SEMESTER III

Sl. No	Code	Title	L	T	P	C	Category
1	MA2001	Mathematics – III	3	1	-	3	BS
2	EE2001	Signals & Systems	3	-	-	3	PT
3	EE2002	Logic Design	3	-	-	3	PT
4	EE2003	Electrical Measurements	3	-	-	3	PT
5	EE2004	Basic Electronic Circuits	3	-	-	3	PT
6	EE2090	Basic Electrical Engineering Lab	-	-	3	2	PT
7	EE2091	Electronics Lab - I	-	-	3	2	PT
			15	**1**	**6**	**19**	

BRIEF SYLLABI

EE2001 SIGNALS & SYSTEMS

Pre-requisites: None

L	T	P	C
3	0	0	3

System as interconnection of elements - Signal definition – Size of a signal - Classification of signals – Basic signal operations – Linearity of system elements – element relation – superposition principle – Time-invariance - Bilateral versus unilateral elements -Formulation of differential equation for first order systems – need for initial condition specification - Source-free response of first order systems – Complete Solution for step/impulse/sinusoid inputs – First order mechanical system impulse and step response - zero-input response and zero-state response – relation between them to natural response and transient response – superposition principle as applied to various response components – Concept of steady-state – DC steady-state – Sinusoidal steady-state in first order systems - sinusoidal steady-state frequency response function of first order systems – periodic steady-state in first order systems -Time-domain analysis of second-order systems –undamped and weakly damped spring-mass system and LC system – Q factor versus rate of decay in stored energy in a weakly damped system - time-domain specifications for a second order system -Time-domain analysis of higher order systems –Convolution Integral – Properties of systems – linearity, time-invariance, causality and stability in terms of impulse response – Zero-state output of an LTI System for complex exponential input – condition of 'dominance' - eigen function — system function H(s) of a n^{th} order LTI system - Signal Expansion in terms of e^{st} kind of signals – Fourier Series -Frequency Response Function of a LTI System - Fourier Transforms (FT)- Laplace Transforms (LT)- use of LT for solving complete response of LTI system – transfer function– poles, zeros- impulse response from pole-zero plot – relation between transfer function and frequency response – Block diagrams and structures for system realisation.

Total Hours: 42 Hours

EE2002 LOGIC DESIGN

Pre-requisites: None

L	T	P	C
3	0	0	3

Basic digital circuits - Review of number systems and Boolean algebra - Karnaugh map and Quine McCluskey methods - Boolean function Minimization and combinational design- Ordered Binary Decision diagram (OBDD) and Reduced Order Binary decision diagram (ROBDD) - Combinational circuit design using Multiplexer, ROM, PAL, PLA. - Introduction to Sequential circuits: Latches and flip-flops - Design and analysis of sequential circuits- -State diagrams – Analysis and design of Synchronous sequential Finite Sate Machine – State reduction - Counters: Design of single mode counters and multimode counters - Practical design aspects - Asynchronous sequential logic: Analysis and Design

Total Hours: 42 Hours

EE2003 ELECTRICAL MEASUREMENTS

Pre-requisites: None

L	T	P	C
3	0	0	3

General Principles of measurements -Cathode ray oscilloscope - D'Arsonval Galvanometer - Direct Deflecting Instruments - Measurement of Current, Voltage and resistance – Insulation Resistance, Earth Resistance, Earth Tester Localization of Cable Fault - Measuremet of Power and energy :Dynamometer Type Wattmeter - Ampere Hour Meter - Single and Three Phase Energy Meters (Induction Type) -Current transformer and potential transformer : Trivector Meter - Frequency Meters - Power Factor Meters -DC Potentiometers –A.C. Potentiometers – Various A.C. Bridges - Magnetic Measurements: Ballistic Galvanometer Flux Meter- Magnetic potentiometer- Hall effect devices- Hibbert's Magnetic Standard - Core Loss Measurement- Illumination: Laws of Illumination – standards of luminous intensity- Measurement of luminous intensity- Distribution of Luminous intensity- MSI- Rousseau's construction – Integrating sphere- Illumination Photometers.

Total Hours: 42 Hours

EE2004 BASIC ELECTRONIC CIRCUITS

Pre-requisites: None

L	T	P	C
3	0	0	3

Semiconductors Devices and Small Signal Models - BJT, JFET and MOSFET Amplifier Circuits – Midband Analysis-Transistor as an inverter – switching delays -Charging and discharging a capacitive load by a BJT and MOSFET – rise time and fall time calculations for capacitive load switching -Analysis of basic DTL gate, propagation delay, rise and fall times, fan-in and fan out – power supply current versus frequency of operation - TTL , ECL, CMOS gates - Frequency Response of BJT/FET/MOSFET Amplifiers - Distortion in amplifiers – Low Frequency response of BJT and FET Amplifiers-High Frequency Response of CE current gain- α-cut off and β cut off frequencies - Gain-Bandwidth product-Miller Effect-Emitter Follower at high frequencies-FET and MOSFET amplifiers at high frequencies-Cascode Amplifier

Total Hours: 42 Hours

EE2090 BASIC ELECTRICAL ENGINEERING LABORATORY

Pre-requisites: None

L	T	P	C
0	0	3	2

Study of Analog/Digital meters/Multimeters/CROs, Study of Linear and Non- linear characteristics of loads , Potential divider,Resistance Measurement, Circuit Laws, Power and Power Factor Measurement, Inductance and Mutual Inductance measurement,Earth resistance measurement.

Total Hours: 42 Hours

EE2091 ELECTRONICS LAB - I

Pre-requisites: None

L	T	P	C
0	0	3	2

Use of CRO, Device Characteristics, Rectifiers and Filters, Voltage regulators, Basic BJT and FET Amplifiers

Total Hours: 42 Hours

DETAILED SYLLABI

EE2001 SIGNALS & SYSTEMS

Pre-requisites: None

L	T	P	C
3	0	0	3

Total Hours: 42 Hours

Module 1: First Order LTI Systems in Time-domain (11 hours)

Signals and Systems-

System as interconnection of elements – electrical system elements, thermal system elements, translational and rotational mechanical system elements.

Signal definition – Size of a signal - Classification of signals – Basic signal operations – Commonly used signal models (impulse, step, ramp, complex exponential etc), even and odd components of a signal

Linearity of system elements – element relation – superposition principle – Time-invariance - Bilateral versus unilateral elements

Independent source elements – voltage, current, force, velocity, heat, temperature sources-

Interconnection of elements – interconnection laws for electrical, mechanical and thermal systems

Formulation of System Differential Equation –

Formulation of differential equation for Series and Parallel RC circuits, Series and Parallel RL circuits, mass-damper system, single body heating and cooling system – need for initial condition specification - equivalence between impulse excitation and initial conditions

First-Order Dynamics –

Source-free response of RC circuit – time constant – Source-free response of RL circuit – time constant –Source-free response of first order mechanical system and thermal system – mechanical time constant, thermal time constant – DC switching problem in RC and RL Circuits with and without initial energy storage– Natural response and forced response – transient response – Rise time and fall time in first order systems – Difference between DC switching and applying step input - Complete Solution for step/impulse/sinusoid inputs – First order mechanical system impulse and step response - First order thermal system impulse and step response, generalisations for all first order systems – zero-input response and zero-state response – relation between them to natural response and transient response – superposition principle as applied to various response components –

Concept of steady-state – DC steady-state in RC and RL Circuits – Sinusoidal steady-state in first order systems - sinusoidal steady-state frequency response function of first order systems – periodic steady-state in first order systems.

Module 2: Higher Order LTI Systems in Time-domain – Impulse Response Description (11 hours)

Time-domain analysis of second-order systems –

The mass-spring-damper system (for example, an ammeter or voltmeter) - series and parallel RLC –initial conditions – zero-state and zero-input response components - impulse response – step response – undamped and damped natural frequencies – damping factor – quality factor – undamped spring-mass system and LC system – weakly damped spring-mass system and LC system – Q factor versus rate of decay in stored energy in a weakly damped system - time-domain specifications for a second order system.

Time-domain analysis of higher order systems –

Formulation of differential equation for multi-mesh circuits – determination of initial conditions - solution of n^{th} order Linear ODE using material learnt from Maths-I - natural frequencies – natural frequencies versus stability – frequency response function in terms of coefficients of differential equation - generalisations for n^{th} order linear time-invariant system - Instability in circuits involving dependent sources.

Convolution Integral –

Impulse decomposition of an arbitrary input– convolution integral for zero-state response of a LTI system – importance of impulse response – scanning function – depth of memory of an LTI system and duration of impulse response – relation between DC steady-state output and impulse response – relation between AC steady-state frequency response function and impulse response –

Properties of systems – linearity, time-invariance, causality and stability in terms of impulse response – cascading LTI systems with and without inter-stage interaction –

Zero-state output of an LTI System for complex exponential input – condition of 'dominance' - eigen function – eigen value versus system function – system function $H(s)$ of a n^{th} order LTI system

Module 3: LTI Systems in Frequency-domain - with Periodic Inputs (9 hours)

Signal Expansion in terms of e^{st} kind of signals – Fourier Series

Expansion of an arbitrary input function into a sum of complex exponential inputs of e^{st} type with different values of s - Special case : periodic waveforms – Fourier series – **revise** exponential and trigonometric Fourier

series (covered in Maths-I) – symmetry properties – Fourier series coefficients and time-domain differentiation and integration– rate of decay of harmonic coefficients –

Frequency Response Function of a LTI System

Frequency response function by substituting $s = jw$ in System Function – first order and second order system examples - one-sided frequency response plots versus two-sided frequency response plots – interpreting negative values of ω - symmetry properties of frequency response of LTI systems – use of frequency response and Fourier series to solve for periodic steady-state output in RC, RL and RLC Circuits

Module 4: LTI Systems in Frequency-domain - with Arbitrary Inputs (11 hours)

Signal Expansion in terms of e^{st} kind of signals – Fourier Transforms (FT)

Aperiodic inputs – Fourier Transform from Fourier Series – interpretation of Fourier transform – **revise** what was learnt in Maths-I (properties and theorems)– frequency response function and its role in LTI system solution for aperiodic inputs – band-limiting versus time-limiting of signals – continuity of Fourier transform – convolution theorem – modulation theorem – sampling of CT signals and reconstruction – Nyquist's Theorem on sampling – ideal interpolation versus practical interpolation.

Signal Expansion in terms of e^{st} kind of signals – Laplace Transforms (LT)

Laplace transform from Fourier transform – LT as signal expansion in terms of complex exponential functions – ROC – **revise** what was learnt in Maths-I – Unilateral Laplace Transform – Shifting theorem - use of LT for solving complete response of LTI system – transfer function and its relation with what was called system function earlier – poles, zeros- impulse response from pole-zero plot – relation between transfer function and frequency response –

Block diagrams and structures for system realisation.

Text/Reference Books :

1. Lathi,, B.P., *Signal Processing and Linear Systems*, Oxford University Press, New Delhi, 2006
2. Lathi,, B.P., *Signals, Systems and Communication*, BS Publications, Hyderabad, 2008
3. Shearer, Murphy and Richardson, *Introduction to System Dynamics*, Addison-Wesley Publishing Company, 1967
4. Eronini Umez-Eronini, '*System Dynamics & Control*, Thomson Asia Pvt. Ltd.,Singapore, 1998
5. Charles L. Phillips, John M. Parr & Eve A. Riskin, '*Signals, Systems and Transforms*', Pearson Education, New Delhi, 2008
6. Simon Haykin, Barry Van Veen, '*Signals and Systems*', Wiley India,2nd edn, 2009

EE2002 LOGIC DESIGN

Pre-requisites: None

L	T	P	C
3	0	0	3

Total Hours: 42 Hours

Module 1: **(12 Hours)**

Basic digital circuits:

Review of number systems and Boolean algebra - Simplification of functions using Karnaugh map and Quine McCluskey methods - Boolean function Minimization and combinational design.

Examples of useful digital circuits: Arithmetic Circuits, Comparators and parity generators, multiplexers and demultiplexers, decoders and encoders.

Ordered Binary Decision diagram (OBDD) and Reduced Order Binary decision diagram (ROBDD), unate covering, prime, essential and irredundant properties of implicants, Two level optimization

Module 2: **(11 Hours)**

Combinational logic design:

Combinational circuit design using Multiplexer, ROM, PAL, PLA.

Introduction to Sequential circuits:

Latches and flip-flops (RS, JK, D, T and Master Slave) - Design of a clocked flip-flop – Flip-flop conversion - Practical clocking aspects concerning flip-flops.

Module 3: **(12 Hours)**

Design and analysis of sequential circuits:

General model of sequential networks - State diagrams – Analysis and design of Synchronous sequential Finite Sate Machine – Exact State reduction – State reduction with don't cares - Minimization and design of the next state decoder.

Counters: Design of single mode counters and multimode counters – Ripple Counters – Ring Counters – Shift registers counter design.

Module 4: **(7 Hours)**

Practical design aspects:

Timing and triggering considerations in the design of synchronous circuits – Set up time - Hold time – Clock skew - Static timing analysis - Dynamic analysis.

Asynchronous sequential logic: Analysis and Design – Race conditions and Cycles – Hazards in combinational circuits – Hazard free realization.

Text/Reference Books:

1. M. Mano, "Digital Design", 3rd Ed., Prentice Hall, India.
2. Roth C.H., Fundamentals of Logic Design, Jaico Publishers. IV Ed.
3. W. I. Fletcher, An Engineering Approach to Digital Design, Prentice-Hall, Inc., Englewood Cliffs, NJ, 1980
4. Tocci, R. J. and Widner, N. S., Digital Systems - Principles and Applications, Prentice Hall, 7th Ed.
5. Wakerly J F, Digital Design: Principles and Practices, Prentice-Hall, 2nd Ed.
6. D.D. Givone, "Digital Principles and Design", Tata McGraw Hill
7. Katz R, Contemporary Logic Design, Addison Wesley, 1993.
8. Lewin D. & Protheroe D., Design of Logic Systems, Chapman & Hall, University and Professional Division, 1992, II Ed.
9. T. L. Floyd, Digital Fundamentals, Prentice Hall, June 2005.

EE2003 ELECTRICAL MEASUREMENTS

Pre-requisites: None

L	T	P	C
3	0	0	3

Total Hours: 42 Hours

Module 1: **(11 Hours)**

General Principles of measurements, units, dimensions, standards and calibration of meters.
Characteristics of Instruments - qualities and errors of Measurements and its analysis.
Cathode ray oscilloscope - Theory and working –measurements using CRO - Types of CRO – Time base generator circuit – Applications.
principle, construction, operation, torque equation ,calibration and application of D'Arsonval Galvanometer.
Direct Deflecting Instruments - Moving Coil - Moving Iron, Dynamo Meter, Induction, Thermal, Electrostatic and Rectifier Type meters- Shunts and Multipliers- Various Types of Galvanometers. (principle, construction, operation, torque equation and comparison)

Module 2: **(12 Hours)**

Measurement of Current, Voltage and resistance –
Wheatstone bridge - Kelvin Double Bridge - Carey Foster Slide Wire Bridge - Bridge Current Limitations
Insulation Resistance, Earth Resistance, Earth Tester Localization of Cable Fault by Murray and Varley Loop Tests.
Measuremet of Power and energy : Dynamometer Type Wattmeter - Error and Compensation - Ampere Hour Meter - Single and Three Phase Energy Meters (Induction Type) – Calibration- phantom loading.
Current transformer and potential transformer : Construction, theory operation, phasor diagram, characteristics – error elimination and its application.
Trivector Meter - Frequency Meters - Power Factor Meters.

Module 3: **(9 Hours)**

DC Potentiometer –Crompton Potentiometer- Vernier Potentiometer- Diesselhorst Potentiometer-Method of Use-Use of potentiometer for Measurement of Resistance, current and Voltage and power. Applications of DC Potentiometers
A.C. Potentiometers – Applications of AC Potentiometers.
Various A.C. Bridges and Measurement of Inductance & Capacitance and frequency.

Module 4: **(10 Hours)**

Magnetic Measurements: Classification – Magnetometer measurement, Ballistic Galvanometer Flux Meter-Magnetic potentiometer- Hall effect devices- B.H. Curve and Permeability Measurement Hysteresis Measurement– Hibbert's Magnetic Standard - Core Loss Measurement.
Illumination: Laws of Illumination – standards of luminous intensity- Measurement of luminous intensity-Distribution of Luminous intensity- MSI- Rousseau's construction – Integrating sphere- Illumination Photometers.

Reference/Text Books:

1: Golding E.W *Electrical Measurements & Measuring Instruments*, 5e, Reem Publications,2009.
2: Cooper W.D, *Modern Electronics Instrumentation*, Prentice Hall of India, 1996.
3: Stout M.B, *Basic Electrical Measurements*, Prentice Hall, 1986.
4: Oliver & Cage, *Electronic Measurements & Instrumentation*, McGraw Hill, 1979.
5: Sawhney A. K., Electrical and Electronic Measurements and Instrumentation, Dhanpath Rai & Co.,2007

EE2004 BASIC ELECTRONIC CIRCUITS

Pre-requisites: None

L	T	P	C
3	0	0	3

Total Hours: 42 Hours

Module 1: (11 Hours)

Semiconductors Devices and Small Signal Models

Revision of principles of operation of diodes and bipolar junction transistors - transition capacitance of a diode - minority carrier storage-diffusion capacitance-breakdown diodes -schottky diode – forward and reverse recovery processes in a diode -Transistor capacitances – Transistor ratings – Biasing a BJT – Thermal stability of bias.

Concept of small signal operation of semiconductor devices – small equivalent circuit for diodes including capacitances – h-parameter equivalent circuit for a BJT – hybrid-π equivalent for a BJT – determination of small signal parameters from static characteristics- Construction and characteristics of JFETs – capacitances of a JFET – biasing a JFET - small signal model for a JFET-Construction and characteristics of depletion type and enhancement type MOSFETs – MOSFET capacitances – biasing a MOSFET – small signal model of a MOSFET

Module 2: (10 Hours)

BJT, JFET and MOSFET Amplifier Circuits – Midband Analysis.

Amplification in a CE amplifier - CE , CB and Emitter Follower Analysis and Comparison using h parameters as well as hybrid-π parameters - considerations in cascading transistor amplifiers -CS and CD Amplifiers using JFETs and MOSFETs – comparison of BJT, FET and MOSFET amplifiers - Class B and Class AB Power Amplifiers using BJT.

Module 3: (11 Hours)

Digital Electronic Circuits

Transistor as an inverter – switching delays – various components of switch-off and switch-on delays – calculation of switching time components – comparison between high frequency transistor and switching transistor- Charging and discharging a capacitive load by a BJT and MOSFET – rise time and fall time calculations for capacitive load switching- Analysis of basic DTL gate, propagation delay, rise and fall times, fan-in and fan out – power supply current versus frequency of operation -Analysis of basic TTL gate, propagation delay, rise and fall times, fan-in and fan out, ratings, power supply current versus frequency of operation -Different variants of TTL gates-Analysis of basic ECL gate, propagation delay, rise and fall times, fan-in and fan out -Analysis of basic CMOS gate, propagation delay, rise and fall times, fan-in and fan out – power dissipation in the gate and effect of (i) supply voltage (ii) frequency of operation and (iii) load capacitance on gate dissipation -Comparison of various digital logic families.

Module 4: (10 Hours)

Frequency Response of BJT/FET/MOSFET Amplifiers (phasor equivalent circuit approach is envisaged)

Distortion in amplifiers – Non-linear distortion – linear distortion due to frequency response – conditions for distortionless amplification- Low Frequency response of BJT and FET Amplifiers-Dominant Time Constant-Selection of Coupling and Bypass Capacitors -High Frequency Response of CE current gain- α-cut off and β cut off frequencies - Gain-Bandwidth product-Miller Effect-Emitter Follower at high frequencies- FET and MOSFET amplifiers at high frequencies -Cascode Amplifier – BJT discrete version, BJT IC version, MOSFET IC version

Text/Reference Books

1. A.S Sedra and K.C Smith, .'*Microelectronic Circuits*', Oxford University Press, 5th Edn,2009
2. Taub & Scilling, '*Digital Integrated Elecronics*', McGraw-Hill, Singapore, 1997
3. Millman J, '*Microelectronic'*, 2nd edition, McGraw-Hill, New Delhi,2005.
4. Schilling & Belove, '*Electronic Circuits – Discrete and Integrated*', 3rd edition , McGraw-Hill, New Delhi,2006
5. Boylested & Nashesky , Electronic Devices and Circuit Theory, 10th Edn, Pearson Education, New Delhi, 2009

EE2090 BASIC ELECTRICAL ENGINEERING LABORATORY

Pre-requisites: None

L	T	P	C
0	0	3	2

Total Hours: 42 Hours

1. a) Study of Analog/Digital meters/Multimeters/CROs. Interfacing a C.R.O with a PC.
   b) Verification of Kirchhoff's laws in D.C circuits.
2. Study of Linear and Non- linear characteristics of loads – Determination of voltage – current characteristics of linear resistor and linear inductor, incandescent and CFL lambs, iron cored solenoid
3. a) Potential divider connection and study of the dependence of output voltage upon the value of the loading resistance.
   b) Methods of measurement for low- medium-high resistance using voltmeter and ammeter.
4. Verification of Superposition Theorem and Maximum Power Transfer theorem.
5. Verification of Thevenin's Theorem and Generalized Reciprocity theorem.
6. a) study of Fuse, MCB, ELCB – Selection of Fuse rating for circuits.
   b) Determination of fuse characteristics and fusing factor of different specimens (open, enclosed, HRC fuses and MCB).
7. a) Single phase power measurement (fan load) – study of variation of speed, input power and power factor with supply voltage.
   b) Determination of thermal efficiency of an electric kettle.
8. Measurement of power and power factor in R-L-C series and parallel circuits and design of P.F compensator.
9. Three phase power measurement of balanced and unbalanced loads.
10. Experiments and Analysis of Resonance in the RLC circuits and design of an RF circuits to receive an RF signal and verifying it experimentally.
11. Measurement of Self-inductance, Mutual inductance and Coupling coefficient of windings.
12. Measurement of Earth Resistance and Insulation Resistance.

Note: Normally the practical classes are administered in two cycles. Depending on the availability of equipments and time, class coordinators may choose the experiments for each cycle.

Reference/Text Books:

1. H-cotton, Advanced Electrical Technology, Wheeler Publications.
2. Suresh Kumar K.S, Electrcial Circuit and Networks, Pearson Education, New Delhi, 2009
3. EW. Golding Electrical Measurements and Measuring Instruments, 5th edition, reem publications.
4. Huges, Electrical Technology, ed 6

EE2091 ELECTRONICS LAB - I

Pre-requisites: None

L	T	P	C
0	0	3	2

Total Hours: 42 Hours

List of Experiments:

1. Use of CRO: a) Measurement of current, voltage, frequency and phase shift.
2. Semiconductor diodes: V-I and transfer characteristics of Si, Ge and zener diodes.
3. Characteristics of clipping and clamping circuits using diodes and zener diodes.
4. Rectifiers and filters with and without shunt capacitors- Characteristics of half-wave, full wave and bridge rectifiers- Ripple factor, Rectification efficiency, and % regulation.
5. Transistor characteristics in CB and CE configurations - Identification of cut off, active and saturation regions.
6. JFET characteristics in the common source configuration- determination of equivalent circuit parameters.
7. Characteristics of voltage regulators- Design and testing of:
    a) Simple zener voltage regulator
    b) Zener regulator with emitter follower output.
8. UJT Characteristics and UJT relaxation oscillator- Design for a particular frequency.
9. RC coupled amplifier using BJT in CE configuration- measurement of gain, input and output impedance and frequency response
10. BJT emitter follower- Measurement of voltage gain, current gain, input impedance, output impedance and load characteristics
11. FET amplifier- Measurement of voltage gain, current gain, input and output impedance.
12. Power amplifiers- Class AB (complementary symmetry).

Text/Reference Books:

1. Boylested & Nashesky , Electronic Devices and Circuit Theory, 10th Edn, Pearson Education, New Delhi, 2009