UNIVERSITY OF MUMBAI

Bachelor of Engineering

Bachelor of Electronics 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)

From Dean's Desk:

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

Faculty of Technology, University of Mumbai, in one of its meeting unanimously resolved that, each Board of Studies shall prepare some Program Educational Objectives (PEO's) and give freedom to affiliated Institutes to add few (PEO's) and course objectives and course outcomes to be clearly defined for each course, so that all faculty members in affiliated institutes understand the depth and approach of course to be taught, which will enhance learner's learning process. It was also resolved that, maximum senior faculty from colleges and experts from industry to be involved while revising the curriculum. I am happy to state that, each Board of studies has adhered to the resolutions passed by Faculty of Technology, and developed curriculum accordingly. In addition to outcome based education, semester based credit and grading system is also introduced to ensure quality of engineering education.

Semester based Credit and Grading system enables a much-required shift in focus from teacher-centric to learner-centric education since the workload estimated is based on the investment of time in learning and not in teaching. It also focuses on continuous evaluation which will enhance the quality of education. University of Mumbai has taken a lead in implementing the system through its affiliated Institutes and Faculty of Technology has devised a transparent credit assignment policy and adopted ten points scale to grade learner's performance.Credit assignment for courses is based on 15 weeks teaching learning process, however content of courses is to be taught in 12-13 weeks and remaining 3-2 weeks to be utilized for revision, guest lectures, coverage of content beyond syllabus etc.

Credit and grading based system was implemented for First Year of Engineering from the academic year 2012-2013. Subsequently this system will be carried forward for Second Year Engineering in the academic year 2013-2014, for Third Year and Final Year Engineering in the academic years 2014-2015 and 2015-2016 respectively.

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

Preamble:

The engineering education in India in general is expanding in manifolds. Now, the challenge is to ensure its quality to the stakeholders along with the expansion. To meet this challenge, the issue of quality needs to be addressed, debated and taken forward in a systematic manner. Accreditation is the principal means of quality assurance in higher education and reflects the fact that in achieving recognition, the institution or program of study is committed and open to external review to meet certain minimum specified standards. The major emphasis of this accreditation process is to measure the outcomes of the program that is being accredited. Program outcomes are essentially a range of skills and knowledge that a student will have at the time of graduation from the program. An engineering program must ensure that its graduates understand the basic concepts of science and mathematics, have gone through one engineering field in dept of appreciate and use its methodologies of analyses and design, and have acquired skills for lifelong learning.

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

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

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

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

In addition to Program Educational Objectives, for each course of undergraduate program, objectives and expected outcomes from learner's point of view are also included in the curriculum to support the philosophy of outcome based education. I believe strongly that small step taken in right direction will definitely help in providing quality education to the stake holders.

Dr. Dileep G. Borse
M. Tech. Ph. D. (E E with Specialization in Microelectronics) I I T Bombay
Chairman, Board of Studies in Electronics Engineering
University of Mumbai

SE Electronics Engineering
Semester III
Credit and Evaluation Scheme
Semester III

Sub Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical/TW	Tutorial	Total
EXS301	*Applied Mathematics III	04	--	01	04	--	01	05
EXC302	Electronic Devices	04		--	04	--	--	04
EXC303	Digital Circuits and Design	04		--	04	--	--	04
EXC304	Circuit Theory	04	--	--	04	--	--	04
EXC305	Electronic Instruments and Measurements	04	---	--	04	--	--	04
EXL301	Electronic Devices Laboratory	--	02	--	--	01	--	01
EXL302	Digital Circuits and Design Laboratory	--	02	--	--	01	--	01
EXL303	Circuit Theory and Measurements Laboratory	--	02	--	--	01	--	01
EXL304	*Object Oriented Programming Methodology Laboratory	--	02+02**	--	--	02	--	02
Total		20	10	01	20	04	01	26

*Common subject with EXTC, Electrical Engg. Instrumentation Engg, Biomedical Engg.
** 2 Hours be converted to theory for entire class and 2 hour for hands on practice.

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical and Oral	Oral	Total
		Internal Assessment			End Sem. Exam				
		Test 1	Test 2	Ave. of Test 1 and Test 2					
EXS301	*Applied Mathematics III	20	20	20	80	***25	--	--	125
EXC302	Electronic Devices	20	20	20	80	--	--	--	100
EXC303	Digital Circuits and Design	20	20	20	80	--	--	--	100
EXC304	Circuit Theory	20	20	20	80	--	--	--	100
EXC305	Electronic Instruments and Measurements	20	20	20	80	--	--	--	100
EXL301	Electronic Devices Laboratory	--	--	--	--	25	50	--	75
EXL302	Digital Circuits and Design Laboratory	--	--	--	--	25	50	--	75
EXL303	Circuit Theory and Measurements Laboratory	--	--	--	--	25	--	--	25
EXL304	*Object Oriented Programming Laboratory	---	---			25	50	--	75
		--	--	100	400	125	150	--	775

*Common subject with EXTC, Electrical Engg, Instrumentation Engg., Biomedical Engg.

*** Tutorial work will be assessed as term work

SE Electronics Engineering
Semester III
Syllabus of Theory Subjects

Subject Code	Subject Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial-work	Total
EXS 301	Applied Mathematics III	04	--	01	04	-	01	05

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Tutorial as Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test 2	Ave. Of Test 1 and Test 2					
EXS 301	Applied Mathematics III	20	20	20	80	25	--	--	125

Course Prerequisite:

FE C 101: Applied Mathematics I
FE C 201: Applied Mathematics II

Course Objective:

- To provide students with a sound foundation in Mathematics and prepare them for graduate studies in Electronics Engineering
- To make students to understand mathematics' fundamentals necessary to formulate, solve and analyze engineering problems.

Expected Outcome:

- 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 Engineering problems using Applied Mathematics.
- Students will show the understanding of impact of engineering mathematics in the engineering
- Students will become capable and eligible to 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, direct- 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 derivatives and integrals, change of scale, convolution theorem, initial and final value theorem, Parsevel's identity	
	1.3	**Inverse Laplace Transform:** Partial fraction method, long division method, residue method, theorem of LT to find inverse	
	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, 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 a 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 pint 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. equations 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**

Recommended Books

1. P. N. Wartikar and J. N. Wartikar, *"A Text Book of Applied Mathematic",* Vol. I & II, Vidyarthi Griha Prakashan, Pune
2. A Datta, *"Mathematical Methods in Science and Engineerin",* 2012
3. Dr. B.S. Grewal, *"Higher Engineering Mathematics",* Khanna Publication
4. B. S. Tyagi, "*Functions of a Complex Variable*," Kedarnath Ram Nath Publication
5. B V Ramana, "*Higher Engineering Mathematics*", Tata McGraw-Hill Publication
6. Wylie and Barret, "*Advanced Engineering Mathematics*", McGraw-Hill 6th Edition
7. Erwin Kreysizg, "*Advanced Engineering Mathematics*", John Wiley & Sons, Inc
8. Murry R. Spieget, "*Vector Analysis", Schaun's Out Line Series*, McGraw Hill Publication

Internal Assessment (IA):

Two tests must be conducted which should cover 80% of syllabus. The average marks of two 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 (Q.2 to Q.6) will be set on all the modules.
5: Weight age 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 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.

Subject Code	Subject Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tut.	Theory	TW/Pract.	Tut.	Total
EXC302	Electronic Devices	04	--	-	04	--	-	04

Sub. Code	Subject Name	Examination Scheme							
		Theory Marks				TW	Pract and Oral.	Oral	Total
		Internal Assessment			End Semester Exam				
EXC302	Electronic Devices	Test 1	Test 2	Average of Test1 & Test2					
		20	20	20	80	--	--	--	100

Prerequisite: FEC105 Basic Electrical & Electronics Engineering

Course Objectives:

1. To deliver the knowledge about physics of basic semiconductor devices
2. To enhance comprehension capabilities of students through understanding of electronic devices
3. To introduce and motivate students to the use of advanced microelectronic devices
4. To create foundation for forthcoming circuit design courses

Course Outcome:

1. Ability to understand semiconductor devices through energy band diagrams
2. Ability to analyze characteristics of semiconductor junctions
3. Ability to differentiate between bipolar and unipolar conduction
4. Ability to understand physics of optical devices
5. Ability to understand working principle of power devices
6. Knowledge about advanced semiconductor devices used in research
7. Ability to appreciate the role of semiconductor devices in various applications

Module No.	Topics	Hrs.
1.0	**Junction Analysis**	**14**
1.1	**PN junction Diode:** Basic Structure, Energy Band Diagrams, Zero Applied Bias, Forward Applied Bias, Reverse Applied Bias, PN Junction current, Small signal model of PN junction, Generation and recombination of currents, junction breakdown. **Zener Diode:** Breakdown mechanisms, Characteristics, Effect of Temperature, Application as voltage regulator and backward diode **Varactor diode:** Working and characteristics **Tunnel diode:** V-I Characteristics and working **TED (Transferred Electron Device):** Basic concept, Negative differential resistance, V-I Characteristics and working of **Gunn Diode** **IMPATT:** Static and Dynamic Characteristics	

1.2	**Metal semiconductor and semiconductor Heterojunctions:** **Schottkey barrier diode:** Qualitative characteristics, Ideal junction properties, Nonideal effects on barrier height and V-I characteristics **Metal-semiconductor ohmic contacts:** Ideal Non rectifying barriers, Tunneling Barrier, Specific contact resistance **Heterojunctions:** Heterojunction materials, Energy Band Diagrams, Two dimensional electron gas.	
2	**Bipolar Devices**	**08**
2.1	BJT: The bipolar transistor action, minority carrier distribution, low-frequency common-base current gain, non-ideal effects, Ebers-Moll Model, Gummel-Poon Model, Hybrid-Pi Model, Frequency Limitations	
2.2	HBT (Heterojunction bipolar transistor): Current gain in HBT, Basic n-p-n HBT structure with band diagram	
3.0	**Field Effect Devices**	**16**
3.1	**JFET:** Construction, operation and device characteristics. V-I relationship and transconductance. Small signal equivalent model, frequency limitation factors and cutoff frequency	
3.2	**MOSFET:**Two terminal MOS structure, MOSFET construction, Band diagrams under equilibrium and external bias, Threshold Voltage, V-I and CV characteristics, Channel length modulation, Short Channel effects, MOSFET Model	
3.3	**MESFET:** Device structure, principle of operation, V-I characteristics, High frequency performance **MODFET (i.e HEMT)** : Fundamentals, V-I Characteristics, Cutoff Frequency	
4.0	**Optical Devices**	**06**
4.1	**Optical absorption:** Photon absorption coefficient, EHP generation rate **Solar Cells:** The pn junction, heterojunction and amorphous silicon solar cells	
4.2	**Photodetectors:** Photoconductor, photodiode, PIN photodiode, APD (avalanche photodiode), phototransistor **Optocouplers:** Operation, construction, specifications and applications	
5.0	**Power Devices**	**08**
5.1	**PNPN Diode:** Basic structure and characteristics **SCR:** Basic structure, characteristics, Two transistor analogy. **DIAC and TRIAC:** Basic Structure and characteristics	
5.2	**GTO:** Basic structure and characteristics **PUT:** Operation and characteristics **UJT:** Operation, characteristics, parameters and UJT as a relaxation oscillator **IGBT:** Device structure, equivalent circuit and characteristics	
	Total	**52**

Recommended Books:

1. Donald A. Neamen, "*Semiconductor Physics and Devices*" Tata MCGraw Hill, Third Edition
2. S. M. Sze, "*Semiconductor Devices: Physics and Technology*", Wiley, Second Edition
3. Sung-Mo Kang,Yusuf Leblebici, "*CMOS Digital Integrated Circuits*", Tata McGraw Hill, Third Edition
4. David Bell, "Electronic Devices and Circuits", Oxford, Fifth Edition.
5. S Slivahanan and N. Suresh Kumar, "*Electronic Devices and Circuits*", McGraw Hill, Third Edition
6. Gordon W. Roberts and Adel S. Sedra, "*Spice*", Oxford, Second 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 set from all the modules.
5: Weightage of marks will be as per Blueprint.

Subject Code	Subject Name	Teaching Scheme			Credits Assigned			
		Theory	Pract.	Tut.	Theory	TW/Pract.	Tut.	Total
EXC303	Digital Circuits and Design	04	--	-	04	--	-	04

Sub. Code	Subject Name	Examination Scheme							
		Theory Marks				TW	Pract.	Oral	Total
		Internal Assessment			End Semester Exam				
EXC303	Digital Circuits and Design	Test 1	Test 2	Average of Test1 & Test2					
		20	20	20	80	--	-	--	100

Prerequisite: FEC105 Basic Electrical & Electronics Engineering

Course Objectives:

1. To deliver the knowledge, motivate and train students in logic design
2. To introduce the students to various logic gates, SOP, POS and their minimization techniques.
3. To explain and describe various logic families and to provide information on different IC's.
4. To teach the working of combinational circuits and their applications.
5. To make students aware of characteristics of various types of SSI, LSI and MSI devices and their use in various applications.
6. To teach students to analyze, understand and design sequential circuits.
7. To describe State Machines and explain their design using state diagrams.
8. To explain various types of programmable devices
9. To train students in writing program with hardware description languages.
10. To prepare students for understanding courses like microprocessors, microcontrollers, VLSI design, embedded systems and digital communications

Course Outcome:

1. Ability to develop a logic and apply it to solve real life problems
2. Ability to understand current applications, trends and new directions in logic design
3. Ability to reduce SOP and POS equations.
4. Ability to understand differences between logic families TTL and CMOS
5. Ability to understand various SSI, LSI and MSI devices
6. Ability to use SSI, LSI and MSI devices in various applications
7. Ability to analyze, design and implement combinational circuits
8. Ability to analyze, design and implement sequential circuits
9. Ability to solve state machines
10. Ability to design state machines using state diagrams, State Reduction techniques and State machine synthesis using transition lists
11. Ability to understand the concept of simulation, synthesis and implementation
12. Ability to use hardware description languages for logic circuit design.

13. Ability to understand programmable logic devices
14. Ability to program CPLD and FPGA

Module No.	Topics	Hrs.
1.0	**Fundamentals of Digital Design**	**14**
1.1	**Logic Gates:** Review of basic gates, Universal gates, Sum of products and products of sum, minimization with Karnaugh Map (upto four variables) and realization.	
1.2	**Logic Families:** Types of logic families (TTL and CMOS), characteristic parameters (propagation delays, power dissipation, Noise Margin, Fan-out and Fan-in), transfer characteristics of TTL NAND, Interfacing CMOS to TTL and TTL to CMOS.	
1.3	**Combinational Circuits using basic gates as well as MSI devices:** Half adder, Full adder, Half Subtractor, Full Subtractor, multiplexer, demultiplexer, decoder, Comparator (Multiplexer and demultiplexer gate level upto 4:1). MSI devices IC7483, IC74151, IC74138, IC7485.	
2.0	**Elements of Sequential Logic Design :**	**10**
2.1	**Sequential Logic:** Latches and Flip-Flops (Conversions, timing considerations and metastability are **not** expected)	
2.2	**Counters:** Asynchronous, Synchronous Counters, Up Down Counters, Mod Counters, Ring Counters Shift Registers, Universal Shift Register	
3.0	**Sequential Logic Design:**	**10**
3.1	Mealy and Moore Machines, Clocked synchronous state machine analysis, State reduction techniques and state assignment, Clocked synchronous state machine design. (*Complex word problems like traffic light controller etc. are not expected*)	
3.2	MSI counters (7490, 74163, 74169) and applications, MSI Shift registers (74194) and their applications	
4.0	**Programmable Logic Devices:**	**07**
4.1	Concepts of PAL and PLA. Simple logic implementation using PAL and PLA. Introduction to CPLD and FPGA architectures.	
5.0	**Simulation:**	**07**
5.1	Functional Simulation, Timing simulation, Logic Synthesis, RTL	
5.2	Introduction to VHDL, Framework of VHDL Program.	
6.0	**Testability:**	**06**
6.1	Fault Models, Stuck at faults, Bridging faults, Controllability and Observability	
6.2	Path sensitization, ATPG, Design for Testability, Boundary Scan Logic, JTAG and Built in self test.	
	Total	**52**

Recommended Books

1. William I. Fletcher, 'An Engineering Approach to Digital Design', PHI.
2. B. Holdsworth and R. C. Woods, 'Digital Logic Design', Newnes, 4th Edition
3. Morris Mano, Digital Design, Pearson Education, Asia 2002.
4. John F. Wakerley, Digital Design Principles And Practices, third Edition Updated, Pearson Education, Singapore, 2002
5. Anil K. Maini, Digital Electronics, Principles, Devices and Applications, Wiley
6. Stephen Brown and Zvonko Vranesic, Fundamentals of digital logic design with VHDL, McGraw Hill, 2nd 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 set 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	Tutorial	Total
EXC304	Circuit Theory	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	Ave. of 2 Tests					
EXC304	Circuit Theory	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:
1. To analyze the circuits in time and frequency domain
2. To study network functions, inter relationship among various circuit parameters, solve more complex network using these parameters.
3. To analyze and synthesize circuits and to become familiar with the propagation of signals/wave through transmission lines.

Course Outcome:
1. Through test and laboratory exercises, students will be able to apply their knowledge in solving complex circuits.
2. Students will be able to evaluate the time and frequency response which is useful in understanding behavior of electronic circuits and control system.
3. Student will be able to understand how the power or information in terms of electromagnetic energy is transmitted through the transmission lines and importance of impedance matching.

Module No.	Unit No.	Topics	Hrs.
1.0		**Analysis of Electrical Circuits**	**09**
	1.1	**Analysis of DC circuits:** Analysis of circuits with and without controlled sources using generalized loop, node matrix, Superposition, Thevenin, Norton, Millman theorems	
	1.2	**Analysis of coupled circuits:** Self and mutual inductances, coefficient of coupling, Dot convention, equivalent circuit, solution using loop analysis	
	1.3	**Series and parallel resonance circuits:** Selectivity, bandwidth, quality factor	
2.0		**Time and Frequency Domain Analysis**	**12**
	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, frequency response	
3.0		**Synthesis of RLC Circuits**	**06**
	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 circuits:** Concepts of synthesis of RC, RL, LC driving point functions (numerical problems not expected on 3.2)	
4.0		**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,	
5.0		**Flirters and attenuators**	**08**
	5.1	**Basic filter circuits:** Low pass, high pass, band pass and band stop filters, transfer function, frequency response, cutoff frequency, bandwidth, quality factor, attenuation constant, phase shift, characteristic impedance	
	5.2	**Concept of design and analysis of filters:** Constant K, M derived and composite filters (numerical problems not expected on 5.2)	
	5.3	**Attenuators:** Basic concepts, classification, attenuation in dB, K factor (impedance factor) and design concepts (numerical problems not expected on 5.3)	
6.0		**Transmission Lines**	**09**
	6.1	**Power frequency lines:** Representation, losses and efficiency in power lines, effect of length, calculation of inductance and capacitance (numerical problems not expected)	
	6.2	**Radio frequency lines:** Representation, propagation constant, attenuation constant, phase constant, group velocity, input impedance, characteristic impedance, reflection coefficient, standing wave ratio, VSWR, ISWR, S-parameters	
	6.3	**Smith Chart**: Impedance locus diagram, impedance matching	
		Total	**52**

Recommended Books:

1. Franklin F Kuo, *"Network Analysis and Synthesis",* Wiley Toppan,
2. M E Van Valkenburg, *"Network Analysis",* Prentice-Hall of India Pvt Ltd, New Delhi
3. K V V Murty and M S Kamth*, "Basic Circuit Analysis",* Jaico Publishing house, London
4. A. Chakrabarti*, "Circuit Theory",* Dhanpat Rai and Co.,New Delhi
5. Reinhold Ludwig and Pavel Bretchko, "*RF Circuit Design"*, Pearson Education, Asia
6. Joseph J. Carr, "*Secrets of RF Circuit Design"*, Tata McGraw-Hill, New Delhi

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 set 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
EXC 305	Electronic Instruments and Measurements	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	Ave. Of Test 1 and Test 2					
EXC305	Electronic Instruments and Measurements	20	20	20	80	--	-	--	100

Prerequisite Topics*:*
System of units, Measuring Instrument.

Course Objective:
Objectives of this course are:

1. In depth knowledge of measurement methods and instruments of electrical quantities.
2. Understanding design aspects and performance criterion for measuring instruments.
3. Implementation of the different signal generators and its analysis techniques.
4. To understand the working principle of the transducers.
5. To aware the students about the advances in Instrumentation.

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

1. An ability to apply knowledge of electronic instrumentation for measurement of electrical quantities.
2. Ability to apply the principles and practices for instrument design and development to real world problems.
3. Ability to select and use latest hardware for measurements and instrumentation.
4. An ability to design and conduct experiments for measurement and ability to analyze and interprets data.

Module No	Topics	Hrs.
1.	**Principles 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 etc.	
	1.2 Errors in Measurement: Errors in Measurement, Classification of Errors, Remedies to Eliminate/Reduce Errors.	
2	**Test and Measuring Instruments**	10
	2.1 Analog Multi-meters: Multi-range, Multi-parameter Measurement, Electronics Voltmeter using Transistors, FETs and Opamps. Specifications of a multi-meter.	
	2.2 RLC and Q-meter: Measurement of Low, Medium and High Resistance using Wheatstone bridge, Kelvin's Double Bridge and Mega ohm Bridge; Measurement of Inductance using Maxwell Bridge and Hey Bridge; Measurement of Capacitance using Schering Bridge; Operating Principle and Applications of Q-Meter.	
	2.3 Digital Multi-meters: DMM; Automation, Auto Ranging and Auto Zero Adjustments in Digital Instruments.	
3	**Oscilloscopes**	10
	3.1 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.	
	3.2 Measurement using Oscilloscope: Measurement of Voltage, Frequency, Rise Time, Fall Time and Phase Difference. Lissajous Figures in Detection of Frequency and Phase.	
	3.3 Digital Storage Oscilloscope (DSO): Features like Roll, Refresh, Storage Mode and Sampling Rate; Applications of DSO.	
4	**Transducers for Displacement and Temperature Measurement**	08
	4.1 Basics of Transducers/Sensors : Characteristics of Transducers; Requirement of Transducers; Classification of transducers; Selection Criteria of Transducers.	
	4.2 Displacement: Potentiometers; Linear Variable Differential Transformer, Resistance Strain Gauges, Capacitance Sensors.	
	4.3 Temperature: RTD, Thermisters, Thermocouples- Their Ranges, and Applications.	
5	**Transducers for Pressure, Level and Flow Measurement**	10
	5.1 Pressure: Pressure gauges; Elastic Pressure Transducers; Dead Weight Tester; Vacuum Pressure Measurement- McLeod Gauge and Pirani Gauge.	
	5.2 Level: Side glass tube method; Float type methods; Capacitance type method; Ultrasonic type transducer.	
	5.3 Flow: Restriction type Flow meters-Orifice and Venturi; Rotameter; Magnetic Flow meter; Turbine Flow meter.	
6	**Data Acquisition and advances in Instrumentation Systems**	08
	6.1 Monitoring Instruments : Indicators, Alarm, Recorders.	
	6.2 Data Acquisition and Converters: Data logger; Data acquisition system (DAS)- Single channel, Multichannel.	
	6.3 PC based Instrumentation: PC based Instrumentation System; Introduction to Programmable Logic Controller.	
	Total	**52**

Rcommended Books:

1. H. Oliver and J. M. Cage, Electronic Measurement and Instrumentation, McGraw Hill, 3rd edition.
2. W. Cooper, A. Helfric, Electronic Instrumentation and Measurement Techniques, PHI, 4th edition.
3. C. S. Rangan, G.R. Sarma, V.S.V. Mani, Instrumentation Devices and Systems, Tata McGraw Hill, 9^{th} edition.
4. A. K. Sawhney, Electrical & Electronic Instruments & Measurement, Dhanpat Rai and Sons, Eleventh ed., 2000.
5. Dally, William F. Riley and Kenneth G, Instrumentation for Engineering Measurements, James John Wiley and Sons. Inc., 2nd Edition 1993.
6. A.J. Bowens, Digital Instrumentation, McGraw-Hill, latest addition.
7. J.J.Carr, Elements of Electronic Instrumentation and Control, Prentice Hall, 3rd 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 set from all the modules.
5: Weightage of marks will be as per Blueprint.

SE Electronics Engineering
Semester III
Syllabus of Laboratory

Subject Code	Subject Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tut.	Theory	TW/Pract.	Tut.	Total
EXL301	Electronic Devices Laboratory	--	02	-	--	01	-	01

Sub. Code	Subject Name	Examination Scheme							
		Theory Marks				TW	Pract and Oral.	Oral	Total
		Internal Assessment			End Semester Exam				
EXL301	Electronic Devices Laboratory	Test 1	Test 2	Average of Test1 & Test2					
		--	--	--	--	25	50	--	75

Syllabus: Same as that of Subject EXC 302 Electronic Devices

Term Work:

At least **10** experiments covering entire syllabus of **EXC 302 (Electronic Devices)** should be set to have well predefined inference and conclusion. Computation/simulation based experiments are encouraged. **Therefore at least 5 simulation experiments to be carried out (out of total 10 Expts.).** 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 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.

Guidelines for Simulation Experiments:

1. One SPICE simulations and implementation for junction analysis
2. One SPICE simulation and implementation for BJT characteristics
3. One SPICE simulation and implementation for JFET characteristics
4. One SPICE simulation and implementation for Optical devices
5. One SPICE simulation and implementation for power devices
6. One SPICE simulation for MOSFET characteristics

Subject Code	Subject Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW	Tutorial	Total
EXL 302	Digital Circuits and Design 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	Ave. Of Test 1 and Test 2					
EXL 302	Digital Circuits and Design Laboratory	--	--	--	--	25	50	-	75

Syllabus: Same as **EXC 303 (Digital Circuits and Design)**

Term Work:
At least **10** experiments covering entire syllabus of **EXC 303 (Digital Circuits and Design)** should be set to have well predefined inference and conclusion. Computation/simulation based experiments are encouraged. **Therefore, 5 simulation experiments be carried out (out of total 10 Expts.).** 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 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.

Suggested Experiments:

1. SOP and POS Minimization (different problem statement for each student)
2. Characteristics of TTL and MOS logic family
3. Implementation of combinational circuits using MSI devices. (at least two)
4. Implementation of counters with flip-flops (at least one synchronous and one asynchronous)
5. Implementation of sequential circuits using MSI devices. (at least two)
6. Implementation of FSM (different problem statement for each student)
7. VHDL based simulations (Instructor should teach syntax and give different program to each student for simulation. Minimum Four programs covering behavioral, structural and dataflow modeling)
8. Verilog/VHDL based simulations (Instructor should teach syntax and give different program to each student for simulation. Minimum Four programs covering behavioral, structural, dataflow and switch level modeling)
9. Synthesis, downloading and Verification on CPLD and FPGA (for both VHDL and Verilog programs)

10. Troubleshooting of given fault (teacher should generate set of faults in different circuits and ask students to troubleshoot)

Subject Code	Subject Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW	Tutorial	Total
EXL 303	Circuit Theory and Measurements 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	Ave. Of Test 1 and Test 2					
EXL 303	Circuit Theory and Measurements Laboratory	--	--	--	--	25	--	--	25

Syllabus: EXC 304 (Circuit Theory) and
EXC 305 (Electronic Instruments and Measurements)
05 Experiments Each

Term Work:
At least **05 experiments on of EXC 304 (Circuit Theory) and 05 experiments on EXC 305 (Electronic Instruments and Measurements)** based on the 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 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.

Subject Code	Subject Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Term Work and Pract.	Tutorial	Total
EXL 304	*Object Oriented Programming Methodology Laboratory	--	02+02**	--	--	02	--	02

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

** 02 Hours be converted to theory hours for entire class theory discussion

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

Course Objectives:

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

Course Outcomes:

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