UNIVERSITY OF MUMBAI

Bachelor of Engineering

BACHELOR OF ELECTRONICS AND TELECOMMUNICATION ENGINEERING

Second Year (Semester III And IV), Revised Course (Rev2012) From Academic Year 2013-14

(As per Credit Based Semester and Grading System with effect from the academic year 2012–2013)

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	Microprocessor 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	Microprocessor and Peripherals Laboratory	--	02	--	--	01	--	01
ETL403	SSW 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	Microprocessor 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	50	--	75
ETL402	Microprocessor and Peripherals Laboratory	--	--	--	--	25	50	--	75
ETL403	SSW Laboratory	--	--	--	--	25	25	--	50
Total		**--**	**--**	**120**	**480**	**125**	**125**	**--**	**850**

Subject Code	Subject Name	Teaching Scheme			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 Objective:
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 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.

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 Engg. problem using Applied Mathematics.
- Students who can participate and succeed in competitive exams like GATE, GRE.

Module No.	Unit No.	Topics	Hrs.
1. 0	**1. 0**	**Calculus of Variation**	**10**
	1.1	Euler's 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	**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	**3.0**	**Linear Algebra: Matrix Theory**	**15**
	3.1	Characteristic equation, Eigen values and Eigen vectors, properties of Eigen values and Eigen vectors	
	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	**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.
5: Weightage of marks will be as per Blueprint.

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			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Practical	Tutorial	Total
ETC 402	Analog Electronics II	4	--	--	4	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 402	Analog Electronics II	20	20	20	80	25	50	--	175

Course Pre-requisite:

ETC : 302 – Analog Electronics I

Course Objective:

- To deliver the core concepts and reinforce the analytical skills learned in Electronic Devices and Circuits-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	**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 of multistage (CE-CE, CS-CS), cascode (CE-CB, CS-CG) Amplifiers, Darlington pair, design of two stage Amplifiers	
2	**2**	**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	
		MOSFET Differential Amplifiers: DC Transfer characteristics, Small signal Analysis, differential and common mode gain, CMRR, differential and common mode input impedance	
3.0	**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 source	
4.0	**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	**5.0**	**Fundamentals of Operational Amplifier**	**08**
	5.1	**Fundamentals of Op-amp:** characteristics of op-amp, ideal and non ideal properties, High frequency effects on op-amp gain and phase, frequency response, Slew rate limitation,	
	5.2	**Linear and Nonlinear Circuits Operations of op-amps:** adder, abstractor, multiplier Circuits, integrator, differentiator, active filters(first order low and high pass)	
6.0	**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 Edition

Recommended Books:

1. Electronic Devices and Circuits Salivan
2. Electronic Devices and Circuits Jacob Millima
3. Electronic Devices and Circuits Rashid

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.
5: Weightage of marks will be as per Blueprint.

Subject Code	Subject Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/ Practical	Tutorial	Total
ETC 402	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					
ETC 402	Analog Electronics II Laboratory	--	--	--	--	25	50	--	75

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 / Oral examination will be based on entire syllabus.

Subject Code	Subject Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ETC 403	Microprocessor and Peripherals	4	--	--	4	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					
ETC403	Microprocessor and Peripherals	20	20	20	80	25	50	-	175

Course Pre-requisite:

ETC 303 : Digital Electronics

Course Objective

- 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 Outcome

- To impart knowledge on the architecture and software aspects of microprocessor 8086
- To write assembly language program in 8086 for various application.
- To provide a framework on the co-processor configurations.
- To create the various interfacing techniques with 8086 for various application.
- To give an overview on the architecture and 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 system design.**	**10**
	5.1	8087 Math coprocessor, its data types and interfacing with 8086.	
	5.2	Memory interfacing with 8086.	
6.0		**Advanced Microprocessor**	**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.
5: Weightage of marks will be as per Blueprint.

Subject Code	Subject Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ETC 403	Microprocessor and Peripherals Laboratory	--	01	--	01	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					
ETC403	Microprocessor and Peripherals Laboratory	--	--	--	--	25	50	-	75

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 / Oral examination will be based on entire syllabus.

Subject Code	Subject Name	Teaching Scheme (Hrs)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ETC 404	Wave Theory and Propagation	4	--	--	4	--	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					
ETC 404	Wave Theory and Propagation (WTP)	20	20	20	80	--	-	-	100

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 Prepogation, 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.
5: Weightage of marks will be as per Blueprint.

Subject Code	Subject Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ETC 406	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 406	Signals and Systems	20	20	20	80	25	--	--	125

Course Pre-requisite :

ETS : 301 : Applied Mathematics III
ETC : 204 : Circuits and Transmission Lines

Course Objective:

- 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
- Students will be able to conduct experiments 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	**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 continuous time LTI systems using Laplace Transform:** Transfer Function, causality and stability of systems, solution of Differential Educations 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.	
	4.3	**Fourier series of continuous and discrete time signals**	
5.0		**Fourier Series**	**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).	
	5.3	Continuous Time Fourier Transform (CTFT) and Discrete Time Fourier Transform (DTFT)	
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.
5: Weightage of marks will be as per Blueprint.

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			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ETC 405	Control Systems	04	02	--	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

Pre-requisite Topics*:*
Dynamics; Differential Educations; Laplace Transforms.

Course Objective:
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**	**10**
	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**	**06**
	4.1	**Concepts of Stability:** Concept of absolute, relative and robust stability; Routh stability criterion. ; Lag compensator; Lead compensator.	
	4.2	**Root Locus Analysis:** Root-locus concepts; General rules for constructing root-locus; Root-locus analysis of control systems.	
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**	**12**
	6.1	**Optimal control:** Performance measure for optimal control problems, the principle of optimality, concept of dynamic programming, Hamilton-Jacobi-Bellman Equation, Fundamental of a single Function, Functions involving several independent Functions, constrained minimization of Functions	
	6.2	**Adaptive Control Systems:** model reference 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",*** IIIrd edition.
3. 3.2.Benjamin C.Kuo, ***"Automatic Control Systems, Eearson education"***, VIIth edition.

Reference Books:

1. Madam Gopal, Control Systems Principles and Design, Tata McGraw hill, seventh edition,1997.
2. Normon, Control System Engineering, John Wiley & sons, 3rd edition.
3. Curtis Johnson, Process Control Instrumentation Technology, Pearson education fourth 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 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.
5: Weightage of marks will be as per Blueprint.

Subject Code	Subject Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ETL 403	SSW 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	SSW Laboratory	--	--	--	--	25	25	-	50

Objectives

- Students will demonstrate an ability to design a system, components or process as per needs and specifications.
- Students will demonstrate an ability to visualize and work on laboratory and multi disciplinary task.
- Students will demonstrate 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, 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. It is advisable to use required application softwares for simulation based experiments. Use open source software should be encouraged.

Oral examination will be based on simulation experiments.