Mathematics",* Tata Mc-Graw Hill Publication
3. Wylie and Barret, *"Advanced Engineering Mathematics",* Tata Mc-Graw Hill 6th Edition
4. Erwin Kreysizg, *"Advanced Engineering Mathematics",* John Wiley & Sons, Inc
5. Murry R. Spieget, *"Vector Analysis",* Schaum's outline series, Mc-Graw Hill Publication

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

End Semester Examination:
1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

Term Work/ Tutorial:
At least 08 assignments covering entire syllabus must be given during the '**class wise tutorial'**. The assignments 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 graded from time to time. The grades will 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.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW	Tutorial	Total
ETC 302	Analog Electronics I	4	--	--	4	--	--	04

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical and Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test 2	Avg. Of Test 1 and Test 2					
ETC 302	Analog Electronics I	20	20	20	80	--	--	--	100

Course pre-requisite:

- FEC102: Applied Physics I
- FEC105: Basic Electrical and Electronics Engineering

Course objectives:

- To understand physical operation of semiconductor devices
- To understand DC and AC models of semiconductor devices
- To apply concepts of DC and AC modeling of semiconductor devices for the design and analysis
- To verify the theoretical concepts through laboratory and simulation experiments.

Course outcomes:

After completion of this course students will be:

- Able to understand the current voltage characteristics of semiconductor devices.
- Able to understand and relate dc and ac models of semiconductor devices with their physical Operation.
- Able to perform design and analysis of electronic circuits
- Able to design analog system and components

Module No.	Unit No.	Topics	Hrs.
1.0		**Diodes and their Applications**	**08**
	1.1	**PN Junction Diode:** Diode current equation, effect of temperature on diode characteristics, breakdown mechanism, diode as a switch, small signal model	
	1.2	**Clippers and Clampers**: Voltage transfer characteristics, series and shunt clippers, single diode series and shunt clamper circuits	
	1.3	**Other PN junction devices:** Construction and operation of Varactor diode, photodiode, Schottkey diode	
2.0		**Field Effect Transistors**	**08**
	2.1	**Junction Field Effect Transistor (JFET):** Construction, working, regions of operation, transfer (V_{GS}, Vs, I_D) and output (V_{DS}, Vs, I_D) characteristics, Schockely equation	
	2.2	**Metal-Oxide Semiconductor Field Effect Transistor (MOSFET):** **E-MOSFET:** MOS capacitor, energy band diagram of MOS capacitor in accumulation, depletion and inversion region, concept of threshold voltage, operation of MOSFET, derivation of threshold voltage and drain current, body effect, channel length modulation **D-MOSFET**: Construction and working	
3.0		**DC Analysis of Transistor Circuits**	**10**
	3.1	**Bipolar Junction Transistor:** Review of BJT characteristics, DC load line and regions of operation, transistor as a switch, DC analysis of common BJT circuits, analysis and design of fixed bias, collector to base bias and voltage divider bias, stability factor analysis	
	3.2	**Junction Field Effect Transistor:** Analysis and design of self bias and voltage divider bias	
	3.3	**MOSFET:** DC load line and region of operation, common MOSFETs configurations, analysis and design of biasing circuits	
4.0		**Small Signal Analysis of BJT Amplifiers**	**10**
	4.1	**BJT CE Amplifier:** Understanding of amplification concept with reference to input/output characteristics, AC load line analysis, definition of amplifier parameters Z_i, Z_0, A_v and A_i, graphical analysis to evaluate parameters	
	4.2	**Small Signal mid Frequency Models:** Hybrid-pi model, early effect, h-parameter model	
	4.3	**Small Signal Analysis:** Small signal analysis (mid-frequency) (Z_i, Z_0, A_v and A_i) of CE, CB, and CC configurations using hybrid-pi model, comparison between CE, CB, and CC configurations with reference to parameters	
5.0		**Small Signal Analysis of FET Amplifiers**	**08**
	5.1	**JFET CS Amplifier:** Small signal equivalent circuit and analysis (mid-frequency) (Z_i, Z_0 and A_v)	
	5.2	**E-MOSFET Amplifier:** Graphical analysis to evaluate parameters, AC load line, small signal model, small signal (mid-frequency) analysis of CS, CD and CG amplifiers	
6.0		**Oscillators (no numericals)**	**08**
	6.1	**Concepts of Oscillator:** Concept of negative and positive feedback and conditions for oscillation	
	6.2	**RC oscillators**: Phase shift and Wein bridge	
	6.3	**LC Oscillators**: Hartley, Colpitts and Clapps	
	6.4	**Tuned Oscillator**: Twin-T oscillator and crystal oscillator	
		Total	**52**

Text Books:

1. Donald A. Neamen, *"Electronic Circuit Analysis and Design",* Tata McGraw Hill, 2nd Edition
2. Adel S. Sedra, Kenneth C. Smith, and Arun N Chandorkar, *"Microelectronic Circuits Theory and Applications",* International Version, OXFORD International Students, Sixth Edition

Recommended Books:

1. Sung-Mo Steve Kang, and Yusuf Leblebici*, "CMOS Digital Integrated Circuits Analysis and Design",* TATA McGraw Hill,
2. S. Salivahanan*,* N. Suresh Kumar, *"Electronic Devices and Circuits",* Tata Mc-Graw Hill, 3rd Edition
3. Jacob Millman*,* Christos C Halkias and Satyabrata G., *"Millman's Electronic Devices and Circuits",* Mc-Graw Hill, 3rd Edition
4. Muhammad H. Rashid, *"Microelectronics Circuits Analysis and Design",* Cengage Learning, 2nd Edition
5. Anil K. Maini and Varsha Agrawal*, "Electronic Devices and Circuits",* Wiley Publications

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

End Semester Examination:
1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW	Tutorial	Total
ETC 303	Digital Electronics	04	--	--	04	--	--	04

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical and oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test 2	Avg. of Test 1 and Test 2					
ETC303	Digital Electronics	20	20	20	80	-	-	-	100

Course objectives:

- To introduce the fundamental concepts and methods for design of various digital circuits.
- To build the skill of digital system design and testing used in various fields of computing, communication, automatic control of mechanisms and instrumentation.

Course outcomes:

After completion of course, students will be

- Able to distinguish between analog and digital signals & data.
- Able to analyze, transform & minimize combination logic circuits.
- Able to understand basic arithmetic circuits.
- Able to design and analyze sequential circuits.
- Able to design digital system and components.

Module No.	Unit No.	Topics	Hrs.
1.0		**Number Systems and Codes**	04
	1.1	**Arithmetic codes**: Review of number system, BCD code, Octal code, Hexa-decimal code, EX-3 code, Gray code, ASCII Code	
2.0		**Logic Gates and Combinational Logic Circuits**	16
	2.1	**DTL, TTL, ECL and CMOS gates:** Transfer characteristics, noise margin, fan-in, fan-out, introduction to their logic families, their transfer characteristics and noise margin	
	2.2	**Universal gates and combinational circuits**: Realization of basic gates using NAND and NOR gates, Boolean algebra, De Morgan's theorem, SOP and POS representation, K-map up to five variables, Quine-McClusky method, variable entered mapping	
	2.3	**Arithmetic circuits:** Adder, subtractor, carry look ahead adder, BCD adder, magnitude comparator, binary multiplier, series and parallel adder	
	2.4	**Multiplexer and de-multiplexer:** Boolean functions implementation using multiplexer and de-multiplexer, encoder and decoder, parity generator and checker	
3.0		**Sequential Logic Circuits**	16
	3.1	**Flip flops and registers:** RS, JK, T, D and master slave flip flops, conversion of flip flops, universal shift registers	
	3.2	**Counter design:** Asynchronous and synchronous counter, up/down counter, mod-N counter, pre-settable counter, skipping state counter	
	3.3	**Shift registers design:** SISO, SIPO, PISO, PIPO, shift left and shift right registers	
	3.4	**Applications of sequential circuits:** Frequency division, ring counter, Johnson counter, Moore and Mealy machine, state transition diagram, synthesis table	
	3.6	**State reduction techniques:** Row elimination and implication table methods	
4.0		**Different types of Memory**	06
	4.1	**Classification and characteristics of memory:** SRAM, DRAM, ROM, PROM, EPROM and FLASH memories	
5.0		**Introduction to Programmable Logic Devices**	10
	5.1	**CPLD and FPGA:** Architecture of CPLD and FPGA, Xilinx XC 9500 CPLD Series and Xilinx XC 4000 FPGA Series	
	5.2	**VHDL:** Data types, Structural Modeling using VHDL, attributes, data flow, behavioral, VHDL implementation of basic combinational and sequential Circuits	
	5.3	**Programmable Logic Devices:** PLA and PAL	
		Total	**52**

Text Books:

1. Morris Mano and Michael D. Ciletti, *"Digital Design"*, Pearson Education, Fourth Edition, 2008.
2. Malvino A.P. and Leach D.P., *"Digital Principles and Applications",* TMH, 6th Edition

Reference Books:

1. John F. Warkerly, "*Digital Design Principles and Practices"*, Person Education, Fourth Edition, 2008. .
2. J. Bhaskar, *"VHDL Primer",* Prentice Hall, 3rd Edition
3. William I. Fletchter, "*An Engineering Approach to Digital Design"*, PHI, Tenth Indian Reprint, 2001.
4. Norman Balabanian and Bradley Carlson, "*Digital Logic Design Principles"*, John Wiley & Sons, First Edition, 2011.
5. A. Anand Kumar, *"Fundamentals of Digital Circuits"*, PHI, Second Edition, 2012.
6. Charles H. Roth, *"Fundamentals of Logic Design"*, Jaico Publishing House, First Edition, 2004.
7. G. K. Kharate, *"Digital Electronics"*, Oxford University Press, First Edition, 2010
8. R. P. Jain, "*Modern Digital Electronics*", Tata McGraw Hill Education, Third Edition 2003.
9. Frank Vahid, "*Digital Design*", John Willy and Sons, First Edition, 2011.

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

End Semester Examination:
1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3: Question No.1 will be compulsory and based on entire syllabus.
4: Remaining question (Q.2 to Q.6) will be selected from all the modules.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW	Tutorial	Total
ETC 304	Circuits and Transmission Lines	04	--	--	04	--	--	04

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test 2	Avg. of 2 Tests					
ETC 304	Circuits and Transmission Lines	20	20	20	80	--	--	--	100

Course pre-requisite:
FEC 105: Basic electrical and electronics engineering

Partial fraction expansion, matrices, determinants calculus and differential equations,

Course objectives:

- To analyze and synthesize circuits and to become familiar with the propagation of signals through transmission lines.
- To analyze the circuits in time and frequency domain
- To study network functions, inter relationship among various circuit parameters, solve more complex network using these parameters.

Course outcomes:

- Through test, laboratory exercises and home assignment, students will be able to apply their knowledge in solving complex circuits.
- Students will be able to evaluate the time and frequency response which is useful in understanding behavior of electronic circuits and control system.
- Student will able to understand how the information in terms of voltage and current is transmitted through the transmission lines and importance of matching.

Module No.	Unit No.	Topics	Hrs.
1.0		**Electrical circuit analysis**	**12**
	1.1	**Analysis of DC circuits:** Analysis of circuits with and without controlled sources using generalized loop and node matrix methods and Source Transformation, Superposition, Thevenin, Norton, Millman theorems	
	1.2	**Magnetic circuits:** Self and mutual inductances, coefficient of coupling, dot convention, equivalent circuit, solution using loop analysis	
	1.3	**Tuned coupled Circuits:** Analysis of tuned coupled circuits	
2.0		**Time and frequency domain analysis**	**10**
	2.1	**Time domain analysis of R-L and R-C circuits:** Forced and natural response, time constant, initial and final values **Solution using first order equation for standard input signals:** Transient and steady state time response, solution using universal formula	
	2.2	**Time domain analysis of R-L-C Circuits:** Forced and natural response, effect of damping **Solution using second order equation for standard input signals:** transient and steady state time response	
	2.3	**Frequency domain analysis of RLC Circuits:** S-domain representation, applications of Laplace Transform in solving electrical networks, driving point and transfer Function, Poles and Zeros, calculation of residues by analytical and graphical method, analysis of ladder and lattice network **Response to standard signals:** Transient and steady state time response of R-L-C circuits	
3.0		**Synthesis of RLC circuits**	**10**
	3.1	**Positive real functions:** Concept of positive real function, testing for Hurwitz polynomials, testing for necessary and sufficient conditions for positive real functions	
	3.2	**Synthesis of RC, RL, LC and RLC circuits:** Properties and synthesis of RC, RL, LC driving point functions	
4.0		**Two port circuits**	**10**
	4.1	**Parameters:** Open circuits, short circuit, transmission and hybrid parameters, relationship among parameters, reciprocity and symmetry conditions.	
	4.2	Interconnections of two-port circuits, T & π representation.	
	4.3	Terminated two-port circuits.	
5.0		**Radio frequency transmission lines**	**10**
	5.1	**Transmission Line Representation:** T and Л representations, terminated transmission line, infinite line	
	5.2	**Parameters of radio frequency lines:** Propagation constant, attenuation constant, phase constant, group velocity, input impedance, characteristic impedance, reflection coefficient, standing wave ratio, VSWR, ISWR, S-parameters	
	5.3	**Smith Chart**: Impedance locus diagram, impedance matching	
	Total		**52**

Text Books

1. Franklin F Kuo, *"Network Analysis and Synthesis",* Wiley Toppan, 2nd.ed. 1966
2. W L Everitt and G E Anner, *"Communication Engineering",* Mc-GrawHill, New York, 3rd Edition, 1956

Reference Books

1. M E Van Valkenburg, *"Network Analysis",* Prentice-Hall of India Pvt Ltd, New Delhi, 26th Indian Reprint, 2000
2. K V V Murty and M S Kamth*, "Basic Circuit Analysis",* Jaico Publishing house, London
3. A Chakrabarti*, "Circuit Theory",* Dhanpat Rai & Co., Delhi, 6h Edition

Internal Assessment (IA):
Two tests must be conducted which should cover at least 80% of syllabus. The average marks of both the test will be considered for final Internal Assessment.

End Semester Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3: Question No.1 will be compulsory and based on entire syllabus.
4: Remaining question (Q.2 to Q.6) will be selected from all the modules.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW	Tutorial	Total
ETC 305	Electronic Instruments and Measurements	04	--	--	04	--	--	04

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical and oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test 2	Avg. Of Test 1 and Test 2					
ETC 305	Electronic Instruments and Measurements	20	20	20	80	--	--	--	100

Pre-requisites:

- Students are expected to have basic knowledge of analog and digital electronics

Course objectives:

- To understand basic functions and principle of working of sensors and components used in Electronic Measurement
- To understand principles of advanced electronic instruments and application in measurement of electronics parameters

Course outcomes:

- Students will learn measurement of physical parameters using various transducers and working of sensors.
- They will become familiar with basics of instruments and details of operation of measuring instruments and their applications.

Module No.	Unit No.	Topics	Hrs.
1. 0		**Principals of measurement**	**06**
	1.1	**Introduction to basic instruments:** Components of generalized measurement system, applications of instrument systems, static and dynamic characteristics of instruments, concepts of accuracy, precision, linearity, sensitivity, resolution, hysteresis, calibration	
	1,2	**Errors in measurement:** Errors in measurement, classification of errors, remedies to eliminate errors	
2.0		**Sensors and transducers**	**12**
	2.1	**Basics of sensors and transducers:** Active and passive transducers, characteristics and selection criteria of transducers, working principle of Eddy-current sensors, Pizoelectric transducers, photoelectric and photo voltaic sensors, capacitive sensors	
	2.2	**Displacement and pressure:** Potentiometers, pressure gauges, Linear Variable Differential Transformers (LVDT) for measurement of pressure and displacement, strain gauges	
	2.3	**Temperature transducers:** Resistance Temperature Detectors (RTD), thermistors, and thermocouples, their ranges and applications	
3.0		**Testing and measuring Instruments**	**10**
	3.1	**Analog multi-meter:** Multi-range measurement of voltage, current and resistance, specifications	
	3.2	**Measurement of resistance:** Kellvin's double bridge, Wheatstone bridge, and Megaohm bridge **Measurement of inductance:** Maxwell bridge and Hey bridge; **Measurement of capacitance:** Schering bridge **Q-Meter:** Operating principle and applications	
	3.3	**Energy and power meters:** Working of energy and power meter	
4.0		**Data Acquisition and Digital Instruments**	**10**
	4.1	**Data acquisition and converters**: single channel, multichannel and PC based DAS **A/D and D/A converters:** Types and specifications of A/D and D/A converters, Significance of X½ digit display	
	4.2	**Digital multi-meter:** Block diagram, multi range measurement of voltage, current and resistance, specifications	
5.0		**Oscilloscopes**	**08**
	5.1	**Cathode ray oscilloscope:** Block diagram based Study of CRO, specifications, controls, sweep modes, role of delay line, single- and dual-beam dual-trace CROs, chop and alternate modes	
	5.2	**Measurement using oscilloscope:** measurement of voltage, frequency, rise time, fall time and phase difference. Lissajous figures in detection of frequency and phase	
	5.3	**Digital storage oscilloscope (DSO):** Block diagram based study of DSO, study of features like roll, refresh, storage mode and sampling rate; applications of DSO	
6.0		**Signal analyzers**	**06**
	6.1	**Wave analyzers:** Introduction to harmonic, total harmonic distortion analyzer; block diagram and applications of wave analyzers	
	6.2	**Spectrum and network analyzers:** Block diagram and applications	
		Total	52

Text Books:

1. H. Oliver and J. M. Cage, "*Electronic Measurement and Instrumentation",* McGraw Hill, 3rd edition, 2008
2. C. S. Rangan, G.R. Sarma, and V.S.V. Mani, *"Instrumentation Devices and Systems",* Tata McGraw Hill, 9th edition, 2007

Reference Books:

1. T. S. Rathore, *"Digital Measurement Techniques",* Narosa Publishing House, New Delhi, 2nd Edition, 2003
2. W. Cooper and A. Helfric, "*Electronic Instrumentation and Measurement Techniques"*, PHI, 4th edition, 2009
3. H. S. Kalsi, *"Electronics Instrumentation",* Tata Mcgraw Hill, 2nd Edition, 2009

Internal Assessment (IA):
Two tests must be conducted which should cover at least 80% of syllabus. The average marks of both the test will be considered for final Internal Assessment.

End Semester Examination:
1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3: Question No.1 will be compulsory and based on entire syllabus.
4: Remaining question (Q.2 to Q.6) will be selected from all the modules.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ETS 306	Object Oriented Programming Methodology	--	--	--	--	--	--	--

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical and Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test 2	Avg. Of Test 1 and Test 2					
ETS 306	Object Oriented Programming Methodology	--	--	--	--	--	--	--	--

Pre-requisites:
Course in Structured Programming Approach/ Any Programming Language

Course Objectives:

- To understand the concept of Object Oriented Programming
- To help student to understand use of programming language such as JAVA to resolve problems.
- To impart problems understanding, analyzing skills in order to formulate Algorithms.
- To provide knowledge about JAVA fundamentals: data types, variables, keywords and control structures.
- To understand methods, arrays, inheritance, Interface, package and multithreading and concept of Applet.

Course Outcomes:

- Students will be able to code a program using JAVA constructs.
- Given an algorithm a student will be able to formulate a program that correctly implements the algorithm.
- Students will be able to generate different patterns and flows using control structures and use recursion in their programs.
- Students will be able to use thread methods, thread exceptions and thread priority.
- Students will implement method overloading in their code.
- Students will be able to demonstrate reusability with the help of inheritance.
- Students will be able to make more efficient programs.

Module No.	Unit No.	Topic	Hrs.
1		**Fundamental concepts of object oriented programming**	**4**
	1.1	Overview of programming	
	1.2	Introduction to the principles of object-oriented programming: classes, objects, messages, abstraction, encapsulation, inheritance, polymorphism, exception handling, and object-oriented containers	
	1.3	Differences and similarity between C++ and JAVA	
2		**Fundamental of Java programming**	**4**
	2.1	Features of Java	
	2.2	JDK Environment & tools	
	2.3	Structure of Java program	
	2.4	Keywords , data types, variables, operators, expressions	
	2.5	Decision making, looping, type casting	
	2.6	Input output using scanner class	
3		**Classes and objects**	**6**
	3.1	Creating classes and objects	
	3.2	Memory allocation for objects	
	3.3	Passing parameters to Methods	
	3.4	Returning parameters	
	3.5	Method overloading	
	3.6	Constructor and finalize ( )	
	3.7	Arrays: Creating an array	
	3.8	Types of array : One dimensional arrays ,Two Dimensional array, string	
4		**Inheritance, interface and package**	**6**
	4.1	Types of inheritance: Single, multilevel, hierarchical	
	4.2	Method overriding, super keyword, final keyword, abstract class	
	4.3	Interface	
	4.4	Packages	
5		**Multithreading**	**4**
	5.1	Life cycle of thread	
	5.2	Methods	
	5.3	Priority in multithreading	
6		**Applet**	**2**
	6.1	Applet life cycle	
	6.2	Creating applet	
	6.3	Applet tag	
		Total	**26**

Text Books:

1. Rajkumar Buyya, "*Object-oriented programming with JAVA"*, Mcgraw Hill
2. E Balgurusamy, *"Programming with JAVA",* Tata McGraw Hill

Reference Books:

1. Herbert Schildt, *"The Complete Reference JAVA",* Tata McGraw Hill
2. Barry Holmes and Daniel T. Joyce, *"Object Oriented Programming with Java",* Jones & Bartlett Learning

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW	Tutorial	Total
ETL 301	Analog Electronics I Laboratory	--	02	--	--	01	--	01

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical and Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test 2	Avg. Of Test 1 and Test 2					
ETL 301	Analog Electronics I Laboratory	--	--	--	--	25	25	-	50

Term Work:
At least **10** experiments covering entire syllabus should be set to have well predefined inference and conclusion. Computation/simulation based experiments are also encouraged. The experiments should be students' centric and attempt should be made to make experiments more meaningful, interesting and innovative.

Term work assessment must be based on the overall performance of the student with every experiment graded from time to time. The grades will be converted to marks as per '**credit and grading'** system manual and should be added and averaged. Based on the above scheme grading and term work assessment should be done.

The practical and oral examination will be based on entire syllabus.

Subject Code	Subject Name	Teaching Scheme (Hrs)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW	Tutorial	Total
ETL 302	Digital Electronics Laboratory	--	02	--	--	01	--	01

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical and oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test 2	Avg. of Test 1 and Test 2					
ETL302	Digital Electronics Laboratory	--	--	--	--	25	25	-	50

Term Work:
At least **10** experiments covering entire syllabus should be set to have well predefined inference and conclusion. Computation/simulation based experiments are also encouraged. The experiments should be students' centric and attempt should be made to make experiments more meaningful, interesting and innovative.

Term work assessment must be based on the overall performance of the student with every experiment graded from time to time. The grades will be converted to marks as per '**credit and grading'** system manual and should be added and averaged. Based on the above scheme grading and term work assessment should be done.

The practical and oral examination will be based on entire syllabus.

Subject Code	Subject Name	Teaching Scheme(Hrs)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ETL 303	Circuits and Measurement Laboratory	--	02	--	--	01	--	01

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical and Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test 2	Avg. Of Test 1 and Test 2					
ETL 303	Circuits and Measurement Laboratory	--	--	--	--	25	--	--	25

Term Work:

At least **10** experiments (5 on Circuits and Transmission lines and 5 on Electronics Instruments and Measurements) covering entire syllabus should be set to have well predefined inference and conclusion. Computation/simulation based experiments are also encouraged. The experiments should be students' centric and attempt should be made to make experiments more meaningful, interesting and innovative.

Term work assessment must be based on the overall performance of the student with every experiment graded from time to time. The grades converted into marks as per '**credit and grading'** System manual should be added and averaged. Based on this final term work grading and term work assessment should be done.

Subject Code	Subject Name	Teaching Scheme (Hrs)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ETSL 304	Object Oriented Programming Methodology Laboratory	--	02+02*	--	--	01	--	01

*-Out of four hours, 2 hours theory shall be taught to entire class followed by 2 hrs. practical in batches.

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical and Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test 2	Avg. Of Test 1 and Test 2					
ETSL 304	Object Oriented Programming Methodology Laboratory	--	--	--	--	25	50	-	75

Term Work:
At least **10** experiments covering entire syllabus should be set to have well predefined inference and conclusion. The experiments should be students' centric and attempt should be made to make experiments more meaningful, interesting and innovative.

Term work assessment must be based on the overall performance of the student with every experiment graded from time to time. The grades will be converted to marks as per **Credit and Grading** System manual and should be added and averaged. Based on the above scheme grading and term work assessment should be done.

The Practical and oral examination will be based on entire syllabus.

Programme Structure B.E. (Electronics & Telecommunication)
S.E. (Electronics & Telecommunication) Sem IV

Sub Code	Subject Name	Teaching Scheme(Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ETS401	Applied Mathematics IV	04	--	01	04	--	01	05
ETC402	Analog Electronics II	04	--	--	04	--	--	04
ETC403	Microprocessors and Peripherals	04	--	--	04	--	--	04
ETC404	Wave Theory and Propagation	04	--	--	04	--	-	04
ETC 405	Signals and Systems	04	--	01	04	-	01	05
ETC406	Control Systems	04	--	--	04	--	-	04
ETL401	Analog Electronics II Laboratory	--	02	--	--	01	--	01
ETL402	Microprocessors and Peripherals Laboratory	--	02	--	--	01	--	01
ETL403	Software Simulation Laboratory	--	02	--	--	01	--	01
Total		**24**	**06**	**02**	**24**	**03**	**02**	**29**

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical and Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test 2	Avg. Of Test 1 and Test 2					
ETS401	Applied Mathematics IV	20	20	20	80	25	--	--	125
ETC402	Analog Electronics II	20	20	20	80	--	--	--	100
ETC403	Microprocessors and Peripherals	20	20	20	80	--	--	--	100
ETC404	Wave Theory and Propagation	20	20	20	80	--	--	--	100
ETC 405	Signals and Systems	20	20	20	80	25	--	--	125
ETC406	Control Systems	20	20	20	80	--	--	--	100
ETL401	Analog Electronics II Laboratory	--	--	--	--	25	25	--	50
ETL402	Microprocessors and Peripherals Laboratory	--	--	--	--	25	25	--	50
ETL403	Software Simulation Laboratory	--	--	--	--	25	25	--	50
Total		**--**	**--**	**120**	**480**	**125**	**75**	**--**	**800**

Subject Code	Subject Name	Teaching Scheme(Hrs)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ETS 401	Applied Mathematics IV	04	--	01	04	--	01	05

Subject Code	Subject 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					
ETS 401	Applied Mathematics IV	20	20	20	80	25	--	--	125

Course pre-requisite:

FE C 101 : Applied Mathematics I
FE C 201 : Applied Mathematics II
SE S 301 : Applied Mathematics III

Course objectives:
This course will present the method of calculus of variations (CoV), basic concepts of vector spaces, matrix theory, concept of ROC and residue theory with applications.

- To provide students with a sound foundation in mathematics and prepare them for graduate studies in Electronics and Telecommunication Engineering
- To provide students with mathematics fundamental necessary to formulate, solve and analyze engineering problems.
- To provide opportunity for students to work as part of teams on multi disciplinary projects.

Expected outcomes:
- Students will able to apply method of calculus of variations to specific systems, demonstrate ability to manipulate matrices and compute eigenvalues and eigenvectors, Identify and classify zeros, singular points, residues and their applications.
- Students will demonstrate an ability to identify formulate and solve Telecommunication Engineering problem using applied mathematics.
- Students who can participate and succeed in competitive exams like GATE, GRE.

Module No.	Unit No.	Topics	Hrs.
1. 0		**Calculus of variation**	**10**
	1.1	Euler Langrange equation, solution of Euler's Langrange equation (only results for different cases for function) independent of a variable, independent of another variable, independent of differentiation of a variable and independent of both variables	
	1.2	Isoperimetric problems, several dependent variables	
	1.3	**Functions involving higher order derivatives:** Rayleigh-Ritz method	
2.0		**Linear algebra: vector spaces**	**12**
	2.1	**Vectors in n-dimensional vector space**: Properties, dot product, cross product, norm and distance properties in n-dimensional vector space.	
	2.2	Metric spaces, vector spaces over real field, properties of vector spaces over real field, subspaces.	
	2.3	Norms and normed vector spaces	
	2.4	Inner products and inner product spaces	
	2.5	The Cauchy-Schwarz inequality, orthogonal Subspaces, Gram-Schmidt process	
3.0		**Linear Algebra: Matrix Theory**	**15**
	3.1	Characteristic equation, Eigenvalues and Eigenvectors, properties of Eigenvalues and Eigenvectors	
	3.2	Cayley-Hamilton theorem, examples based on verification of Cayley-Hamilton theorem	
	3.3	Similarity of matrices, Diagonalisation of matrix	
	3.4	Functions of square matrix, derogatory and non-derogatory matrices	
	3.5	Quadratic forms over real field, reduction of quadratic form to a diagonal canonical form, rank, index, signature of quadratic form, Sylvester's law of inertia, value-class of a quadratic form of definite, semi-definite and indefinite	
	3.6	Singular Value Decomposition	
4.0		**Complex variables: Integration**	**15**
	4.1	**Complex Integration:** Line Integral, Cauchy's Integral theorem for simply connected regions, Cauchy's Integral formula	
	4.2	Taylor's and Laurent's series	
	4.3	Zeros, singularities, poles of f(z), residues, Cauchy's Residue theorem	
	4.4	Applications of Residue theorem to evaluate real Integrals of different types	
		Total	**52**

Text books:

1) A Text Book of Applied Mathematics Vol. I & II by P.N.Wartilar & J.N.Wartikar, Pune, Vidyarthi Griha Prakashan., Pune
2) Mathematical Methods in science and Engineering, A Datta (2012)
3) Higher Engg. Mathematics by Dr. B.S. Grewal, Khanna Publication

Reference Books:

1) Todd K.Moon and Wynn C. Stirling, Mathematical Methods and algorithms for Signal Processing, Pearson Education.
2) Kreyszig E., Advanced Engineering Mathematics, 9th edition, John Wiley, 2006.
3) Linear Algebra- Hoffman & Kunze (Indian editions) 2002
4) Linear Algebra- Anton & Torres (2012) 9th Indian Edition.
5) Complex Analysis – Schaum Series.

Internal Assessment (IA):

Two tests must be conducted which should cover at least 80% of syllabus. The average marks of both the tests will be considered for final Internal Assessment.

End Semester Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3: Question No.1 will be compulsory and based on entire syllabus.
4: Remaining question (Q.2 to Q.6) will be selected from all the modules.

Term Work/Tutorial:

At least 08 assignments covering entire syllabus must be given during the **Class Wise Tutorial**. The assignments 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 graded from time to time. The grades will 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.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW	Tutorial	Total
ETC 402	Analog Electronics II	4	--	--	4	--	--	04

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical and Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test 2	Avg. Of Test 1 and Test 2					
ETC 402	Analog Electronics II	20	20	20	80	-	-	--	100

Course Pre-requisite:

ETC : 302 – Analog Electronics I

Course Objective:

- To deliver the core concepts and reinforce the analytical skills learned in Analog Electronics I
- To motivate students to use MOS devices for designing and analyzing electronic Circuits which will help them to understand the fundamentals of VLSI design.

Expected Outcomes:

After completion of the course students will be able to

- Analyze and design multistage electronic Circuits.
- Differentiate between discrete and integrated biasing techniques.
- Differentiate between small signal and large signal Amplifiers.

Module No.	Unit No.	Topics	Hrs.
1.0		**Frequency Response of Amplifiers**	**14**
	1.1	**High Frequency Model:** High frequency hybrid-pi equivalent Circuits of BJT and MOSFET, Miller effect and Miller capacitance, gain bandwidth product	
	1.1	**Single Stage Amplifiers :** Effect of capacitors (coupling, bypass, load) on frequency response of single stage BJT (CE, CC,CB configurations) , MOSFET (CS,CG, CD configuration) amplifiers, low and high frequency response of BJT (CE, CB, CC) and MOSFET (CS, CG,CD) amplifiers	
	1.2	**Multistage Amplifier:** Low and high frequency response and mid – frequency analysis of multistage (CE-CE, CS-CS), cascode (CE-CB, CS-CG) Amplifiers, Darlington pair, design of two stage amplifiers	
2.0		**Differential Amplifiers**	**10**
	2.1	**BJT Differential Amplifiers:** Terminology and qualitative description, DC transfer characteristics, small signal analysis, differential and common mode gain, CMRR, differential and common mode input impedance	
	2.2	**MOSFET Differential Amplifiers:** DC transfer characteristics, small signal analysis, differential and common mode gain, CMRR, differential and common mode input impedance	
3.0		**Integrated Circuits Biasing Techniques**	**08**
	3.1	**Current Mirror:** Two transistor (BJT, MOSFET) current source, current relationship, output resistance.	
	3.2	**Improved Current Source:** Three transistor (BJT,MOSFET) current source	
	3.3	**Special Current Source:** Cascode (BJT, MOSFET) current source, Wilson and Widlar current sources	
4.0		**Power Amplifiers**	**8**
	4.1	**Power Devices:** Power BJTs, power MOSFETs, heat sinks	
	4.2	**Classification:** Class A, Class B, Class AB and Class C operation, and performance parameters	
	4.3	**Transformer and Transfomerless Amplifiers**: Transformer coupled Class A Amplifier, Class AB output stage with diode biasing, V_{BE} multiplier biasing, input buffer transistors, Darlington configuration	
5.0		**Fundamentals of Operational Amplifier**	**08**
	5.1	**Fundamentals of Op-amp:** characteristics of op-amp, high frequency effects on op-amp gain and phase, slew rate limitation,	
	5.2	**Applications of Op-amps:** Inverting and non-inverting amplifier, adder, abstractor, integrator, differentiator, active filters (first order low and high pass)	
6.0		**DC Regulated Power Supply**	**04**
	6.1	**Series and Shunt Regulator:** Regulator performance parameters, Zener shunt regulator, transistorized series and shunt regulator	
		Total	**52**

Text Books:

1. Donald A. Neamen, Electronic Circuit Analysis and Design, Tata McGraw Hill, 2nd Edition
2. Adel S. Sedra, Kenneth C. Smith and Arun N Chandorkar, Microelectronic Circuits Theory and Applications, Fifth Edition, International Version, OXFORD International Students Sixth Edition

Recommended Books:

1. S. Salivahanan, N. Suresh Kumar,*"Electronic Devices and Circuits",* Tata McGraw Hill, 3rd Edition
2. Jacob Millman, Christos C Halkias, and Satyabratatajit, *"Millman's Electronic Devices and Circuits",* McGrawHill, 3rd Edition
3. Muhammad H. Rashid, *"Microelectronics Circuits Analysis and Design",* Cengage Learning, 2nd Edition
4. Jacob Milliman and Arvin Grabel, " Microelectronics" Tata McGrawHill, 2nd Edition
5. Anil K. Maini and Varsha Agrawal*, "Electronic Devices and Circuits",* Wiley Publications

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

End Semester Examination:
1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3: Question No.1 will be compulsory and based on entire syllabus.
4: Remaining question (Q.2 to Q.6) will be selected from all the modules.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ETC 403	Microprocessors and Peripherals	4	--	--	4	--	--	04

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical and Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test 2	Avg. Of Test 1 and Test 2					
ETC403	Microprocessor and Peripherals	20	20	20	80	-	-	-	100

Course pre-requisite:

ETC 303 : Digital Electronics

Course objectives:

- To develop background knowledge and core expertise in microprocessor.
- To study the concepts and basic architecture of 8085, 8086, 80286, 80386, 80486 Pentium processor and Co-processor 8087.
- To know the importance of different peripheral devices and their interfacing to 8086.
- To know the design aspects of basic microprocessor.
- To write assembly language programs in microprocessor for various applications.

Course outcomes:

Students will learn

- The architecture and software aspects of microprocessor 8086
- Assembly language program in 8086 for various applications.
- Co-processor configurations.
- Various interfacing techniques with 8086 for various applications.
- Basic concepts of advanced microprocessors.

Module No.	Unit No.	Topics	Hrs.
1.0		**Architecture of 8085 and 8086 Microprocessor**	**08**
	1.1	8085 Architecture and pin configuration.	
	1.2	8086 Architecture and organization, pin configuration.	
	1.3	Minimum and Maximum modes of 8086.	
	1.4	Read and Write bus cycle of 8086.	
2.0		**Instruction set and programming of 8086**	**10**
	2.1	8086 Addressing modes.	
	2.2	8086 Instruction encoding formats and instruction set.	
	2.3	Assembler directives.	
	2.4	8086 programming and debugging of assembly language program.	
3.0		**Peripherals interfacing with 8086 and applications.**	**10**
	3.1	8086-Interrupt structure.	
	3.2	Programmable interrupt controller 8259A.	
	3.3	Programmable peripheral Interface 8255.	
	3.4	Programmable interval Timer 8254.	
	3.5	DMA controller 8257	
	3.6	Interfacing 8259A, 8255, 8254, 8257 with 8086 and their applications	
4.0		**ADC, DAC interfacing with 8086 and its application**	**08**
	4.1	Analog to Digital Converter (ADC) 0809	
	4.2	Digital to Analog Convertor (DAC) 0808	
	4.3	Interfacing ADC 0809, DAC 0808 with 8086 and their applications.	
	4.4	8086 based data Acquisition system.	
5.0		**8086 Microprocessor interfacing**	**10**
	5.1	8087 Math coprocessor, its data types and interfacing with 8086.	
	5.2	Memory interfacing with 8086 microprocessor	
6.0		**Advanced Microprocessors**	**06**
	6.1	Basic architectures of 80286, 80386, 80486 and Pentium processor.	
		Total	**52**

Text Books:

1. Gaonkar R.S.: “Microprocessor Architecture Programming and Applications with the 8085” Penram International Pub, 5th Edition.
2. John Uffenbeck: “8086/8088 family: “Design, Programming and Interfacing”, Prentice Hall, 2nd Edition
3. B. B. Brey: “The Intel Microprocessors 8086/8088, 80186/80188, 80286, 80386, 80486, Pentium and Pentium Pro Processor”, Pearson Pub, 8th Edition

Reference Books:

1. Hall D.V: “Microprocessor and Interfacing Programming and Hardware”, Tata McGraw Hill, 2nd Edition.
2. A. K. Ray and K. M. Burchandi: “Advanced Microprocessor and Peripherals, Architecture Programming and Interfacing”, Tata McGrawHill, 3rd Edition
3. Don Anderson, Tom Shanley: “Pentium Processor System Architecture”, MindShare Inc., 2nd Edition
4. National Semiconductor: Data Acquisition Linear Devices Data Book
5. Intel Peripheral Devices: Data Book.

Internal Assessment (IA):

Two tests must be conducted which should cover at least 80% of syllabus. The average marks of both the test will be considered for final Internal Assessment.

End Semester Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3: Question No.1 will be compulsory and based on entire syllabus.
4: Remaining question (Q.2 to Q.6) will be selected from all the modules.

Subject Code	Subject Name	Teaching Scheme (Hrs)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ETC 404	Wave Theory and Propagation	4	--	--	4	--	-	04

Subject Code	Subject 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					
ETC 404	Wave Theory and Propagation	20	20	20	80	--	-	-	100

Course Pre-requisite
Vector Algebra, Vector Integral

Course Objective:

- To understand basic laws of electrostatics and magnetostatics in vector form.
- To understand the propagation of wave in different media like dielectric and conducting media by solving wave equation and find parameters of media.
- To calculate energy transported by means of electromagnetic waves from one point to another and to study polarization of waves.
- To solve electromagnetic problems using different numerical methods.
- To extend the students' understanding about the propagation of the waves by different types such as ground waves and space waves.
- To study the factors affecting the wave during its propagation.
- To understand sky wave propagation; related parameters such as MUF, skip distance and critical frequency.

Expected Outcomes:

- Ability to find nature of electric or magnetic field produced due to different charge distributions.
- Ability to understand working of different equipments based on electromagnetic used in day to day life.
- Knowledge of behavior of EM waves and travelling of waves in free space as well as media.
- Able to find conditions for loss of signal.
- Able to apply numerical methods for designing antennas.
- An ability to select proper parameters for propagation of the waves by considering the factors affecting.
- Any ability to identify and solve problems related to the propagation of waves.
- To understand the basics of wave propagation required for the study of antennas.

Module No.	Unit No.	Topics	Hrs.
1.0		**Basic Laws of electromagnetic & Maxwell's equations**	**13**
	1.1	**Fundamental laws of electromagnetic fields:** Coulomb's law, Gauss's law, Bio-Savart's law, Ampere's law, Poisson's and Laplace equations	
	1.2	**Boundary conditions:** Static electric and magnetic fields	
	1.3	**Maxwell's equations:** Integral and differential form for static and time varying fields and its interpretations	
	1.4	**Applications of electromagnetic fields:** Ink-jet printer, CRO, electromagnetic pump	
2.0		**Uniform plane wave equation and power balance**	**08**
	2.1	**Wave equation:** Derivation and its solution in Cartesian co-ordinates	
	2.2	**Solution of wave equations:** Partially conducting media, perfect dielectrics and good conductors, concept of skin dept	
	2.3	**Electromagnetic Power:** Poynting Vector and Power Flow in free space and in dielectric, conducting media	
3.0		**Plane Wave Propagation**	**06**
	3.1	**Polarization of wave;** Elliptical. Linear and Circular	
	3.2	**Propagation in different mediums:** Behavior of waves for normal and oblique incidence in dielectrics and conducting media, propagation in dispersive media	
4.0		**Computational Electromagnetics**	**08**
	4.1	**Finite Difference Method (FDM):**Neumann type and mixed boundary conditions, Iterative solution of finite difference equations, solutions using band matrix method	
	4.2	**Finite Element Method (FEM**): Triangular mesh configuration, Finite element discretization, Element governing equations, Assembling all equations and solving resulting equations	
	4.3	**Method of Moment (MOM):**Field calculations of conducting wire, parallel conducting wires and complicated geometries	
5.0		**Radio Wave Propagation**	**10**
	5.1	**Types of wave propagation:** Ground, space and surface wave propagation, tilt and surface waves, impact of imperfect earth and earth's behavior at different frequencies	
	5.2	**Space wave propagation:** Effect of imperfection of earth, curvature of earth, effect of interference zone, shadowing effect of hills and building, atmospheric absorption, Super-refraction, scattering phenomena, troposphere propagation and fading	
6.0		**Sky Wave Propagation**	**07**
	6.1	**Reflection and Refraction of waves**: Ionosphere and Earth magnetic field effect	
	6.2	**Measures of Ionosphere Propagation:** Critical frequency, Angle of incidence, Maximum unstable frequency, Skip distance, Virtual height, Variations in ionosphere and Attenuation and fading of waves in ionosphere	
		Total	**52**

Text Books:

1. J.A. Administer, *"Electromagnetic"*, McGraw Hill Companies, 2nd Edition, 2006
2. Bhag Guru and Huseyin Hiziroglu, *"Electromagnetic field theory fundamentals",* Cambridge University Press, 2nd Edition, 2010.
3. J.D. Kraus, R.J. Marhefka, A.S. Khan *"Antennas & Wave Propagation",* McGraw Hill Publications, 4th Edition, 2011

Reference Books

1. R.K. Shevgaonkar, Electromagnetic Waves, TATA McGraw Hill Companies, 3rd Edition, 2009
2. R.L. Yadava, Antenna & Wave Propagation, PHI Publications, 1st Edition, 2011
3. Edward C. Jordan, Keth G. Balmin, Electromagnetic Waves & Radiating Systems, Pearson Publications, 2nd Edition, 2006
4. Matthew N.D. SADIKU, Principles of Electromagnetics, Oxford International Student 4th Edition, 2007
5. W.H. Hayt, J.A. Buck, Engineering Electromagnetics, McGraw Hill Publications, 7th Edition, 2006.

Internal Assessment (IA):
Two tests must be conducted which should cover at least 80% of syllabus. The average marks of both the test will be considered for final Internal Assessment.

End Semester Examination:
1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3: Question No.1 will be compulsory and based on entire syllabus.
4: Remaining question (Q.2 to Q.6) will be selected from all the modules.

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ETC 405	Signals and Systems	04	--	01	04	--	01	05

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical And Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test 2	Avg. Of Test 1 and Test 2					
ETC 405	Signals and Systems	20	20	20	80	25	--	--	125

Course pre-requisite :

ETS : 301 - Applied Mathematics III
ETC : 304 - Circuits and Transmission Lines

Course objectives:

- To introduce students to the idea of signal and system analysis and characterization in time and frequency domain.
- To provide foundation of signal and system concepts to areas like communication, control and comprehend applications of signal processing in communication systems.

Course outcomes:

- Students will be able to understand significance of signals and systems in the time and frequency domains
- Students will be able to interpret and analyze signal and report results.
- Students will be able to evaluate the time and frequency response of continuous and discrete time, system which is useful in understanding behavior of Electronics circuits and communication systems.

“

Module No.	Unit No.	Topics	Hrs.
1.0		**Overview of signals and systems**	**06**
	1.1	**Introduction:** Signals, systems, examples of systems for controls and communication, sampling theorem, sampling of continuous time signals, elementary signals, exponential, sine, step, impulse, ramp, rectangular, triangular and operations on signals	
	1.2	**Classification of signals:** Continuous and discrete time, deterministic and non deterministic, periodic and aperiodic, symmetric (even) and asymmetric (odd), energy and power, causal and anti-causal signals.	
2.0		**Time domain analysis of Continuous Time and Discrete Time systems**	**12**
	2.1	**Classification of systems:** Static and dynamic, time variant and time invariant, linear and nonlinear, causal and noncausal, stable and unstable systems.	
	2.2	**Linear Time Invariant (LTI) systems:** Representation of systems using differential /difference equation, Impulse, step and exponential response, system stability, examples on applications of LTI systems, convolution, impulse response of interconnected systems, auto-correlation, cross correlation, properties of correlation, analogy between correlation and convolution, total response of a system	
3.0		**Laplace Transform**	**06**
3.0	**3.1**	**Overview of Laplace Transform:** Laplace Transform and properties, relation between continuous time Fourier Transform and Laplace Transform, unilateral Laplace Transform.	
	3.2	**Analysis of continuous time LTI systems using Laplace Transform:** Transfer Function, causality and stability of systems, solution of differential equation using Laplace Transform.	
4.0		***z* – Transform**	**08**
	4.1	z-Transform of finite and infinite duration sequences, relation between discrete time Fourier Transform and z-Transform, properties, Inverse *z*-Transform, one sided *z*–Transform.	
	4.2	**Analysis of discrete time LTI systems using z-Transform**: Transfer Function, causality and stability of systems, frequency response, relation between Laplace Transform and *z*–Transform.	
5.0		**Fourier series of continuous and discrete time signals**	**10**
	5.1	**Review of Fourier series:** trigonometric and exponential Fourier series representation of signals, magnitude and phase spectra, power spectral density and bandwidth. Gibbs phenomenon.	
	5.2	**Properties of Fourier Series:** Linearity, time shifting, time reversal, frequency shifting, time scaling, differentiation, symmetry. Parsevel's relation. Examples based on properties, analogy between Continuous Time Fourier Series (CTFS) and Discrete Time Fourier Series (DTFS).	
6.0		**Continuous Time Fourier Transform (CTFT) and Discrete Time Fourier Transform (DTFT)**	**10**
	6.1	**Fourier Transform:** Fourier Transform and Inverse Fourier Transform on periodic and non-periodic signals, limitations of Fourier Transform and need for Laplace and *z*-Transform	
	6.2	**Properties of Fourier Transform:** Linearity, time shifting, time reversal, frequency shifting, time and frequency scaling, modulation, convolution in time domain, differentiation in time domain, differentiation in frequency domain, symmetry. Parsevel's relation. Energy, power spectral density and bandwidth. Definition and problems on DTFT	
		Total	**52**

Text books

1. Nagoor Kani, Signals and Systems, Tata McGraw Hill, Third Edition, 2011.
2. B.P. Lathi, Principles of Linear Systems and Signals, Oxford, Second Edition, 2010.
3. Simon Haykin and Barry Van Veen, Signals and Sytems, John Wiley and Sons, Second Edition, 2004.

Reference books

1) Hwei. P Hsu, Signals and Systems, Tata McGraw Hill, Third edition, 2010
2) V. Krishnaveni and A.Rajeshwari, Signals and Systems, Wiley-India, First Edition 2012.
3) Narayana Iyer, Signals and Systems, Cenage Learning, First Edition 2011.
4) Michael J Roberts, Fundamentals of Signals and systems, Tata McGraw Hill, special Indian Economy edition, 2009.
5) Rodger E Ziemer, William H. Tranter and D. Ronald Fannin, Signals and Systems, Pearson Education, Fourth Edition 2009.
6) Alan V. Oppenhiem, Alan S. Willsky and S. Hamid Nawab, Signals and Systems, Prentice-Hall of India, Second Edition, 2002.

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

End Semester Examination:
1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3: Question No.1 will be compulsory and based on entire syllabus.
4: Remaining question (Q.2 to Q.6) will be selected from all the modules.

Term Work:
At least 08 assignments covering entire syllabus must be given during the "**Class Wise Tutorial"**. The assignments 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 graded from time to time. The grades will 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.

Subject Code	Subject Name	Teaching Scheme Hrs.			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ETC 405	Control Systems	04	-	--	04	--	--	04

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical And Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test 2	Avg. Of Test 1 and Test 2					
ETC 405	Control Systems	20	20	20	80	--	--	--	100

Course pre-requisite*:*
Dynamics; Differential Educations; Laplace Transforms.

Course objectives:
Objectives of this course are:

- To teach the fundamental concepts of Control systems and mathematical modeling of the system.
- To study the concept of time response and frequency response of the system.
- To teach the basics of stability analysis of the system

Course outcomes:
The outcomes of this course are**:**

- Students will be able to derive the mathematical model of different type of the systems.
- Students will understand the basic concepts of control system.
- Students will understand the analysis of systems in time and frequency domain.
- Students will be able to apply the control theory to design the conventional controllers widely used in the industries.

Module No.	Unit No.	Topics	Hrs.
1.0		**Introduction to Control System Analysis**	**08**
	1.1	**Introduction:** Open loop and closed loop systems, feedback and feed forward control structure, examples of control systems.	
	1.2	**Modeling:** Types of models, impulse response model, state variable model, transfer function model	
	1.3	**Dynamic Response:** Standard test signals, transient and steady state behavior of first and second order systems, steady state errors in feedback control systems and their types	
2.0		**Mathematical Modeling of Systems**	**08**
	2.1	**Transfer Function models of various systems:** Models of mechanical systems, models of electrical systems, block diagram reduction, signal flow graph, and the Mason's gain rule	
3.0		**State Variable Models**	**12**
	3.1	**State Variable Models of Various Systems:** State variable models of mechanical systems, state variable models of electrical systems	
	3.2	**State Transition Equation:** Concept of state transition matrix, properties of state transition matrix, solution of homogeneous systems, solution of non-homogeneous systems	
	3.3	**Controllability and Observability:** Concept of controllability, controllability analysis of LTI systems, concept of observability, observability analysis of LTI systems	
4.0		**Stability Analysis In Time Domain**	**08**
	4.1	**Concepts of Stability:** Concept of absolute, relative and robust stability, routh stability criterion	
	4.2	**Root Locus Analysis:** Root-locus concepts, general rules for constructing root-locus, root-locus analysis of control systems, design of lag and lead compensators	
5.0		**Stability Analysis In Frequency Domain**	**08**
	5.1	**Introduction**: Frequency domain specifications, response peak and peak resonating frequency, relationship between time and frequency domain specification of system, stability margins	
	5.2	**Bode plot:** Magnitude and phase plot; Method of plotting Bode plot; Stability margins on the Bode plots; Stability analysis using Bode plot.	
	5.3	**Nyquist Criterion:** Polar plots, Nyquist stability criterions; Nyquist plot; Gain and phase margins.	
6.0		**Optimal and Adaptive Control Systems**	**08**
	6.1	**Optimal control:** Performance measure for optimal control problems, the principle of optimality, concept of dynamic programming, fundamental of a single Function, Functions involving several independent Functions, constrained minimization of Functions	
	6.2	**Adaptive Control Systems:** Model reference adaptive control approach for controller design, Neuro-Fuzzy adaptive control (only concept)	
		Total	**52**

Text books:

1. Nagrath, M.Gopal, *"Control System Engineering"*, Tata McGraw Hill.
2. K.Ogata, *"Modern Control Engineering, Pearson Education",* III[rd] edition.
3. Benjamin C.Kuo, *"Automatic Control Systems, Eearson education"*, VII[th] edition.

Reference Books:

1. Madam Gopal, Control Systems Principles and Design, Tata McGraw hill, 7th edition,1997.
2. Normon, Control System Engineering, John Wiley & sons, 3rd edition.
3. Curtis Johnson, Process Control Instrumentation Technology, Pearson education fourth edition.
4. Dhanesh N. Manik, *"Control Systems"*, Cengage Learning, 1[st] edition, 2012.
5. Sastry S. S., *"Adaptive Control"*, PHI.

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

End Semester Examination:
1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3: Question No.1 will be compulsory and based on entire syllabus.
4: Remaining question (Q.2 to Q.6) will be selected from all the modules.

Subject Code	Subject Name	Teaching Scheme (Hrs)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW	Tutorial	Total
ETL 401	Analog Electronics II Laboratory	--	02	--	--	01	--	01

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical And Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test 2	Avg. Of Test 1 and Test 2					
ETL 401	Analog Electronics II Laboratory	--	--	--	--	25	25	--	50

Term Work:
At least **10** experiments covering entire syllabus should be set to have well predefined inference and conclusion. Computation/simulation based experiments are also encouraged. The experiments should be students' centric and attempt should be made to make experiments more meaningful, interesting and innovative.

Term work assessment must be based on the overall performance of the student with every experiment graded from time to time. The grades converted into marks as per **Credit and Grading** System manual should be added and averaged. Based on this final term work grading and term work assessment should be done.

The Practical and Oral examination will be based on entire syllabus.

Subject Code	Subject Name	Teaching Scheme (Hrs)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ETL402	Microprocessors and Peripherals Laboratory	--	02	--	--	01	--	1

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical and Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test 2	Avg. Of Test 1 and Test 2					
ETL402	Microprocessors and Peripherals Laboratory	--	--	--	--	25	25	--	50

Term Work:
At least **10** experiments covering entire syllabus should be set to have well predefined inference and conclusion. Computation/simulation based experiments are also encouraged. The experiments should be students' centric and attempt should be made to make experiments more meaningful, interesting and innovative.

Term work assessment must be based on the overall performance of the student with every experiment graded from time to time. The grades will be converted to marks as per '**credit and grading'** System manual and should be added and averaged. Based on the above scheme grading and term work assessment should be done.

The Practical and Oral examination will be based on entire syllabus.

Subject Code	Subject Name	Teaching Scheme (Hrs)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ETL 403	Software Simulation Laboratory	--	02	--	--	01	--	01

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical And Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test 2	Avg. Of Test 1 and Test 2					
ETL 403	Software Simulation Laboratory	--	--	--	--	25	25	-	50

Objectives

Students will demonstrate

- an ability to design a system and process as per needs/specifications.
- an ability to visualize and work on laboratory and multi disciplinary task.
- skills to use modern Engineering tools, software's and equipments to analyze problems.

Term Work:

At least 10 simulation based experiments from Analog Electronics, Digital Electronics, Circuits and Transmission, Microprocessor, Signals and Systems and Wave Theory and Propagation should be set to have well predefined inference and conclusion. The experiments should be students centric and attempt should be made to make experiments more meaningful, interesting and innovative.

Term work assessment must be based on the overall performance of the student with every experiment graded from time to time. The grades converted into marks as per Credit and Grading System manual should be added and averaged. Based on this final term work grading and term work assessment should be done. It is advisable to use required application software for simulation based experiments. Use of open source software should be encouraged.

Practical and oral examination will be based on simulation experiments.

AC 7/6/2014

Item No. 4.21

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 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
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	
3		**Fundamental Concept of Digital Video**	
	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.

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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.

UNIVERSITY OF MUMBAI

Bachelor of Engineering
Electronics and Telecommunication Engineering

Final Year Engineering
(Sem. VII and VIII), Revised course
(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.

The institution or program of study is committed and open to external review to meet certain minimum specified standards. The major emphasis of this process is to measure the outcomes of the program. Program outcomes are essentially a range of skills and knowledge that a student will have at the time of graduation.

So 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 of University of Mumbai has taken a lead in incorporating philosophy of outcome based education in the process of curriculum development.

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

1. 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.
2. To prepare students to demonstrate an ability to identify, formulate and solve electronics and telecommunication engineering problems.
3. To prepare students to demonstrate ability to design electrical and electronics systems and conduct experiments, analyze and interpret data.
4. To prepare students to demonstrate for successful career in industry to meet needs of Indian and multi-national companies.
5. To develop the ability among students to synthesize data and technical concepts from applications to product design.
6. To provide opportunity for students to work as part of teams on multidisciplinary projects.
7. 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.

The subjects offered to undergraduate students in final year are at par to the requirement of industry. The students are also made competent to appear for various competitive examination conducted in India and abroad. The subjects offered are at enough level to prepare a base of the students to understand and learn latest state of technology. The students are trained in such a way that they become versatile in hardware and software simulation. Some subjects offered upgrades them in the field of information and technology which is a need of today's' era.

At the end I must outset extend my gratitude to all 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 VII

Course Code	Course Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ETC701	Image and Video Processing	04	--	--	04	--	--	04
ETC702	Mobile Communication	04	--	--	04	--	--	04
ETC703	Optical Communication and Networks	04	--	-	04	--	-	04
ETC704	Microwave and Radar Engineering	04	--	--	04	--	--	04
ETE70X	Elective	04	--	--	04	--	--	04
ETL701	Image and Video Processing Laboratory	--	02	--	--	01	--	01
ETL702	Advanced communication Engineering. Laboratory I	--	02	--	--	01	--	01
ETL703	Advanced communication Engineering. Laboratory II	--	02	--	--	01	--	01
ETEL70X	Elective	--	02	--	--	01	--	01
ETP701	Project (Stage I)	--	*	--	--	03	--	03
Total		**20**	**08**	**--**	**20**	**07**	**--**	**27**

Course Code (ETE70X)	Sem. VII Elective
ETE 701	Data Compression and Encryption
ETE 702	Statistical Signal Processing
ETE 703	Neural Network and Fuzzy Logic
ETE 704	Analog and Mixed Signal VLSI

- **Work load of learner in Semester VII is equivalent to 6 hours /week**

Semester VII

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 & Test 2				
ETC701	Image and Video Processing	20	20	20	80	--	--	100
ETC702	Mobile Communication	20	20	20	80	--	--	100
ETC703	Optical Communication and Networks	20	20	20	80	-	--	100
ETC704	Microwave and Radar Engineering	20	20	20	80	--	--	100
ETE70X	Elective	20	20	20	80	--	--	100
ETL701	Image and Video Processing Laboratory	--	--	--	--	25	25	50
ETL702	Advanced communication Engineering. Laboratory I	--	--	--	--	25	25	50
ETL703	Advanced Communication Engineering. Laboratory II	--	--	--	--	25	25	50
ETEL70X	Elective	--	--	--	--	25	25	50
ETP701	Project (Stage I)					25	25	50
Total		**100**	**100**	**100**	**400**	**125**	**125**	**750**

Semester VIII

Course Code	Course Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ETC801	Wireless Networks	04	--	--	04	--	--	04
ETC802	Satellite communication and Networks	04	--	--	04	--	--	04
ETC803	Internet and Voice Communication	04	--	--	04	--	--	04
ETE80X	Elective	04	--	--	04	--	--	04
ETL801	Wireless Networks Laboratory	--	02	--	--	01		01
ETL802	Satellite communication and Networks Laboratory	--	02	--	--	01		01
ETL803	Internet and Voice Communication Laboratory	--	02	--	--	01		01
ETEL80X	Elective Laboratory	--	02	--	--	01		01
ETP801	Project (Stage II)	--	**	--	--	06		06
Total		**16**	**08**	**--**	**16**	**10**		**26**

Course Code (ETE 80X)	Sem. VIII Elective
ETE 801	Speech Processing
ETE 802	Telecom Network Management
ETE 803	Microwave Integrated Circuits
ETE 804	Ultra Wideband Communication

**** Work load of learner in Semester VIII is equivalent to 12 hours /week.**

Semester VIII

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					
ETC801	Wireless Networks	20	20	20	80	--	--	--	100
ETC802	Satellite communication and Networks	20	20	20	80	--	--	--	100
ETC803	Internet and Voice Communication	20	20	20	80	--	--	--	100
ETE80X	Elective	20	20	20	80	--	--	--	100
ETL801	Wireless Networks Laboratory	--	--	--	--	25	--	25	50
ETL802	Satellite communication and Networks Laboratory	--	--	--	--	25	--	25	50
ETL803	Internet and Voice Communication Laboratory	--	--	--	--	25	--	25	50
ETEL80X	Elective Laboratory	--	--	--	--	25	--	25	50
ETP801	Project (Stage II)	--	--	--	--	50	--	50	100
Total		**80**	**80**	**80**	**320**	**150**		**150**	**700**

Course Code	Course Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ETC701	Image and Video 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					
ETC701	Image and Video Processing	20	20	20	80	-	-	-	100

Course pre-requisite:

- ETC 405: Signals and Systems
- ETC 602: Discrete Time Signal Processing

Course Objectives:

- To cover the fundamentals and mathematical models in digital image and video processing.
- To develop time and frequency domain techniques for image enhancement.
- To expose the students to current technologies and issues in image and video processing.
- To develop image and video processing applications in practice.

Course outcomes: Students will be able to

- Understand theory and models in Image and Video Processing.
- Interpret and analyze 2D signals in frequency domain through image transforms.
- Apply quantitative models of image and video processing for various engineering applications.
- Develop innovative design for practical applications in various fields.

Module No.		Topics	Hrs.
1		**Image Fundamentals**	04
	1.1	Image acquisition, sampling and quantization, image resolution, basic relationship between pixels, color images, RGB, HSI and other models	
2		**Two Dimensional Transforms**	06
	2.1	Discrete Fourier Transform, Discrete Cosine Transform, KL Transform, and Discrete Wavelet Transform	
3		**Image Enhancement**	
	3.1	**Spatial Domain** **Point Processing:** Digital Negative, contrast stretching, thresholding, gray level slicing, bit plane slicing, log transform and power law transform. **Neighborhood Processing**: Averaging filters, order statistics filters, high pass filters and high boost filters	08
	3.2	**Frequency Domain:** DFT for filtering, Ideal, Gaussian and Butterworth filters for smoothening and sharpening, and Homomorphic filters	
	3.3	**Histogram Modeling:** Histogram equalization and histogram specification	
4		**Image Segmentation and Morphology**	07
	4.1	Point, line and edge detection, edge linking using Hough transform and graph theoretic approach, thresholding, and region based segmentation.	
	4.2	Dilation, erosion, opening, closing, hit or miss transform, thinning and thickening, and boundary extraction on binary images	
5		**Image Restoration:**	07
	5.1	Degradation model, noise models, estimation of degradation function by modeling, restoration using Weiner filters and Inverse filters	
6		**Video Formation, Perception and Representation**	08
	6.1	Digital Video Sampling, Video Frame classifications, I, P and B frames, Notation, ITU-RBT 601Digital Video formats, Digital video quality measure.	
	6.2	**Video Capture and display:** Principle of colour video camera, video camera, digital video	
	6.3	**Sampling of video Signals:** Required sampling rates, sampling in two dimensions and three dimensions, progressive virus interlaced scans	
7		**Two Dimensional Motion Estimation**	12
	7.1	**Optical Flow:** 2-D motion Vs optical flow, optical flow equations, motion representation, motion estimation criteria, optimization method.	
	7.2	**Pixel based motion estimation:** Regularization using motion smoothing constraints, using multipoint neighborhood.	
	7.3	**Block Matching Algorithms:** Exhaustive block matching algorithms, phase correlation method, Binary feature matching.	
	7.4	**Multi resolution Motion Estimation:** General formulation, Hierarchical blocks matching Algorithms.	
Total			**52**

Recommended Books:

1. Gonzales and Woods, "*Digital Image Processing*", Pearson Education, India, Third Edition,
2. Anil K.Jain, "*Fundamentals of Image Processing*", Prentice Hall of India, First Edition, 1989.
3. Murat Tekalp, "*Digital Video Processing*", Pearson, 2010.
4. John W. Woods, "*Multidimensional Signal, Image and Video Processing*", Academic Press 2012
5. J.R.Ohm , "*Multimedia Communication Technology*", Springer Publication.
6. A.I.Bovik, "*Handbook on Image and Video Processing*", Academic Press.

Internal Assessment (IA):
Two tests must be conducted which should cover at least 80% of syllabus. The average marks of both the test will be considered for final internal assessment.

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 of 2 to 5 marks will be asked.
4. Remaining question will be selected from all the modules.

Course Code	Course Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ETC702	Mobile 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					
ETC702	Mobile communication	20	20	20	80	-	-	-	100

Prerequisites:

- ETC 601 Digital Communication
- ETC 603 Computer Communication and Networks

Course Objective:

- To study the concept of Mobile radio propagation, cellular system design.
- To understand mobile technologies like GSM and CDMA.
- To know the mobile communication evolution of 2G, 3G and 3 GPP in detail.
- To have overview of immerging technologies for 4 G standards.

Course Outcomes: Students will be able to:

- Understand GSM, CDMA concepts and architecture, frame structure, system capacity, services provided.
- Study of evolution of mobile communication generations 2G, 2.5G, 3G with their characteristics and limitations.
- Understand emerging technologies required for fourth generation mobile systems such as SDR, MIMO etc.
- Understand different indoor and outdoor propagation models related to losses and different types of fading.

Module No.		Topics	Hrs.
1. 0		**Fundamentals of Mobile Communication**	10
	1.1	Introduction to wire1ess communication	
	1.2	Frequency Division Multiple access, Time Division Multiple access, Spread Spectrum Multiple access, Space Division Multiple access, and OFDM	
	1.3	Frequency reuse, channel assignment strategies, handoff strategies, interference and system capacity, trunking and grade of service, improving the capacity of cellular systems. and related design problems	
2.0		**2G Technologies**	13
	2.1	GSM Network architecture, signaling protocol architecture, identifiers, channels, introduction frame structure, speech coder RPE-LTP, authentication and security, call procedure, handoff procedure, services and features	
	2.2	**GSM evolution in GPRS and EDGE:** Architecture and services offered	
	2.3	**IS-95 A& B(CDMA-1):** Frequency and channel specifications of forward and reverse CDMA channel, packet and frame formats, mobility and radio resource management	
3.0		**3G Technology**	09
	3.1	**IMT-2000/UMTS:** Network architecture, air Interface specification, forward and reverse channels in W-CDMA and CDMA 2000, spreading and modulation.	
	3.2	Cell search and synchronization, establishing a connection, hand off and power control in 3G system	
4.0		**3GPP LTE**	08
	4.1	Introduction and system overview	
	4.2	Frequency bands and spectrum ,network structure, and protocol structure	
	4.3	Frame slots and symbols, modulation, coding, multiple antenna techniques	
	4.4	**Logical and Physical Channels:** Mapping of data on to logical sub-channels physical layer procedures, establishing a connection, retransmission and reliability, power control.	
5.0		**Emerging Technologies for 4G**	06
	5.1	4G Introduction and vision	
	5.2	Multi antenna Technologies: MIMO; software defined radio	
	5.3	Adaptive multiple antenna techniques, radio resource management, QOS requirements	
	5.4	Overview of 4G research initiatives and developments.	
6.0		**Mobile Radio Propagation**	06
	6.1	Study of indoor and outdoor propagation models	
	6.2	Small scale fading and multi-path Small-scale multi-path propagation, parameter of multi-path channels, types of small scale fading, Raleigh and Ricean distribution,	
Total			**52**

Recommended Books:

1. Theodore S. Rappaport , "*Wireless Communications*", Prentice Hall of India, PTR publication
2. Andreas Molisch , "*Wireless Communications*", Wiley, Student second Edition.
3. Vijay Garg , "*Wireless Network Evolution 2G-3G*", Pearson Education.
4. Young Kyun Kim and Ramjee Prasad, "*4 G Roadmap and Emerging Communication Technologies* ", Artech house.:
5. Raj Pandya , "*Mobile And Personal Communications Systems And Services*", Prentice hall.
6. Singhal , "*Wireless Communication*", TMH
7. C.Y Lee , "Mobile Communication", Wiley

Internal Assessment (IA):
Two tests must be conducted which should cover at least 80% of syllabus. The average marks of both the test will 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 of 2 to 5 marks will be asked.
4. Remaining question will be selected from all the modules.

Course Code	Course Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ETC703	Optical Communication and 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					
ETC703	Optical Communication and Networks	20	20	20	80	-	-	-	100

Pre requisites:

- ETC404 Wave Theory and Propagation
- ETC502 Analog Communication
- ETC601 Digital Communication.

Course Objective: To teach students

- Optical fiber structures wave guide, fabrication and signal degradation in fiber.
- The characteristics of optical sources and detectors.
- Link budged and optical networks, design and management.
- Study the multiplexing schemes.

Course Outcome: This course enables the students to:

- Apply the fundamental principles of optics and light wave to design optical fiber communication systems.
- Identify structures, functions, materials, and working principle of optical fibers, light sources, couplers, detectors, and multiplexers.
- Design optical fiber communication links using appropriate optical fibers, light sources, couplers, detectors, and multiplexers.
- Explore concepts of designing and operating principles of modern optical communication systems and networks.
- Apply the knowledge developed in-class to contemporary optical fiber communication research and industrial areas.

Module No.		Topics	Hrs.
1.		**Optical Fiber Communication Technology**	10
	1.1	Block diagram**,** advantages**,** loss and bandwidth window**,** ray theory transmission, total internal reflection, acceptance angle, numerical aperture, and skew rays	
	1.2	EM waves, modes in planer guide, phase and group velocities, types of fibers according to refractive index profile and mode transmission.	
	1.3	Fiber material, fiber cables and fiber fabrication, fiber joints, fiber connectors, splices.	
2		**Transmission Characteristic of Optical Fiber**	08
	2.1	Attenuation, absorption, linear and nonlinear scattering losses, bending losses, modal dispersion, waveguide dispersion, dispersion and pulse broadening, dispersion shifted and dispersion flattened fibers, and non linear effects	
	2.2	Measurements of attenuation, dispersion and OTDR	
3		**Optical Communication Systems**	08
	3.1	Working principle and **c**haracteristics of sources (LED, LASER), and optical amplifiers	
	3.2	Working principle and characteristics of detectors (PIN, APD), noise analysis in detectors, coherent and non-coherent detection, receiver structure, bit error rate of optical receivers, and receiver performance.	
	3.3	Point to point links system considerations, link power budget, and rise time budget	
4		**Optical Network System Components and Optical Networks**	10
	4.1	Couplers, isolators, circulators, multiplexers, filters, **f**iber gratings, Fabry Perot filters, **a**rrayed waveguide grating, switches and wavelength converters	
	4.2	SONET and SDH standards, architecture of optical transport networks (OTNs), network topologies, protection schemes in SONET/SDH, and wavelength routed architectures.	
	4.3	Operational principle of WDM, WDM network elements and Architectures, Introduction to DWDM, Solitons.	
5		**Packet Switching and Access Networks**	08
	5.1	OTDM, multiplexing and de-multiplexing, synchronization and broadcast OTDM networks.	
	5.2	Network architecture overview, OTDN networks, optical access networks, and future access networks.	
6		**Network Design and Management**	08
	6.1	Transmission system model, power penalty-transmitter, receiver optical amplifiers, crosstalk, dispersion, wavelength stabilization.	
	6.2	Network management functions, configuration management, performance management, fault management, optical safety, and service interface	
Total			**52**

Recommended Books:

1. John M. Senior, "*Optical Fiber Communication*", Prentice Hall of India Publication, Chicago, 3rd Edition, 2013
2. Gred Keiser, "*Optical Fiber Communication*", Mc-Graw Hill Publication , Singapore, 4th Edition, 2012
3. G Agrwal, "*Fiber optic communication Systems*", John Wiley and Sons, 3rd Edition, New York 2014
4. Rajiv Ramaswami and Kumar N. Sivarajan, "*Optical Networks: A Practical Perespective*", Elsevier Publication Elsevier India Pvt.ltd, 3rd Edition, 2010
5. P.E.Green, "*Optical Networks*", Prentice Hall,1994
6. Biswanath Mukherjee, "*Optical Communication Networks*", McGraw-Hill, 1997.
7. Le Nguyen Binh, "*Optical Fiber Communication System: Theory and Practice with MATLAB and Simulink*", CRC Press, 2010

Internal Assessment (IA):
Two tests must be conducted which should cover at least 80% of syllabus. The average marks of both the test will 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 of 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	Practical	Tutorial	Total
ETC704	Microwave and Radar 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					
ETC704	Microwave and Radar Engineering	20	20	20	80	-	-	-	100

Pre requisite :

- ETC 404 Wave Theory and Propagation
- ETC 504 RF Modeling and Antenna

Course Objective: To teach the students

- Radio-frequency spectrum space, microwave communication.
- Microwave principles, working of microwave devices.
- RADAR and their applications.

Course Outcome: After Completing this course student will be able to

- Analyze the microwave passive circuit components and design the tunning and matching networks.
- Identify the state of art in microwave tubes and semiconductors and their uses in real life.
- Apply the microwave devices and RADAR for industrial and scientific purposes

Module No.		Topics	Hrs.
1.		**Waveguides and Microwave Components**	10
	1.1	Frequency bands and characteristics of microwaves	
	1.2	Rectangular and circular waveguides, mode analysis	
	1.3	Resonators, reentrant cavities, scattering parameters, tees, hybrid ring, directional couplers, phase shifters, terminations attenuators, ferrite devices such as isolators, gyrators, and circulators.	
2		**Impedance Matching and Tuning**	08
	2.1	Lumped element matching	
	2.2	Single stub tuning, double stub tuning, triple stub tuning	
	2.3	Quarter wave transformer	
3		**Generation and Amplification of Microwaves**	10
	3.1	Two Cavity Klystron and Reflex Klystron	
	3.2	Helix Travelling Wave Tube and Backward Wave Oscillator	
	3.3	Cross Field Amplifier, Cylindrical Magnetron, and Gyrotrons	
4		**Semiconductor Microwave Devices** (construction, working, equivalent circuit and performance characteristics)	10
	4.1	Varactor, PIN, Tunnel, Point Contact, Schottky Barrier, Gunn, IMPATT, TRAPATT, and BARITT.	
	4.2	BJT, Hetro junction BJT, MESFET, and HEMT	
	4.3	Parametric Amplifiers	
5		**RADAR**	08
	5.1	Basics of RADAR and RADAR range equation	
	5.2	**Types of RADAR:** Pulsed, Continuous wave and FMCW, Doppler, MTI, and Phased Array	
	5.3	Types of displays and Clutter	
	5.4	**Tracking RADAR**: Monopulse, Conical, Sequentiallobing	
6		**Microwave Applications**	06
	6.1	Microwave heating and bio-medical applications	
	6.2	Remote sensing RADAR, MSTRADAR, radiometer, instrumentation landing system, and RADAR based navigation	
Total			**52**

Recommended Books:

1. David M Pozar, "*Microwave Engineering*", John Wieley & Sons,Inc. Hobokenh,New Jersey, Fourth Edition, 2012.
2. Samuel YLiao, "*Microwave Devices and Circuits*", Pearson Education, Third Edition
3. Merill Skolnik, "*Introduction to RADAR Systems*", TataMcgraw Hill , Third Edition
4. Annapurna Das and Sisir K Das, "*Microwave Engineering*", Tata McGraw Hill,New Delhi, Second Edition, 2009
5. K. T. Matthew, "*Microwave Engineering*", Wieleyindia, ,2011

Internal Assessment (IA):
Two tests must be conducted which should cover at least 80% of syllabus. The average marks of both the test will 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 of 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	Practical	Tutorial	Total
ETE701	Data Compression and Encryption	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					
ETE701	Data Compression and Encryption	20	20	20	80	-	-	-	100

Pre requisite :

- ETC 503 Random Signal Analysis
- ETC 601 Digital Communication
- ETC 603 Computer Communication and Networks

Course Objective: To teach the students

- Lossless and Lossy compression techniques for different types of data.
- Understand data encryption techniques
- Network security and ethical hacking.

Course Outcome : Student will able to

- Implement text, audio and video compression techniques.
- Understand symmetric and asymmetric key cryptography schemes.
- Understand network security and ethical hacking.

Module No.		Topics	Hrs.
1.		**Data Compression**	08
	1.1	**Compression Techniques:** Loss less compression, Lossy compression, measure of performance, modeling and coding, different types of models, and coding techniques	
	1.2	**Text Compression**: Minimum variance Huffman coding, extended Huffman coding, Adaptive Huffman coding. Arithmetic coding, Dictionary coding techniques ,LZ 77, LZ 78, LZW	
2		**Audio Compression**	04
	2.1	High quality digital audio, frequency and temporal masking, lossy sound compression, μ-law and A-law companding, and MP3 audio standard	
3		**Image and Video Compression**	12
	3.1	PCM, DPCM JPEG, JPEG –LS , and JPEG 2000 standards	
	3.2	Intra frame coding, motion estimation and compensation, introduction to MPEG - 2 H-264 encoder and decoder	
4		**Data Security**	12
	4.1	Security goals, cryptography, stenography cryptographic attacks, services and mechanics.	
	4.2	Integer arithmetic, modular arithmetic, and linear congruence	
	4.3	Substitution cipher, transposition cipher, stream and block cipher, and arithmetic modes for block ciphers	
	4.4	Data encryption standard, double DES, triple DES, attacks on DES, AES, key distribution center.	
5		**Number Theory and Asymmetric Key Cryptography**	12
	5.1	Primes, factorization, Fermat's little theorem, Euler's theorem, and extended Euclidean algorithm	
	5.2	RSA, attacks on RSA, Diffie Hellman key exchange , key management, and basics of elliptical curve cryptography	
	5.3	Message integrity, message authentication, MAC, hash function, H MAC, and digital signature algorithm	
6		**System Security**	
	6.1	Malware, Intruders, Intrusion detection system, firewall design, antivirus techniques, digital Immune systems, biometric authentication, and ethical hacking.	04
		Total	52

Recommended Books:

1. Khalid Sayood, " *Introduction to Data Compression*" ,Morgan Kaufmann, 2000
2. David Saloman, "*Data Compression: The complete reference*" , Springer publication
3. Behrous Forouzen, "*Cryptography and Network Security*", Tata Mc Graw –Hill Education 2011
4. Berard Menezes, "*Network Security and Cryptography*", learning publication Cengage
5. William Stallings, "*Cryptography and Network Security*", Pearson Education Asia Publication, 5th edition

Internal Assessment (IA):
Two tests must be conducted which should cover at least 80% of syllabus. The average marks of both the test will 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 of 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	Practical	Tutorial	Total
ETE702	Statistical 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					
ETE702	Statistical Signal Processing	20	20	20	80	-	-	-	100

Course Prerequisite:

- ETC 405 Signals and Systems,
- ETC503 Random Signal Analysis

Course Objective:

- To enable the student to understand the basic principles of random signal processing.
- To study spectral detection and estimation methods used in communication system design and their applications.

Course Outcome Students will able to:

- Design System for estimation, spectral estimation
- To perform wave formation analysis of the system
- Understand role of statistical fundamentals in real world applications.

Module No.		Topics	Hrs.
1.		**Review of Signals and Systems**	**6**
	1.1	Review of stochastic Processes	
	1.2	Gauss-Markow models, representation of stochastic process, likelihood and sufficiency	
2		**Detection Theory**	**8**
	2.1	One way, two way ANOVA table, hypothesis testing, decision criteria	
	2.2	Multiple measurements, multiple-hypothesis testing, and composite	
	2.3	Chi-square testing, asymptotic error rate of LRT for simple hypothesis testing, CFAR detection, sequential detection and Wald's test.	
3		**Detection of Signals in Noise**	**8**
	3.1	Detection of known signals in white noise	
	3.2	Correlation receiver and detection of known signals in colored noise	
	3.3	Detection of known signals in noise and maximum SNR criterion	
	3.4	Solution of integral equations and detection of signals parameters	
4		**Estimation Theory**	**10**
	4.1	Estimation of Parameters	
	4.2	Bayes Estimates and estimation of nonrandom parameters	
	4.3	Properties of estimators, linear mean-square estimation, and reproducing densities	
5		**Estimation of Waveforms**	**10**
	5.1	Linear MMSE Estimation of Waveforms	
	5.2	The Wiener Filter for estimation of stationary processes	
	5.3	Kalman Filter for estimation of non-stationary processes	
	5.4	Relation between the Kalman and Wiener Filters, nonlinear estimation, and nonparametric detection	
6		**Applications**	**10**
	6.1	Spread spectrum communications	
	6.2	RADAR target models, and target detection	
	6.3	Parameter estimation in RADAR systems	
	6.4	Dynamic Target Tracking, pattern classification and system identification	
Total			**52**

Recommended Books:

1. M.D. Srinath, P.K. Rajasekaran, and R. Viswanathan, "*Introduction to Statistical Signal Processing with Application*", Pearson Education
2. Robert M. Gray and Lee D. Davisson, "*An Introduction to Statistical Signal Processing*", Pearson Education
3. Steven Kay, "*Fundamentals of Statistical Signal Processing Volume-I: Estimation Theory*", Prentice hall publication
4. Steven Kay, "*Fundamentals of Statistical Signal Processing Volume-II: Detection Theory*", Prentice hall publication
5. Steven Kay, "*Fundamentals of Statistical Signal Processing Volume-III: Practical Algorithm Development*", Prentice hall publication

Internal Assessment (IA):

Two tests must be conducted which should cover at least 80% of syllabus. The average marks of both the test will 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 of 2 to 5 marks will be asked.
4. Remaining question will be selected from all the modules.

Course Code	Course Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ETE703	**Neural Networks and Fuzzy Logic**	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					
ETE703	**Neural Networks and Fuzzy Logic**	20	20	20	80	-	-	-	100

Prerequisites: FEC 101 Applied Mathematics I

Course Objective: To teach students

- Concepts and understanding of artificial neural networks
- Fuzzy logic basic theory and algorithm formulation
- To solve real world problems.

Course Outcome: Students will get:

- Knowledge about different neural networks, their architecture and training algorithm
- Concept of Fuzzy logic, Fuzzy Sets, fuzzy rules and fuzzy reasoning
- Exposure to the applicability of neural networks and fuzzy logic

Module No.		Topics	Hrs.
1.		**Introduction to Neural Networks and its Basic Concepts:**	08
	1.1	Biological neurons and McCulloch and Pitts models of neuron	
	1.2	Types of activation functions	
	1.3	Neural networks architectures	
	1.4	Linearly separable and linearly non-separable systems and their examples	
	1.5	Features and advantages of neural networks over statistical techniques	
	1.6	Knowledge representation, learning process, error-correction learning, concepts of supervised learning, and unsupervised learning	
2		**Supervised Learning Neural Networks:**	07
	2.1	Single layer perception and multilayer perceptron neural networks, their architecture	
	2.2	Error back propagation algorithm, generalized delta rule, learning factors, step learning	
	2.3	Momentum learning	
	2.4	Concept of training, testing and cross-validation data sets for design and validation of the networks	
3		**Unsupervised Learning Neural Networks:**	09
	3.1	Competitive earning networks, kohonen self-organizing networks	
	3.2	K-means and LMS algorithms	
	3.3	RBF neural network, its structure and Hybrid training algorithm for RBF neural networks	
	3.4	Comparison of RBF and MLP networks Learning	
	3.5	Vector Quantization neural network architecture and its training algorithm	
	3.6	Hebbian learning, Hopfield networks.	
4		**Applications of Neural Networks:**	06
	4.1	Pattern classification	
	4.2	Handwritten character recognition	
	4.3	Face recognition	
	4.4	Image compression and decompression	
5		**Fuzzy logic**	14
	5.1	Basic Fuzzy logic theory, sets and their properties	
	5.2	Operations on fuzzy sets	
	5.3	Fuzzy relation and operations on fuzzy relations and extension principle	
	5.4	Fuzzy membership functions and linguistic variables	
	5.5	Fuzzy rules and fuzzy reasoning	
	5.6	Fuzzification and defuzzification and their methods	
	5.7	Fuzzy inference systems, Mamdani Fuzzy models, and Fuzzy knowledge based controllers	
6		**Applications of Fuzzy Logic and Fuzzy Systems:**	08
	6.1	Fuzzy pattern recognition	
	6.2	Fuzzy image processing	
	6.3	Simple applications of Fuzzy knowledge based controllers like washing machines, traffic regulations, and lift control	
		Total	52

Recommended Books:

1. S. Rajsekaran and G. A. Vijaylakshmi Pai, "*Neural Networks, Fuzzy Logic, and Genetic Algorithms*", PHI
2. Simon Haykin, "*Neural Network- A Comprehensive Foundation*", Pearson Education
3. Thimothy J. Ross, "*Fuzzy Logic with Engineering Applications*", Wiley India Publications
4. Laurence Fausett, "*Fundamentals of Neural Networks*", Pearson Education
5. S. N. Sivanandam, S. Sumathi, and S. N. Deepa, "*Introduction to Neural Network Using MATLAB",* Tata McGraw-Hill Publications
6. Bart Kosko, "*Neural networks and Fuzzy Systems"*, Pearson Education

Internal Assessment (IA):
Two tests must be conducted which should cover at least 80% of syllabus. The average marks of both the test will 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 of 2 to 5 marks will be asked.
4. Remaining questions will be selected from all the modules

Subject Code	Course Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ETE704	CMOS Analog and Mixed Signal VLSI Design	04	02	--	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	Avg. of Test 1 and Test 2					
ETE704	CMOS Analog and Mixed Signal VLSI Design	20	20	20	80	--	--	--	100

Course Pre-requisite:

- ETC302: Analog Electronics I
- ETC303. Digital Electronics
- ETC402: Analog Electronics II
- ETC 505: Integrated Circuits
- ETC 606 :VLSI Design

Course Objectives: To teach the students

- Importance of CMOS and Mixed Signal VLSI design in the field of Electronics and Telecommunication.
- Underlying methodologies for analysis and design of fundamental CMOS Analog and Mixed signal Circuits like Current and Voltage references, Single stage Amplifiers, Operational Amplifiers, Data Converters.
- The issues associated with high performance Mixed Signal VLSI Circuits.

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

- Differentiate between Analog, Digital and Mixed Signal CMOS Integrated Circuits.
- Analyze and design current sources and voltage references for given specifications.
- Analyze and design single stage MOS Amplifiers.
- Analyze and design Operational Amplifiers.
- Analyze and design data converter circuits.

Module No.		Topics	Hrs.
1		**Fundamental Analog Building Blocks**	08
	1.1	MOS Transistor as sampling switch, active resistances, current source and sinks, current mirror and current amplifiers	
	1.2	Voltage and current references, band gap voltage reference, Beta-Multipler referenced self-biasing	
2		**Single Stage MOS Amplifiers**	14
	2.1	Common-source stage (with resistive load, diode connected load, current-source load, triode load, source degeneration), source follower, common-gate stage, cascode stage, folded cascade stage, simulation of CMOS amplifiers using SPICE	
	2.2	Single-ended operation, differential operation, basic differential pair, large-signal and small-signal behavior, common-mode response, differential pair with MOS loads, simulation of differential amplifiers using SPICE	
	2.3	Noise characteristics in the frequency and time domains, thermal noise, shot noise, flicker noise, popcorn noise, noise models of IC components, representation of noise in circuits, noise in single-stage amplifiers (CS, CD and CG stages), noise in differential pairs, noise bandwidth, noise figure, noise temperature.	
3		**MOS Operational Amplifiers Desing**	08
	3.1	Trans-conductance operational amplifier (OTA), two stage CMOS operational amplifier	
	3.2	CMOS operational amplifiers compensation, cascade operational amplifier and folded cascade	
4		**Non-Linear & Dynamic Analog Circuits**	08
	4.1	Switched capacitor amplifiers (SC), switched capacitor integrators, first and second order switched capacitor circuits.	
	4.2	Basic CMOS comparator design, adaptive biasing, analog multipliers	
5		**Data Converter Fundamentals**	06
	5.1	Analog versus digital discrete time signals, converting analog signals to data signals, sample and hold characteristics	
	5.2	DAC specifications, ADC specifications, mixed-signal layout issues	
6		**Data Converter Architectures**	08
	6.1	DAC architectures, digital input code, resistors string, R-2R ladder networks, current steering, charge scaling DACs, Cyclic DAC, pipeline DAC,	
	6.2	ADC architectures, flash, 2-step flash ADC, pipeline ADC, integrating ADC, and successive approximation ADC	
Total			**52**

Recommended Books:

1. B. Razavi, **"***Design of Analog CMOS Integrated Circuits***"**, first edition, McGraw Hill,2001.
2. Harry W. Li and David E Boyce, **"***CMOS Circuit Design, Layout, Stimulation***",** PHI Edn, 2005
3. P.E.Allen and D R Holberg, **"***CMOS Analog Circuit Design***"**, second edition, Oxford University Press, 2002.
4. Gray, Meyer, Lewis and Hurst **"***Analysis and design of Analog Integrated Circuits***"**, 4th Edition Willey International, 2002

Internal Assessment (IA):
Two tests must be conducted which should cover at least 80% of syllabus. The average marks of both the test will 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 of 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	Practical	Tutorial	Total
ETL701	Image and Video Processing	--	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				
ETL701	Image and Video Processing	--	--	--	--	25	25	50

Term Work:
At least ten experiments covering entire syllabus for ETC 701: Image and Video Processing be set to have predefined inference and conclusion. Simulation based experiments are also encouraged. An attempt should be made to make experiments more meaningful, interesting and innovative. Term work assessment must be based on the overall performance of the student with every experiment graded. The average of grades converted in to marks should be taken into account for term work assessment.
Practical and Oral examination will be based on entire syllabus.

Course Code	Course Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ETL702	Advanced Communication Engineering Laboratory I	--	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				
ETL702	Advanced Communication Engineering Laboratory I	--	--	--	--	25	25	50

Term Work:
At least ten experiments covering entire syllabus for ETC 702: Mobile Communication be set to have predefined inference and conclusion. Simulation based experiments are also encouraged. An attempt should be made to make experiments more meaningful, interesting and innovative. Term work assessment must be based on the overall performance of the student with every experiment graded. The average of grades converted in to marks should be taken into account for term work assessment.
Practical and Oral examination will be based on entire syllabus.

Course Code	Course Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ETL703	Advanced Communication Engineering Laboratory II	--	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				
ETL703	Advanced Communication Engineering Laboratory II	--	--	--	--	25	25	50

Term Work:
At least ten experiments covering entire syllabus for ETC 703: Optical Communication and Network and ETC 704: Microwave and Radar Engineering be set to have predefined inference and conclusion. Simulation based experiments are also encouraged. An attempt should be made to make experiments more meaningful, interesting and innovative. Term work assessment must be based on the overall performance of the student with every experiment graded from time to time. The average of grades converted in to marks should be taken into account for term work assessment.
Practical and Oral examination will be based on entire syllabus of ETC 703 and ETC 704

Course Code	Course Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ETL70X	Elective	--	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				
ETL70X	Elective	--	--	--	--	25	25	50

Term Work:
At least ten experiments covering entire syllabus for respective elective subject be set to have predefined inference and conclusion. Simulation based experiments are also encouraged. An attempt should be made to make experiments more meaningful, interesting and innovative. Term work assessment must be based on the overall performance of the student with every experiment graded. The average of grades converted in to marks should be taken into account for term work assessment.
Practical and Oral examination will be based on entire syllabus.

Course Code	Course Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ETP701	Project (Stage I)	--	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					
ETP701	Project (Stage I)	--	--	--	--	25	-	25	50

Term Work:

The final year students have already under gone project assignment in their pre-final year in Mini Project I and II. In final year group of maximum **four** students will be completing a comprehensive project work based on the courses studied. The project work may be internally assigned or may be externally assigned by the research institutes, industry etc. Each group will be assigned one faculty as a supervisor. This project work in final year may be extension of the Mini Project work done in pre-final year.

The main intention of Project work is to enable students to apply the knowledge and skills learned out of courses studied to solve/implement predefined practical problem. The Project work may be beyond the scope of curriculum of courses taken or may be based on the courses but thrust should be

- Learning additional skills
- Development of ability to define, design, analysis and implementation of the problem and lead to its accomplishment with proper planning
- Learn the behavioral science by working in a group
- The project area may be selected in which the student intend to do further education and/or may be either intend to have employment or self employment
- The topic of project should be different and / or may be advancement in the same topic of Mini Project
- 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 Project work.

The college should keep proper assessment record of the progress of project and at the end of the semester it should be assessed for awarding TW marks. The TW should be examined by approved internal faculty appointed by the head of the institute on the basis of following:

- Scope and objective of the project work.
- Extensive Literature survey.
- Progress of the work (Continuous assessment)
- Report in prescribed University format.

An approved external examiner and internal examiner appointed by the head of the institute together will assess during oral examination. The oral examination is a presentation by the group members on the project along with demonstration of the work done. In the examination each individual student should be assessed for his/her contribution, understanding and knowledge gained.

Subject Code	Course Name	Teaching Scheme	Credits Assigned					
		Theory	Practical	Tutorial	Theory	TW/ Practical	Tutorial	Total
ETC801	Wireless 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	Avg. of Test 1 and Test 2					
ETC801	Wireless Networks	20	20	20	80	--	--	--	100

Course Pre requisites :

- ETC 603 Computer Communication and Networks
- ETC 702 Mobile Communication

Course Objectives:

- Introduction to planning and design of wireless networks
- Introduction to HSPA systems
- To study emerging technologies like Bluetooth, zigbee, Wimax
- Understanding the wireless sensor network architecture and the protocol stack and WSN applications.

Course Outcomes: The students will be able to:

- Describe the phases of planning and design of mobile wireless networks
- List and compare personal area network (PAN) technologies such as Zigbee, Bluetooth etc
- Students will details of sensor network architecture, traffic related protocols , transmission technology etc
- Understand middleware protocol and network management issues of sensor networks

Module No.		Topics	Hrs.
1		**Overview of Cellular Systems**	**08**
	1.1	Mobile telephony, introduction to GSM.	
	1.2	Universal mobile telecommunication system	
	1.3	Introduction to HSPA, Advanced Antenna Systems for HSPA + and LTE	
2		**Planning and Design of Wide-Area Wireless Networks**	**12**
	2.1	Basics of indoor RF planning	
	2.2	Three phases of wireless network design	
	2.3	Indoor coverage from the macro layer	
	2.4	Link budgets for GSM, CDMA, CDMA2000, HSDPA systems, indoor UMTS/HSPA challenge, common UMTS rollout mistake	
3		**Emerging Wireless Technologies**	**10**
	3.1	**Bluetooth:** concepts of Pico net , scatter net etc., protocol stack, link types, security, network connection establishments, usage models, etc.	
	3.2	**ZigBee**: components, architecture, network topologies, protocol stack etc.	
	3.3	**UWB and RFID:** technical requirements, components and characteristics, applications	
	3.4	**WiMAX:** 802.16 based protocol architecture, physical layer, fixed and mobile WiMAX	
4		**Overview of Wireless Sensor Network**	**12**
	4.1	Background of sensor network technology, sensor network architectural elements, historical survey of sensor networks	
	4.2	Applications of wireless sensor network, range of applications, examples of category 1 and 2 WSN Applications	
	4.3	Technologies for wireless sensor network, sensor node technology, hardware and software, sensor taxonomy	
	4.4	Wireless network, operating environment, wireless network trends, transmission technology	
	4.5	Medium access control protocols, routing protocols, transport control protocols	
6		**Middleware for Sensor Networks & Network Management**	**10**
	6.1	Middleware principles	
	6.2	Middleware architecture, existing middleware	
	6.3	Network management, requirements	
	6.4	Network management models, design issues	
Total			**52**

Recommended Books:

1. Indoor Radio Planning: A Practical Guide for GSM, DCS, UMTS, HSPA and LTE, 2nd Edition Morten Tolstrup ISBN: 978-0-470-71070-8 480 - July 2011 -Wiley
2. Vijay K. Garg, "*Wireless Communication and Networking*", Morgan -Kaufmann Series in Networking—Elsevi**er**
3. Kazem Sohraby, Daniel Minoli, and Taieb Znati, "*Wireless Sensor Networks: Technology, Protocols, and Applications*", Wiley Student Edition
4. Feng Zhao and Leonidas Guibas, "*Wireless Sensor Networks, An Information Processin Approach*",--Morgan Kaufmann
5. Holger and Andreas Willig, "*Protocols and Architectures for WSN*", Wiley student edition

Internal Assessment (IA):
Two tests must be conducted which should cover at least 80% of syllabus. The average marks of both the test will 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 of 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	Practical	Tutorial	Total
ETC 802	Satellite Communication and Network	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 802	Satellite Communication and Network	20	20	20	80	-	-	-	100

Pre-requisites:

- ETC 502: Analog communication
- ETC 601: Digital Communication

Course Objective:

- To provide an in-depth understanding of different concepts used in a satellite communication system.
- To explain the tools necessary for the calculation of basic parameters in a satellite communication system.
- To get knowledge of every aspects of satellite communication like orbital mechanics, launching techniques, satellite link design, earth station technology and different access system towards a satellite.

Course Outcome: The Students will be able to

- Explain the basics of satellite communication
- Explain and analyzes link budget of satellite signal for proper communication
- Use the system for the benefit of society
- Use the different application of satellite communication

Module No.		Topics	Hrs.
1.		**Overview of Satellite Systems, Orbits and Launching**	10
	1.1	Frequency allocation for satellite services, system design consideration, satellite services-VSAT, global positioning satellite system, maritime satellite services, gateways	
	1.2	Polar orbiting satellites, Kepler's First, second and third law, orbital elements, apogee, perigee heights, orbital perturbations, effects of a non-spherical earth, atmospheric drag	
	1.3	Sub-satellite Point, predicting satellite position, antenna look angels, polar mount antenna, limits of visibility, near geostationary orbits, earth eclipse of satellite, sun transit outage	
	1.4	Selection of launching site, launch window, zero and non-zero degree latitude launching, sea launch, launch vehicles; satellite launch vehicle (SLV), augmented satellite launch vehicle (ASLV), polar SLV, geostationary satellite launch vehicle (GSLV)	
2		**Space Segment**	8
	2.1	Attitude control, spinning satellite stabilization, momentum wheel stabilization, station keeping, thermal control, TT and C subsystem, transponders, wideband receiver, input de-multiplexer, power amplifier, antenna subsystem	
	2.2	Equipment reliability and space qualification	
3		**Satellite Links**	12
	3.1	Isotropic radiated power, transmission losses, free-space transmission, feeder losses, antenna misalignment losses, fixed atmospheric and ionospheric losses, link power budget	
	3.2	System noise, antenna noise, amplifier noise temperature, amplifiers in cascade, noise factor, noise temperature of absorptive networks, overall system noise temperature, carrier to noise ratio	
	3.3	**Uplink:** Saturation flux density, input back off, earth station HPA, **Downlink:** Output back off, satellite TWTA output	
	3.4	Effects of rain, uplink rain-fade margin, downlink rain-fade margin, combined uplink and downlink C/N ratio, inter-modulation noise	
4		**Earth Station.**	04
	4.1	Design considerations, receive-only home TV systems, outdoor–indoor unit for analog (FM) TV, master antenna TV system, transmit-receive earth stations	
	4.2	Community antenna TV systems	
5		**The Space Segment Access and Utilization**.	8
		Space segment access methods, pre-assigned FDMA, demand assigned FDMA, SPADE system, bandwidth-limited and power-limited TWT amplifier operation	
		TDMA: Reference Burst; Preamble and Postamble, carrier recovery, network synchronization, unique word detection, traffic date, frame efficiency, channel capacity, preassigned TDMA, demand assigned TDMA, satellite switched TDMA	
		Code Division Multiple Access: Direct-sequence spread spectrum–acquisition and trackling, spectrum spreading and dispreading – CDMA throughput	
6		**Satellite Networking**	10
	6.1	**Satellite Network:** net work reference models and protocols, layering principle, open system interconnection (OSI), reference model, IP reference model, reference architecture for satellite networks, basic characteristics of satellite networks, onboard connectivity with transparent processing, analogue transparent switching, Frame organization, Window organization, On board connectivity with beam scanning	
	6.1	**Laser Satellite Communication:** Link analysis, optical satellite link transmitter, optical satellite link receiver, satellite beam acquisition, tracking & positioning, deep space optical communication link	
		Total	**52**

Recommended Books:

1. Dennis Roddy, *"Satellite Communications"*, 3rd Ed., Mc. Graw-Hill International Ed. 2001.
2. Wilbur L. Pritchard, Henri G. Suyderehoud, and Robert A. Nelson, *"Satellite Communication systems Engineering",* Pearson Publication
3. Gerard Maral and Michel Bousquet, *"Satellite Communication Systems",* 4th Edition Wiley Publication
4. Timothy Pratt, Charles Bostian, and Jeremy Allmuti, *"Satellite Communications"*, John Willy & Sons (Asia) Pvt. Ltd. 2004
5. M. Richharia, "*Satellite Communication Systems Design Principles*", Macmillan Press Ltd. Second Edition 2003.
6. Gerard Maral, "*VSAT Networks*", John Willy & Sons

Internal Assessment (IA):

Two tests must be conducted which should cover at least 80% of syllabus. The average marks of both the test will 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 of 2 to 5 marks will be asked.
4. Remaining question will be selected from all the module

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					
ETC803	**Internet and Voice Communication**	20	20	20	80	-	-	-	100

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					
ETC803	**Internet and Voice Communication**	20	20	20	80	-	-	-	100

Course Pre requisite :

- ETC 502: Analog communication
- ETC 601: Digital Communication
- ETC 604: Computer Communication and Networks

Course Objectives:

- To focus on Internet protocol, standards, services and administration.
- To discuss voice over IP as a real-time interactive audio/video service.

Course Outcomes: The students will be able to:

- Implement local area networks using both static and dynamic addressing techniques including sub netting.
- Install, configure, and troubleshoot server and client operating systems.
- Disassemble, troubleshoot/debug, upgrade, replace basic components, and reassemble servers and client systems.
- Explain the concept of encapsulation and its relationship to layering in the network models.
- Explain how TCP's byte-stream sliding window is related to a traditional packet-based sliding window algorithm.
- Explain the operation of the components of a router including, DHCP, NAT/PAT, Routing function, Switching function.
- Describe how DNS works in the global Internet including caching and root servers.

Module No.		Topics	Hrs.
1.		**Review of TCP /IP:**	06
	1.1	TCP /IP networking model, layer functions.	
	1.2	TCP/IP protocols, services, sockets and ports, encapsulations, difference between ISO and Internet layering.	
2		**Application Layer:**	08
	2.1	Host configuration, DHCP	
	2.2	Domain Name System (DNS), remote Login, TELNET and SSH	
	2.3	FTP and TFTP, World Wide Web, HTTP, electronic mail, SMTP, POP, IMAP, and MIME	
3		**Transport Layer:**	12
	3.1	User datagram protocol(UDP) header fields and their functions, pseudo header	
	3.2	Transmission control protocol (TCP), need for stream delivery, properties of reliable stream delivery, TCP header fields, ports, connections, end points, passive and active open, segment, stream and sequence numbers, variable window size and flow control.	
	3.3	Out of band data, checksum, acknowledgement and retransmission, round trip samples	
	3.4	Karn's algorithm, timer back off, response to delay variation and congestion, TCP state machine, connection establishment	
4		**Internetworking layer:**	08
	4.1	Internet protocol (IP) datagram, header fields and their functions	
	4.2	Internet control message protocol, IP address classes, broadcast, multicast and special addresses, network space and host space, subnets and supernets	
	4.3	Private IP addresses, classless inter domain routing (CIDR), CIDR subnet addressing, variable length in CIDR subnet addressing	
5.		**Voice Communication**	04
	5.1	Digitizing audio and video, audio compression, video compression	
6.		**Real-Time Interactive Audio and Video**	16
	6.1	Characteristics, RTP, RTP packet format	
	6.2	UDP port, RTCP, sender report, receiver report, source description message, bye message, application-specific message, UDP port	
	6.3	SIP,H.323	
	6.4	Flow characteristics, flow classes, techniques to improve QOS, resource reservation, admission control	
Total			**52**

Recommended Books:

1. B. Forouzan, "*TCP/IP Protocol Suite*", 4th Edition, McGraw-Hill Publication
2. Leon Garcia, "*Communication Networks*", 2nd Edition McGraw-Hill Publication
3. Kurose and Ross, "*Computer Networking*", 5th Edition Pearson Publication
4. Ted Wallingford, "*Switching to VoIP*", Oreilly Publication

Internal Assessment (IA):
Two tests must be conducted which should cover at least 80% of syllabus. The average marks of both the test will 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 of 2 to 5 marks will be asked.
4. Remaining question will be selected from all the modules.

Course Code	Course Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ETE801	Speech 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					
ETE801	Speech Processing	20	20	20	80	-	-	-	100

Course Pre-Requisites:

- ETC405 Signals and Systems
- ETC602 Discrete Time Signal Processing

Course Objective:

- To introduce the models of speech production and acoustic phonetics
- To teach time and frequency domain techniques for estimating speech parameters
- To teach predictive techniques for speech coding
- To introduce speech recognition and speech synthesis applications

Course Outcomes: Students will be able to:

- Demonstrate basic knowledge in speech production mechanism, phoneme classification, digital models for speech production, Homomorphic speech processing and LPC analysis
- Demonstrate applications of signal processing theory for estimation of speech parameters in time and frequency domain including pitch and formants
- Analyze application of speech processing in speech compression, speech recognition, and speech synthesis
- Enhance their written and oral technical communication skills related to speech processing subject and will be better prepared for higher study and lifelong learning

Module No.		Topics	Hrs.
1.		**Speech Production, Acoustic Phonetics and Auditory Perception**	10
	1.1	Anatomy and physiology of speech organs, articulatory phonetics, acoustic phonetics, acoustic theory of speech production, discrete time model for speech production	
	1.2	Ear physiology and psychoacoustics	
2		**Speech Analysis in Time Domain**	06
	2.1	Time energy, average magnitude, and zero-crossing rate, speech vs silence discrimination	
	2.1	Short-time autocorrelation, pitch period estimation using short-time autocorrelation, median smoothing	
3		**Speech Analysis in Frequency Domain:**	06
	3.1	Time dependent Fourier representation for voiced and unvoiced speech signals, linear filtering interpretation, spectrographic displays	
	3.2	Pitch period estimation based on FFT and harmonic peak detection method, estimation of formants using log spectrum	
4		**Homomorphic Speech Processing**	08
	4.1	Cepstral analysis of speech, mel frequency cepstral coefficients (MFCC), perceptual linear prediction (PLP)	
	4.2	Pitch period estimation in cepstral domain, evaluation of formants using cepstrum	
5		**LPC and Parametric Speech Coding**	12
	5.1	Review of lattice structure realization, forward and backward error filters, normal equations & its solutions, levinson-durbin algorithm, covariance method, Berg's algorithm	
	5.2	Channel Vocoders, linear prediction (LP) based vocoders, residual excited LP (RELP) based Vocoders, voice Excited LP (VELP) based vocoders, multi-pulse LP (MPLP) based vocoders, code excited LP (CELP) based vocoders	
6		**Speech Processing Applications**	10
	6.1	Speech recognition systems, deterministic sequence recognition for ASR, statistical sequence recognition for ASR (Hidden Markov Model (HMM))	
	6.2	Text to speech system (TTS), concatenative synthesis, synthesis using formants, LPC synthesizer	
		Total	52

Recommended Books:

1. Rabiner and Schafer, "*Digital Processing of Speech Signals*", Pearson Education, Delhi, 2004.
2. Shaila D. Apte, "*Speech and Audio Processing*", Wiley India, New Delhi, 2012.
3. Douglas O'Shaughnessy, "*Speech Communications: Human & Machine*", Universities Press, Hyderabad, Second Edition, 2001.
4. Ben Gold and Nelson Morgan, "*Speech and Audio Signal Processing*", Wiley India (P) Ltd, New Delhi, 2006.
5. Thomas F. Quatieri, "*Discrete-Time Speech Signal Processing: Principles and Practice*", Prentice Hall, 2001.
6. J. L. Flanagan, "*Speech Analysis Synthesis and Perception*", Second edition, Springer-Verlag (1972).

Internal Assessment (IA):
Two tests must be conducted which should cover at least 80% of syllabus. The average marks of both the test will 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 of 2 to 5 marks will be asked.
4. Remaining question will be selected from all the modules.

Course Code	Course Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ETE802	Telecom Network Management	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					
ETE802	Telecom Network Management	20	20	20	80	-	-	-	100

Prerequisite: ETC 603: Computer Communication and Networks

Course Objective:

- To familiarize the student with the design, analysis operation and management of modern data communications networks.
- To provide the student with a working knowledge of the types of communications network management systems and their strengths and limitations in solving various information network management problems.

Course Outcomes: The students will be able to:

- Demonstrate broad knowledge of fundamental principles and technical standards underlying
- Understand basic of telecommunication, networking and information technologies.
- Architect and implement networked informative systems.
- Continuously improve their technology knowledge and communication skills.
- Anticipate the way technological change and emerging technologies might alter the assumptions underlying architectures and systems.

Module No.		Topics	Hrs
1.		**Overview of Network Management**	06
	1.1	Case histories on network, system and service management, challenges of IT managers	
	1.2	Network Management: Goals, organization and functions	
	1.3	Network management architecture and organization network management perspectives	
2		**OSI Network Management**	08
	2.1	Network management standards	
	2.2	Network management models	
	2.3	Organization model	
	2.4	Information model	
	2.5	Communication model and functional model	
	2.6	Abstract syntax notation – encoding structure, macros functional model CMIP/CMISE	
3		**Internet Management (SNMP)**	13
	3.1	SNMP-organizational model-	
	3.2	System overview.	
	3.3	Information model, communication model, functional model	
	3.4	SNMP proxy server, Management information, Protocol	
	3.5	Remote monitoring. RMON	
4		**Broadband Network Management**	10
	4.1	Broadband networks and services, ATM Technology – VP, VC, ATM Packet, Integrated service, ATM LAN emulation, Virtual LAN	
	4.2	ATM Network Management – ATM network reference model, integrated local management interface. ATM management information base, role of SNMP and ILMI in ATM management.	
	4.3	M1, M2, M3, M4 interface. ATM digital exchange interface management	
5		**Network Management Applications**	08
	5.1	Configuration management.	
	5.2	Fault management	
	5.3	Performance management	
	5.4	Event correlation techniques	
	5.5	Security management	
	5.6	Accounting management, report management, policy based management services	
	5.7	Level management	
6		**Telecommunication Management Networks(TMN)**	07
	6.1	Need for TMN	
	6.2	Conceptual model	
	6.3	TMN standards	
	6.4	TMN management services architecture and TMN implementation	
Total			**52**

Recommended Books:

1. Mani Subramaniam, "*Network Management Principles and Practise"*, Addison Wisely, New York, 2000.
2. Lakshmi G. Raman, " *Fundamental of Telecommunications Network Management"* Eastern Economy Edition, IEEE Press New Delhi.
3. Salh Aiidarons, Thomas Plevoyak "*Telecommunications Network Technologies and implementations"* Eastern Economy Edition, IEEE press New Delhi-1998.

Internal Assessment (IA):
Two tests must be conducted which should cover at least 80% of syllabus. The average marks of both the test will 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 of 2 to 5 marks will be asked.
4. Remaining question will be selected from all the modules.

Course Code	Course Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ETE803	**Microwave Integrated Circuit**	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					
ETE803	**Microwave Integrated Circuit**	20	20	20	80	-	-	-	100

Course pre requisite:

- ETC 403: Wave Theory and Propagation
- ETC 504: RF Modeling and Antennas
- ETC 704: Microwave and Radar Engineering
-

Course Objective:

- To understand the integration of microwave devices in the form of IC.
- To understand the basic principles and advanced applications of Microwave Engineering,
- To design different amplifier, oscillator and mixers for various applications.

Course outcome: The students will be able to

- Design and implement the microwave layouts.
- Design and implement the microwave amplifier, oscillator, and mixer circuits.

Module No.		Topics	Hrs.
1.		**Hybrid MICs And Monolithic MICs**	**08**
	1.1	Definition, characteristics, comparison with conventional circuits, field of application and limitations and criteria for the choice of substrate material in HMICS and MMICS.	
	1.2	Thin film hybrid circuits, thick film hybrid circuits, art work, masking, photolithography, resistor stabilization, sawing, brazing process, wire bonding.	
	1.3	Monolithic MICs: Doping by ion implantation, Ohmic contacts, metal resistive layers, gate metal, dielectric and air-bridge vias, wafer process steps.	
2		**Micro Strip Lines**	**08**
	2.1	Planar wave guides, non-tem propagation, line impedance definitions, quasi-static approximations, quasi-static line parameters.	
	2.2	Micro strip open circuits and gaps, micro strip corners, step change in width.	
	2.3	Dispersion analysis, micro strip characteristic impedance, symmetric t junction, green's functions, millimeter wave modeling of micro strip lines.	
3		**Coupled Line Propagation**	**10**
	3.1	Coupled line propagation: wave equations for coupled lines, propagation models, coupled line parameters, coupled line parameter variations with frequency, directional couplings, lange coupler, coupled line pair operated as a four port.	
	3.2	Coplanar wave guides: design considerations and coplanar line circuits.	
4		**Microwave Amplifier Design**	**12**
	4.1	Introduction, derivation of transducer power gain, stability, power gains, voltage gains, and current gains, single-stage transistor amplifier design.	
	4.2	Power amplifier design: device modeling and characteristics, optimum loading.	
	4.3	Single-stage power amplifier design and multi-stage design.	
	4.4	Power distributed amplifiers. class of operation, power amplifier stability, amplifier linearization methods.	
5		**Microwave Oscillator Design**	**08**
	5.1	Introduction, compressed smith chart, series of parallel resonance, resonators, two-port oscillator design, negative resistance from transistor model, oscillator q and output power.	
	5.2	Noise in oscillators: linear approach, analytical approach to optimum oscillator design using s parameters, nonlinear active models for oscillators.	
	5.3	Microwave oscillator performance, design of an oscillator using large single y parameters, example for large single design based on bessel functions, design examples for best phase noise and good output power.	
6		**Microwave Mixer Design**	**06**
	6.1	Introduction, diode mixer theory, single-diode, single-balanced and double-balanced mixers.	
	6.2	FET mixer theory, balanced FET mixers, special mixer circuits, mixer noise.	
Total			**52**

Recommended Books:

1. D. H. Schrader, "*Microstrip Circuit Analysis*", Prentice Hall PTR, New Jersey.
2. D. M. Pozar, "*Microwave Engineering*", John Wiley & Sons Publication, 2013.
3. K. C. Gupta, R. Garg, and I. J. Bahl, "*Microstrip Lines and Slot Lines*", Artech House.
4. M. M. Radmanesh, "*Radio Frequency and Microwave Electronics*", Pearson Education, 2006.
5. D. Vendelin, A. M. Pavio, and U. L. Rohde, "*Microwave Circuit Design*", John Wiley & Sons Publication.
6. Sweet, "*MIC and MMIC Amplifier and Oscillator Design*", 1990 Edition, Artech House.

Internal Assessment (IA):
Two tests must be conducted which should cover at least 80% of syllabus. The average marks of both the test will 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 of 2to 5 marks will be asked.
4. Remaining question will be selected from all the modules.

Course Code	Course Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ETE804	Ultra Wide Band 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					
ETE804	Ultra Wide Band Communication	20	20	20	80	-	-	-	100

Prerequisite: ETC 504: RF Modeling and Antennas.

Course Objective:

- To focuses on the basic techniques that concerns present and future dynamic UWB communication systems.
- To encompass all areas of design and implementation of UWB systems.
- To develop a comprehensive overview of UWB system design that spans propagation, transmit and receive antenna implementations, standards and advanced topics, modulation and multiple access, network issues, and applications.

Course Outcomes: Students will be able to;

- Understand nuances of planning and design of RF network
- Work professionally in the area of Antenna design and Radio Propagation.
- Apply the knowledge of mathematics and engineering to solve practical EM engineering problems.

Module No.		Topics	Hrs.
1.		**Introduction**	**10**
	1.1	UWB BASICS.	
	1.2	Regulatory bodies	
	1.3	UWB signals and systems with UWB waveforms	
	1.4	Power spectral density, Pulse shape, Pulse trains, Spectral masks	
	1.5	Multipath, penetration characteristics, spatial and spectral capacities – speed of data transmission	
	1.6	Gaussian waveforms, Designing waveforms for specific spectral masks.	
	1.7	Practical constraints and effects of imperfections.	
2		**Signal Processing Techniques For UWB Systems And UWB Channel Modeling**	**10**
	2.1	Effects of lossy medium on UWB transmitted signal	
	2.2	Time domain analysis, frequency domain analysis	
	2.3	Detection and Amplification,	
	2.4	Two ray UWB propagation model,	
	2.5	Frequency domain auto regressive model, IEEE proposals for UWB channel models	
3		**UWB Communications**	**05**
	3.1	UWB modulation methods, pulse trains	
	3.2	UWB transmitter/receiver	
	3.3	Multiple access techniques in UWB, capacity of UWB systems	
4		**Advanced UWB Pulse Generation**	**05**
	4.1	Comparison of UWB with other wideband communication systems	
	4.2	Interference and coexistence of UWB with other systems	
	4.3	Hermite pulses: orthogonal prolate spheroidal wave functions	
	4.4	Wavelet packets in UWB PSM	
	4.5	Applications of UWB communication systems	
5		**UWB Antennas and Arrays, Position and Location with UWB Signals**	**10**
	5.1	Antenna fundamentals: Antenna radiation for UWB signals	
	5.2	Conventional antennas and Impulse antennas for UWB systems	
	5.3	Beam forming for UWB signals: radar UWB array systems	
	5.4	Wireless positioning and location: GPS techniques, Positioning techniques time resolution issues, UWB positioning and communications	
6		**UWB Communication Standards and Systems**	**12**
	6.1	UWB standardization in wireless personal area networks	
	6.2	DS-UWB proposal, MB-OFDM UWB proposal: IEEE proposals for UWB channel models	
	6.3	UWB ad-hoc and sensor networks	
	6.4	MIMO and Space-time coding for UWB systems	
	6.5	Self-interference in high data-rate UWB communications, coexistence of DS-UWB with WIMAX	
Total			**52**

Recommended Books:

1. M. Ghavami, L. B. Michael and R. Kohno, "*Ultra Wideband Signals and Systems In Communication Engineering*", 2nd Edition, John Wiley & Sons, NY, USA, 2007.
2. Jeffrey H. Reed, "*An Introduction To Ultra Wideband Communication Systems*", Prentice Hall Inc., NJ, USA, 2005.
3. Ian Oppermann, Matti Hamalainen and Jari Iinatti "*UWB Theory and Applications*", John Wiley & Sons Ltd, 2004

Internal Assessment (IA):
Two tests must be conducted which should cover at least 80% of syllabus. The average marks of both the test will 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 of 2 to 5 marks will be asked.
4. Remaining question will be selected from all the modules.

Course Code	Course Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ETL 801	Wireless Networks Laboratory	--	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					
ETL801	Wireless Networks Laboratory	--	--	--	--	25	--	25	50

Term Work:
At least ten experiments covering entire syllabus of ETC 801: Wireless Network be set to have predefined inference and conclusion. Simulation based experiments are also encouraged. An attempt should be made to make experiments more meaningful, interesting and innovative. Term work assessment must be based on the overall performance of the student with every experiment graded. The average of grades converted in to marks should be taken into account for term work assessment
Oral examination will be based on entire syllabus.

Course Code	Course Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ETL 802	Satellite Communication and Networks Laboratory	--	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					
ETL802	Satellite Communication and Networks Laboratory	--	--	--	--	25	--	25	50

Term Work:
At least ten experiments covering entire syllabus of ETC 802: Satellite Communication and Network be set to have predefined inference and conclusion. Simulation based experiments are also encouraged. An attempt should be made to make experiments more meaningful, interesting and innovative. Term work assessment must be based on the overall performance of the student with every experiment graded. The average of grades converted in to marks should be taken into account for term work assessment.
Oral examination will be based on entire syllabus.

Course Code	Course Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ETL 803	Internet and Voice Communication Laboratory	--	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					
ETL803	Internet and Voice Communication Laboratory	--	--	--	--	25	--	25	50

Term Work:
At least ten experiments covering entire syllabus of ETC 803: Internet and Voice Communication Laboratory be set to have predefined inference and conclusion. Simulation based experiments are also encouraged. An attempt should be made to make experiments more meaningful, interesting and innovative. Term work assessment must be based on the overall performance of the student with every experiment graded. The average of grades converted in to marks should be taken into account for term work assessment
Oral examination will be based on entire syllabus.

Course Code	Course Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ETEL 80X	Elective	--	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					
ETEL 80X	Elective	--	--	--	--	25	--	25	50

Term Work:
At least ten experiments covering entire syllabus of respective Elective subject be set to have predefined inference and conclusion. Simulation based experiments are also encouraged. An attempt should be made to make experiments more meaningful, interesting and innovative. Term work assessment must be based on the overall performance of the student with every experiment graded. The average of grades converted in to marks should be taken into account for term work assessment
Oral examination will be based on entire syllabus.

Course Code	Course Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ETP801	Project (Stage II)	--	04	--	--	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					
ETP801	Project (Stage II)	--	--	--	--	50	-	50	100

Term Work:

The final year students have already under gone project assignment in their seventh semester and in this semester the students are expected to continue the project work of stage I.

The college should keep proper assessment record of the progress of project and at the end of the semester it should be assessed for awarding TW marks. The TW should be examined by approved internal faculty appointed by the head of the institute on the basis of following:

- Scope and objective of the project work.
- Extensive Literature survey.
- Progress of the work (Continuous assessment)
- Design, implementation, and analysis of the project work.
- Results, conclusions and future scope.
- Report in prescribed University format.

An approved external examiner and internal examiner appointed by the head of the institute together will assess during oral examination. The oral examination is a presentation by the group members on the project along with demonstration of the work done. In the examination each individual student should be assessed for his/her contribution, understanding and knowledge gained.