DR. A.P.J. ABDUL KALAM TECHNICAL UNIVERSITY
UTTAR PRADESH, LUCKNOW

Syllabus

3rd Year

[Effective from Session 2016-17]

1. **B.Tech. Electronics & Instrumentation Engineering**
2. **B.Tech. Instrumentation & Control Engineering**
3. **B. Tech. Applied Electronics and Control Engineering**

Semester - V

No.	Subject Code	Name of the Subject	Periods			Evaluation Scheme				Subject Total	Credit
			L	T	P	Sessional Assessment			ESE		
						CT	TA	Total			
THEORY SUBJECTS											
1	NEC-501R	Integrated Circuits	3	1	0	30	20	50	100	150	4
2	NIC-501	Control Systems -I	3	1	0	30	20	50	100	150	4
3	NIC-502	Transducer and Sensors	3	1	0	30	20	50	100	150	4
4	NEC-503	Microprocessors	3	1	0	30	20	50	100	150	4
5	NCE-509	Fluid Mechanics	2	1	0	15	10	25	50	75	3
6	NHU-501	Engineering Economics	2	0	0	15	10	25	50	75	2
PRACTICAL/DESIGN/DRAWING											
7	NEC-551R	Integrated circuits Lab	0	0	2	10	10	20	30	50	1
8	NIC-551	Control Systems-I Lab	0	0	2	10	10	20	30	50	1
9	NIC-552	Transducer Lab	0	0	2	10	10	20	30	50	1
10	NEC-553	Microprocessors Lab	0	0	2	10	10	20	30	50	1
11	NGP-501	GP						50		50	
		TOTAL	16	5	8					1000	25

CT Class Test **AT** Attendance **TA** Tutorial Assignment
ESE End Semester Examination
L/T/P Lecture/ Tutorial/ Practical

SEMESTER - VI

No.	Subject Code	Name of the Subject	Periods			Evaluation Scheme				Subject Total	Credit
			L	T	P	Sessional Assessment			ESE		
						CT	TA	Total			
THEORY SUBJECTS											
1	NIC-601R	Microcontrollers for Embedded Systems	3	1	0	30	20	50	100	150	4
2	NIC-602	Industrial Instrumentation	3	1	0	30	20	50	100	150	4
3	NEC-609	Communication Engineering	3	1	0	30	20	50	100	150	4
4		Departmental Elective-I	3	1	0	30	20	50	100	150	4
5		Departmental Elective-II	2	1	0	15	10	25	50	75	3
6	NHU-601	Industrial Management	2	0	0	15	10	25	50	75	2
PRACTICAL/DESIGN/DRAWING											
7	NIC-651R	Microcontrollers for Embedded Systems Lab	0	0	2	10	10	20	30	50	1
8	NEC-652	Instrumentation Lab	0	0	2	10	10	20	30	50	1
9	NEC-659	Communication Lab	0	0	2	10	10	20	30	50	1
10	NIC-654	Seminar	0	0	2	10	10	20	30	50	1
11	NGP-601	GP						50		50	
		TOTAL	16	5	8					1000	25

Departmental Elective-I

NEC – 011 Digital Signal Processing
NEC – 012 Computer Architecture and Organization
NEC – 601 Microwave Engineering
NIC – 011 Electrical Machines

Departmental Elective-II

NIC – 021 Opto-Electronics
NIC – 022 Intelligent Instrumentation
NEC – 021 Industrial Electronics
NEC – 023 Analog Signal Processing

NEC 501R Integrated Circuits		
Unit	Topic	Lect.
I	**Analog Integrated circuit Design: an overview:** Current Mirrors using BJT and MOSFETs, Simple current Mirror, Base current compensated current Mirror, Wilson and Improved Wilson Current Mirrors, Widlar Current source and Cascode current Mirror **The 741 IC Op-Amp:** Bias circuit, short circuit protection circuitry, the input stage, the second stage, the output stage, and device parameters; D**C** Analysis of 741: Small Signal Analysis of input stage, the second stage, the output stage; Gain, Frequency Response of 741; a Simplified Model, Slew Rate, Relationship Between ft and SR	10
II	**Linear Applications of IC op-amps:** An Overview of Op-Amp (ideal and non-ideal) based Circuits V-I and I-V converters, generalized Impedance converter, simulation of inductors **Filters:** First and second order LP, HP, BP BS and All pass active filters, KHN.	8
III	**Digital Integrated Circuit Design-An Overview**: CMOS Logic Gate Circuits**:** Basic Structure CMOS realization of Inverters, AND, OR, NAND and NOR Gates **Latches and Flip flops:** The Latch, The SR Flip-flop, CMOS Implementation of SR Flip- flops, A Simpler CMOS Implementation of the Clocked SR Flip-flop, D Flip-flop Circuits.	8
IV	**Non-Linear applications of IC Op-amps:** Log–Anti Log Amplifiers, Precision Rectifiers, Peak Detectors, Simple and Hold Circuits, Analog Multipliers and their applications. Op- amp as a comparator, Zero crossing detector, Schmitt Trigger, Astable multi vibrator, Mono stable multi vibrator, Generation of Triangular Waveforms	7
V	**D/A and A/D converters** **Integrated Circuit Timer:** The 555 Circuit, Implementing a Monostable Multivibrator Using the 555 IC, Astable Multi vibrator Using the 555 IC. **Phase locked loops (PLL):** Ex-OR Gates and multipliers as phase detectors**,** Block Diagram of IC PLL, Working of PLL and Applications of PLL.	7

Text Books:

1. Sedra and Smith, "Microelectronic Circuits", 6th Edition, Oxford University Press.
2. Michael Jacob, "Applications and Design with Analog Integrated Circuits", PHI, 2nd Edition.

Reference Books:

1. Jacob Millman and Arvin Grabel, "Microelectronics", 2nd Edition, Tata McGraw Hill.
2. Behzad Razavi, "Fundamentals of Microelectronics", 2nd Edition, Wiley.
3. Mark N. Horenstein, "Microelectronic Circuits and Devices", PHI.
4. Paul R. Gray, Paul J. Hurst, Stephen H. Lewis and Robert G. Meyer, "Analysis and Design of Analog Integrated Circuits", Wiley.
5. Data Sheet: http://www.ti.com/lit/ds/symlink/tl082.pdf

6. Application Note: http://www.ti.com/lit/an/sloa020a/sloa020a.pdf
7. MPY634 Data Sheet: http://www.ti.com/lit/ds/symlink/mpy634.pdf
8. Application Note: http://www.ti.com/lit/an/sbfa006/sbfa006.pdf
9. ASLK Pro Manual: ASLK Manual

NIC-501 CONTROLSYSTEM-I		
Unit	**Topic**	**Lectures**
1	**Introduction:** Basic Components of a control system, Feedback and its effect, types of feedback control systems. Block diagrams Reduction and signal flow graphs, Modeling of Physical systems	**8**
2	**State-Variable Analysis:** Introduction, Vector matrix representation of State equation, State Transition Matrix, State-Transition Equation, Relationship between State Equations and Higher-order Differential Equations, Relationship between State Equations and Transfer Functions. Similarity Transformation, Decomposition of transfer functions, Controllability and observability.	**8**
3	**Time domain Analysis of Control Systems:** Time response of continuous data systems, typical test signals for the time response of control systems, the unit step response and time- domain specifications, Steady-State error, Time response of a First order system, Transient response of a Prototype second order system	**8**
4	**Stability of Linear Control Systems:** Introduction, Bounded- Input Bounded-output Stability Continuous Data Systems, Zero-input and asymptotic stability of continuous data systems, Methods of determining stability, RH criterion. **Root-Locus Technique:** Introduction, Properties of the Root Loci, Design aspects of the Root Loci	**8**
5	**Frequency Domain Analysis:** Introduction: Mrωr and Bandwidth of the Prototype Second Order System, Effects of Adding a zero to the Forward path, Effects of Adding a pole to the Forward Path, Nyquist Stability criterion, Relative Stability: Gain Margin and Phase Margin, Stability Analysis with the Bode Plot.	**8**

Text Book:

1. B.C. Kuo & Farid Golnaraghi, "Automatic Control Systems", 8th Edition, John Wiley India Publication.

Reference Books:

1. William A. Wolovich, "Automatic Control Systems", Oxford University Press.

2. Joseph J. Distefano III, Allen R. Stubberud, Ivan J. Williams,"Feedback and Control Systems" Schaums Outlines Series, Tata McGraw Hill Publication.

3. I. J. Nagrath& M. Gopal, "Control System Engineering", New Age International Publishers.

NIC-502 TRANSDUCERS AND SENSORS		
Unit	**Topic**	**Lectures**
1	**Generalized configurations, functional description & performance characteristics of measuring instruments:** Functional elements of an instrument; active &passive transducers; analog & digital modes of operation; null & deflection methods; I/O configuration of measuring instruments &instrument system-methods of correction for interfering &modifying inputs. Generalized performance characteristics of Instruments: Static characteristics and static calibration-Meaning of static calibration, measured value versus true value, Some basic statistics least square calibration curves, calibration accuracy versus installed accuracy, Combination of component errors in overall system accuracy calculations, static sensitivity, linearity, threshold, noise floor, resolution, hysteresis and dead space. Scale readability. Span, Generalized static stiffness & input impedance.	8
2	**Motion and Dimensional measurement:** Fundamental standards, relative displacements- translational and rotational, Calibration, Resistive potentiometers, differential transformers, variable inductance & variable reluctance pickups, capacitance pickup, Digital displacement transducers, Mechanical fly ball angular velocity sensor, Mechanical revolution counters and timers, tachometer encoder methods, stroboscopic method, translational velocity transducer, eddy current Drag-cup tachometer, velocity sensors.	8
3	**Force, Torque, Shaft power:** Standards & calibration; basic methods of force measurement; characteristics of elastic force transducer-Bonded strain gauge, differential transformer, Piezo electric transducer, variable reluctance/FM-oscillator, digital systems. Loading effects; Torque measurement on rotating shafts, shaft power measurement (dynamometers).	8
4	**Flow measurement:** Local flow velocity, magnitude and direction. Flow Visualization. Velocity magnitude from pilot static tube. Velocity direction from yaw tube, dynamic wind vector indicator. Hot-film shock-tube velocity sensor. Laser Doppler anemo-meter; gross volume flow rate: calibration and standards. Constant-area, variable-pressure-drop meters (obstruction meters). Averaging pitot tubes. Constant pressure drop, variable area meters (Rota meters), turbine meters, positive displacement meters. **Measurement of Liquid Level:** inductive method, capacitive method, ultrasonic method, using gamma rays, using float.	8

5	**Temperature measurement:** Standards & calibration; thermal expansion methods-bimetallic thermometers, liquid-in-glass thermometers, pressure thermometers; RTD, termister and thermocouple (comparative study); digital thermometers. Radiation Methods - radiation fundamentals, radiation detectors: thermal and photon, monochromatic brightness radiation thermometers, two color radiation thermometers, black body tipped fiber optic radiation thermometer, Fluor optic temperature measurement, infrared imaging systems.	8

Text Book:

1. 1. E. O. Doebelin and D.N. Manik,"Measurement systems application and design", Tata McGraw Hill Publication.

Reference Book:

1. Arun K Ghosh, "Introduction to Transducers", PHI Publication.
2. Bela G. Liptak, "Process Measurement and Analysis, Vol. 1", CRC Press Publication.

NEC 503 MICROPROCESSORS		
Unit	**Topic**	**Lectures**
1.	Evolution of microprocessors, Microprocessor architecture and its operations, 8085 pins description, programming model, basic interfacing concepts, input and output devices, logic devices and memory interfacing, addressing modes, Concept of instruction cycle, machine cycle and T-states, Concept of interrupts, Classification of 8085 instructions.	**8**
2.	8086 architecture-functional diagram, register organization, memory segmentation, programming model, memory address, physical memory organization, pins description, clock generator 8284A, maximum mode and minimum mode signal descriptions, timing diagrams, introduction to DOS and BIOS interrupts.	**8**
3.	Instruction formats, addressing modes, classification of instruction set, assembler directives (debug, TASM & MASM), macros, Programs techniques and assembly language programs: simple programs involves data transfer operation, arithmetic operation, logical operation, branch operation, machine control operation, string manipulations, stack and subroutine operations.	**8**
4.	8255 Programmable peripheral interfacing various mode of operation to 8086, interfacing keyboard and seven segment display, stepper motor interfacing, D/A and A/D converter, 8254 (8253) programmable interval timer, Direct Memory Access and 8237 DMA controller.	**8**
5.	Memory interfacing to 8086. Interrupt structure of 8086, interrupt handling, vector interrupt table and interrupt Service routine. Interfacing interrupt controller 8259 and DMA Controller 8257 to 8086. Serial communication standards, Serial data transfer schemes.	**8**

Text Book:

1. Ramesh Gaonkar, "Microprocessor architecture, programming and applications with the 8085", Penram International Publication (India) Pvt. Ltd.
2. Douglas V. Hall, "Microprocessors and Interfacing", Tata McGraw Hill Publication.

Reference Books:

1. Sivarama P. Dandamudi,"Introduction to Assembly Language Programing From 8086 to Pentium Processors", Springer Publication.
2. Walter A. Triebel and Avtar Singh, "The 8088 and 8086 Microprocessors: Programming, Interfacing Software, Hardware and Applications", Pearson Publication.
3. A. K. Ray and K. M. Bhurchandi,"Advance microprocessors and Peripherals", Tata McGraw Hill Publication.
4. Lyla B. Das, "The X86 Microprocessors, Architecture, Programming and Interfacing (8086 to Pentium)", Pearson Publication.

NCE-509 FLUID MECHANICS		
Unit	**Topic**	**Lectures**
1	Introduction: Fluids and continuum: Physical properties of fluids, ideal and rearfluids, Newtonian and non-Newtonian fluids, measurement of surface tension. Kinematics of Fluid Flow: Steady and unsteady, uniform and non-uniform, laminar and turbulent flows, one, two and three dimensional flows, streamlines, streak lines and path lines, continuity equation, rotation and circulation, elementary explanation of stream function and velocity potential, graphical and experimental methods of drawing flow nets.	**8**
2	Fluid statics: Pressure-density-height relationship, manometers, pressure on plane and curved surfaces, centre of pressure, buoyancy, stability of immersed and floating bodies. Dynamics of Fluid flow: Euler's equation of motion along a streamline and its integration, Bernoulli's equation and its applications- Pitot tube, flow through orifices, mouthpieces, nozzles, notches, free and forced vortex.	**8**
3	Laminar and Turbulent Flow: Equation of motion for laminar flow through pipes, Stoke's law, flow between parallel plates, flow through porous media, fluidization, measurement of viscosity, transition from laminar to turbulent low, turbulent flow, equation for turbulent flow, eddy viscosity, mixing length concept and velocity distribution in turbulent flow, Hot-wire anemometer and LDA.	**8**
4	Dimensional Analysis and Hydraulic Similitude: Dimensional analysis, Buckingham's theorem, important dimensionless numbers and their significance, geometric, Kinematic and dynamic similarity, model studies. Pipe Flow: Nature of turbulent flow in pipes, equation for velocity distribution Over smooth and rough surfaces, resistance coefficient and its variation, flow in sudden expansion, contraction, diffusers, bends, valves and siphons, concept of Equivalent length, branched pipes, pipes in series and parallel, simple networks. Compressibility Effects in pipe flow	**8**

Text Books:

1. Som and Biswas, "Introduction to fluid mechanics and machines", Tata McGraw Hill Publication.
2. S.K.Agrawal, "Fluid mechanics and machinery", Tata McGraw Hill Publication.

LABORATORY

NEC- 551R INTEGRATED CIRCUITS LAB

Objective: - To design and implement the circuits to gain knowledge on performance of the circuit and its application. These circuits should also be simulated on Pspice and implemented using TL082, LM741, NE555, ASLK, MPY634 KP connecting wires, Power Supply, function generator and oscilloscope.

1. Design and test a function generator that can generate square wave and triangular wave output for a given frequency and cascade a multiplier MPY634KP in feedback loop to form VCO
2. Voltage to current and current to voltage convertors.
3. Second order filters using operational amplifier in universal active filter topology for –
    a. Low pass filter of specified cutoff frequency
    b. High pass filter of specified frequency
    c. Band pass filter with unit gain of specified pass band
    d. Design a notch filter to eliminate 50Hz power line frequency
4. Wien bridge oscillator using operational amplifier.
5. Astable and monostable multivibrator using IC 555.
6. Design the following amplifiers:
    a. A unity gain amplifier
    b. A non-inverting amplifier with a gain of 'A'
    c. An inverting amplifier with a gain of 'A'
    d. Log and antilog amplifiers.
    e. Voltage comparator and zero crossing detectors.
7. Design and test a PLL to get locked to a given frequency 'f'. Measure the locking range of the system and also measure the change in phase of the output signal as input frequency is varied within the lock range.
8. Design and test the integrator for a given time constant.
9. Design and test a high-Q Band pass self-tuned filter for a given center frequency.
10. Design and test an AGC system for a given peak amplitude of sine-wave output.
11. Design and test a Low Dropout regulator using op-amps for a given voltage regulation characteristic and compare the characteristics with TPS7250IC.
12. Design of a switched mode power supply that can provide a regulated output voltage for a given input range using the TPS40200 IC.

Note: All listed experiments are compulsory. In addition to it, the Institutes may include more experiments based on the expertise.

NIC-551 CONTROL SYSTEM-I LAB

1. Different Toolboxes in MATLAB, Introduction to Control Systems Toolbox.
2. Determine transpose, inverse values of given matrix.
3. Plot the pole-zero configuration in s-plane for the given transfer function.
4. Determine the transfer function for given closed loop system in block diagram representation.
5. Plot unit step response of given transfer function and find peak overshoot, peak time.
6. Plot unit step response and to find rise time and delay time.
7. Plot locus of given transfer function, locate closed loop poles for different values of k.
8. Plot root locus of given transfer function and to find out S, Wd, Want given root & to discuss stability.
9. Plot Bode plot of given transfer function.

10. Plot Bode plot of given transfer function and find gain and phase margins
11. Plot Nyquist plot for given transfer function and to compare their relative stability
12. Plot the Nyquist plot for given transfer function and to discuss closed loop stability, gain and phase margin.

Note:-In addition to it, the Institutes may include more experiments based on the expertise.

NIC-552 TRANSDUCER LAB

1. Characteristics of resistance transducer
   (i) Potentiometer
   (ii) Strain Gauge
2. Characteristics of LVDT.
3. Characteristics of capacitive transducer

(i) Variable area
(ii) Variable distance.

4. Characteristics of Thermistors
5. Characteristics of RTD.
6. Characteristics of Thermocouples
7. Characteristics of LDR, Photo Diode, and Phototransistor:
   (i) Variable Illumination.
   (ii) Linear Displacement.
8. Measurement of resistance by Wheatstone bridge and measurement of bridge sensitivity.
9. Measurement of Capacitance by De'Sautys and Schering Bridge.
10. Measure of low resistance by Kelvin's double bridge.
11. Characteristics of diaphragm type pressure transducer.
12. Characteristics of one Solid State sensor/ Fiber optic sensor.

NEC-553 MICROPROCESSORS LAB

1. Write a program using 8085/ 8086 Microprocessor for Decimal, Hexadecimal addition and subtraction of two Numbers.
2. Write a program using 8085/ 8086 Microprocessor for addition and subtraction of two BCD numbers.
3. To perform multiplication and division of two 8 bit numbers using 8085/ 8086.
4. To find the largest and smallest number in an array of data using 8085/8086 instruction set.
5. To write a program to arrange an array of data in ascending and descending order using 8085/ 8086.
6. To convert given Hexadecimal number into its equivalent ASCII number and vice versa using 8085/ 8086 instruction set.
7. To write a program to initiate 8251 and to check the transmission and reception of character.
8. To interface 8253 programmable interval timer to 8085/ 8086 and verify the operation of 8253 in six different modes.
9. To interface DAC with 8085/ 8086 to demonstrate the generation of square, saw tooth and triangular wave.
10. Serial communication between two 8085/8086 through RS-232 C port.

Note:-In addition, Institutes may include two more experiments based on the expertise.

Syllabus of Sixth Semester

NIC 601R Microcontrollers for Embedded Systems		
Unit	**Topic**	**Lectures**
I	Introduction , Microcontrollers and Embedded systems, Overview of the 8051, Inside the 8051, Addressing modes, assembly programming, 8051 data types and directives, Interfacing with 8051, Programming the 8051 timers.	6
II	MSP430x5x series block diagram, address space, on-chip peripherals (analog and digital), and Register sets. Instruction set, instruction formats, and various addressing modes of 16-bit microcontroller; Sample embedded system on MSP430 microcontroller. Memory Mapped Peripherals, programming System registers, I/O pin multiplexing, pull up/down registers, GPIO control. Interrupts and interrupt programming.	8
III	Watch dog timer, system clocks, Timer & Real Time Clock (RTC), PWM control, timing generation and measurements. Analog interfacing and data acquisition: ADC and Comparator in MSP430, data transfer using DMA.	10
IV	Serial communication basics, Synchronous/Asynchronous interfaces (like UART, USB, SPI, and I2C). UART protocol, I2C protocol, SPI protocol. Implementing and programming UART, I2C, SPI interface using MSP430, Interfacing external devices.	10
V	Internet of Things (IoT) overview and architecture, Overview of wireless sensor networks and design examples. Various wireless connectivity: NFC, ZigBee, Bluetooth, Bluetooth Low Energy, Wi-Fi. Adding Wi-Fi capability to the Microcontroller, Embedded Wi-Fi, User APIs for Wireless and Networking applications, Building IoT applications using CC3100 user API for connecting sensors.	6

Text Book:

1. Mazidi Ali Muhammad, Mazidi Gillispie Janice, and Mc Kinlay Rolin D " The 8051 Microcontroller and Embedded Systems using Assembly and C", Pearson Publication.
2. John H Davies, "MSP430 Microcontroller Basics" Newnes Publication.

Reference Book:

1. TI MSP430x5xx and MSP430x6xx Family User's Guide.

NIC-602 INDUSTRIALINSTRUMENTATION		
Unit	**Topic**	**Lectures**
1	Introduction to industrial symbols and standards, classification of industry and type of measurement required; detectors, probe analyzers, actuators-principles and applications. Measurement of weight- Load cell method, strain gauge, LVDT; piezoelectric, pneumatic and hydraulic load cell, null balance method.	**8**
2	Temperature measurements: Standards and calibration, thermal expansion methods, bimetallic thermometer, thermocouple, reference junction considerations, special materials, configuration & techniques, Measurement of thermocouple output, electrical resistance sensors - conductive sensor (resistance thermometers), bulk semiconductor sensors thermistors), Radiation thermometers, automatic null balance radiation thermometers. Optical pyrometers.	**8**
3	**Units of pressure and vacuum:** dead weight gauges & manometer dynamics; Different type of manometers, diaphragm gauges bellows and force balance type sensors, Boudern gauge, Piezoelectric, Capacitive and Inductive Pressure pickups. Vacuum pressure measurements: Meleod gauge, Pirani gauge, thermocouple gauge, Knudsen gauge Ionization gauge	**8**
4	Differential pressure flow meters: Bernoulli's theorem: pituttube, orifice, vanturi, flow nozzle, Hot wire and hot film anemometers, variable area meters (rotameter), turbine meters, Electromagnetic flow meters, Ultrasonic flow meters. Drag force flow meters, vortex shedding flow meters. Measurement of level, Float type gauge, purge method, differential pressure method, conductive and capacitive method; electromechanical method	**8**
5	Measurement of Moisture, Thermal Dying Method, Distillation Method, Chemical Reaction Method, Electrical Method. Measurement of viscosity, definition of absolute and kinematic viscosity, industrial viscosity meter.	**8**

Text Book:

1. E. O. Doebelin, "Measurements systems: Applications and Design", McGraw Hill Publication.
2. D. P. Eckman, "Industrial Instrumentation", Wiley Publication.

Reference Book:

1. T. G. Beckwith, R. D. Maragoni and J. H. Lienhard, "Mechanical Measurements", Pearson Publication.
2. B. C. Nakra and K. K. Chaudhry, "Instrumentation: Measurements & Analysis" Tata McGraw Hill Publication.

NEC-609 COMMUNICATION ENGINEERING		
Unit	**Topic**	**Lectures**
1	**Introduction:** The Communication Process, Modulation Process, The Layered Approach, Example of communication **Amplitude Modulation:** Introduction, Amplitude modulation, Double Sideband-Suppressed Carrier modulation, Quadrature-Carrier Multiplexing, Single-Sideband and Vestigial-Sideband Methods of modulation, Frequency Translation, Frequency- Division Multiplexing	8
2	**Phase and Frequency Modulation:** Introduction, Basic Definitions, Frequency Modulation Phase Modulation, Phase-Locked Loop, Nonlinear Effects in FM Systems, The Super-heterodyne Receiver,	8
3	**Noise in Analog Modulation:** Introduction, white noise ,power spectral densities, Noise inDSB-SC Receivers, Noise in AM receivers, Noise in FM Receivers, Pre-emphasis and De-emphasis in FM **Digital Representation of Analog Signals:** Introduction, Digitization of Analog Sources, The Sampling Process, The Quantization Process, Pulse-Amplitude Modulation, Pulse-Position Modulation, Pulse-Code Modulation, Delta Modulation, Time-Division Multiplexing,	8
4	**Baseband Transmission of digital Signals:** Introduction, Baseband Pulses and matched Filter Detection, Probability Of Error Due to Noise, Inter symbol Interference, Eye Pattern, Nyquist Criterion for Distortion less Transmission, Baseband M-ary PAM Transmission, Tapped Delay Line Equalization	8
5	**Band-Pass Transmission of Digital Signals:** Introduction, band-Pass Transmission Model, Transmission Binary ASK ,PSK and FSK, Orthogonal Frequency Division Multiplexing (OFDM) . **Information and Forward Error Correction:** Introduction, Uncertainty, Information and Entropy, Information rate, Channel capacity, Source-Coding Theorem, Lossless Data Compression	8

Text Book:

1. Simon Haykin & Michael Moher, "Communication Systems", Wiley India Publication.
2. Herbert Taub and Donald L. Schilling, "Principles of Communication Systems", Tata McGraw Hill Publication.

Reference Book

1. B.P. Lathi & Zhi Ding, "Modern Digital and Analog Communication Systems", International Oxford University Press.
2. R.P. Singh and Sapre, "Communication Systems: Analog and Digital",McGraw Hill Publication.
3. H.P.HSU & D.Mitra,"Analog and Digital communication", Tata McGraw Hill Publication.

LABORATORY

NIC 651R Microcontrollers for Embedded Systems Lab

1. Write a program of Flashing LED connected to port 1 of the 8051 Micro Controller
2. Write a program to generate 10 kHz square wave using 8051.
3. Write a program to show the use of INT0 and INT1 of 8051.
4. Write a program for temperature & to display on intelligent LCD display.
5. Write a program to generate a Ramp waveform using DAC with micro controller.
6. Write a program to Interface GPIO ports in C using MSP430 (blinking LEDs , push buttons)
7. Write a program Interface potentiometer with GPIO.
8. Write a program of PWM based Speed Control of Motor controlled by potentiometer connected to GPIO.
9. Write a program of PWM generation using Timer on MSP430 GPIO.
10. Write a program to Interface an accelerometer.
11. Write a program using USB (Sending data back and forth across a bulk transfer-mode USB connection.)
12. Write a program for Master Slave Communication between 2 MSP430s using SPI
13. Write a program of basic Wi-Fi application – Communication between two MSP430 based sensor nodes.
14. Setting up the CC3100 as a HTTP server.
15. Review of User APIs for TI CC3100 & Initialization and Setting of IP addresses.

Note: All listed experiments are compulsory. In addition to it, the Institutes may include more experiments based on the expertise.

NIC-652 INSTRUMENTATION LAB

1. Instrumentation Amplifier: Design for specific gain and verification of CMRR.
2. Realization of PCM signal using ADC and reconstruction using DAC using 4-bit/ 8 bit systems. Observe the Quantization noise in each case.
3. Study of Storage Oscilloscope & Transient response of RLC.
4. Convert a given AC Analog signal into digital using S/H & ADC and recover the analog signal using DAC IC.
5. Study of Characteristics of a Strain Gauge.
6. Construction of chopper amplifier.
7. Study of low noise and low frequency amplifier for biomedical application.
8. Study of Piezoelectric transducer.
9. Study of Capacitive and Inductive Pressure pickups.

Note:-In addition to it, the Institutes may include more experiments based on the expertise.

NEC-659 COMMUNICATION LAB

1. With the help of Fourier series,
   i. To construct a triangular wave with the help of Fundamental Frequency and its Harmonic component,
   ii. To construct a Square wave with the help of Fundamental Frequency and its Harmonic component.
2. Amplitude Modulation & Demodulation
   i. To generate amplitude modulated wave and determine the percentage modulation,
   ii.To demodulate the modulated wave using envelope detector.
3. To study DSB-SC and SSB modulation & determine power in side bands.
4. Frequency Modulation & Demodulation

i. To study frequency modulation and determine its modulation factor
ii. To demodulate a Frequency Modulated signal using FM detector

5. To study Pulse Amplitude Modulation, Pulse Width Modulation and Pulse Position Modulation.
6. To study and verify the sampling theorem and reconstruction of sampled wave form.
7. Study of Pulse code modulation (PCM) and its demodulation.
8. To verify the operation of Time Division Multiplexing.
9. To study of Amplitude shift keying modulator and demodulator.
10. To study of Frequency shift keying modulator and demodulator.
11. To study of Phase shift keying modulator and demodulator
12. Design and implement a Transmitter and receiver for the corresponding modulation system.

NEC 011 DIGITAL SIGNAL PROCESSING		
Unit	**Topic**	**Lectures**
1	**Realization of Digital Systems:** Introduction, direct form realization of IIR systems, cascade realization of an IIR systems, parallel form realization of an IIR systems, Ladder structures: continued fraction expansion of H(z), realization of a ladder structure with example.	8
2	**Design of Infinite Impulse Response Digital Filters:** Introduction to All Pole Analog Filter, Butterworth and Chebyshev, Design of Digital Butterworth and Chebyshev Filters	8
3	**Finite Impulse Response Filter Design:** Designof FIR filters by Windowing and other commonly used Windowing Techniques, Examples of Filter Designs Using Windows ,The Kaiser Window	8
4	**Discrete Fourier Transforms:** Definitions, Properties of the DFT, Circular Convolution and Its Methodology, Linear Convolution, Examples of Circular Convolution and Linear Convolution.	8
5	**Fast Fourier Transform Algorithms:** Introduction, Decimation -In Time(DIT) Algorithm, Computational Efficiency, Decimation in Frequency(DIF) Algorithm, Composite-Radix FFT	8

Text Book:

1. John G Prokias, Dimitris G Manolakis, "Digital Signal Processing", Pearson Education Publication.
2. Oppenheim & Schafer, "Digital Signal Processing" PHI Publication.

Reference Book:

1. Johnny R. Johnson, "Digital Signal Processing", PHI Publication.

NEC 012 COMPUTER ARCHITECTURE AND ORGANIZATION		
Unit	**Topic**	**Lectures**
1.	Introduction to Design Methodology: System Design - System representation, Design Process, the gate level (revision), the register level components and PLD (revision), register level design The Processor Level: Processor level components, Processor level design.	8
2.	Processor basics: CPU organization- Fundamentals, Additional features Data Representation - Basic formats, Fixed point numbers, Floating point numbers. Instruction sets - Formats, Types, Programming considerations.	8
3.	Datapath Design: Fixed point arithmetic - Addition and subtraction, Multiplication and Division, Floating point arithmetic, pipelining.	8
4.	Control Design: basic concepts - introduction, hardwired control, Micro programmed control - introduction, multiplier control unit, CPU control unit, Pipeline control-instruction pipelines, pipeline performance.	8
5.	Memory organization: Multi level memories, Address translation, Memory allocation, Caches - Main features, Address mapping, structure vs performance, System Organisation: Communication methods- basic concepts, bus control. Introduction to VHDL.	8

Text Books:

1. John P Hayes "Computer Architecture and Organisation", McGraw Hill Publication.

Reference Books:

1. M Morris Mano, "Computer System Architecture", Pearson Publication.
2. Carl Hamacher, Zvonko Vranesic and Safwat Zaky, "Computer Organization and Embedded Systems", McGraw Hill Publication.
3. David A. Patterson and John L. Hennessy," Computer Organization and Design: The Hardware/Software Interface", Elsevier Publication.

NEC-601 MICROWAVE ENGINEERING		
Unit	**Topic**	**Lectures**
1	Rectangular Wave Guide: Field Components, TE, TM Modes, Dominant TE10 mode, Field Distribution, Power, Attenuation. Circular Waveguides: TE, TM modes. Wave Velocities, Micro strip Transmission line(TL), Coupled TL, Strip TL, Coupled Strip Line, Coplanar TL, Microwave Cavities.	**8**
2	Scattering Matrix, Passive microwave devices: Microwave Hybrid Circuits, Terminations, Attenuators, Phase Shifters, Directional Couplers: Two Hole directional couplers, S Matrix of a Directional coupler, Hybrid Couplers, Microwave Propagation in ferrites, Faraday Rotation, Isolators, Circulators. Sparameter analysis of all components.	**8**
3	Microwave Tubes: Limitation of Conventional Active Devices at Microwave frequency, Two Cavity Klystron, Reflex Klystron, Magnetron, Traveling Wave Tube, Backward Wave Oscillators: Their Schematic, Principle of Operation, Performance Characteristic and their applications.	**8**
4	Solid state amplifiers and oscillators: Microwave Bipolar Transistor, Microwave tunnel diode, Microwave Field-effect Transistor, Transferred electron devices, Avalanche Transit -time devices: IMP ATT Diode, TRAPPAT Diode.	**8**
5	Microwave Measurements: General setup of a microwave test bench, Slotted line carriage, VSWR Meter, microwave power measurements techniques, Crystal Detector, frequency measurement, wavelength measurements, Impedance and Refection coefficient, VSWR, Insertion and attenuation loss measurements, measurement of antenna characteristics, microwave link design.	**8**

Text Book:

1. Samuel Y. Liao, "Microwave Devices and Circuits", Pearson Publication.
2. A. Das and S.K. Das ," Microwave Engineering", 3rd Edition, Tata McGraw Hill Publication.

Reference Book:

1. R.E Collin, "Foundation for Microwave Engineering", John Wiley India Publication.

Unit	NIC-011 ELECTRICAL MACHINES	Lectures
1	Basic concept of rotating machines: Elementary machines - synchronous machines, dc machine, generated emf, rotating magnetic field, torque in round rotor machines. Operations of Basic Machine types - synchronous, asynchronous, ac machines, dc machines, matching characteristics of electric machines and load.	**8**
2	DC Machine: Introduction, emf equation, torque equation, power balance, linear magnetization, circuit model, generating mode, motoring mode, armature reaction, compensating winding, commutation, method of excitation, characteristics of dc shunt, series and compound motors and generators. Starting of dc motor, speed control of dc motor, breaking of dc motor.	**8**
J	Synchronous machines: Introduction of basic synchronous machine model, circuit model of synchronous machine, determination of armature reaction ampere turn and leakage reactance of synchronous machine, synchronizing to infinite bus bar, operating characteristics, power flow equations, parallel operation of synchronous generators, hunting in synchronous machines.	**8**
4	Induction Motor: Introduction, construction, flux and mmf phasor in induction motors, slip and frequency of rotor currents, rotor emf, power, induction motor phasor diagram, torque slip characteristics, determination of equivalent circuit parameters, circle diagram, starting of induction motor, speed control	**8**
5	Single Phase Motors: Introduction, types of single phase motor, single phase induction motor, split phase motors, single phase commutator motor, single phase synchronous motor, stepper motor.	**8**

Text Book:

1. DP Kothari & I J Nagrath, "Electric Machines", Tata McGraw Hill Publication.

Reference Book:

1. Fitzgerald, C. Kingsley and S.Umans , "Electric Machinery", Tata McGraw Hill Publication.

NIC-021 OPTO ELECTRONICS		
Unit	**Topic**	**No. of Lectures**
1	Introduction to Optical waveguide, Photo sources and detectors: Optical waveguide modes-Theory of Dielectric slab waveguides-Symmetric and Asymmetric slab waveguide, Channel waveguide Light emitting diode (LED),materials, constructions, Drive circuitry, Fundamentals of lasers and its applications	**8**
2	Electro Optic Effects: Birefringence phenomenon EO Retardation, EO Amplitude and Phase Modulator, Electro optic Intensity Modulators, Beam deflection, Acousto-optics, A-O Modulators, Integrated optic spectrum analyzer.	**8**
J	Optical Fiber Sensors: Multimode fiber Sensors-Displacement, pressure, stress, strain. Intensity modulated sensors, Active multimode FO sensors, Micro-bend optical fiber sensor, Current sensors, Magnetic sensors, Single mode FO sensors, Phase modulated, Polarization modulated, Fibre Optic Gyroscope.	**8**
4	Optical Computing: Analog arithmetic operation- addition/subtraction, multiplication, division, averaging, differentiation and integration. Digital logic: modified signed digit number system, residue number system, logarithmic number system. Arithmetic operations: MSD, residue, signed logarithmic arithmetic, threshold logic, threshold devices, spatial light modulators.	**10**

Text Book:

1. J. Wilson and J. Hawkes," Optoelectronics- An Introduction", PHI Publication.
2. M.A.Karim,"Optical Computing-An Introduction", Wiley India Publication.

Reference Book:

2. A.Yariv,P.Yeh,"Photonics", Oxford University Press.

Emmanuel Rosencher and BorgeVinter, "Optoelectronics", Cambridge University Press.

NIC-022 INTELLIGENT INSTRUMENTATION		
Unit	**Topic**	**No. of Lectures**
1	Introduction: Introduction to intelligent instrumentation, Historical Perspective, Current status, software based instruments.	4
2	Virtual Instrumentation :Introduction to graphical programming, data flow & graphical programming techniques, advantage of VI techniques, Vis and sub VIs loops and charts, arrays, clusters and graphs, case and sequence structure, formula nodes,string and file I/O, Code Interface Nodes and DLL links.	Book 2 12
3	Data Acquisition Methods: Analog and Digital IO, Counters, Timers, Basic ADC designs, interfacing methods of DAQ hardware, software structure, use of simple and intermediate Viz. Use of Data Sockets for Networked communication and controls.	Book2 8
4	PC Hardware Review and Instrumentation Buses: Structure, timing, interrupts, DMA, operating system, ISA, PCI, USB, and PCMCIA Buses. IEEE488.1 & 488.2 serial Interfacing-RS 232C, RS422, RS423, RS485, USB, VXI, SCXI, PXI. Smart Instruments: Smart/intelligent transducer — comparison with conventional transducers — self-diagnosis and remote calibration features — smart transmitter with HART communicator —Micro Electro Mechanical Systems — sensors, nonlinearity compensation.	8

Text Books:

1. G.C. Barney," Intelligent instrumentation: microprocessor applications in measurement and control", Prentice Hall Publication.
2. Jovitha Jerome," Virtual Instrumentation using Lab VIEW", PHI Publication.

Reference Book:

1. Lisa, K.Wells & Jeffery Travis," Lab VIEW For everyone", Prentice Hall, Publication.
2. D. Patranabis, "Principle of Industrial Instrumentation", Tata McGraw Hill Publication.
3. E. O. Doebelin, "Measurement systems", McGraw Hill Publication.
4. P. Chapman, "Smart Sensors", ISA Publication.

NEC 021 INDUSTRIAL ELECTRONICS		
Unit	**Topic**	**Lectures**
1	**Power Semiconductor Devices:** Power semiconductor devices their symbols and static characteristics and specifications of switches, types of power electronic circuits Operation, steady state & switch characteristics & switching limits of Power Transistor Operation and steady state characteristics of Power MOSFET and IGBT Thyristor - Operation V-I characteristics, two transistor model, methods of turn-on Operation of GTO, MCT and TRIAC.	8
2	**Phase Controlled Rectifiers:** Phase Angle Control, Single-phase Half-wave Controlled Rectifier (One quadrant), Single-phase Full-wave Controlled Rectifier (Two quadrant Converters),Performance Factors of Line-commutated Converters, The Performance Measures of Two-pulse Converters, Three phase Controlled Converters **Inverters:** Introduction Thyristor Inverter Classification, Series Inverters, Parallel Inverter, Three-phase Bridge Inverters, Three-phase Bridge Inverter with Input-circuit Commutation.	8
3	**Choppers:** Introduction, Principle of Chopper Operation, Control Strategies, step-up/Down Chopper, Jones Chopper. Introduction to basic Cycloconverters. **Control of D.C. Drives:** Introduction, Basic Machine Equations, Breaking Modes, Schemes for D.C. Motor Speed Control, Single-phase Separately Excited Drives, Braking Operation of Rectifier Controlled Separately excited Motor, Single-phase Separately Excited Drives, Power Factor Improvement, Three-phase Separately Excited Drives, D.C. Chopper Drives	8
4	**Control of A.C. Drives:** Introduction, basic Principle of Operation, Squirrel-cage Rotor Design, Speed Control of Induction Motors, stator Voltage Control, Variable Frequency control, Rotor Resistance Control, Slip Power Recovery Scheme, Synchronous Motor Drives	8

Text Books:

1. M. H. Rashid, "Power Electronics", Pearson Education.
2. M. D. Singh & K. Khanchandani, "Power Electronics", Tata McGraw Hill Publication.

Reference Books:

1. V.R. Moorthy, "Power Electronics: Devices, Circuits and Industrial Applications", Oxford University Press.
2. M.S. Jamil Asghar, "Power Electronics", PHI Publication.
3. Chakrabarti & Rai, "Fundamentals of Power Electronics & Drives" Dhanpat Rai & Sons.
4. Ned Mohan, T.M. Undeland and W.P. Robbins, "Power Electronics: Converters, Applications and Design", Wiley India Publication.
5. S.N. Singh, "A Text Book of Power Electronics",Dhanpat Rai & Sons.

NEC 023 Analog Signal Processing		
Unit	**Topic**	**Lectures**
I	Introduction to domains and the analogue/digital trade off, Introduction to basic building blocks: null or, voltage feedback amplifier, operation transconductance amplifier, current conveyor, current feedback amplifier. Analog signal filtering: introduction to bilinear transfer functions and active realizations. First-order and second-order filter realization, filter design parameters (Q and ω_0), frequency response, and effect of finite gain of op-amp, realization of Single-Amplifier Biquad and General Impedance Convertor circuit.	8
II	Ideal low-pass filter, Buttreworth and Chebyshev magnitude response, pole locations, low-pass filter specifications.	8
III	Delay equalization: equalization procedures, equalization with first-order and second-order modules, strategies for equalization design. Definition of Bode sensitivity.	8
IV	Properties of Lossless ladders, the general impedance convertor (GIC), optimal design of the GIC, realization of simple ladders, Gorski-Popiel's Embedding Technique, Bruton's FDNR technique, creating negative components.	8

Text Books:

1. R. Schaumann and M.E. Valkenberg,"Design of Analog Circuits", Oxford University Press.