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UNIVERSITYOFMUMBAI

Revised syllabus (Rev- 2016) from Academic Year 2016 -17
Under

FACULTY OF TECHNOLOGY

Electronics Engineering

Second Year with Effect from **AY 2017-18**
Third Year with Effect from **AY 2018-19**
Final Year with Effect from **AY 2019-20**

As per **Choice Based Credit and Grading System**
With effect from the AY 2016–17

Co-ordinator, Faculty of Technology's 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). It is also resolved that course objectives and course outcomes are 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.

Choice 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 2-3 weeks to be utilized for revision, guest lectures, coverage of content beyond syllabus etc.

Choice based Credit and grading system is implemented from the academic year 2016-17 through optional courses at department and institute level. This will be effective for SE, TE and BE from academic year 2017-18, 2018-19 and 2019-20 respectively.

Dr. S. K. Ukarande
Co-ordinator,
Faculty of Technology,
Member - Academic Council
University of Mumbai, Mumbai

Chairman's Preamble:

Quality of education is one of the major factors to contribute to the growth of a nation and subsequently quality of education is largely decided by the syllabi of the Educational Programme and its proper implementation. In order to make B.E (Electronics) Engineering programme of University of Mumbai rich in quality, revision of the syllabi is being undertaken as per the guidelines of University of Mumbai. While deciding the core courses and department level optional courses, inputs from various stake holders were taken into account. The exposure to the latest technology and tools used all over the world is given by properly selecting courses and their hierarchy in the programme curriculum. Thus this syllabus is made to groom the postgraduate students to be made competent in all respect with best possible efforts put in by the experts in framing detailed contents of individual courses.

I, as Chairman, Board of Studies in Electronics Engineering University of Mumbai, am happy to state here that, heads of the department and senior faculty from various institutes took timely and valuable initiative to frame the Program Educational Objectives as listed below as per National Board of Accreditation (NBA) guidelines.

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 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 strongly believe that small step taken in right direction will definitely help in providing quality education to the stake holders.

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 engineering.

Dr.Sudhakar S. Mande

Chairman, Board of Studies in Electronics Engineering, University of Mumbai

S.E. (Electronics Engineering) – Semester III

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ELX301	Applied Mathematics III	04	---	01@	04	---	01	05
ELX302	Electronic Devices and Circuits I	04	---	---	04	---	---	04
ELX303	Digital Circuit Design	04	---	---	04	---	---	04
ELX304	Electrical Network Analysis and Synthesis	04	---	---	04	---	---	04
ELX305	Electronics Instruments and Measurement	04	---	---	04	---	---	04
ELXL301	Electronic Devices and Circuits I Laboratory		02	---	---	01	---	01
ELXL302	Digital Circuit Design Laboratory		02	---	---	01	---	01
ELXL303	Electrical Network and Measurement Laboratory		02	---	---	01	---	01
ELXL304	Object Oriented Programming Methodology Laboratory		02+02#	---	---	02	---	02
	Total	**20**	**10**	**01**	**20**	**05**	**01**	**26**

@1 hour tutorial classwise

#02 hours classwise and 02 hours batchwise

Course Code	Course Name	Examination Scheme – Semester III							
		Theory					Term Work	Oral /Prac	Total
		Internal Assessment (IA)			End Sem Exam Marks	Exam Duration (Hours)			
		Test I	Test II	AVG.					
ELX301	Applied Mathematics III	20	20	20	80	03	25	---	125
ELX302	Electronic Devices and Circuits I	20	20	20	80	03	---	---	100
ELX303	Digital Circuit Design	20	20	20	80	03	---	---	100
ELX304	Electrical Network Analysis and Synthesis	20	20	20	80	03	---	---	100
ELX305	Electronic Instruments and Measurements	20	20	20	80	03	---	---	100
ELXL301	Electronic Devices and Circuits I Laboratory						25	25	50
ELXL302	Digital Circuit Design Laboratory						25	25	50
ELXL303	Electrical Network and Measurement Laboratory						25	---	25
ELXL304	Object Oriented Programming Methodology Laboratory						25	25	50
Total		**100**	**100**	**100**	**400**	**15**	**125**	**75**	**700**

Course Code	Course Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Practical	Tutorial	Total
ELX301	Applied Mathematics III	04	--	01	04	--	01	05

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Oral &Practical	Total
		Internal assessment			End Sem. Exam			
		Test1	Test 2	Avg.				
ELX301	Applied Mathematics III	20	20	20	80	25	--	125

Prerequisite:

FEC 101: Applied Mathematics I
FEC 201: Applied Mathematics II

Course objectives:

1. To build the strong foundation in Mathematics of students needed for the field of Electronics and Telecommunication Engineering
2. To provide students with mathematics fundamentals necessary to formulate, solve and analyses complex engineering problems.
3. To prepare student to apply reasoning informed by the contextual knowledge to engineering practice.
4. To prepare students to work as part of teams on multi-disciplinary projects.

Course outcomes:

1. Students will be able demonstrate basic knowledge of Laplace Transform. Fourier series, Bessel Functions, Vector Algebra and Complex Variable.
2. Students will be able to identify and model the problems in the field of Electronics and Telecommunication Engineering with feasible and practical solution.
3. Students will be able to apply the application of Mathematics in Electronics and Telecommunication Engineering.

Module No	Unit No.	Topic	No of Contact Hour
1	**Laplace Transform**		7
	1.1	**Laplace Transform (LT) of Standard Functions:** Definition of Laplace transform, Condition of Existence of Laplace transform, Laplace transform of $e^{at}, Sin(at), \cos(at), \sinh(at), \cosh(at), t^n$ Heaviside unit step function, Dirac-delta function, Laplace transform 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, Evaluation of integrals using Laplace transform.	
2	**Inverse Laplace Transform & its Applications**		6
	2.1	Partial fraction method, Method of convolution, Laplace inverse by derivative	
	2.2	**Applications of Laplace Transform:** Solution of ordinary differential equations, Solving RLC circuit differential equation of first order and second order with boundary condition using Laplace transform (framing of differential equation is not included)	
3	**Fourier Series**		11
	3.1	**Introduction:** Orthogonal and orthonormal set of functions, Introduction of Dirichlet's conditions, Euler's formulae	
	3.2	**Fourier Series of Functions:** Exponential, trigonometric functions of any period =2L, even and odd functions, half range sine and cosine series	
	3.3	Complex form of Fourier series, Fourier integral representation, Fourier Transform and Inverse Fourier transform of constant and exponential function.	
4	**Vector Algebra & Vector Differentiation**		7
	4.1	**Review of Scalar and Vector Product**: Scalar and vector product of three and four vectors, Vector differentiation, Gradient of scalar point function, Divergence and Curl of vector point function	
	4.2	**Properties:** Solenoidal and irrotational vector fields, conservative vector field	
5	**Vector Integral**		6
	5.1	Line integral	
	5.2	Green's theorem in a plane, Gauss' divergence theorem and Stokes' theorem	
6	**Complex Variable & Bessel Functions**		11
	6.1	**Analytic Function:** Necessary and sufficient conditions (No Proof), Cauchy Reiman equation Cartesian form (No Proof) Cauchy Reiman Equation in polar form (with Proof), Milne Thomson Method and it application, Harmonic function, orthogonal trajectories	
	6.2	**Mapping:** Conformal mapping, Bilinear transformations, cross ratio, fixed points	

	6.3	**Bessel Functions:** Bessel's differential equation, Properties of Bessel function of order +1/2 and -1/2, Generating function, expression of cos(xsin θ), sin (x sin θ) in term of Besselfunctions	
		Total	**48**

Text books:

1. H.K. Das, "*Advanced engineering mathematics*", S . Chand, 2008
2. A. Datta, *"Mathematical Methods in Science and Engineering",* 2012
3. B.S. Grewal, *"Higher Engineering Mathematics",* Khanna Publication

Reference Books:

1. B. V. Ramana, *"Higher Engineering Mathematics",* Tata Mc-Graw Hill Publication
2. Wylie and Barret, *"Advanced Engineering Mathematics",* Tata Mc-Graw Hill 6th Edition
3. Erwin Kreysizg, *"Advanced Engineering Mathematics",* John Wiley & Sons, Inc
4. 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.
5. Weightage of each module in question paper will be proportional to the number of respective lecture hours mentioned in the syllabus.

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.

Course Code	Course Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Practical	Tutorial	Total
ELX302	Electronic Device and Circuits I	04	--	--	04	--	--	04

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Oral &Practical	Total
		Internal assessment			End Sem. Exam			
		Test1	Test 2	Avg.				
ELX302	Electronic Device and Circuits I	20	20	20	80	-	-	100

Course Objectives:

1. To deliver the knowledge about physics of basic semiconductor devices and circuits.
2. To enhance comprehension capabilities of students through understanding of electronic devices and circuits
3. To introduce and motivate students to the use of advanced microelectronic devices
4. To analyze and design electronic circuits using semiconductor devices.

Course Outcomes:

1. Students will be able to explain working of semiconductor devices.
2. Students will be able to analyze characteristics of semiconductor devices.
3. Students will be able to perform DC and AC analysis of Electronics circuits.
4. Students will be able to compare various biasing circuits as well as various configurations of BJT,JFET and MOSFETs.
5. Students will be able to select best circuit for the given specifications/application.
6. Students will be able to design electronics circuits for given specifications.

Module No.	Unit No.	Topics	Hours
1		**PN junction Diode Analysis and applications.**	**08**
	1.1	PN junction Diode: Basic Structure, Energy Band Diagrams, Zero Applied Bias, Forward bias, Reverse bias, PN junction current, drift and diffusion current, junction capacitance, , DC load line, small signal model , Applied Bias, Reverse Applied Bias, temperature effects.	
	1.2	Clippers and Clampers	
2		**Bipolar Junction Transistor**	**12**
	2.1	BJT operations, voltages and currents, BJT characteristics (CE, CB, CC configurations) , early effect	
	2.2	DC Circuit Analysis: DC load line and region of Operation, Common Bipolar Transistor Configurations, biasing circuits, bias stability and compensation, analysis and design of biasing circuits.	
	2.3	AC Analysis of BJT Amplifiers : AC load line, small signal models (h-parameter model, re model, Hybrid-pi model), graphical analysis, ac equivalent circuits and analysis to obtain voltage gain, current gain, input impedance, output impedance of CE,CB and CC amplifiers	
3		**Field Effect Devices**	**10**
	3.1	JFET: Construction, operation and characteristics. MOSFET: Construction, operation and characteristics of D-MOSFET and E-MOSFET.	
	3.2	DC Circuit Analysis : DC load line and region of operation, Common-MOSFETs configurations, Analysis and Design of Biasing Circuits	
	3.3	AC Analysis: AC load line, Small-Signal model of MOSFET and its equivalent Circuit, Small-Signal Analysis MOSFET Amplifiers (Common-Source, Source Follower, Common Gate)	
4		**Special semiconductor devices – I**	**06**
	4.1	Construction, working and characteristics of : Zener diode, Schottkey diode, Varactor diode, Tunnel diode, Solar Cells, Photodiodes, LEDs	
5		**Rectifiers and Regulators**	**06**
	5.1	Rectifiers: working and analysis of Half wave, Full wave and Bridge	
	5.2	Filters: C,L,LC, pi	
	5.3	Regulators: Zener shunt regulator, Series and shunt regulator using single transistor and Zener	
6		**Design of electronic circuits**	**06**
	6.1	Design of single stage CE amplifier	
	6.2	Design of single stage CS MOSFET amplifier	
	6.3	Design of full wave rectifier with LC and pi filter.	
		Total Hours	**48**

Text Books:

1. Millman and Halkies, "Integrated Electronics", TATA McGraw Hill.

2. Donald A. Neamen, "Electronic Circuit Analysis and Design", TATA McGraw Hill, 2nd Edition

Reference Books:

1. Boylestad," Electronic Devices and Circuit Theory", Pearson
2. David A. Bell, "Electronic Devices and Circuits", Oxford, Fifth Edition.
3. Muhammad H. Rashid, "Microelectronics Circuits Analysis and Design", Cengage
4. S. Salivahanan, N. Suresh Kumar,"Electronic Devices and Circuits", Tata McGraw Hill,
5. Adel S. Sedra, Kenneth C. Smith and Arun N Chandorkar,"
6. Microelectronic Circuits Theory and Applications", International Version, OXFORD International Students Edition, Fifth Edition.

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 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 questions (Q2 to Q6) will be set from all modules.
5. Weightage of each module in question paper will be proportional to the number of respective lecture hours mentioned in the syllabus.

Course Code	Course Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Practical	Tutorial	Total
ELX303	Digital Circuit Design	04	--	--	04	--	--	04

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Oral &Practical	Total
		Internal assessment			End Sem. Exam			
		Test1	Test 2	Avg.				
ELX303	Digital Circuit Design	20	20	20	80	-	-	100

Course Objective:

1. To understand various number representations and conversion between different representation in digital electronic circuits.
2. To introduce the students to various logic gates, SOP,, POS and their minimization techniques.
3. To analyze logic processes and implementation of logical operations using combinational logic circuits.
4. To explain and describe various logic families and provide information on different IC's.
5. To understand, analyze and design sequential circuits.

Course Outcomes:

1. Students will be able to perform various logical and arithmetic operations various number systems as well as conversion of one representation to another.
2. Students will be able to apply Boolean algebra for the implementation and minimization of logic functions.
3. Students will be analyze, design and implement combinational logic circuits.
4. Students will be able to differentiate between logic families TTL and CMOS.
5. Students will be able to analyze, design and implement sequential logic circuits.

Module No.	Topics	Hrs.
1	**Number Systems and Codes:**	06
	Review of Number System, Binary Code, Binary Coded Decimal, Octal Code, Hexadecimal Code and their conversions, Binary Arithmetic: One's and two's complements,Excess-3 Code, Gray Code, Weighted code, Parity Code: Hamming Code	
2	**Logic Gates and Boolean Algebra:**	08
	Digital logic gates, Realization using NAND, NOR gates, Boolean Algebra, De Morgan's Theorem, SOP and POS representation, K Map up to four variables and Quine-McClusky method upto four variables	
3	**Combinational Logic Circuits and Hazards**	12
	Arithmetic Circuits: Adders/Subtractors:Half adder, Full adder, Half Subtractor, Full Subtractor, Ripple carry adder, Carry Look ahead adder and BCD adder, Magnitude Comparator	
	Multiplexer and De-multiplexer: Multiplexer, cascading of Multiplexer, Boolean Function implementation using single multiplexer and basic gates, De-multiplexer, encoder and decoder, Parity Circuits, ALU	
	Hazards: Timing hazards static and dynamic	
4	**Logic Families:**	06
	Basics of standard TTL (Two input NAND gate operation), CMOS (Inverter, Two input NAND gate, Two input NOR gate), Interfacing of TTL to CMOS and CMOS to TTL, ECL, Working and characteristics of logic families	
5	**Sequential Logic Principles:**	08
	Latches and Flip flops: Difference between latches and flip flops, RS, JK, Master slave flip flops, T & D flip flops with various triggering methods, Conversion of flip flops, Applications of latches and flip flops in switch debouncing, bus holder circuits, Flip flops timing considerations and Metastability	
6	**Counters and Registers:**	08
	Asynchronous and Synchronous, Up/Down, Johnson Counter, MOD N, BCD counter using Decade counter, Ring counters, Shift registers, Universal Shift Register	
Total		**48**

Text Books:

1. R. P. Jain, Modern Digital Electronics, Tata McGraw Hill Education, Third Edition 2003.
2. John F. Warkerly, Digital Design Principles and Practices, Pearson Education, Fourth Edition, 2008.

Reference Books:

1. A. Anand Kumar, Fundamentals of Digital Circuits, PHI, Fourth Edition, 2016.
2. Morris Mano / Michael D. Ciletti , Digital Design, Pearson Education, Fourth Edition, 2008.
3. Donald P. Leach / Albert Paul Malvino / Gautam Saha, Digital Principles and Applications, The McGraw Hill, Seventh Edition, 2011.
4. Thomas L. Floyd, Digital Fundamentals, Pearson Prentice Hall, Eleventh Global Edition, 2015.
5. Charles H. Roth, Fundamentals of Logic Design, Jaico Publishing House, First Edition, 2004.
6. Norman Balabanian/ Bradley Carlson, Digital Logic Design Principles, John Wiley & 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 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 questions (Q2 to Q6) will be set from all modules.
5. Weightage of each module in question paper will be proportional to the number of respective lecture hours mentioned in the syllabus.

Course Code	Course Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Practical	Tutorial	Total
ELX304	Electrical Network Analysis and Synthesis	04	--	--	04	--	--	05

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Oral &Practical	Total
		Internal assessment			End Sem. Exam			
		Test1	Test 2	Avg.				
ELX304	Electrical Network Analysis and Synthesis	20	20	20	80	-	-	100

Course Pre-requisites:

- FEC105**:** Basic Electrical Engineering
- Partial fraction expansion, matrices, calculus and Laplace Transforms.

Course Objectives:

1. To make the students understand DC and AC electrical networks and analyze the Networks in time and frequency domain.
2. To understand synthesis of electrical networks and study various filters.

Course Outcome:

1. Students will be able to apply their understanding of network theorems in analyzing complex circuits.
2. Students will be able to evaluate the time and frequency response of electrical circuits and thereby understand the behaviour of electrical networks.
3. Students will be able to evaluate the inter-relationship among various circuit parameters and solve complex networks using these parameters.
4. Students will be able to synthesize electrical networks for a given network function and design simple filters.

Module No.	Unit No.	Topics	Hours
1		**Analysis of DC Circuits**	**06**
	1.1	**DC Circuit Analysis:** Analysis of DC circuits with dependent sources using generalized loop, node matrix analysis.	
	1.2	**Application of Network Theorems to DC Circuits**: Superposition, Thevenin, Norton, Maximum Power Transfer and Millman theorems.	
2		**Analysis of AC Circuits**	**08**
	2.1	**Analysis of Steady State AC circuits:** Analysis of AC circuits with independent sources using generalized loop, node matrix analysis.	
	2.2	**Application of Network Theorems to AC Circuits**: Superposition, Thevenin, Norton, Maximum Power Transfer and Millman theorems.	
	2.3	**Analysis of Coupled Circuits:** Self and mutual inductances, coefficient of coupling, dot convention, equivalent circuit, solution using loop analysis.	
3		**Time and Frequency Domain Analysis of Electrical Networks**	**12**
	3.1	**Time domain analysis of R-L and R-C circuits:** Forced and natural responses, time constant, initial and final values.	
	3.2	**Solution using first order equation for standard input signals:** Transient and steady state time response, solution using universal formula.	
	3.3	**Frequency domain analysis of RLC circuits:** S-domain representation, Concept of complex frequency, applications of Laplace Transform in solving electrical networks, Driving point and Transfer Function, Poles and Zeros, calculation of residues by analytical and graphical method.	
4		**Two Port Networks**	**08**
	4.1	**Parameters:** Open Circuit, Short Circuit, Transmission and Hybrid parameters, relationships among parameters, reciprocity and symmetry conditions	
	4.2	**Series/parallel connection:** T and Pi representations, interconnection of Two-Port networks.	
5		**Synthesis of RLC Circuits**	**08**
	5.1	**Positive Real Functions:** Concept of positive real function, testing for Hurwitz polynomials, testing for necessary and sufficient conditions for positive real functions.	
	5.2	**Synthesis of RC, RL, LC circuits:** Concepts of synthesis of RC, RL, LC driving point **f**unctions.	
6		**Filters**	**06**
	6.1	**Basic filter circuits:** Low pass, high pass, band pass and band stop filters, transfer function, frequency response, cut-off frequency, bandwidth, quality factor, attenuation constant, phase shift, characteristic impedance.	
	6.2	**Design and analysis of filters:** Constant K filters	

Text Books:

1. *Circuits and Networks: Analysis and Synthesis,* A. Sudhakar and S.P. Shyammohan, Tata McGraw-Hill Publishing Company Ltd.

2. *Engineering Circuit Analysis*, William Hayt and Jack Kemmerly, McGraw-Hill.

Reference Books:

1. *Networks and Systems*, D.Roy Choudhury, New Age International Publications.
2. *Network Analysis and Synthesis*, Franklin F. Kuo, Wiley.
3. *Network Analysis*, M.E.VanValkenburg, 3/E, PHI.
4. *Shaum's Outline of Theory and Problems of Basic Circuit Analysis*, John O'Malley, McGraw-Hill.

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 as final IA marks.

End Semester Examination:

- Question paper will comprise of 6 questions, each carrying 20 marks.
- The students need to solve total 4 questions.
- Question No. 1 will be compulsory and based on the entire syllabus.
- Remaining questions (Question No. 2 to 6) will be set from all the modules.
- Weightage of each module in question paper will be proportional to the number of respective lecture hours mentioned in the syllabus.

Course Code	Course Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Practical	Tutorial	Total
ELX305	Electronic Instruments and Measurements	04	--	--	04	--	--	04

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Oral &Practical	Total
		Internal assessment			End Sem. Exam			
		Test1	Test 2	Avg.				
ELX305	Electronic Instruments and Measurements	20	20	20	80	-	-	100

Course Objectives

1 To impart in-depth knowledge of measurement methods & instruments of electrical quantities

2 To explain the design aspect & performance criterion for measuring instruments

3 To understand the working principle of transducers

Course Outcomes

1 Students will be able to describe the static & dynamic characteristics of an instrument, components of general instrumentation system & different types of errors in the measurement process

2 Students will be analyze various test & measuring instruments including AC and DC bridges to determine the unknown quantity under measurement

3 Students will be able to use cathode ray oscilloscope (CRO) to perform wide range of simple to complex measurement functions for voltage, current, frequency, phase & component testing

4 Students will be able to select choice of transducer for practical & real-life applications based on their principle of operation, working, construction & characteristics

Module No	Unit No	Topic	Hours
1		**Principles of Measurements**	06
	1.1	**Principles of Measurements & Instrumentation** :- Components of a generalized measurement system, applications of instrument systems & revision of SI electrical units (units of current, charge, EMF, potential difference, voltage, resistance, conductance, magnetic flux & flux density, inductance & capacitance)	
	1.2	**Performance Characteristics** :- Static characteristics (accuracy, precision, linearity, drift, sensitivity, calibration, repeatability, reproducibility, resolution, hysteresis & dead band zone) & dynamic characteristics (speed of response, fidelity, lag & dynamic error)	
	1.3	**Errors in Measurement :-** Errors in measurement, classification of errors, remedies to eliminate or to minimize errors, statistical analysis of errors	
2		**Measurement of R, L and C**	08
	2.1	**Measurement of Resistance :-** Measurement of low, medium & high resistances by using Wheatstone bridges, Kelvin's Double bridge & mega-ohm meter (megger)	
	2.2	**Measurement of Inductance & Capacitance :-** Inductance & capacitance comparison bridge, Maxwell's bridge, Hay's bridge, Schering's bridge, Wien's bridge & LCR Q Meter	
3		**Oscilloscopes**	10
	3.1	**Cathode Ray Oscilloscope** :- Block diagram based study of CRO, control & specifications, sweep mode, role of delay line, single & dual beam, dual-trace CRO, chop & alternate modes	
	3.2	**Measurement using Oscilloscope :-** Measurement of voltage, frequency, rise time, fall time & phase difference, Lissajous figures in detecting phase & frequency difference	
	3.3	**Digital Storage Oscilloscope :-** Features like roll, refresh, storage mode & sampling rate, applications of DSO	
4		**Analog and Digital Instruments**	08
	4.1	**Digital Instruments :-** DVM (ramp, dual-slope, integrating & successive approximation), Digital multimeter, Digital frequency meter, Digital phase meter, Digital time measurement	
	4.2	**Signal Generators :-** Low frequency signal generator, function generator, pulse generator, RF signal generator & sweep frequency generators	
	4.3	**Wave Analyzer :-** Basic wave analyzer, frequency selective & heterodyne	

		wave analyser, harmonic distortion analyzer & spectrum analyzer	
5		**Transducers for Displacement and Temperature Measurement**	**08**
	5.1	**Basics of Transducers / Sensors :-** Characteristics of transducers & sensors, requirements of transducers, classification of transducers, criteria for selection of transducers	
	5.2	**Temperature :-** Resistance temperature detector (RTD), thermistor, thermocouple, their range & applications, comparison of RTD, thermistor & thermocouple	
	5.3	**Displacement :-** Potentiometers, linear variable differential transformer (LVDT), resistance strain gauges, capacitance sensors	
6		**Transducers for Pressure, Level and Flow Measurements**	**08**
	6.1	**Pressure :-** Pressure gauges, elastic pressure transducers, dead weight tester, vacuum pressure measurement – McLeod gauge & Pirani gauge	
	6.2	**Level :-** Side glass tube method, float type methods, capacitance type methods, ultrasonic type transducers, optical level detectors	
	6.3	**Flow :-** Restriction type flow meter – orifice & venturi, rotameter, magnetic type flow meter, turbine flow meter, rotameters	
		Total	**48**

Text books:

1. David A. Bell, Electronic Instrumentation & Measurements, Oxford Publishing, 2nd edition
2. H. S. Kalsi, Electronic Instrumentation, McGraw Hill, 4th edition

Reference Books:

1. C. S. Rangan, G.R. Sarma, V.S.V. Mani, Instrumentation Devices and Systems, Tata McGraw Hill, 9th edition.
2. A. K. Sawhney, Electrical & Electronic Instruments & Measurement, Dhanpat Rai & Sons, 11th edition
3. S. K. Singh, Industrial Instrumentation & Control, McGraw Hill, 3rd edition

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 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 questions (Q2 to Q6) will be set from all modules.

5. Weightage of each module in question paper will be proportional to the number of respective lecture hours mentioned in the syllabus.

Course Code	Course Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Practical	Tutorial	Total
ELXL301	Electronic Device and Circuits I Laboratory	--	02	--	--	01	--	01

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Oral &Practical	Total
		Internal assessment			End Sem. Exam			
		Test1	Test 2	Avg.				
ELXL301	Electronic Device and Circuits ILaboratory	--	--	--	--	25	25	50

Term Work:

At least 6 experiments covering entire syllabus of ELX 302 (Electronic Devices and Circuits I) 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. Simulation experiments are also encouraged. Experiment must be graded from time to time. Also each student (in group of 3/4) has to perform a ***Mini Project*** as a part of the laboratory and report of mini project should present in laboratory journal. The grades should be converted into marks as per the Credit and Grading System manual and should be added and averaged. The grading and term work assessment should be done based on this scheme. The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work. Practical and Oral exam will be based on the entire syllabus. Equal weightage should be given to laboratory experiments and project while assigning term work marks.

Suggested List of Experiments, however Instructor is free to design his/her own experiments as per the guidelines

Laboratory Experiments

1. To study passive(R,L,C) and active (BJT,MOSFTET) components
2. To study equipment (CRO, Function Generator,Power supply).
3. To perform characteristics of PN junction diode.
4. To perform Clippers and Clampers.
5. To perform analysis and design Fixed bias,voltage divider bias for CE amplifier.
6. To perform CE amplifier as voltage amplifier (Calculate Av,Ai,Ri,Ro).
7. To perform CS MOSFET amplifier as voltage amplifier and measurment of its performance parametes.
8. To perform Half wave/Full wave/Bridge rectifier with LC/pi filter.
9. To perform Zener as a shunt voltage regulator.
10. To design Half wave/Full wave/Bridge rectifier with LC/pi filter.

11. To design single stage CE Amplifier.
12. To design single stage CS Amplifier.

Guidelines for Simulation Experiments

1. SPICE simulation of and implementation for junction analysis
2. SPICE simulation of and implementation for BJT characteristics
3. SPICE simulation of and implementation for JFET characteristics
4. SPICE simulation of for MOSFET characteristics
5. SPICE simulation of Half wave/Full wave/Bridge rectifier with LC/pi filter.
6. SPICE simulation of CE amplifier
7. SPICE simulation of CS MOSFET amplifier.

Course Code	Course Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Practical	Tutorial	Total
ELXL302	Digital Circuit Design Laboratory	--	02	--	--	01	--	01

Subject Code	Subject Name	Examination Scheme						
		Theory Marks				Term Work	Oral &Practical	Total
		Internal assessment			End Sem. Exam			
		Test1	Test 2	Avg.				
ELXL302	Digital Circuit Design Laboratory	--	--	--	--	25	25	50

Term Work:

At least 6 experiments covering entire syllabus of ELX 303 (Digital Circuit Design)
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. Simulation experiments are also encouraged. Experiment must be graded from time to time. Also each student (in group of 3/4) has to perform a ***Mini Project*** as a part of the laboratory and report of mini project should present in laboratory journal. The grades should be converted into marks as per the Credit and Grading System manual and should be added and averaged. The grading and term work assessment should be done based on this scheme. The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work. Practical and Oral exam will be based on the entire syllabus. Equal weightage should be given to laboratory experiments and project while assigning term work marks.

Suggested List of Experiments, however Instructor is free to design his/her own experiments as per the guidelines

Laboratory Experiments

1. Verify different logic gates.
2. Simplification of Boolean functions.
3. Verify Universal gates NAND and NOR and design EXOR and EXNOR gates using Universal gates.
4. Implement Half adder, Full adder, Half subtractor and Full subtractor circuits.
5. Implement BCD adder using four bit binary adder IC-7483.
6. Flip flops conversion JK to D, JK to T and D to TFF.
7. Implement logic equations using Multiplexer.
8. Design synchronous MOD N counter using IC-7490.
9. Verify encoder and decoder operations.
10. Implement digital circuits to perform binary to gray and gray to binary operations.
11. Verify truth table of different types of flip flops.
12. Verify different counter operations.
13. Verify operations of shift registers.
14. Implement parity checker circuit.

Course Code	Course Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Practical	Tutorial	Total
ELXL303	Electrical Networks and Measurements Laboratory	--	02	--	--	01	--	01

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Oral &Practical	Total
		Internal assessment			End Sem. Exam			
		Test1	Test 2	Avg.				
ELXL303	Electrical Network and Measurement Laboratory	--	--	--	--	25	--	25

Term Work:

At least 5 experiments covering entire syllabus of ELX 305 (Electronic Instruments and Measurements) should be set to have well predefined inference and conclusion and minimum of five tutorials covering entire syllabus of ELX304 (Electrical Network Analysis and Synthesis) with each tutorial shall have a minimum of four numerical problems solved and duly assessed. Simulation based tutorials shall be based using any circuit simulation tool like Spice/LTspice are encouraged. The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work.

Suggested List of Experiments for ELX305

1.To experimentally determine static characteristics of instruments & perform error analysis
2.To measure low & medium resistances using Kelvin's Bridge & Kelvin's Double Bridge
3.To measure high resistances using mega-ohm-meter (megger)
4.Study of CRO & understand various front panel controls
5.Study of function / signal generator & understand various front panel controls
6.Study of spectrum / wave analyser & understand various front panel controls
7.Study of linear variable differential transducer (LVDT)
8.Study of strain gauges
9.Study of thermistor characteristics
10.Study of RTD characteristics

Suggested topics (but not limited to) for tutorial for ELX304 are as follows:
1. Find Open circuit parameters, Short circuit parameters, Hybrid parameters of 2 port network.
2. Obtain the Frequency response of Low pass and High pass filters.
3. Find the time response of R-L and R-C circuits and obtain the time constants.
4. Study of dependent sources – Voltage controlled voltage source and Current controlled current source.
5. Verification of Superposition theorem and Thevenin's theorem in AC circuits.
6. Time response of a 2nd order system.

7. Calculation of driving point functions for various circuit topologies.
8. Simulation of initial/final conditions (switching) of RLC circuit with DC source on any circuit simulation platform.
9. Simulation of initial/final conditions (switching) of RLC circuit with AC source on any circuit simulation platform.

Course Code	Course Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/Practical	Tutorial	Total
ELXL304	Object Oriented Programming Methodology Laboratory	02 Classwise	02 Batchwise	--	--	02	--	02

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Oral &Practical	Total
		Internal assessment			End Sem. Exam			
		Test1	Test 2	Avg.				
ELXL304	Object Oriented Programming Methodology Laboratory	--	--	--	--	25	25	50

Prerequisite:
FEC205: Structured Programming Approach

Course Objective:
1.To learn the object oriented programming concepts.
2.To study various java programming concept like multithreading, exception handling, packages etc.
3.To explain components of GUI based programming.

Course Outcomes: At the end of the course Student should be able:
1.To apply fundamental programming constructs.
2.To illustrate the concept of packages, classes and objects.
3.To elaborate the concept of strings, arrays and vectors.
4.To implement the concept of inheritance and interfaces.
5.To implement the notion of exception handling and multithreading.
6.To develop GUI based application.

Module No	Unit No	Topic	Hours
1		**Introduction to Object Oriented Programming**	02
	1.1	OOP Concepts: Object, Class, Encapsulation, Abstraction, Inheritance, Polymorphism	
	1.2	Features of Java, JVM	
	1.3	3 Basic Constructs/Notions: Constants, variables and data types, Operators and Expressions, Revision of Branching and looping	
2		**Classes, Object and Packages**	05
	2.1	Class, Object, Method	
	2.2	Constructor, Static members and methods	
	2.3	Passing and returning Objects	
	2.4	Method Overloading	
	2.5	Packages in java, creating user defined packages, access specifiers.	
3		**Array, String and Vector**	04
	3.1	Arrays, Strings, String Buffer	
	3.2	Wrapper classes, Vector	
4		**Inheritance and Interface**	03
	4.1	Types of Inheritance, super keyword, Method Overriding, abstract class and abstract method, final keyword	
	4.2	Implementing interfaces, extending interfaces	
5		**Exception Handling and Multithreading**	04
	5.1	Error vs Exception, try, catch, finally, throw, throws, creating own exception	
	5.2	Thread lifecycle, Thread class methods, creating threads, Synchronization	
6		**GUI programming in JAVA**	
	6.1	Applet: Applet life cycle, Creating applets, Graphics class methods, Font and Color class, parameter passing.	
	6.2	Event Handling: Event classes and event listener	

	6.3	Introduction to AWT: Working with windows, Using AWT controls- push Buttons, Label, Text Fields, Text Area, Check Box, and Radio Buttons.	**08**
	6.4	Programming using JDBC: Introduction to JDBC, JDBC Drivers & Architecture.	
		Total	**26**

Text books:

1. Herbert Schildt, 'JAVA: The Complete Reference', Ninth Edition, Oracle Press.
2. Sachin Malhotra and Saurabh Chaudhary, "Programming in Java", Oxford University Press, 2010

Reference Books:

1. Ivor Horton, 'Beginning JAVA', Wiley India.
2. DietalandDietal, 'Java: How to Program', 8/e,PHI
3. 'JAVA Programming', Black Book, Dreamtech Press.
4. 'Learn to Master Java programming', Staredusolutions

Digital Material:

1. www.nptelvideos.in
2. www.w3schools.com
3. http://spoken-tutorial.org
4. www.staredusolutions.org

Suggested List of Programming Assignments/Laboratory Work:

1.Program on various ways to accept data through keyboard and unsigned right shift operator.
2.Program on branching, looping, labelled break and labelled continue.
3.Program to create class with members and methods, accept and display details for single object.
4.Program on constructor and constructor overloading
5.Program on method overloading
6.Program on passing object as argument and returning object
7.Program on creating user defined package
8.Program on 1D array
9.Program on 2D array
10.Program on String
11.Program on StringBuffer
12.Program on Vector
13.Program on single and multilevel inheritance (Use super keyword)
14.Program on abstract class
15.Program on interface demonstrating concept of multiple inheritance
16.Program on dynamic method dispatch using base class and interface reference.
17.Program to demonstrate try, catch, throw, throws and finally.
18.Program to demonstrate user defined exception
19.Program on multithreading
20.Program on concept of synchronization
21.Program on Applet to demonstrate Graphics, Font and Color class.

22.Program on passing parameters to applets
23.Program to create GUI application without event handling using AWT controls
24.Program to create GUI application with event handling using AWT controls
25.Mini Project based on content of the syllabus. (Group of 2-3 students)

Term Work:
At least 10-12 experiments covering entire syllabus of ELXL304 (Object Oriented Programming Methodology) 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. Experiment must be graded from time to time. Also each student (in group of 3/4) has to perform a **Mini Project** as a part of the laboratory and report of mini project should present in laboratory journal. The grades should be converted into marks as per the Credit and Grading System manual and should be added and averaged. The grading and term work assessment should be done based on this scheme. The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work. Practical and Oral exam will be based on the entire syllabus. Equal weightage should be given to laboratory experiments and project while assigning term work marks.

S.E. (Electronics Engineering) – Semester IV

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ELX401	Applied Mathematics IV	04	---	01@	04	---	01	05
ELX 402	Electronic Devices and Circuits II	04	---	---	04	---	---	04
ELX 403	Microprocessors and Applications	04	---	---	04	---	---	04
ELX 404	Digital System Design	04	---	---	04	---	---	04
ELX 405	Principles of Communication Engineering	04	---	---	04	---	---	04
ELX 406	Linear Control Systems	04	---	---	04	---	---	04
ELXL 401	Electronic Devices and Circuits II Lab.		02	---	---	01	---	01
ELXL 402	Microprocessors and Applications Lab.		02	---	---	01	---	01
ELXL 403	Digital System Design Lab.		02	---	---	01	---	01
ELXL 404	Principles of Communication Engineering Lab.		02	---	---	01	---	01
	Total	**24**	**08**	**01**	**24**	**04**	**01**	**29**

@1 hour tutorial classwise

Course Code	Course Name	Examination Scheme – Semester IV							
		Theory					Term Work	Oral /Prac	Total
		Internal Assessment (IA)			End Sem Exam Marks	Exam Duration (Hours)			
		Test I	Test II	AVG.					
ELX401	Applied Mathematics IV	20	20	20	80	3	25	---	125
ELX 402	Electronic Devices and Circuits II	20	20	20	80	3	---	---	100
ELX 403	Microprocessors and Applications	20	20	20	80	3	---	---	100
ELX 404	Digital System Design	20	20	20	80	3	---	---	100
ELX 405	Principles of Communication Engineering	20	20	20	80	3	---	---	100
ELX 406	Linear Control Systems	20	20	20	80	3	---	---	100
ELXL401	Electronic Devices and Circuits II Laboratory						25	25	50
ELXL402	Microprocessors and Applications Laboratory						25	25	50
ELXL 403	Digital System Design Laboratory						25	25	50
ELXL404	Principles of Communication Engineering Laboratory						25	--	50
Total		**120**	**120**	**120**	**480**	**18**	**100**	**75**	**800**