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)

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

* Indicate common subject for Electronics, Electronics & Telecommunication, Instrumentation, Biomedical and Electrical Engineering

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.