MaulanaAbulKalam Azad University of Technology, West Bengal

(Formerly West Bengal University of Technology)

Syllabus for B. Tech in Instrumentation and Control Engineering (ICE)

(Applicable from the academic session 2018-2019)

Curriculum Structure

Second Year Third Semester							
Sl. No.	**Category**	**Subject Code**	**Subject Name**	**Total Number of contact hours**			**Credits**
				L	**T**	**P**	
Theory							
1	Basic science Courses	BS-CS301	Numerical Methods	2	1	0	3
2	Professional Core Courses	PC-IC301	Electric Circuit Theory	3	0	0	3
3	Professional Core Courses	PC-IC302	Analog Integrated circuits	3	0	0	3
4	Professional Core Courses	PC-IC303	Digital Electronic Circuits	3	0	0	3
5	Engineering Science Courses	ES-CS301	Data Structure and algorithm	3	0	0	3
6	Mandatory Courses	MC-ES301	Environmental Science	2	0	0	0
	Total Theory						**15**
Practical							
1	Professional core Courses	PC-IC391	Electric Circuit Lab	0	0	3	1.5
2	Professional core Courses	PC-IC392	Analog circuits Design Lab	0	0	3	1.5
3	Professional core Courses	PC-IC393	Digital Circuits Design Lab	0	0	3	1.5
4	Engineering Science Courses	ES-CS391	Data Structure and algorithm Lab	0	0	3	1.5
	Total Practical						**6**
	Total of Third Semester						**21**

Second Year Fourth Semester							
Sl. No.	**Category**	**Subject Code**	**Subject Name**	**Total Number of contact hours**			**Credits**
				L	**T**	**P**	
Theory							
1	Professional Core Courses	PC-IC401	Electrical &Electronic Measurement	3	0	0	3
2	Professional Core Courses	PC-IC402	Sensor & Transducer	3	0	0	3
3	Professional Core Courses	PC-IC403	Microprocessor and Microcontroller	3	0	0	3
4	Professional Core Courses	PC-IC404	Electric Field Theory	3	0	0	3
5	Professional Core Courses	PC- IC405	Control system I	3	0	0	3

6	Humanities and Social Sciences including Management Courses	HM-HU401	Values and Ethics in Profession	2	0	0	2
	Total Theory						**17**
Practical							
1	Professional core Courses	PC-IC491	Electrical &Electronic Measurement Lab	0	0	3	1.5
2	Professional core Courses	PC-IC492	Sensor & Transducer	0	0	3	1.5
3	Professional core Courses	PC-IC493	Microprocessor and Microcontroller Lab	0	0	3	1.5
4	Professional core Courses	PC-IC494	Control system I Lab	0	0	3	1.5
	Total Practical						**6**
	Total of Fourth Semester						**23**

Third Year Fifth Semester

Sl No.	Category	Subject Code	Subject Name	Total Number of contact hours			Credits
				L	T	P	
Theory							
1	Professional Core Courses	PC-IC501	Industrial Instrumentation	3	0	0	3
2	Professional Core Courses	PC-IC502	Digital Signal Processing	3	0	0	3
3	Professional Core Courses	PC-IC503	Control System II	3	0	0	3
4	Professional Elective Courses-1	PE-IC501/PE-IC502	Optical Instrumentation/Introduction to MEMS	3	0	0	3
5	Open Elective Courses-1	OE-IC501/OE-IC502	Embedded System/DBMS	3	0	0	3
6	Humanities and Social Sciences including Management Courses	HM-HU501	Economics for Engineers	3	0	0	3
	Total Theory						**18**
Practical/ Sessional							
1	Professional core Courses	PC-IC591	Industrial Instrumentation Lab	0	0	3	1.5
2	Professional core Courses	PC-IC592	Control System II	0	0	3	1.5
3	Open Elective-1	OE-	Embedded System/DBMS Lab	0	0	3	1.5

		EI591/OE-EI592					
4	Seminar	IC581	Seminar				1.5
	Total Practical						**6**
			Total of Fifth Semester				**24**

Third Year Sixth Semester

Sl No.	Category	Subject Code	Subject Name	Total Number of contact hours			Credits
				L	T	P	
Theory							
1	Professional Core Courses	PC-IC601	Process control	3	0	0	3
2	Professional Core Courses	PC-IC602	Data Communication and Telemetry	3	0	0	3
3	Professional Core Courses	PC-IC603	Biomedical Instrumentation	3	0	0	3
4	Professional Elective Courses-2	PE-IC601/PE-IC602	Power Electronics & Drivers/Microelectronics and VLSI Technology	3	0	0	3
5	Open Elective Courses-2	OE-IC601/OE-IC602	IOT/Artificial Intelligence	3	0	0	3
6	Mandatory Courses	MC-ES61	Indian Constitution and culture	1	0	0	
	Total Theory						**15**
Practical/ Sessional							
1	Professional core Courses	PC-IC691	Process control Lab	0	0	3	1.5
2	Professional core Courses	PC-IC692	Instrumentation system Design Lab	0	0	3	1.5
3	Open Elective 2	OE-IC691/OE-IC692	IOT Lab/AI lab	0	0	3	1.5
	Total Practical						**4.5**
			Total of Sixth Semester				**19.5**

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Fourth Year Seventh Semester							
Sl No.	**Category**	**Subject Code**	**Subject Name**	**Total Number of contact hours**			**Credits**
				L	**T**	**P**	
Theory							
1	Professional Elective Courses-3	PE-IC701/PE-IC702	Control System Design/Robotics and automation	3	0	0	3
2	Professional Elective Courses-4	PE-IC703/PE-IC704	Analytical Instrumentation/ Digital control system	3	0	0	3
3	Open Elective Courses-3	OE-IC701/OE-IC702	Non-Convectional Energy System/Non-destructive testing	3	0	0	3
4	Engineering Courses	ES-CS701	Computer Networks	3	0	0	3
	Total Theory						**12**
Practical/ Sessional							
1	Project Stage-1	PW-IC791	Project I				4
2	Industrial Training	IC781	Industrial Training Evaluation				1
	Total Practical						**5**
	Total of Seventh Semester						**17**

Fourth Year Eighth Semester							
Sl No.	**Category**	**Subject Code**	**Subject Name**	**Total Number of contact hours**			**Credits**
				L	**T**	**P**	
Theory							
1	Professional Elective Courses-5	PE-IC801/PE-IC802	Power Plant Instrumentation/Nano Electronics	3	0	0	3
2	Open Elective Courses-4	OE-IC801/OE-IC802	Logic and Distributed control systems /Smart and Wireless instrumentation	3	0	0	3
3	Humanities and Social sciences including Management Courses	HM-HU801	Management Concept and Practice	2	0	0	2
	Total Theory						**8**
Practical/ Sessional							
1	Project Stage-1	PW-IC891	Project II				8
2	Grand Viva	IC881	Grand Viva-Voce				1.5
	Total Practical						**9.5**
	Total of Eighth Semester						**17.5**

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Sl No.	Category	Suggested Breakup of Credits (Dept. of ICE)	Suggested Breakup of Credits (160) (As per AICTE)
1	Humanities and Social sciences including Management Courses	10	12
2	Basic Science course	22	25
3	Engineering Science courses	23.5	24
4	Professional core Courses	55.5	48
5	Professional Elective Courses	15	18
6	Open Elective Courses	18	18
7	Project work Seminar and internship in industry	16	15
8	Mandatory Courses		(NON-CREDIT)
	TOTAL	160	160

BS-CS301	NUMERICAL METHODS	2L:1T:0P	3 credits

Approximation in numerical computation: Truncation and rounding errors, Fixed and floating-point arithmetic, Propagation of errors. **(4 Hours)**

Interpolation: Newton forward & backward interpolation, Lagrange's and Newton's divided difference Interpolation. **(5 Hours)**

Numerical integration: Trapezoidal rule, Simpson's 1/3 rule, Weddle's rule. **(4 Hours)**

Numerical solution of a system of linear equations:
Gauss elimination method, Matrix inversion, LU Factorization method, Gauss-Jacobi and Gauss-Seidel iterative methods. **(6 Hours)**

Numerical solution of Algebraic equation:
Bisection method, Secant method, Regula-Falsi method, Newton-Raphson method. **(4 Hours)**

Numerical solution of ordinary differential equation: Taylor's series method, Euler's method, Runge-Kutta methods, Predictor-Corrector methods and Finite Difference method. **(6 Hours)**

Text Books:
1. C. Xavier: C Language and Numerical Methods.
2. Dutta & Jana: Introductory Numerical Analysis.
3. J.B. Scarborough: Numerical Mathematical Analysis.
4. Jain, Iyengar, & Jain: Numerical Methods (Problems and Solution).

References:
1. Balagurusamy: Numerical Methods, Scitech.
2. Baburam: Numerical Methods, Pearson Education.
3. N. Dutta: Computer Programming & Numerical Analysis, Universities Press.
4. Soumen Guha & Rajesh Srivastava: Numerical Methods, OUP.
5. Srimanta Pal: Numerical Methods, OUP.

PC-IC-301	**Electric Circuit Theory**	**3L:0T:0P**	**3 credits**

Course Outcomes:
At the end of this course, students will demonstrate the ability to

- Understand basics electrical circuits with nodal and mesh analysis.
- Apply network theorems for the analysis of electrical circuits.
- Apply Laplace Transform for steady state and transient analysis.
- Determine different network functions.
- Appreciate the frequency domain techniques.

Module 1: Introduction (4 Hours)
Continuous & Discrete, Fixed & Time varying, Linear and Nonlinear, Lumped and Distributed, Passive and Active networks and systems. Independent & Dependent sources, Step, Ramp, Impulse, Sinusoidal, Square, Saw tooth signals, Coupled circuits.

Module 2: Network Theorems (8 Hours)
Node and Mesh Analysis. Concept of duality and dual networks.
Superposition theorem, Thevenin theorem, Norton theorem, Maximum power transfer theorem, Reciprocity theorem, Compensation theorem. Analysis with dependent current and voltage sources.

Module 3: Solution of First and Second order networks (10 Hours)
Solution of first and second order differential equations for Series and parallel R-L, R-C, R-L-C circuits, initial and final conditions in network elements, time constants, steady state and transient state response.

Module 4: Laplace Transforms (8 Hours)
Laplace transforms and properties Analysis of electrical circuits using Laplace Transform for standard inputs, convolution integral, inverse Laplace transform, transformed network with initial conditions. series and parallel resonances

Module 5: Two Port Network and Network Functions (6 Hours)
Two Port Networks, terminal pairs, relationship of two port variables, impedance parameters, admittance parameters, transmission parameters and hybrid parameters, interconnections of two port networks.

Module 6: Filters Circuits (4 Hours)
Analysis and synthesis of Low pass, High pass, Band pass, Band reject, All pass filters (first order only) using operational amplifier. Solution of Problems .

Text / References:
1. M. E. Van Valkenburg, “Network Analysis”, Prentice Hall, 2006.

2. D. Roy Choudhury, "Networks and Systems", New Age International Publications, 1998.
3. W. H. Hayt and J. E. Kemmerly, "Engineering Circuit Analysis", McGraw Hill Education, 2013.
4. C. K. Alexander and M. N. O. Sadiku, "Electric Circuits", McGraw Hill Education, 2004.
5. K. V. V. Murthy and M. S. Kamath, "Basic Circuit Analysis", Jaico Publishers, 1999.

PC-IC302	**Analog Integrated Circuits**	**3L:0T:0P**	**3 credits**

Course Outcomes:

At the end of this course, students will demonstrate the ability to

- Understand the characteristics of transistors.
- Design and analyze various rectifier and amplifier circuits.
- Design sinusoidal and non-sinusoidal oscillators.
- Understand the functioning of OP-AMP and design OP-AMP based circuits.

Module 1: Introduction (6 Hours)

Crystalline material: mechanical properties, energy band theory, Fermi level, Conductors, Semiconductors and Insulators: electrical properties, band diagrams. Semiconductors: intrinsic and extrinsic, energy band diagram, electrical conduction phenomenon, P-type and N-type semiconductors, drift and diffusion carriers, mass action law and continuity equation.

Module 2: Diode circuits (4 Hours)

P-N junction diode, I-V characteristics of a diode; review of half-wave and full-wave rectifiers, Zener diodes, clamping and clipping circuits.

Module 3: BJT circuits (6 Hours)

Structure and I-V characteristics of a BJT; BJT as a switch. BJT as an amplifier: small-signal model, biasing circuits, current mirror; common-emitter, common-base and common-collector amplifiers; Small signal equivalent circuits, high-frequency equivalent circuits

Module 4: MOSFET circuits (6 Hours)

MOSFET structure and I-V characteristics. MOSFET as a switch. MOSFET as an amplifier: small-signal model and biasing circuits, common-source, common-gate and common-drain amplifiers; small signal equivalent circuits - gain, input and output impedances, trans-conductance, high frequency equivalent circuit.

Module 5: Differential, multi-stage and operational amplifiers (8 Hours)

Differential amplifier; power amplifier; direct coupled multi-stage amplifier; internal structure of an operational amplifier, ideal op-amp, non-idealities in an op-amp (Output offset voltage, input bias current, input offset current, slew rate, gain bandwidth product)

Module 6: Linear applications of op-amp (6 Hours)

Idealized analysis of op-amp circuits. Inverting and non-inverting amplifier, differential amplifier, instrumentation amplifier, integrator, active filter, P, PI and PID controllers and lead/lag compensator using an op-amp, voltage regulator, oscillators (Wein bridge and phase shift). Analog to Digital Conversion.

Module 7: Nonlinear applications of op-amp (6 Hours)

Hysteretic Comparator, Zero Crossing Detector, Square-wave and triangular-wave generators. Precision rectifier, peak detector. Monoshot.

Text/References:

1. A. S. Sedra and K. C. Smith, "Microelectronic Circuits", New York, Oxford University Press, 1998.
2. J. V. Wait, L. P. Huelsman and G. A. Korn, "Introduction to Operational Amplifier theory and applications", McGraw Hill U. S., 1992.
3. J. Millman and A. Grabel, "Microelectronics", McGraw Hill Education, 1988.
4. P. Horowitz and W. Hill, "The Art of Electronics", Cambridge University Press, 1989.
5. P.R. Gray, R.G. Meyer and S. Lewis, "Analysis and Design of Analog Integrated Circuits", John Wiley & Sons, 2001.

PC-IC303	**Digital Electronic Circuits**	**3L:0T:0P**	**3 credits**

Course Outcomes:

At the end of this course, students will demonstrate the ability to

- Understand the fundamentals of digital systems and logic gates.
- Design and implement various Combinational and Sequential logic circuits.
- Understand the process of Analog to Digital conversion and Digital to Analog conversion.
- Able to use PLDs and semiconductor memories to design various logic circuits.

Module 1: Fundamentals of Digital Systems and logic families (10 Hours)

Digital signals, digital circuits, AND, OR, NOT, NAND, NOR and Exclusive-OR and Exclusive-NOR operations, Boolean algebra, IC gates, number systems-binary, signed binary, octal, hexadecimal number, number conversion, binary arithmetic, one's and two's complements arithmetic, 9's 10's complements, codes, error detecting and correcting codes, characteristics of digital lCs, digital logic families, TTL, Schottky TTL, ECL and CMOS logic, interfacing CMOS and TTL, Tri-state logic.

Module 2: Combinational Digital Circuits (8Hours)

Standard representation for logic functions, K-map representation, and simplification of logic functions using K-map, minimization of logical functions. SOP and POS representation, Don't care conditions, Multiplexer, De-Multiplexer/Decoders, Adders, Subtractors, Parallel adder, BCD arithmetic, carry look ahead adder, serial adder, digital comparator, parity checker/generator, code converters, priority encoders, decoders/drivers for display devices, Q-M method of function realization.

Module 3: Sequential circuits and systems (8Hours)

Latch, the circuit properties of Bistable latch, the clocked SR flip flop, J- K, T and D type flip-flops, Conversion of flip-flops, applications of flip-flops, shift registers, Universal shift register, applications of shift registers, serial to parallel converter, parallel to serial converter, ring counter, sequence generator, ripple (Asynchronous) counters, synchronous counters, Modulus counter, counters

design using flip flops, Irregular counter, State table & State transition diagram, Sequential circuit design methodology, applications of counters.

Module 4: A/D and D/A Converters (6Hours)

Digital to analog converters: weighted resistor/converter, R-2R Ladder D/A converter, specifications for D/A converters, examples of D/A converter lCs, sample and hold circuit, analog to digital converters: quantization and encoding, parallel comparator A/D converter, successive approximation A/D converter, counting A/D converter, dual slope A/D converter, A/D converter using Voltage to frequency and voltage to time conversion, specifications of A/D converters, example of A/D Converter ICs.

Module 5: Semiconductor memories and Programmable logic devices. (8Hours)

Memory organization and operation, expanding memory size, classification and characteristics of memories, sequential memory, read only memory (ROM), read and write memory (RAM), content addressable memory (CAM), charge de coupled device memory (CCD), commonly used memory chips, ROM as a PLD, Programmable logic array, Programmable array logic, complex Programmable logic devices (CPLDS), Field Programmable Gate Array (FPGA).

Text Books:

1. Digital Principles & Application, 5th Edition, Leach & Malvino, McGraw Hill Company.
2. Digital Fundamental, 8th Edition, Floyd & Jain. Pearson Education.
3. Fundamental of Digital Circuits, A. Anand Kumar, PHI.

Reference Books:

1. Digital Logic Design, Morries Mano, PHI.
2. Digital Integrated Electronics, H. Taub & D. Shilling, McGraw Hill Company.
3. Digital Electronics, James W. Bignell & Robert Donovan, Thomson Delman Learning.
4. Fundamental of logic Design, Charles H. Roth, Thomson Delman Learning.

ES-CS301	**Data Structure and algorithm**	**3L:0T:0P**	**3 credits**

Introduction: (8 Hours)

Importance of study of Data structure**,** Concept of data structure: Data and data structure, Abstract data type and data type. Algorithm and programs, Basic idea of
pseudo-code, Algorithm efficiency and analysis, time and space analysis of algorithms-order notations.
Different representation: row major, column major.
Sparse matrix, its implementation and usage. Array representation of polynomials.
Singly linked list, circular linked list, doubly linked list, linked list representation
of polynomial and applications.

Stack & queue: (7 Hours)

Stack and its implementation, (using array, using linked list) application.
Queue, circular queue, dequeue, Implementation of queue- both linear and circular
(using array, using linked list) applications.
Recursion: Principle of recursion- use of stack, difference between recursion and
iteration, tail recursion., Application-The Tower of Hanoi, Eight Queen Puzzle.

Nonlinear data structure: (15 Hours)

Trees: Basic terminologies, forest, tree representation (using array, using linked list). Basic trees, binary tree traversal (Pre-,in-,post-order), threaded binary tree(left, right, full), non recursive traversal algorithm using threaded binary tree,
expression tree. Binary search tree-operations (creation, insertion, deletion, searching), Height balanced binary tree-AVL tree (insertion, deletion with examples only). B tree orations ((insertion, deletion with examples only)

Graph:

Graph definition and concept, (directed/undirected graph, weighted/un-weighted edges, sub-graph, degree, cut vertex /articulation point, pendant node, clique, complete graph, connected –strongly connected component, weakly connected

component-path, shortest path, isomorphism. Graph representation/storage implementation- adjacency matrix, adjacency list, adjacency multi-list. Graph traversal and connectivity- Depth First Search (DFS), Breadth-First Search (BFS), concept of edges used in DFS and BFS (tree-edge, back-edge, cross-edge, and forward-edge, application. Minimal spanning tree-Prim's algorithm (Basic idea of greedy methods)

Searching, Sorting: (10 Hours)

Sorting algorithm, Bubble sort and optimization, insertion sort, shell sort, selection sort, merge sort, quick sort, heap sort (Concept, of max heap, application-priority queue, radix sort.
Searching, sequential search, binary search, interpolation search.
Hashing, Hashing functions, collision resolution techniques.

Books:

1. Data structure using C, ReemaThareja, Oxford.
2. Data structure, S.Lipschutz.
3. Data structure and program design in C, Robert L Krusse, B.P.Leung

Reference Books:

1. Data structure using C++, Varsha H. Patil, Oxford

MC-ES301	**Environmental Science**	**2L:0T:0P**	**0 credits**

General

Basic ideas of environment, basic concepts, man, society & environment, their interrelationship. **(1 Hour)**

Mathematics of population growth and associated problems, Importance of population study in environmental engineering, definition of resource, types of resource, renewable, non-renewable, potentially renewable, effect of excessive use vis-à-vis population growth, Sustainable Development. **(2 Hour)**

Materials balance: Steady state conservation system, steady state system with non conservative pollutants, step function. **(1 Hour)**

Environmental degradation: Natural environmental Hazards like Flood, earthquake, Landslide-causes, effects and control/management; Anthropogenic degradation like Acid rain-cause, effects and control. Nature and scope of Environmental Science and Engineering. **(2 Hours)**

Ecology

Elements of ecology: System, open system, closed system, definition of ecology, species, population, community, definition of ecosystem- components types and function. **(1 Hour)**

Structure and function of the following ecosystem: Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems, Mangrove ecosystem (special reference to Sundar ban); Food chain [definition and one example of each food chain], Food web. **(2 Hours)**

Biogeochemical Cycle- definition, significance, flow chart of different cycles with only elementary reaction [Oxygen, carbon, Nitrogen, Phosphate, Sulphur]. **(1 Hour)**

Biodiversity- types, importance, Endemic species, Biodiversity Hot-spot, Threats to biodiversity, Conservation of biodiversity. **(2 Hours)**

Air pollution and control

Atmospheric Composition: Troposphere, Stratosphere, Mesosphere, Thermosphere, Tropopause and Mesopause. **(1 Hour)**

Energy balance: Conductive and Convective heat transfer, radiation heat transfer, simple global temperature model [Earth as a black body, earth as albedo], Problems. **(1 Hour)**

Green house effects: Definition, impact of greenhouse gases on the global climate and consequently on sea water level, agriculture and marine food. Global warming and its consequence, Control of Global warming. Earth's heat budget. **(1 Hour)**

Lapse rate: Ambient lapse rate Adiabatic lapse rate, atmospheric stability, temperature inversion (radiation inversion). **(2 Hours)**

Atmospheric dispersion: Maximum mixing depth, ventilation coefficient, effective stack height, smokestack plumes and Gaussian plume model. **(2 Hours)**

Definition of pollutants and contaminants, Primary and secondary pollutants: emission standard, criteria pollutant. Sources and effect of different air pollutants- Suspended particulate matter, oxides of carbon, oxides of nitrogen, oxides of sulphur, particulate, PAN. **(2 Hours)**

Smog, Photochemical smog and London smog. Depletion Ozone layer: CFC, destruction of ozone layer by CFC, impact of other green house gases, effect of ozone modification. **(1 Hour)**

Standards and control measures: Industrial, commercial and residential air quality standard, control measure (ESP. cyclone separator, bag house, catalytic converter, scrubber (ventury), Statement with brief reference). **(1 Hour)**

Water Pollution and Control

Hydrosphere, Hydrological cycle and Natural water. Pollutants of water, their origin and effects: Oxygen demanding wastes, pathogens, nutrients, Salts, thermal
application, heavy metals, pesticides, volatile organic compounds. **(2 Hours)**

River/Lake/ground water pollution: River: DO, 5 day BOD test, Seeded BOD test, BOD reaction rate constants, Effect of oxygen demanding wastes on river[deoxygenation, reaeration], COD, Oil, Greases, pH. **(2 Hours)**

Lake: Eutrophication [Definition, source and effect]. **(1 Hour)**

Ground water: Aquifers, hydraulic gradient, ground water flow (Definition only)
(1 Hour)

Standard and control: Waste water standard [BOD, COD, Oil, Grease],

Water Treatment system [coagulation and flocculation, sedimentation and filtration, disinfection, hardness and alkalinity, softening]

Waste water treatment system, primary and secondary treatments [Trickling filters, rotating biological contractor, Activated sludge, sludge treatment, oxidation ponds] tertiary treatment definition. **(2 Hour)**

Water pollution due to the toxic elements and their biochemical effects: Lead, Mercury, Cadmium, and Arsenic **(1 Hour)**

Land Pollution

Lithosphere; Internal structure of earth, rock and soil **(1 Hour)**

Solid Waste: Municipal, industrial, commercial, agricultural, domestic, pathological and hazardous solid wastes; Recovery and disposal method- Open dumping, Land filling, incineration, composting, recycling. Solid waste management and control (hazardous and biomedical waste). **(2 Hours)**

Noise Pollution

Definition of noise, effect of noise pollution, noise classification [Transport noise, occupational noise, neighbourhood noise] **(1 Hour)**

Definition of noise frequency, noise pressure, noise intensity, noise threshold limit value, equivalent noise level, $L10$ (18hrIndex), $n\ Ld$. Noise pollution control.

(1 Hour)

Environmental Management:

Environmental impact assessment, Environmental Audit, Environmental laws and protection act of India, Different international environmental treaty/ agreement/ protocol. **(2 Hours)**

References/Books

1. Masters, G. M., "Introduction to Environmental Engineering and Science", Prentice-Hall of India Pvt. Ltd., 1991.
2. De, A. K., "Environmental Chemistry", New Age International.

PC-IC-391	**Electric Circuit Lab**	**3L:0T:0P**	**1.5 credits**

ELECTRIC CIRCUIT THEORY LABORATORY

PC-IC391

Contact: 3

1. Transient response of R-L and R-C network: simulation with PSPICE /Hardware.

2. Transient response of R-L-C series and parallel circuit: Simulation with PSPICE/ Hardware.

3. Determination of Impedance (Z) and Admittance (Y) parameter of two port network: Simulation /Hardware.

4. Frequency response of LP and HP filters: Simulation / Hardware.

5. Frequency response of BP: Simulation /Hardware.

6. Generation of Periodic, Exponential, Sinusoidal, Damped Sinusoidal, Step, Impulse, Ramp signal using MATLAB in both discrete and analog form.

7. Determination of Laplace transform and Inverse Laplace transform using MATLAB.

PC-IC392	**Analog Circuits Design Lab**	**3L:0T:0P**	**1.5 credits**

Analog Electronic Circuits Laboratory (PC-IC-392)

1. Study on V-I characteristics of Junction Diode.
2. Study on V-I characteristics of Zener Diode.
3. Study on Half Wave and Full Wave rectifiers.
4. Study of I-V characteristics of a BJT.
5. Study on characteristics of Field Effect Transistors.
6. Determination of Input offset voltage, Input Bias current, Slew rate of Op-Amp.
7. Determination of Common Mode Rejection Ratio, Bandwidth, Offset null of Op-Amp.
8. Study of DAC & ADC.

PC-IC393	**Digital Circuits Design Lab**	**3L:0T:0P**	**1.5 credits**

Digital Electronic Circuits Lab (PC-IC393)

1. Realization of basic gates using Universal logic gates.
2. Code conversion circuits- BCD to Excess-3 & vice -versa.
3. 4-bit parity generator & comparator circuits.
4. Construction of simple Decoder & Multiplexer circuits using logic gates.
5. Design of combinational circuit for BCD to decimal conversion to drive 7-segment display using multiplexer.
6. Construction of simple arithmetic circuits-Adder, Subtractor.
7. Realization of RS-JK & D flip-flops using Universal logic gates.
8. Realization of Universal Register using multiplexer & flip-flops.
9. Realization of Asynchronous Up/Down counter.
10. Realization of Synchronous Up/Down counter.

ES-CS391	**Data Structure and algorithm Lab**	**3L:0T:0P**	**Credit- 1.5**

DATA STRUCRURE & ALGORITHM LABORATORY
ES-CS391

1. Implementation of array operation
2. Stack and queue: adding, deleting elements. Circular Queue: adding & deleting elements, Merging problems .
3. Evaluation of expression operation on multiple stack & queues.
4. Implementation of linked lists, inserting, deleting, inverting a linked list, implementation of stacks & queue using linked list.
5. Polynomial addition, Polynomial multiplication
6. Sparse Matrices, Multiplication, addition
7. Recursive and Nonrecursive traversal of Trees
8. Threaded binery tree traversal. AVL tree implementation.
9. Application of Trees. Application of sorting and searching algorithm.
10. Hash tables implementation, searching, inserting and deleting, searching & sorting techniques.