A18

M.Tech. (ELECTRONICS & INSTRUMENTATION)

M.Tech. Amended R18 [A18] CBCS Curriculum

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

An Autonomous, ISO 9001:2015 & QS I-Gauge Diamond Rated Institute, Accredited by NAAC with 'A++' Grade
NBA Accreditation for B.Tech. CE, EEE, ME, ECE, CSE, EIE, IT Programmes
Approved by AICTE, New Delhi, Affiliated to JNTUH, NIRF 135th Rank in Engineering Category
Recognized as "College with Potential for Excellence" by UGC
Vignana Jyothi Nagar, Pragathi Nagar, Nizampet (S.O), Hyderabad – 500 090, TS, India.
Telephone No: 040-2304 2758/59/60, Fax: 040-23042761
E-mail: postbox@vnrvjiet.ac.in, Website: www.vnrvjiet.ac.in

VISION OF THE INSTITUTE

To be a World Class University providing value-based education, conducting interdisciplinary research in cutting edge technologies leading to sustainable development of the nation

MISSION OF THE INSTITUTE

- To produce technically competent and socially responsible engineers, managers and entrepreneurs, who will be future ready.

- To involve students and faculty in innovative research projects linked with industry, academic and research institutions in India and abroad.

- To use modern pedagogy for improving the teaching-learning process.

DEPARTMENT OF

ELECTRONICS AND INSTRUMENTATION ENGINEERING

VISION OF THE DEPARTMENT

A resource center of academic excellence for imparting quality technical education, meeting the need of students at National and International levels and imbibing strong ethical values, to improve the standards of the society.

MISSION OF THE DEPARTMENT

- To impart quality education in the domain of Electronics and Instrumentation Engineering by Implementing learning centric processes.
- To provide specific best of breed laboratory practices to promote diverse collaborative research for meeting the changing societal needs.

M.TECH.
(ELECTRONICS AND INSTRUMENTATION)

M.TECH. (EI)

PROGRAM EDUCATIONAL OBJECTIVES

PEO-I: To excel in professional career and/or higher education by acquiring knowledge in measurements, transduction, and instrumentation engineering principles.

PEO-II: To enhance knowledge to design & develop advanced instrumentation and automation systems for remote monitoring and control applications.

PEO-III: To analyze real life problems, design data acquisition systems with computing platforms appropriate to Electronics and Instrumentation that are economically feasible and acceptable.

PEO-IV: To acquire soft skills through teamwork, presentations, seminar, and dissertation.

PEO-V: To serve research and development organizations to solve the problems raised in the industries and society and involve in lifelong learning.

M.TECH. (EI)

PROGRAM OUTCOMES

PO-1: To independently carry out research /investigation and development work to solve practical problems.

PO-2: To write and present a substantial technical report/document.

PO-3: To demonstrate a degree of mastery over the area as per the specialization of the program.

PO-4: To identify suitable sensors and transducers for real time applications.

PO-5: To acquire Knowledge of Instrumentation Engineering with ability to evaluate, analyze and synthesize problems related to process-oriented industries.

PO-6: To use innovative technologies, skills and modern engineering tools to carry out projects related to real life applications like Robotics, Analytical and biomedical instruments.

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY, HYDERABAD
M.TECH. I YEAR COURSE STRUCTURE AND SYLLABUS

(ELECTRONICS AND INSTRUMENTATION)

I SEMESTER **A18**

Course Type	Course Code	Name of the Course	L	T	P	Credits
Professional Core-I	A18PC1LI01	Transducers and Applications	3	0	0	3
Professional Core-II	A18PC1LI02	Signal Conditioning Circuits	3	0	0	3
Professional Core-III	A18PC1LI03	Process Instrumentation and Control	3	0	0	3
Professional Elective-I	A18PE1LI01	Instrumental Methods of Chemical and Physical Analysis	3	0	0	3
	A18PE1LI02	Optical Electronics and Laser Instrumentation				
	A18PE1LI03	Instrumentation Practices in Industries				
Professional Elective -II	A18PE1LI04	Neural Networks and Fuzzy Systems	3	0	0	3
	A18PE1LI05	Data Acquisition Systems				
	A18PE1LI06	Pollution Control in Process Industries				
Professional Core Lab-I	A18PC2LI01	Instrumentation Laboratory	0	0	3	1.5
Professional Core Lab-II	A18PC2LI02	Process Control Laboratory	0	0	3	1.5
Project	A18PW4LI01	Technical Seminar	0	0	4	2
Audit	A18AU5CS01	Research Methodology and IPR	2	0	0	0
Total			**17**	**0**	**10**	**20**

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY, HYDERABAD
M.TECH. I YEAR COURSE STRUCTURE AND SYLLABUS

(ELECTRONICS AND INSTRUMENTATION)

II SEMESTER **A18**

Course Type	Course Code	Name of the Course	L	T	P	Credits
Professional Core-IV	A18PC1LI04	PLC, SCADA Programming and their Applications	3	0	0	3
Professional Core-V	A18PC1LI05	Virtual Instrumentation	3	0	0	3
Professional Core-VI	A18PC1LI06	Medical Electronics	3	0	0	3
Professional Elective-III	A18PE1LI07	Micro Electro-Mechanical Systems	3	0	0	3
	A18PE1LI08	Industrial and Power Electronics				
	A18PE1LI09	Instrumentation in Pharmaceutical industries				
Professional Elective-IV	A18PE1LI10	Instrumentation in Paper and Pulp Industries	3	0	0	3
	A18PE1LI11	Image Processing and Pattern Recognition				
	A18PE1LI12	Adaptive Control Systems				
Professional Core Lab-III	A18PC2LI03	Industrial Process Control Systems Laboratory	0	0	3	1.5
Professional Core Lab-IV	A18PC2LI04	Virtual Instrumentation Laboratory	0	0	3	1.5
Project	A18PW4LI02	Mini-Project	0	0	4	2
Audit	A18AU5EN01	English for Academic and Research Writing	2	0	0	0
Total			**17**	**0**	**10**	**20**

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY, HYDERABAD
M.TECH. II YEAR COURSE STRUCTURE AND SYLLABUS

(ELECTRONICS AND INSTRUMENTATION)

III SEMESTER **A18**

Course Type	Course Code	Name of the Course	L	T	P	Credits
Professional Elective-V	A18PE1LI13	Instrumentation in Power Plants	3	0	0	3
	A18PE1LI14	IoT Technologies				
	A18PE1LI15	Principles and Applications of Nano Sciences				
Open Elective	A18OE1CN01	Business Analytics	3	0	0	3
	A18OE1AM01	Industrial Safety				
	A18OE1AM02	Operations Research				
	A18OE1AM03	Composite Materials				
	A18OE1PS01	Waste to Energy				
Project	A18PW4LI03	Project Part - I	0	0	16	8
Total			**6**	**0**	**16**	**14**

IV SEMESTER **A18**

Course Type	Course Code	Name of the Course	L	T	P	Credits
Project	A18PW4LI04	Project Part - II	0	0	28	14
Total			**0**	**0**	**28**	**14**

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

M.Tech. I Semester (E & I)	**L**	**T/P**	**C**
	3	**0**	**3**

(A18PC1L01) TRANSDUCERS AND APPLICATIONS

COURSE OBJECTIVES:

- To understand Static and Dynamic Characteristics of Measuring Systems
- To learn the concepts of various measuring devices to measure physical parameters like displacement, temperature, pressure, flow
- To learn the concepts of transducers for measuring acceleration, velocity, force, torque etc.

COURSE OUTCOMES: After completion of the course, students should be able to
CO-1: Identify suitable sensors and transducers for real time applications
CO-2: Translate theoretical concepts into working models
CO-3: Design the experimental applications to engineering modules and practices
CO-4: Design engineering solution to the Industry/Society needs and develop products

UNIT-I:
Introduction to Measurement Systems: General concepts and terminology, measurement systems, sensor classification, static characteristics of measurement systems-accuracy, linearity, resolution, precision and sensitivity etc. estimation of errors. Dynamic characteristics of measurement systems. Zero-order first-order and second-order measurement systems and response.

UNIT-II:
Measuring Devices Displacement and Temperature: Displacement Resistive Potentiometer, Resistive strain gauges inductive displacement transducer, Capacitive Displacement Transducers, Piezo Electric Transducers, Ultrasonic Methods. Temperature Thermal expansion methods, Thermo electric, radiation methods-thermal and photon detectors based thermometers.

UNIT-III:
Measuring Devices Pressure and Flow: Pressure Methods of pressure measurement: Dead weight gauges and manometers, elastic transducers, high pressure measurement. Flow Anemometers, velocity sensors obstruction meters, averaging Pitot tubes, Rota meters, Electromagnetic, Vortex shedding, Ultrasonic Flow meters.

UNIT-IV:
Measuring Devices Velocity and Acceleration: Seismic displacement, velocity and acceleration pickups (Accelerometers). Gyroscopic angular displacement and velocity sensors. Force and Torque: Methods of force measurement and characteristics, Bonded strain gauge, Variable Reluctance, Piezo Electric Transducer, Torque measuring on rotating shafts.

UNIT-V:
Measuring Devices Humidity, Density and Radiation: Capacitive, Impedance and Piezoelectric Hygrometers Differential Pressure, U-tube and ultrasonic Densitometers, pH measurement- Ion Selective Type; Viscosity Measurement; Radiation Detectors - Radiation Thermometers and Optical Pyrometers.

UNIT-VI:
Digital Sensors: Position encodes, variable frequency sensors-quartz digital thermometer, SAW sensors, digital flow meters, sensors based on semiconductor junctions: thermometers

based on semiconductor junctions, magneto diodes and magneto transistors, photodiodes and phototransistors, charge-coupled sensors.

TEXT BOOKS:

1. Measurement Systems, E. O. Doeblin, McGraw Hill
2. Transducers and Instrumentation, D. V. S. Murthy, PHI
3. Sensors & Transducers, D. Patranbis, Wheeler Publishing

REFERENCES:

1. Instrument Transducers, H. K. P. Neubert, Oxford University Press
2. Process Measurement and Analysis, B. G. Liptak, 4th Edition, ISA Publication
3. A Text Book of Mechanical Measurements and Instrumentation, A. K. Sawhney
4. Mechanical Measurements, E. O. Doeblin, McGraw Hill
5. Transducer Engineering, Ranganathan S., Allied Publishers

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

M.Tech. I Semester (E & I)	**L**	**T/P**	**C**
	3	**0**	**3**

(A18PC1LI02) SIGNAL CONDITIONING CIRCUITS

COURSE OBJECTIVES:

- To understand the working principle and design of various analog signal conditioning circuits used in industrial applications
- To impart knowledge on the design of signal conditioning circuits
- To impart the knowledge of various measurement methods of physical parameters like velocity, acceleration, torque, pressure, flow, temperature etc. and their relevance to Industry

COURSE OUTCOMES: After completion of the course, students should be able to
CO-1: Understand principle of working of various signal conditioners used with Temperature, Displacement, optical and various miscellaneous other sensors
CO-2: Design signal conditioning circuits for various transducers
CO-3: Understand applications of various signal conditioners used in industry
CO-4: Capable of selecting best suited signal conditioners for any given application

UNIT-I:
Signal Conditioning for Resistive Sensors: Measurement of Resistance, Voltage Dividers Wheatstone Bridge: Balance Measurements, Detection Measurements, Differential and Instrumentation Amplifiers, Interference.

UNIT-II:
Signal Conditioning for Self-Generating Sensors: Chopper and Low-Drift Amplifiers, Electrometer and Transimpedance Amplifiers, Charge Amplifiers, Noise in Amplifiers, Noise and Drift in Resistors.

UNIT-III:
Temperature Sensors Interfacing: Thermo Switches, Thermocouples Interfacing – Thermo switches, Ambient Referenced Thermocouples, Isolated Thermocouple Measurement, Thermocouple to Frequency, Thermocouple to 4to20 m A Temperature Transmitter, Isolated Multiplexing of Thermocouples
RTD's Interfacing: Single Op Amp Interface, using a Signal Conditioner, Bridge configuration using 3wire RTD, Linearizing RTD Circuits, Current Transmitters for RTD Outputs, RTD Based Precision controller

UNIT-IV:
Semiconductor Temperature Sensors Interfacing: Thermistor Interfacing - Simple Interface Circuits, High-resolution Differential Thermometer, Current Transmitters, Thermistor to Frequency Conversion T to F Conversion using Diodes, Absolute Temperature to current Conversion, Temperature Control Circuits, Multiplexed Applications, Isolation, 4to20 m A Current Transmission

UNIT-V:
Pressure and Force Transducers Interfacing: Pressure Transducer Interfacing - Strain Gauge Based Transducers, Potentiometer to Frequency Transducer, Interfacing High level Semiconductor Transducers, Isolated Pressure Transmitter, Pressure Control System
Force Transducer Interfacing: Spring Driven Rheostat, Strain gauge & Signal Conditioner, High Resolution Load Cell Platform, Interface, Strain Gauge to Frequency Conversion, Isolators & Transmitters

UNIT-VI:

Flow Meters and Level Transducers Interfacing: Flow Meter Interfacing - Differential Pressure Flow meters, Frequency output Flowmeters, Anemometers, Hinged Vane, Flowmeter, Thermal Flow Meter, Transmission & Readout

Level Transducers Interfacing: Float & Potentiometer, Optical Sensing & Thermal Sensing

TEXT BOOKS:

1. Sensors and Signal Conditioning, Raman Pallas Areny, John G. Webster, Second Edition, John Wiley and Sons
2. Transducer Interfacing Handbook A Guide to Analog Signal Conditioning, Daniel H. Sheingold (Editor), Analog Devices Publications

REFERENCES:

1. Op Amp Applications Handbook, Walt Jung (Editor), Elsevier
2. Introduction to Instrumentation and Measurement, Robert B. Northrop, Second Edition-Taylor & Francis Group

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M.Tech. I Semester (E & I)	**L**	**T/P**	**C**
	3	**0**	**3**

(A18PC1LI03) PROCESS INSTRUMENTATION AND CONTROL

COURSE OBJECTIVES:

- To understand the basic characteristics of first order and higher order processes
- To acquire knowledge about the characteristics of various controller modes and methods of tuning of controller
- To acquire knowledge on the construction, characteristics and application of control valves
- To study the UNIT operations and a case study of distillation column control

COURSE OUTCOMES: After completion of the course, students should be able to

CO-1: Determine the mathematical model for real-time first and higher order systems

CO-2: Design various controller modes with appropriate tuning

CO-3: Implement advanced control schemes for various processes

CO-4: Ability to Analyze Multivariable Systems and Design Multi-variable and Multi-loop Control Schemes for various processes

CO-5: Ability to Identify, formulate, and solve problems in the process control domain

UNIT-I:

Introduction: Need for process control, Design aspects of process control system, Process degree of freedom. Mathematical model of first order processes: level, pressure and thermal processes Second order process: Interacting and non-interacting processes, State space modelling– Discrete time systems, analog to digital and digital to analog conversion, sampling of continuous time signal, conversion of discrete time to continuous time signal with zero and first order holds, z-transform.

UNIT-II:

Basic Single Loop Control Actions: Characteristics and dynamics of Discrete Control Modes: ON-OFF, Multi Speed, Floating Controllers. Characteristics and dynamics of feedback control modes: Proportional, Integral and Derivative control modes P+I, P+D and P+I+D control modes

UNIT-III:

P-I-D Controller Tuning and Stability Analysis:

Tuning of Controllers: Evaluation criteria IAE, ISE, ITAE and **¼ decay ratio** Tunings Process reaction curve method Ziegler Nichols method Damped oscillation method, Digital PID Algorithm. Dahlin's algorithm, deadbeat controller.

UNIT-IV:

MIMO Systems-Multiloop Control: MIMO Systems: Multi loop Controllers: Feed-forward control ratio control- cascade control adaptive split-range control multivariable control Multi variable IMC- Model based Predictive Controller examples from distillation column and boiler systems.

UNIT-V:

Final Control Element: I/P converter pneumatic and electric actuators valve positioner control valves characteristics of control valves inherent and installed characteristics control valve sizing cavitation and flashing selection criteria.

UNIT-VI:

Industrial Applications: Dynamics of Four tank system, CSTR, pH neutralization process Distillation column and Modern control practices in: Power plants, pharmaceuticals and petrochemicals industries.

TEXT BOOKS:

1. Chemical Process Control, G. Stephanopoulos, Prentice Hall of India, New Delhi, 1990
2. Process Control: Instrument Engineers' Handbook, Bela G. Liptak, Butterwoth Heinemann, 2013
3. Process Control Instrumentation Technology, Curtis Johnson, Prentice Hall India

REFERENCES:

1. Process Control: Modeling, Design, and Simulation, B. Wayne Bequette, Prentice Hall of India, 2004
2. Process Control, Pollard A., Heinemann Educational Books, London, 1971
3. Automatic Process Control, Eckman. D. P., Wiley Eastern Ltd., New Delhi, 1993
4. Process Control, S. K. Singh, PHI Publications, New Delhi 2010

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

M.Tech. I Semester (E & I)	**L**	**T/P**	**C**
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(A18PE1LI01) INSTRUMENTAL METHODS OF CHEMICAL AND PHYSICAL ANALYSIS

COURSE OBJECTIVES:

- To understand whole array of modern analytical instrumentation with the goal of providing them with the tools to further apply them in industry
- To acquire "hands-on" approach with sample preparation, theory, application, method development, data analysis and interpretation being key elements
- To qualitative and quantitative analysis of chemical compounds

COURSE OUTCOMES: After completion of the course, students should be able to
CO-1: Appreciate basic analytical processes and sampling procedures
CO-2: Appreciate the basic principles of spectroscopy
CO-3: Perform simple analytical procedures on given samples using Ultraviolet or Infrared Spectrophotometers and Interpret data derived from the above
CO-4: Observe basic lab safety rules while working in analytical chemistry laboratories

UNIT-I:
Electrochemical Instruments: Basic concepts of Analytical instrumentation, Electro chemical instruments- pH meters, Conductivity meters, Dissolved oxygen analyzers using Polarographic principle sodium analyzers- silica analyzers–Polarographic Instruments.

UNIT-II:
Absorption Spectrophotometers-I: UV, VIS spectrophotometers single beam and double beam instruments instrumentation associated with the above spectrophotometers sources and detectors, IR SPM– sources and detectors for IR spectrophotometers, FTIR, Raman Spectroscopy, Interpretation & Analysis.
Emission Spectrophotometers-II: Flame emission and atomic absorption spectrophotometer Atomic emission spectrophotometer sources for Flame Photometers and online calorific value measurements.

UNIT-III:
Gas and Liquid Chromatographs: Basic principle of gas chromatography, liquid chromatography, HPLC different types of columns, detectors, recorders and associated equipment, Salient features of liquid chromatography, Detectors used, applications of high pressure liquid chromatography, Interpretation and Analysis.

UNIT-IV:
Principle of Nuclear Magnetic Resonance: Instrumentation associated with NMR spectrophotometer Introduction to mass spectrophotometers, Principle and brief discussion on Electron Spin Resonance (ESR).

UNIT-V:
Gas Analyzers-I: Flue gas analysis using thermal conductivity principle, Katharometer oxygen analyzers using paramagnetic principle, Zirconium oxide cells, Pollution Monitoring Instruments.
Industrial analyzer circuits; CO monitors, Nox analyzer, Sox Analyzer - H2S analyzer system

UNIT-VI:
Nuclear Radiation Detectors: GM counter, Scintillation counter, Ionization chamber Solid state detector, Gamma Spectrometry, Industrial application of radiation measurement,

Thermal Analyzers**:** Differential Scanning Calorimetry (DSC), Derivative Thermo Gravimetric Analyzers (DTGA)

TEXT BOOKS:

1. Handbook of Analytical Instruments, R. S. Khandpur, McGraw Hill, 2006
2. Instrumental Methods of Analysis, Willard, Merrit, Dean, Settle, CBS, 2004
3. Principles of Instrumental Analysis, Skoog D. M. and West D. M., Helt, Saunder Publication

REFERENCES:

1. Process Measurement and Analysis, B. G. Liptak, CRC Press
2. Instrument Technology, E. B. Jones, Butterworth Scientific Publications

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

M.Tech. I Semester (E & I)	**L**	**T/P**	**C**
	3	**0**	**3**

(A18PE1LI02) OPTICAL ELECTRONICS AND LASER INSTRUMENTATION

COURSE OBJECTIVES:

- To understand the principles of optics and Lasers
- To apply the knowledge of Optics to fibers and understand the different industrial applications of Optical Fibers
- To learn the various applications of Lasers in Instrumentation
- To understand the Opto electronic components and their principles of operation along with their applications

COURSE OUTCOMES: After completion of the course, students should be able to

CO-1: Apply fundamental knowledge of mathematics and Optics to design application specific optical fiber

CO-2: Apply Lasers in Instrumentation for the measurement of Pressure, temperature, Level and find the solutions for the errors if any

CO-3: Understand the advantages of using Lasers

CO-4: Apply opto- electronic components and lasers in Medical instrumentation

UNIT–I:

Optical Fibers and their Properties: Introduction to Optical Fibers - principles of light propagation through a fiber Different types of fibers and their properties –Transmission characteristics of optical fiber –Absorption losses Scattering losses –Dispersion - source coupling, splicing and connectors, Fibre termination - advantages and disadvantages of optical fibers

UNIT-II:

Industrial Applications of Optical Fibers: Fiber optic sensors Fiber optic Instrumentation system - Interferometric method of measurement of length - Moiré fringes Measurement of pressure, temperature, current, voltage, liquid level and strain. Fiber optic gyroscope polarization maintaining fibers applications, Biomedical Applications Endoscopy.

UNIT-III:

Opto-Electronic Components: Optical Sources: LED, OLED, AMOLED, laser diodes - Optical Detectors: PIN, APD, phototransistors, photomultipliers, optoisolators, IOC elements, photoresistors, CCD –Electro-Optic, Magneto-Optic and Acoustic–Optic Modulators Application in Instrumentation.

UNIT-IV:

Laser Fundamentals: Fundamental of Lasers Properties of Laser - Three level and four level lasers Laser modes Resonator configuration Q-switching and Mode locking Cavity damping Types of lasers: Gas lasers, Solid lasers, Liquid lasers Semiconductor lasers. Laser Safety: Radiation hazards, maximum permissible exposure, classification, safety measures and Personal Protective Equipment (PPE)

UNIT-V:

Industrial Applications of Lasers: Laser for measurement of distance, length, velocity, acceleration, current, voltage and Atmospheric effect Material processing: Laser Heating, Welding, Melting, Cutting, Hole Drilling and Trimming of material Removal and vaporization.

UNIT-VI:

Medical Applications of Lasers and Hologram: Medical Applications Lasers - Laser and Tissue interaction, Laser instruments for surgery - CO2 laser as bloodless scalpel, Removal of tumors

of vocal cords, Brain surgery, Plastic surgery, Gynecology, Oncology, Dermatology and Ophthalmology. Holography Basic principle; methods (reflection, transmission, and hybrid), Holographic Components, Holographic Interferometry and Applications, Holography for Non-destructive Testing

TEXT BOOKS:

1. Optical Fiber Communication Principles and Practice, J. M. Senior, Prentice Hall of India, 1985
2. Introduction to Opto Electronics, J. Wilson and J. F. B. Hawkes, Prentice Hall of India, 2001
3. Lasers: Theory and Applications, Thyagarajan K. and Ghatak A. K., Plenum Press
4. Optical Fiber Communication and Sensors, M. Arumugam, Anuradha Agencies, 2002

REFERENCES:

1. Understanding Fiber Optics, Jeff Hecht, 5th Edition, Prentice Hall
2. Optical Fiber Communication, G. Keiser, McGraw Hill, 1995

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

M.Tech. I Semester (E & I)	**L**	**T/P**	**C**
	3	**0**	**3**

(A18PE1LI03) INSTRUMENTATION PRACTICES IN INDUSTRIES

COURSE OBJECTIVES:

- To identify and quantitatively estimate different materials required for the manufacturing of Cement, Pulp, Paper, food, Power and pharmacy
- To understand the principles of different manufacturing processes
- To recognize these principles written in form of mathematical & chemical equations
- To apply these equations to analyze problems by making good assumptions and learn systematic engineering method to solve practical industrial problems

COURSE OUTCOMES: After completion of the course, students should be able to

CO-1: Apply fundamental knowledge of chemistry & instrumentation to modeling and analysis of different Industrial engineering

CO-2: Understand disasters caused by an incorrect analysis/design in different Industrial engineering system

CO-3: demonstrate technical knowledge and skills in the calibration and use of equipment used in different industrial process measurement and control

CO-4: demonstrate a working knowledge of safety practices and skills in troubleshooting Problems used in the measurement and control in industrial processes

UNIT-I:

Cement Industries: Corrosion Analyzer Porositester Compressive strength measurement, Blast Furnace Temperature Measurement using Radiation Pyrometers.

UNIT-II:

Pulp and Paper Industries: Manufacture of Pulp: Raw materials, Pulping processes, Craft pulping, Soda pulping, Sulfite pulping, Semi chemical pulping, Mechanical and Thermo mechanical Pulping.

Manufacture of paper: Wet Processing, Fourdrinier Machine, Coated Papers, Special Papers.

Wet-end Instrumentation: Pressure; Temperature: Liquid Density and Specific Gravity, Level, Flow; Consistency: pH ;Oxidation Reduction Potential (ORP),Freeness.

UNIT-III:

Pulp and Paper Industries: Dry-end Instrumentation: Moisture: Conductivity, Resistance, Capacitance, Hygroscopic, Infrared Absorption type systems Basis Weight: Transmission type, On-Machine type, Off-Machine type and Backscatter type systems Caliper or Thickness: Contacting type- Electrical, Mechanical and Electro Mechanical, Non Contacting type.

UNIT-IV:

Petroleum Industries: UNIT Operations: Distillation, Drying Separation Measurements in refineries petrochemical industries– Differential pressure transmitter, Thermocouples Infrared Pyrometer, Mass flow meters, Potentiometric level Transmitter, Vacuum Measurement, Near Infrared Analyzer, Hydro Carbon Dew

Point meter, IR Spectrometry, Mass Spectrometry, Flame Ionization Detectors, Chromatography.

UNIT-V:

Nuclear Power Plant: Introduction, The power plant scheme, Pressure, flow and level measurement, Vibration and expansion measurements, Analysis of impurities in cooling water, Flue Gas analysis, Ultrasonic Thermometry, Radiation Pyrometry, Emittance measurement.

UNIT-VI:

Food Processing and Allied Industries: Chromatography, Spectrometry Mass Spectrometer, Toxicity meter.

TEXT BOOKS:

1. Chemical Process Industries, Austin G. T. Shreeves, McGraw-Hill International
2. Process Measurement and Analysis, Liptak B. G., Third Edition, Chilton Book Company, 1996
3. Pulp and Paper Industry Technology & Instrumentation, Sankaranarayana P. E., Kothari's Deskbook
4. Principles of Industrial Instrumentation, D. Patranabis, Mc Graw Hill

REFERENCES:

1. An Introduction to Paper Industry Instrumentation, John R. Lavigne, Miller Freeman Publications, 1985
2. Measurement and Control in Papermaking, Robert J. McGill, Adam Hilger Limited, 1980
3. Process / Industrial instruments and Controls Hand Book, Gregory K. McMillan, Doigas M. Considine
4. Instrumentation in Process Industries, Liptak B.G., Chilton Book Company, 1994

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

M.Tech. I Semester (E & I)	**L**	**T/P**	**C**
	3	**0**	**3**

(A18PE1LI04) NEURAL NETWORKS AND FUZZY SYSTEMS

COURSE OBJECTIVES:

- To cater the knowledge of Neural Networks and Fuzzy Logic Control and use these for controlling real time systems
- To expose the students to the concepts of feed forward Neural Networks and about feedback Neural Networks
- To teach about the concepts of Fuzziness involved in various systems and comprehensive knowledge of Fuzzy logic control and to design the Fuzzy control

COURSE OUTCOMES: After completion of the course, students should be able to
CO-1: Understand the concepts of feed forward neural networks
CO-2: Acquire adequate knowledge about feedback neural networks
CO-3: Acquire the concept of fuzziness involved in various systems
CO-4: Acquire knowledge about fuzzy set theory

UNIT-I:
Introduction to Neural Networks: Introduction, Humans and Computers, Organization of the Brain, Biological Neuron, Biological and Artificial Neuron Models, Hodgkin-Huxley Neuron Model, Integrate and- Fire Neuron Model, Spiking Neuron Model, Characteristics of ANN, McCulloch-Pitts Model, Historical Developments, Potential Applications of ANN.

UNIT-II:
Essentials of Artificial Neural Networks: Artificial Neuron Model, Operations of Artificial Neuron, Types of Neuron Activation Function, ANN Architectures, Classification Taxonomy of ANN Connectivity, Neural Dynamics (Activation and Synaptic), Learning Strategy (Supervised, Unsupervised, Reinforcement), Learning Rules, Types of Application Feed Forward Neural Networks Introduction, Perceptron Models: Discrete, Continuous and Multi-Category, Training Algorithms: Discrete and Continuous Perceptron Networks, Perceptron Convergence theorem, Limitations of the Perceptron Model, Applications.

UNIT-III:
Multilayer Feed forward Neural Networks: Credit Assignment Problem, Generalized Delta Rule, Derivation of Backpropagation (BP) Training, Summary of Backpropagation Algorithm, Kolmogorov Theorem, Learning Difficulties and Improvements.

UNIT-IV:
Associative Memories: Paradigms of Associative Memory, Pattern Mathematics, Hebbian Learning, General Concepts of Associative Memory (Associative Matrix, Association Rules, Hamming Distance, The Linear Associator, Matrix Memories, Content Addressable Memory), Bidirectional Associative Memory (BAM) Architecture, BAM Training Algorithms: Storage and Recall Algorithm, BAM Energy Function, Proof of BAM Stability Theorem Architecture of Hopfield Network: Discrete and Continuous versions, Storage and Recall Algorithm, Stability Analysis, Capacity of the Hopfield Network.

UNIT-V:
Self-Organizing Maps (SOM) and Adaptive Resonance Theory (ART): Introduction, Competitive Learning, Vector Quantization, Self-Organized Learning Networks, Kohonen Networks, Training Algorithms, Linear Vector Quantization, Stability-Plasticity Dilemma, Feed forward competition, Feedback Competition, Instar, Outstar, ART1, ART2, Applications. Classical and Fuzzy Sets Introduction to classical sets - properties, Operations and relations;

Fuzzy sets, Membership, Uncertainty, Operations, properties, fuzzy relations, cardinalities, membership functions.

UNIT-VI:

Fuzzy Logic System Components: Fuzzification, Membership value assignment, development of rule base and decision making system, Defuzzification to crisp sets, Defuzzification methods. Applications Neural network applications: Process identification, Function Approximation, control and Process Monitoring, fault diagnosis and load forecasting. Fuzzy logic applications: Fuzzy logic control and Fuzzy classification.

TEXT BOOKS:

1. Neural Networks, Fuzzy Logic, Genetic Algorithms: Synthesis and Applications, Rajasekharan and Rai, PHI
2. Introduction to Artificial Neural Systems, Jacek M. Zuarda, Jaico Publishing House, 1997

REFERENCES:

1. Neural and Fuzzy Systems: Foundation, Architectures and Applications, N. Yadaiah and S. Bapi Raju, Pearson Education
2. Neural Networks, James A. Freeman and Davis Skapura, Pearson, 2002
3. Neural Networks, Simon Hykins, Pearson Education
4. Neural Engineering, C. Eliasmith and CH. Anderson, PHI
5. Neural Networks and Fuzzy Logic System, Bork Kosko, PHI

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

M.Tech. I Semester (E & I)	**L**	**T/P**	**C**
	3	**0**	**3**

(A18PE1LI05) DATA ACQUISITION SYSTEMS

COURSE OBJECTIVES:

- To identify the selection of type of data acquisition system
- To understand the principles of A/D, D/A Converters, Error Analysis, Display Systems
- To recognize these principles written in form of mathematical equations
- To apply these equations to analyze problems by making good assumptions and learn systematic engineering method to design a good Data acquisition system
- To apply fundamental principles of A/D's, D/A's, Data Acquisition Hardware & Software requirements for the solution of practical high-performance Data Acquisition system etc.

COURSE OUTCOMES: After completion of the course, students should be able to

CO-1: Apply fundamental knowledge of mathematics to modeling and analysis of A/D & D/A's, error analysis on data acquisition systems

CO-2: Conduct case studies indifferent data acquisition systems and interpreting data from model studies to prototype cases, as well as documenting them in engineering reports

CO-3: Understand the errors/problems by an improper design analysis in data acquisition system

CO-4: Interface the analog and digital acquisition systems with PC, Analyze and display the output

UNIT-I:

Data Loggers and Data Acquisition Systems: Data acquisition systems-configurations components, analog multiplexes and sample and hold circuits-specifications and design considerations. DACs: specifications characteristics, types of DACs (serial, parallel, direct and indirect). Hybrid and monolithic DACs. ADCs: specifications characteristics, types of ADCs (serial, parallel, direct and indirect). Hybrid and monolithic ADCs, sigma delta ADCs', Hybrid DAS Schematic diagram configurations specifications

UNIT-II:

Error Budget of DACs and ADCs: Error sources, error reduction and noise reduction techniques in DAS. Error budget analysis of DAS. Case study of a DAC and an ADC. 31

UNIT-III:

Data Acquisition Hardware and Software: Specifications of Hardware-IO analog signal range, gain for analog input and resolution in ADC converter, resolute\ion in DAC and counter chips, sampling frequency and maximum update rates, triggering capacity. Digital lines and ports, data acquisition VIs.

UNIT-IV:

Distributed and Stand Alone Data Logger: Introduction, methods of operation-programming and logging data using Express cards, standard alone operation-direct and remote connection to the host PC, stand alone logger/controller hardware interfaceRS232C, RS485 standard, communication bottlenecks and system performance, using Ethernet to connect data loggers

UNIT-V:

IEEE 488 Standard: Introduction, characteristics, physical connection configurations, device types, bus structure, GPIB hand shake, device communication, IEEE 488.2, standard commands for programmable instruments. Display systems- LCD Flat panel displays, Digital storage CROs, Plasma displays, Projection systems.

UNIT-VI:

Analyzers: Spectrum Analyzers guidelines, various triggering techniques, different types of spectrum analyzers, Recorders. Display devices and Display systems, Logic Analyzers State and time referenced data capture. Scalar and Vector Network analyzers.

TEXT BOOKS:

1. A Users Handbook of D/A & A/D Converters, E. R. Hnatek, Wiley, 1976
2. Electronic Analog/Digital Converters, H. Schmid, Van Nostrand Reinhold, 1970
3. Clayton: Data Converters, G. B. Clayton, John Wiley & Sons, 1982

REFERENCES:

1. Electronic Instrumentation, H. S. Kalsi, McGraw Hill Education, 2017
2. Electronic Instrumentation & Measurements, David A. Bell, Oxford University Press India, 2013
3. Handbook of Biomedical Instrumentation, Khandapur R. S., Tata Mc. Graw Hill, 1996
4. Electronic Measurements and Instrumentation, Oliver and Cage (ISE), McGraw Hill, 2017

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

M.Tech. I Semester (E & I)	**L**	**T/P**	**C**
	3	**0**	**3**

(A18PE1LI06) POLLUTION CONTROL IN PROCESS INDUSTRIES

COURSE OBJECTIVES:

- To identify the different pollutants that cause serious problems in industries
- To understand the causes of pollutions from various emission reactions
- To recognize the origin of hazardous pollution gases in environment
- Treatment methods of specific pollutant arising out of industrial process

COURSE OUTCOMES: After completion of the course, students should be able to

CO-1: Plan strategies to control and reduce pollution

CO-2: Select the most appropriate technique to control and treat industrial pollution

CO-3: Apply environmental management systems (EMS) to an industrial activity

CO-4: Design and develop anti-pollution monitoring systems

UNIT-I:

Industrial Pollution Emissions and Indian Standards: Introduction-Man and environment, types of pollution, pollution control aspects, Industrial emissions-Gases, and Industrial emissions Liquids-water quality management in India.

UNIT-II:

Analysis of Pollutants: Industrial waste water analysis, industrial gaseous effluent analysis, particle size distribution, water quality regulations and policy development, water quality standards.

UNIT-III:

Pollution Control for Specific Pollutants-I: Removals of BOD-biological oxidation-anaerobic treatment-Removal of Chromium-control methods, reduction precipitation, Ion exchange, reverse osmosis-lime coagulation and adsorption.

UNIT-IV:

Pollution Control for Specific Pollutants-II: Removal of mercury-measurement of mercury-mercury losses in chlor-alkali industries-removal of mercury from gaseous streams-removal of mercury from liquid streams. Removal of oxides of nitrogen-introduction-analysis of NOx control measures.

UNIT-V:

Pollution Control Aspects in Selected Process Industries: Pollution control in chemical industries-pollution control aspects of fertilizer industries-ammonia plant effluents, ammonium sulphate plant-phosphoric acid plant-complex fertilizer plant.

UNIT-VI:

Pollution Control in Petroleum Refineries and Petrochemical Units: Characteristics of liquid effluent-refinery liquid waste-treatment methods-treatment of liquid effluents from petrochemical industries-air pollution control-pollution control in pulp and paper industries.

TEXT BOOKS:

1. Pollution Control in Process Industries, S. P. Mahajan, Tata McGraw Hill Edition
2. Water Quality Concepts, Sampling, and Analyses, Yuncong Li, Kati Migliaccio, 1st Edition, CRC Press, 2010

REFERENCES:

1. Industrial Pollution Prevention Handbook, Harry M. Freeman, McGraw Hill Education, 2017
2. Industrial Pollution - A Reference to Small Scale Industries, N. Saradha, N. Dhulasi Birundha, 1st Edition, Serials Publications, 2008

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

M.Tech. I Semester (E & I)	**L**	**T/P**	**C**
	0	**3**	**1.5**

(A18PC2LI01) INSTRUMENTATION LABORATORY

COURSE OBJECTIVES:
- To acquire hands on experience in active and passive sensors/transducers
- To understand different signal conditioners
- To design basic measuring devices like bridges

COURSE OUTCOMES: After completion of the course, students should be able to
CO-1: Appreciate the use of sensors
CO-2: Identify the sensors required for any specific application
CO-3: Design simple measuring devices
CO-4: Develop simple measuring systems employing appropriate sensors

LIST OF EXPERIMENTS:

(Minimum 12 experiments to be conducted)

1. Measurement of Load using Strain Gauge bridge
2. Measurement of Temperature using Thermistor, RTD and Thermocouple
3. Measurement of Displacement using LVDT
4. Pressure measurement through Bourdon Tube
5. Measurement of Flow
6. Measurement of RPM using opto-coupler and comparing it with stroboscope
7. Measurement of precision, Angular Velocity and RPM of a rotating Disk
8. Measurement of Velocity, Acceleration and Vibration using Piezo-electric transducer
9. Measurement of Humidity
10. Measurement of Density
11. Measurement of Viscosity of Edible Oil using Redwood Viscometer
12. Measurement of Viscosity of Crude Oil using Saybolt Viscometer
13. Characteristics of pH sensors
14. Radiation Measurement and optical Pyrometers
15. Characteristics of Opto-Electronic Transducers (Photo Transistor, Photo Diode and LDR)

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

M.Tech. I Semester (E & I)	**L**	**T/P**	**C**
	0	**3**	**1.5**

(A18PC2LI02) PROCESS CONTROL LABORATORY

COURSE OBJECTIVES:

- To identify and obtain process parameters of various processes in the prototype model
- To understand the working of actuators, converters, controllers and control valves
- To acquire the working knowledge of different controller types, modes of control actions, tuning of controllers and control schemes
- To learn systematic engineering methodologies to solve practical process control problems

COURSE OUTCOMES: After completion of the course, students should be able to

CO-1: Do mathematical modeling of different process to analyze its time response

CO-2: Apply the control system knowledge to monitor and control industrial parameters like flow, level, pressure, temperature, pH problems

CO-3: Identify optimal values for PID controller and realize Electronic, Pneumatic and Hydraulic Control actions for different applications

CO-4: Learn to apply software tools typically used by process control professionals

LIST OF EXPERIMENTS:

(Minimum of 12 experiments should be conducted)

1. Realization of PID control actions and time response analysis with electronic controllers for First and Second Order Systems Using Process Controller Simulator
2. Effect of ON-OFF, P, PI, PD and PID controller on Liquid Level Process Dynamics.
3. Temperature control process with PID Control Action
4. Servo and Regulator operation for Set point tracking and Disturbance Rejection for DC Servo Motor
5. Realization of control actions with Pneumatic and Hydraulic Actuation
6. Optimum Controller settings with Process reaction curve tuning method
7. Optimum Controller settings with continuous and damped oscillation tuning method
8. Effect of ON-OFF, P, PI, PD and PID controller on Flow Process Dynamics
9. Experimental analysis of Control valve characteristics (Different types)
10. Realization of Feed forward control System for Flow-Level Process Station
11. Multi loop control systems for Flow-Level Process Station using Ratio Control
12. Multi loop control systems for Flow-Level Process Station using Cascade Control
13. Mathematical Modeling and Time Response Analysis of Interacting and non-interacting system
14. Split range control for liquid level process dynamics
15. Neutralization of waste water using PID controller for pH Control System

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M.Tech. I Semester (E & I)	**L**	**T/P**	**C**
	0	**4**	**2**

(A18PW4LI01) TECHNICAL SEMINAR

COURSE OUTCOMES: After completion of the course, students should be able to
CO-1: Identify a research topic related to advanced/state-of-the-art technologies
CO-2: Collect the literature and comprehend/analyze critically the technological advancements
CO-3: Engage in effective oral communication through presentation of seminar
CO-4: Engage in effective written communication through report

COURSE OUTLINE:

- A student shall present a seminar on a technical topic during I semester of the M.Tech. programme.
- A student, under the supervision of a faculty member, shall collect literature on a technical topic of his / her choice, critically review the literature and submit it to the Seminar Review Committee (SRC) in a prescribed report form.
- The SRC shall consist of Head of the Department, faculty supervisor and a senior faculty member of the specialization / department.
- Student shall make an oral presentation before the SRC after clearing the plagiarism check.
- Prior to the submission of seminar report to the SRC, its soft copy shall be submitted to the PG Coordinator for PLAGIARISM check.
- The report shall be accepted for submission to the SRC only upon meeting the prescribed similarity index.

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

M.Tech. I Semester (E & I)	**L**	**T/P**	**C**
	2	**0**	**0**

(A18AU5CS01) RESEARCH METHODOLOGY AND IPR

COURSE PRE-REQUISITES: None

COURSE OBJECTIVES:
- To introduce the characteristics of a good research problem
- To choose appropriate approaches of investigation of solutions for research problem
- To familiarize with basic Intellectual Property Rights
- To understand different Patent Rights

COURSE OUTCOMES: After completion of the course, students should be able to
CO-1: Understand research problem formulation, analyze research related information and follow research ethics
CO-2: Realize the importance of ideas, concept, and creativity in the present-day context
CO-3: Recognize that when IPR would take such important place in growth of individuals and nation, it is needless to emphasize the need of information about IPR to be promoted among students in general and engineering in particular
CO-4: Appreciate IPR protection which leads to creation of new and better products, and in turn brings about, economic growth and social benefits

UNIT-I:
Introduction: Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem.
Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, necessary instrumentations.

UNIT-II:
Literature Survey: Effective literature studies approaches, analysis. Plagiarism, Research ethics.

UNIT-III:
Effective Technical Writing: How to write report, Paper. Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee

UNIT-IV:
Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of
Patenting and Development: technological research, innovation, patenting, development.
International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

UNIT-V:
Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

UNIT-VI:
New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR.

TEXT BOOKS:
1. Research Methodology: An Introduction for Science & Engineering Students, Stuart Melville and Wayne Goddard

2. Research Methodology: An Introduction, Wayne Goddard and Stuart Melville
3. Resisting Intellectual Property, Halbert, Taylor & Francis Ltd ,2007

REFERENCES:

1. Research Methodology: A Step-by-Step Guide for Beginners, Ranjit Kumar, 2nd Edition
2. Research Methodology: Methods and Techniques, C. R. Kothari and Gaurav Garg, New Age International Publishers
3. Intellectual Property in New Technological Age, Robert P. Merges, Peter S. Menell, Mark A. Lemley, 2016
4. Intellectual Property Rights Under WTO, T. Ramappa, S. Chand, 2008

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

M.Tech. II Semester (E & I)	**L**	**T/P**	**C**
	3	**0**	**3**

(A18PC1LI04) PLC, SCADA PROGRAMMING AND THEIR APPLICATIONS

COURSE OBJECTIVES:
- To understand the concepts of PLC and SCADA and their application
- To understand PLC programming and data acquisition from real world
- To understand different types of protocols used in industries
- To understand the importance of supervisory control in various levels of industrial automation

COURSE OUTCOMES: After completion of the course, students should be able to
CO-1: Describe the main functional units of PLC and be able to explain how they interact, different bus types
CO-2: Design logic using advanced functions of PLC
CO-3: Create networking between PLC's using standard protocols
CO-4: Provide simple solution for industry problems with PLC and SCADA

UNIT-I:
Programmable Logic Controller (PLC) Basics: Definition, Overview of PLC systems, input/output modules, Power supplies and Isolators. Sourcing and Sinking.

UNIT-II:
Basic PLC Programming: Programming On-Off inputs/ outputs. Creating Ladder diagrams, Basic PLC functions, register basics, timer functions, counter functions. ladder logic programing of industrial applications.

UNIT-III:
PLC Intermediate and Advanced Functions: Arithmetic functions, Number comparison functions, Skip and MCR functions, data move systems. Utilizing digital bits, sequencer functions, Matrix functions. PLC Advanced functions: Analog PLC operation, PID Function, Networking of PLC,

UNIT-IV:
Application of PLC: Controlling of Robot using PLC, PID control of continuous processes, Continuous Bottle-filling system, Batch mixing system, 3-stage air conditioning system, Automatic frequency control of Induction heating

UNIT-V:
HART and Field Bus Introduction: Evolution of signal standard –HART Communication Protocol Communication Modes –HART commands HART Field Controller Field Bus Architecture Basic requirement of field bus standard field bus topology, CAN bus, MOD bus, MOD bus plus protocol.

UNIT–VI:
SCADA: Basic building blocks of computer control system SCADAMTU and RTU, Case studies on SCADA, SCADA, PLC and DCS Compared, HMI, Motor Drives.

TEXT BOOKS:

1. Programmable Logic Controllers Principles and Applications, John. W. Webb Ronald A Reis, Fourth Edition, Prentice Hall Inc., 1998
2. PC Based Instrumentation and Control, Mike Tooley, Third Edition, Elsevier
3. PC Interfacing and Data Acquisition Techniques for Measurement, Instrumentation and Control, Kevin James, Elsevier

REFERENCES:

1. Programmable Logic Controllers: Programming Methods and Applications, John R. Hackworth and Frederick D. Hackworth Jr., PHI, 2003
2. Automating Manufacturing Systems with PLCs, Hugh Jack, Lulu.com, 2010

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

M.Tech. II Semester (E & I)	**L**	**T/P**	**C**
	3	**0**	**3**

(A18PC1LI05) VIRTUAL INSTRUMENTATION

COURSE OBJECTIVES:
- To identify new concepts towards measurement and automation
- To understand about how to control an external measuring device by interfacing a computer
- To understand data acquisition and instrument control
- To acquire knowledge on networking
- To gain knowledge on developing different applications in Digital image processing, control system, signal processing, and in simulation

COURSE OUTCOMES: After completion of the course, students should be able to
CO-1: Acquire knowledge on how virtual instrumentation can be applied for data acquisition and instrument control
CO-2: Identify salient traits of a virtual instrument and incorporate these traits in their projects
CO-3: Experiment, analyze and document in the laboratory prototype measurement
CO-4: Acquire knowledge on developing different applications in Digital image processing control system, signal processing and in simulation systems using a computer, plug-in DAQ interfaces and bench level instruments

UNIT-I:
Virtual Instrumentation: Historical perspective, advantages, block diagram and architecture of a virtual instrument, data-flow techniques, graphical programming in data flow, comparison with conventional programming. Development of Virtual Instrument using GUI, Real-time systems, Embedded Controller, OPC, HMI / SCADA software, Active X programming.

UNIT-II:
VI Programming Techniques: VIs and sub-VIs, loops and charts, arrays, clusters and graphs, case and sequence structures, formula nodes, local and global variables, string and file I/O, Instrument Drivers, Publishing measurement data in the web.

UNIT-III:
VI Chassis Requirements: Common Instrument Interfaces: Current loop, RS 232C/ RS485, GPIB. VISA and IVI. Application of Virtual Instrumentation: Instrument Control, Signal Measurement and generation: Data Acquisition.

UNIT-IV:
Advanced LabVIEW Data Concepts: Advanced file I/O, Configuring INI files, Calling code from other languages, Fitting Square Pegs into round holes.

UNIT-V:
Connectivity in LabVIEW: Lab VIEW web server, E-mailing data from Lab VIEW, Remote Panels, Self describing data, shared variables, talking to other programs and objects, talking to other computers, database, report generation.

UNIT-VI:

Simulation of Systems: Simulation of systems using VI, Development of Control system, Industrial Communication, Image acquisition and processing, Motion control.

TEXT BOOKS:

1. LabVIEW Graphical Programming, Gary Johnson, 2nd Edition, McGraw-Hill, 1997
2. LabVIEW for Everyone, Lisa K. wells & Jeffrey Travis, Prentice Hall, 1997

REFERENCES:

1. PC Interfacing and Data Acquisition: Techniques for Measurement, Instrumentation and Control, Kevin James, Newnes, 2000
2. LabVIEW Advanced Programming Technique, Rick Bitter, 2nd Edition, CRC Press, 2005
3. Virtual Instrumentation using LabVIEW, Jovitha Jerome, 1st Edition, PHI, 2001

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

M.Tech. II Semester (E & I)	**L**	**T/P**	**C**
	3	**0**	**3**

(A18PC1LI06) MEDICAL ELECTRONICS

COURSE OBJECTIVES:
- To identify and obtain biological parameters and relationship between them
- To understand the principles of amplification involved in acquiring a bio signal
- To recognize these principles written inform of mathematical equations
- To apply these equations to analyze problems by making good assumptions and learn systematic engineering method and design robust amplifiers
- To apply fundamental principles of Medical Instrumentation for the solution of practical biological problems

COURSE OUTCOMES: After completion of the course, students should be able to
CO-1: Apply fundamental knowledge of mathematics mixed with electronics and use it for designing bio amplifiers
CO-2: Conduct experiments (in teams) in real time applications as well as documenting them in engineering reports
CO-3: Understand or become aware of artifacts caused by an incorrect diagnosis of the symptoms through sample data

UNIT-I:
Introduction to Biomedical Instrumentation: Bio Potentials - Resting and Action potentials. Electrodes - Different types of electrodes for ECG, EEG, EMG; Equivalent circuits for electrodes; General and Smart Sensors used in Biomedical engineering; Selection Criteria for Transducers and Electrodes for Bio Medical applications; Design of low noise isolation preamplifiers, Differential Amplifiers including Op. Amps and Instrumentation Amplifiers; Chopper amplifiers; Electrical safety - Grounding and isolation.

UNIT-II:
Electro-Physiological Measurements: Electro Cardiography (ECG), Electro Encephalography (EEG), Electromyography (EMG); Vector Cardiograph, Echocardiography, Phonocardiography (PCG), Electroretinography (ERG), Electrooculography (EOG).

UNIT-III:
Cardiac Instrumentation: Blood pressure and Blood flow measurement, Specification of ECG machine, Einthoven triangle, Standard 12-lead configurations, Interpretation of ECG waveform with respect to electro mechanical activity of the heart.

UNIT-IV:
Assisting and Therapeutic Devices: Cardiac pacemakers, Defibrillators, Heat lung machine, Muscle stimulator–Limb Prosthetics, Diathermy. Introduction to artificial kidney, elements of audio and visual aids in Biomedicine, Blood flow meters, Ultra Sonography; Automated Drug injecting systems.

UNIT-V:

Modern Imaging Techniques: X-ray Machine, Computer tomography (CT), Magnetic resonance Imaging system, Ultrasonic Imaging system, Applications of Lasers in biomedicine. IR (Thermographic) Imaging and its diagnostic criteria.

UNIT-VI:

Audiometers: Basic audiometer, Pure tone audiometer, Speech audiometer, audiometer system Bekesy, Evoked response audiometry system.

Measurement and Analysis Techniques- Blood Gas Analysers-Blood pH measurement, blood pCo2 measurement-Oximetry-Blood cell counters-Coulter counters, Automatic recognition and differential counting of cells.

TEXT BOOKS:

1. Hand book of Biomedical Instrumentation, Khanpur R. S., Tata McGraw Hill, 1996
2. Biomedical Instrumentation and Measurements, Cromwell L., Prentice Hall of India, 1995
3. Application & Design of Medical Instrumentation, John G. Webster, John Wiley & Son

REFERENCES:

1. Feyman Lectures on Physics Vol. 2, Richard P. Feyman, Robert B. Leighton and Matahew Sands, Narosa Publications
2. Medical Imaging Systems, Albert Macovski, Prentice Hall
3. Principle of Applied Bio-medical Instrumentation, Geddes and Baker, John Wiley and Sons, 1975
4. Medical Instrumentation Applications and Design, Honghton, Miffince, Bosten

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

M.Tech. II Semester (E & I)	**L**	**T/P**	**C**
	3	**0**	**3**

(A18PE1LI07) MICRO ELECTRO-MECHANICAL SYSTEMS

COURSE OBJECTIVES:

- To obtain knowledge about present MEMS device and their application
- To understand the principle laws of physics and chemistry that apply in fabricating a MEMS device
- To understand different fabrication techniques like micro-machining, etching
- To apply these techniques and understand some practical models and their working
- To study the electronic interface and software design tools for MEMS devices

COURSE OUTCOMES: After completion of the course, students should be able to
CO-1: Understand scaling issues of MEMS based on fundamental knowledge of physics
CO-2: Apply various micro manufacturing techniques to fabricate MEMS devices
CO-3: Apply techniques of additive manufacturing to MEMS
CO-4: Use CAD tools for simulation and layout of MEMS devices

UNIT-I:
Fundamentals of MEMS, Overview of MEMS and Microsystems: Evolution of microfabrication; Applications of MEMS in optical devices (Micro-Opto-Electro-Mechanical Systems or MOEMS), healthcare and biomedicine (including Bio-MEMS and Bio-MOEMS), aerospace, telecommunications, consumer products, automotive, and industrial products; Working principles of microsystems: Microsensors acoustic wave, bio-, chemical, optical, pressure, thermal; Micro actuation thermal, shape-memory alloys, piezoelectric, electrostatic; MEMS devices Microgrippers; Micromotors; Microfluidics Micropumps, Microvalves; Micro accelerometers

UNIT-II:
Materials for MEMS and Microsystems: Substrates and Wafers; Silicon as a Substrate, Silicon Compounds, Silicon piezoresistors, Non-silicon based materials: Gallium Arsenide, Gallium Nitride, Quartz, Piezeoelectric Crystals, Polymers.

UNIT-III:
Basics of Micro-manufacturing: Photolithography; Cleanroom Environment; Deposition techniques: Ion implantation, Diffusion, Vapour Deposition (PVD, CVD, PECVD), Oxidation, Epitaxial growth; Etching techniques: Chemical (Wet) Etching, Plasma (Dry) Etching Design considerations; Process Design; Photomask layout using CAD; Mechanical design overview

UNIT-IV:
Fabrication of MEMS: Bulk micromachining, Surface micromachining, LIGA Process, Deep X-Ray Lithography (DXRL)

UNIT-V:
Characterization of MEMS: Characterization techniques: Principle of working and operation of: Scanning Electron Microscope (SEM), Transmission Electron Microscope (TEM), Atomic Force Microscope (AFM), X-Ray Diffraction (XRD), Optical microscope

UNIT-VI:
Simulation of MEMS: MEMS devices, electronic interfaces, design, simulation and layout of MEMS devices using CAD tools.

TEXT BOOKS:

1. MEMS and Microsystems Design and Manufacture, Tai-Ran Hsu, Tata McGraw Hill, 2002
2. MEMS, N. Mahalik, McGraw-Hill Education, 2007

REFERENCES:

1. Fundamentals of Microfabrication: The Science of Miniaturization, Marc J. Madou, CRC Press, 2002
2. Microsystem Design, Stephen D. Senturia, Springer, 2004

3. Practical MEMS, Ville Kaajakari, Small Gear Publishing

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

M.Tech. II Semester (E & I)	**L**	**T/P**	**C**
	3	**0**	**3**

(A18PE1LI08) INDUSTRIAL AND POWER ELECTRONICS

COURSE OBJECTIVES:
- To make students understand the application of Amplifiers in industries
- To make students understand the need and working of SCR
- To make students understand the need of different operation of SCR and their industrial applications

COURSE OUTCOMES: After completion of the course, students should be able to
CO-1: Appreciate the need of DC amplifiers, RPS and SMPS
CO-2: Appreciate the need for SCR at different firing angle
CO-3: Appreciate the working and applications of industrial timers
CO-4: Appreciate the working of electrodes and RF generators

UNIT-I:
DC Amplifiers: Need for DC amplifiers, DC amplifiers—Drift, Causes, Darlington Emitter Follower, Cascode amplifier, Stabilization, Differential amplifiers—Chopper stabilization, Operational Amplifiers, Ideal specifications of Operational Amplifiers, Instrumentation Amplifiers.

UNIT-II:
Regulated Power Supplies: Block diagram, Principle of voltage regulation, Series and Shunt type Linear Voltage Regulators, Protection Techniques— Short Circuit, Over voltage and Thermal Protection.

UNIT-III:
Switched Mode & IC Regulators: Switched Mode voltage regulator, Comparison of Linear and Switched Mode Voltage Regulators, Servo Voltage Stabilizer, monolithic voltage regulators Fixed and Adjustable IC Voltage regulators, 3-terminal Voltage regulators—Current boosting.

UNIT-IV:
SCR, Thyristor and its Applications: Principles of operation and characteristics of SCR, Triggering of Thyristors, Commutation Techniques of Thyristors—Classes A, B, C, D, E and F, Ratings of SCR. Static circuit breaker, Protection of SCR. Diac and Triac, TriacsTriggering modes, Firing Circuits, Commutation.

UNIT-V:
Inverters and Chopper Circuits Inverters: Inverters-Classification, Single Phase inverters, Converters single phase Half wave and Full wave. Chopper circuits Principle, methods and Configurations, Design of power supplies and regulators.

UNIT-VI:
Industrial Applications: Industrial timers -Classification, types, Electronic Timers Classification, RC and Digital timers, Time base Generators. Electric Welding Classification, types and methods of Resistance and ARC wielding, Electronic DC Motor Control. High Frequency heating principle, merits, applications, High frequency Source for Induction heating. Dielectric Heating principle, material properties, Electrodes and their Coupling to RF generator, Thermal losses and Applications. Ultrasonics Generation and Applications.

TEXTBOOKS:

1. Industrial and Power Electronics, G. K. Mithal and Maneesha Gupta, 19th Ed., Khanna Publishers, 2003
2. Integrated Electronics, J. Millman and C. C. Halkias, McGraw Hill, 1972

REFERENCES:

1. Electronic Devices and Circuits, Theodore. H. Bogart, 6th Ed., Pearson Education, 2003
2. Thyristors and Applications, M. Rammurthy, East-West Press, 1977
3. Integrated Circuits and Semiconductor Devices, Deboo and Burroughs, ISE

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M.Tech. II Semester (E & I)	**L**	**T/P**	**C**
	3	**0**	**3**

(A18PE1LI09) INSTRUMENTATION IN PHARMACEUTICAL INDUSTRY

COURSE OBJECTIVES:
- To understand the working of pharmaceutical industry
- To know the necessity of an instrumentation engineer in pharmaceutical industry
- To understand different processes that are performed in pharmaceutical industry
- To know different components and equipment required to implement these processes and their control in pharmaceutical industry

COURSE OUTCOMES: After completion of the course, students should be able to
CO-1: Know the basic processes being performed in pharmaceutical industry
CO-2: Different equipment used and how they are controlled in pharmaceutical industry
CO-3: Appreciate evaporation, distillation and filtration process involved in pharma industries
CO-4: Appreciate the necessity of homogenization of mixture and size reduction

UNIT-I:
Introduction: Pharma Industries Basic Processors and Instrumentation Techniques, Process Analysis Technology (PAT).
Filtration: Classification of Filtration, Mechanism of Filtration, Filter media, Filter Aids, Pre-treatment of materials, small scale filtration methods, filtration equipment, filter presses, Leaf filters, stacked disc filters, meta filters, Rotary continuous filters, other methods, ceramic filters, seitz filters, sintered (fritted) Glass filters, Membrane filters, factors affecting the rate of filtration, industrial filters including filter press, rotary filter, edge filter, etc. Factors affecting filtration, mathematical problems on filtration, optimum-cleaning cycle in batch filters, Limitations of filter theory.
Centrifugation: General principles, theoretical aspects, classification, Laboratory equipment, Large scale equipment, Semi continuous centrifuge, equipment with non-perforated basket, de laval clarifier, vertical solid bowl centrifuges, continuous centrifuges, Principles of centrifugation, industrial centrifugal filters, centrifugal filters, and centrifugal sedimeters

UNIT-II:
Crystallization: Introduction, Crystal forms and crystal Habit, classification of crystallizers, tank crystallizers, agitated batch crystallizers, Swenson Walker Crystallizer, others, Krystal Crystallizer, Vacuum Crystallizer without External Classifying seed Bed, theoretical aspects of Crystallization, Calculation of yields, theory of Crystallization. The miers super saturation theory, limitations of the miers theory, rate of crystal growth.
Characteristics of crystals like; purity, size, shape, geometry, habit, forms, size and factors affecting it. Solubility curves and calculation of yields, Material and heat balances around Swenson Walker Crystallizer. Super saturation theory and its limitations, Nucleation mechanisms, crystal growth. Study of various types of crystallizers, tanks, agitated batch, single vacuum, circulating magma and crystal crystallizers. Caking of crystals and its prevention. Numerical problems on yields.

UNIT-III:
Evaporation and Distillation Heat Processes: Factors affecting evaporation, study of evaporating stills and evaporating pans, heat transferring evaporators, vapor compression evaporators and evaporation under reduced pressure. Distillation: Importance of distillation in Pharmacy, methods of distillation. Brief introduction to freeze drying, sublimation, desiccation and exsiccation, efflorescence and its importance.

UNIT-IV:

Humidity Control and Refrigeration: Basic concepts and definition, wet bulb temperature, adiabatic cooling lines, use of Humidity chart, determination of humidity, air conditioning, humidification and humidifying equipment, dehumidifiers. Introduction, refrigeration equipment, coefficient of performance and refrigerants, Brine systems, refrigeration load, absorption systems.

UNIT-V:

Size Reduction and Separation: Introduction, mechanism and principles of size reduction, classification of size reduction equipment, law of size reduction, large equipment, mills using impact force for size reduction, cage mills, pin mills, fluid energy or jet mills, attrition and grinding mills tumbling mills. Ball mills and tube mills, practical size classifiers used with grinding mills, wet classifiers, non-rotary ball and bead mills, dry vs wet grinding, end runner mill, edge runner mills, disc attrition mills, dispersion and colloid mills, roller mills, size reduction combined with other operations, factors influencing choice of size reduction machinery, changes resulting in the material due to size reduction.

Size separation sieving, Screening equipment, sedimentation, screen analysis Definition, objectives of size reduction, factors affecting size reduction, laws governing energy and power requirements of a mill, types of mills including ball mill, hammer mill, fluid energy mill etc. Various methods and equipments employed for size separation, centrifugal elutriation, microscopic methods.

UNIT-VI:

Mixing and Homogenization: Introduction, equipment for mixing of miscible liquids, mixing of a soluble solid with a low viscon liquid etc., mixing solids with solids, equipment, consideration while choosing solids mixing equipment, mixing solids with liquids, mixing miscible liquids, mixing viscous masses, mixing of immiscible liquids, equipment for emulsification.

Theory of mixing- solid solid, solid liquid and liquid liquid mixing equipment, double cone, twin-shell, silverson mixer, colloid mill, sigma blade mixer, planetary mixer, propeller mixer and turbine mixer. Semi solid mixing, Triple roller mill.

TEXT BOOKS:

1. Pharmaceutical Engineering, K. Samba Murthy, New Age Publishers
2. Pharmaceutical Engineering, C.V.S. Subrahmanyam, V. Kusum Devi, Sarasija Suresh, J. Thimma Setty, Vallabh Prakashan, 2009
3. Tutorial Pharmacy, S. J. Carter, Cooper and Gunn's, 6th Ed., CBS Publisher

REFERENCES:

1. Perry's Handbook of Chemical Engineering, Don W. Green, McGraw Hill Education, 2018
2. Unit Operations of Chemical Engineering, McCabe & Smith, 7th Edition, McGraw Hill Education, 2017

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

M.Tech. II Semester (E & I)	**L**	**T/P**	**C**
	3	**0**	**3**

(A18PE1LI10) INSTRUMENTATION IN PAPER AND PULP INDUSTRIES

COURSE OBJECTIVES:
- Identify the different paper making processes and the differences between them
- Understand the principles of measurement of moisture, basic weight, caliper, brightness, Consistency, pH, ORP etc.
- Recognize these principles written in form of mathematical equations
- Apply these equations to analyze measurement of different parameters by making good assumptions and learn systematic engineering method to solve practical problems
- Apply fundamental principles of paper measurements for the solution of practical analysis of moisture, basic weight, caliper, brightness, Consistency, pH, ORP etc.

COURSE OUTCOMES: After completion of the course, students should be able to
CO-1: Apply fundamental knowledge of mathematics to modelling and analysis of moisture, basic weight, caliper, brightness, Consistency, pH, ORP in pulp and paper industries
CO-2: Conduct company visits and field study in different industries and interpreting data from model studies to prototype cases, as well as documenting them in engineering reports
CO-3: Understand measurement of different parameters caused by an incorrect analysis in engineering system
CO-4: Understand the Paper Process methodology and instrumentation involved

UNIT-I:
An Overview of Paper Making Process: Paper making process, Raw materials, Pulp separation, screening, Bleaching, Cooking, Chemical reaction, chippers, types of digesters, H factor and Kappa factors, Stock preparation, Instrumentation needs, Energy conservation and paper quality control.

UNIT-II:
Paper Properties and its Measurement: Physical, electrical, optical and chemical properties of paper, Basic weight, thickness, density, porosity, smoothness, softness, hardness and compressibility, stress, strain relationship, Tensile strength, bursting strength, tearing resistance, folding endurance, stiffness and impact strength, Dielectric constant, dielectric strength, dielectric loss and Properties of electrical insulating paper, Brightness, colour, gloss and capacity, Starch constant acidity and pH Measurement techniques.

UNIT-III:
Consistency Measurement: Definition of consistency, Techniques for head box consistency measurement, Stock consistency measurement and control.

UNIT-IV:
Paper Making Machine: Functioning of Paper making machine, Quality parameters moisture, basic weight, caliper, brightness, colour, ash content, strength, gloss and tensile strength-parameters monitoring Instrumentation.

UNIT-V:

Wet End Instrumentation: Conventional measurements at wet end – pressure vacuum, temperature, liquid density, specific gravity level flow; consistency measurement, pH, ORP measurement freeness measurement

Dry End Instrumentation, Conventional measurements-moisture, basis weight caliper, coat thickness, optical variables, measurement of length speed Digester, Rotary, Batch type

UNIT-VI:

Pumps and Control Valves: Flow box - wet end variables - evaporator feedback - feed forward control - lime mud density control, stock proportioning system, refiner control instrumentation, basic pulper instrumentation-headbox

rush/drag control - instrumentation for size preparation, coating preparation, coating weight control

batch digester- k/kappa number control - bleach plant chlorine stage control

Control Aspects - Machine and cross direction control technique - consistency, moisture and basic weight control - dryer control – computer based control systems - mill wide control.

TEXT BOOKS:

1. Pulp and Paper Industries-Technology and Instrumentation, Sankaranarayanan P. E., Kotharis Desk Book Series, 1995
2. Handbook of Pulp and Paper Technology, Britt K. W., Van Nostrand Reinbold Company, 1970
3. Shreve's Chemical Process Industries, Austin G. T., McGraw Hill International Student Edition, 1985

REFERENCES:

1. An Introduction to Paper Industry Instrumentation, John R. Lavigne, Miller Freeman Publications, 1985
2. Measurement and Control in Paper Making, Robert J. McGill, Adam Hilger Limited, 1980
3. Instrumentation Applications for the Pulp and Paper Industry, John R. Lavigne, Miller Freeman Publications, 1990
4. Instrument Engineers Handbook, Volume 2, Process Control, Liptak B. G., Third Edition, CRC Press, 1995
5. Pulp and Paper Chemistry and Chemical Technology, James P. Casey, John Wiley and Sons, 1981

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

M.Tech. II Semester (E & I)	**L**	**T/P**	**C**
	3	**0**	**3**

(A18PE1LI11) IMAGE PROCESSING AND PATTERN RECOGNITION

COURSE OBJECTIVES:

- To analyze the images, operations on pixels and study the fundamental steps of image processing and understand the image transformations techniques
- To apply the different image segmentation techniques such as region-based segmentation, point detection, line detection and edge detection
- To perform the morphological operations such as Dilation, erosion, boundary, skeleton and image compression models
- To study the image restorations and Pattern Recognition techniques

COURSE OUTCOMES: After completion of the course, students should be able to

CO-1: Apply fundamental knowledge of image processing to understand real time analysis and different applications of image processing

CO-2: Finally, this knowledge can be helpful for implementation of some real time projects and research on image processing applications

CO-3: Analyze and compare various image compression techniques and their applications

CO-4: Design and implement various algorithms for image restorations techniques and Pattern recognition techniques.

UNIT-I:

Introduction: Fundamentals steps of Image processing, Components of an Image processing system, Image sampling and quantization, relationship between the pixels. Gray level transformation, Smoothing and sharpening spatial filters, Smoothing and sharpening frequency domain filters, Homo morphic filtering.

Image Transforms: 2-Dimensional Orthogonal and Unitary Transforms,1-Dimensional DFT-2-Dimensional DFT- Cosine Transform-The Sine Transform, The Hadamard Transform, The Haar Transform- The Slant Transform –The KL Transform-The Singular Value Decomposition Transform.

UNIT-II:

Image Enhancement: Basic Gray level Transformations-Image Negatives, Log transformations, Power-law Transformations, Piecewise-Linear Transformation Functions, Histogram Processing-Histogram equalization, Histogram matching, local Enhancement, Use of Histogram Statistics for Image Enhancement-Enhancement using Arithmetic/Logic Operations-Image Subtraction, Image Averaging.

UNIT-III:

Image Segmentation: Edge linking and boundary detection, Thresholding, Global and Adaptive, Region based segmentation, Segmentation by morphological watersheds, color segmentation.

UNIT-IV:

Morphological Operations: Dilation and erosion, Opening and closing, Hit or Miss transforms, Morphological algorithms, Extensions to gray scales images and its applications. Image compression: Compression models, Error free coding, lossy coding, compression standards, color image compression, Introduction to fractals.

Image Representation and Description: Representation-Chain codes, Polygonal Approximations, Signatures, Boundary Segments, Skeletons, Boundary Descriptors, simple descriptors, shape numbers, Fourier Descriptors, statistical moments-Regional Descriptors-simple descriptors, topological descriptors, texture, moments of two dimensional functions.

UNIT-V:

Image Degradation/Restoration: Unconstrained and Constrained Restoration, Restoration in the presence of Noise Only-Spatial Filtering, Periodic Noise Reduction by Frequency Domain Filtering, Estimating the degradation Function-Estimation by Image Observation, Estimation by Experimentation, Estimation by Modelling-Inverse Filtering- Minimum Mean Square Error (Wiener) Filtering- Constrained Least Squares Filtering Geometric Mean Filter - Geometric Transformations-Spatial transformations, Gray-level Interpolation.

UNIT-VI:

Statistical and Non-Parametric Decision Making: Applications of Pattern Recognition Baye's Theorem Multiple Features Conditionality Independent Features Decision Boundaries Unequal Costs of Error Estimation of Error Rates Kernel and Window Estimator Nearest Neighborhood Classification Techniques Adaptive Decision Boundaries Adaptive Discriminant Functions.
Clustering: Introduction Hierarchical Clustering Partitional Clustering

TEXT BOOKS:

1. Digital Image Processing, Rafael C. Gonzalez and Richard E. Woods, 3rd Edition, Pearson, 2008
2. Digital Image Processing, S. Jayaraman, S. Esakkirajan, T. Veerakumar, TMH, 2010
3. Pattern Recognition and Image Analysis, Earl Gose and Richard Johnsonbaugh, Steve Jost, PHI

REFERENCES:

1. Digital Image Processing, Gonzalez and Woods, 4th Edition, Pearson Education, 2017
2. Video Processing and Communication, Yao Wang, Joern Ostermann and Ya Qin Zhang, Prentice Hall
3. Digital Video Processing, M. Tekalp, 1st Edition, Prentice Hall, 1995
4. Fundamentals of Digital Image Processing, Anil K. Jain, PHI

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

M.Tech. II Semester (E & I)	**L**	**T/P**	**C**
	3	**0**	**3**

(A18PE1LI12) ADAPTIVE CONTROL SYSTEMS

COURSE OBJECTIVES:
- To inculcate conceptual understanding of adaptive control
- To provide knowledge on various adaptive schemes, with a basic understanding on closed loop system stability and implementation issues
- To develop ability to design suitable stable adaptive scheme to meet the performance objectives even in the presence of disturbances and changing operating conditions
- To identify the need and apply appropriate adaptive control design technique to real time systems

COURSE OUTCOMES: After completion of the course, students should be able to
CO-1: Formulate adaptive control design problem
CO-2: Identify suitable adaptive controller for a given system with uncertain parameters
CO-3: Apply adaptive design techniques to real time systems whose parameters change during operation
CO-4: Implement adaptive control schemes to meet the performance objectives in challenging situations

UNIT-I:
Introduction: Adaptive Control, effects of process variation - Adaptive Schemes - Adaptive Control problem , Applications – Real Time Parameter Estimation: Introduction - Regression Models - Recursive Least Squares - Exponential Forgetting - Estimating Parameters in Dynamical Systems - Experimental Conditions – Loss of identifiability due to feedback.

UNIT-II:
Deterministic Self-Tuning Regulators: Introduction - Pole Placement Design, MDPP - Design of Indirect Self-tuning Regulators - Continuous Time Self-tuners - Direct Self-tuning Regulators - Properties of Direct Self-tuners - Disturbances with Known Characteristics, Case Study.

UNIT-III:
Model Reference Adaptive Systems: Introduction - MIT Rule - Significance of Adaptation Gain - Lyapunov Stability Theory - Design of MRAS Using Lyapunov Theory - Adaptation of a Feed forward Gain - Applications to Adaptive Control, Case Study.

UNIT-IV:
MARS Vs STR: Relations between MRAS and STR - Nonlinear Systems - Feedback Linearization - Adaptive Feedback Linearization - Back Stepping - Adaptive Back Stepping, Case Study.

UNIT-V:
Gain Scheduling: Introduction - Principle - Design of Gain Scheduling controllers - Nonlinear Transformations - Applications of Gain Scheduling, Case Study.

UNIT-VI:
Practical Issues and Implementation - Controller Implementation - Computational Delay - Sampling and Pre, and Post Filtering - Controller Windup - Estimator Implementation - Operational Issues.

TEXT BOOKS:
1. Adaptive Control, Karl Johan Astrom and Bjom Wittenmark, Addison Wesley, 2003
2. Adaptive Control, Shankar Sastry, PHI (Eastern Economy Edition), 1989

REFERENCES:

1. Adaptive Control, Karl Johan Astrom, Pearson Education, 2001
2. Robust Adaptive Control, Petros A. Loannou, Jing, Prentice Hall, 1995
3. System Identification: Parameter and State Estimation, Eykhoff P., 1974
4. System Identification Theory for the User, Ljung, Prentice Hall, 1987

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

M.Tech. II Semester (E & I)	**L**	**T/P**	**C**
	0	**3**	**1.5**

(A18PC2LI03) INDUSTRIAL PROCESS CONTROL SYSTEMS LABORATORY

COURSE OBJECTIVES:

- To give a novice an understanding of PLC programming, ladder logic and the inner workings of a PLC modules
- To learn the difference between digital and analogy signals and how to bring them into a PLC, process them, and send them back out
- To understand the role of each components (RTU, HMI & Drives) of automation in industry.
- To understand the importance of data acquisition and management

COURSE OUTCOMES: After completion of the course, students should be able to

CO-1: Explore basic, standard control techniques for things like Human Oriented Automation (HOA) control, level control, pressure control, and PID control loops

CO-2: Be introduced to HMI development and given a general understanding of how an HMI program works

CO-3: Learn the applications of SCADA software, SCADA features, creating applications, creating database tags, developing graphic displays, trending, communication with PLC and other hardware

CO-4: Design, Develop and Commissioning of PLC, RTU, Drives and SCADA programs for desired applications

LIST OF EXPERIMENTS:

1. Design and development of ladder logic programming for switching applications in PLC
2. Implementing Timers and Counters for industrial applications using ladder logic programming
3. Interfacing, signal processing & normalization of analog signals to PLC
4. Interfacing, networking & monitoring of PLC's using SCADA
5. Control of level process station with PLC and data logging
6. Control flow process station with PLC and data logging
7. Control of pressure process station with PLC and data logging
8. Implementing Distributed Control System (DCS) using PLC and RTU for remote monitoring and control
9. Design and Development of SCADA system, with PLC Integration
10. HMI development for industrial application
11. Speed control of 3 phase induction motor using PLC through VFD
12. SCADA, PLC technology integration for multi process station monitoring and control

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M.Tech. II Semester (E & I)	**L**	**T/P**	**C**
	0	**3**	**1.5**

(A18PC2LI04) VIRTUAL INSTRUMENTATION LABORATORY

COURSE OBJECTIVES:
- To learn concepts using data acquisition card
- To understand the control of an external measuring device by Interfacing a computer
- To familiarize image processing applications
- To learn to develop the control system and signal simulation applications
- To learn DSP Application

COURSE OUTCOMES: After completion of the course, students should be able to
CO-1: Design and Implement Data acquisition and control sequences using the Lab VIEW software development tool
CO-2: Perform experiments on electrical circuits to determine their frequency response and characteristics of components etc. (using NI Elvis)
CO-3: Perform the image processing techniques on images using Vision Assistant module
CO-4: Develop the control system and signal simulation applications using CDSM and DSP toolkit

LIST OF EXPERIMENTS:

1. Design of Decimal Counter Using Lab VIEW
2. Design of A function generator using Lab VIEW
3. Design of Filters Using NIELVIS
4. Signal processing with speed 33 (speech recording and analysis)
5. Image Processing techniques with Vision Assistant
6. Image Processing application with vision assistant
7. Image corrupted with salt and pepper noise, apply average local 3 X 3 filter, local average 5 X 5, local average 7 X 7 and median filter observe the response using Vision Assistant

CONTROL DESIGN SIMULATION USING LABVIEW
1. Building and Configuring Simulations (Control Design and Simulation Module)
2. Modularizing the Simulation Diagram (Control Design and Simulation Module)
3. Trimming and Linearizing Nonlinear Models
4. Executing Simulations in Real Time
5. Optimizing Design Parameters
6. Simulation Model Converter

NETWORKING USING LABVIEW
1. Creating a TCP Client
2. Creating a TCP Server
3. Binding Front Panel Controls to Shared Variables
4. Binding Front Panel Controls to Shared Variables in Other Projects
5. Binding Shared Variables to an Existing Source
6. Changing the Default Ports for TCP, Based NI, PSP
7. Configuring Firewalls and Network Address Translating Routers for Shared Variables

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M.Tech. II Semester (E & I)	**L**	**T/P**	**C**
	0	**4**	**2**

(A18PW4LI02) MINI-PROJECT

COURSE OUTCOMES: After completion of the course, students should be able to
CO-1: Understand the formulated industry / technical / societal problems
CO-2: Analyze and / or develop models for providing solution to industry / technical / societal problems
CO-3: Interpret and arrive at conclusions from the project carried out
CO-4: Demonstrate effective communication skills through oral presentation
CO-5: Engage in effective written communication through project report

COURSE OUTLINE:

- A student shall undergo a mini-project during II semester of the M.Tech. programme.
- A student, under the supervision of a faculty member, shall collect literature on an allotted project topic of his / her choice, critically review the literature, carry out the mini-project, submit it to the department in a prescribed report form.
- Evaluation of the mini-project shall be done by a Project Review Committee (PRC) consisting of the Head of the Department, faculty supervisor and a senior faculty member of the specialization / department.
- Prior to the submission of mini-project report to the PRC, its soft copy shall be submitted to the PG Coordinator for PLAGIARISM check.
- The mini-project report shall be accepted for submission to the PRC only upon meeting the prescribed similarity index.

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

M.Tech. II Semester (E & I)	**L**	**T/P**	**C**
	2	**0**	**0**

(A18AU5EN01) ENGLISH FOR ACADEMIC AND RESEARCH WRITING

COURSE OBJECTIVES:

- To understand the usage of appropriate vocabulary (Formal, Informal, Gender Insensitive etc.)
- To understand the features and processes of academic writing
- To identify the resources
- To understand standard documentation styles

COURSE OUTCOMES: After completion of the course, students should be able to

CO-1: Use appropriate vocabulary (Formal, Informal, Slang, Gender Insensitive etc.)

CO-2: Employ processes of academic writing

CO-3: Identify the resources

CO-4: Understand standard documentation styles

UNIT- I:

Introduction to Research:

i. Identifying the topic
ii. Identifying Sources; Finding Sources
iii. Defining the broad area; Defining the specific area; Difference between a broad area and specific area
iv. Choosing a topic
v. Mechanics of Writing – Language, Tone, Style, Ethics

UNIT-II:

Referencing & Library Skills:

i. Literature Survey
ii. Writing Objectives
iii. Hypothesis
iv. Methodology
v. Prospects for Future Research

UNIT-III:

Academic Writing Skills:

i. Paraphrasing
ii. Summarizing
iii. Quoting
iv. Rewriting
v. Expansion

UNIT-IV:

Kinds of Academic Writing:

i. Essays
ii. Reports
iii. Reviews
iv. SOPs
v. Abstracts
vi. Proposals

UNIT-V:

Research Process:

i. Selection of Topic
ii. Formulation of Hypothesis
iii. Collection of Data
iv. Analysis of Data
v. Interpretation of Data
vi. Presentation of Data

UNIT-VI:

i. Title
ii. Abstract
iii. Introduction
iv. Literature Survey
v. Methodology
vi. Discussion
vii. Findings/Results
viii. Conclusion
ix. Documenting Sources

TEXT BOOKS:

1. Writing for Science, Goldbort R., Yale University Press (available on Google Books), 2006
2. Handbook of Writing for the Mathematical Sciences, Highman N., SIAM. Highman's Book, 1998

REFERENCES:

1. How to Write and Publish a Scientific Paper, Day R., Cambridge University Press, 2006
2. English for Writing Research Papers, Adrian Wall Work, Springer New York Dordrecht Heidelberg London, 2011
3. MLA Handbook for Research

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

M.Tech. III Semester (E & I)	**L**	**T/P**	**C**
	3	**0**	**3**

(A18PE1LI13) INSTRUMENTATION IN POWER PLANTS

COURSE OBJECTIVES:
- To understand the working model of power plant
- To understand the necessity of a instrumentation engineer in a power plant
- To understand different components and their control in power plants
- To understand various analyzers used in power plant

COURSE OUTCOME: After completion of the course, students should be able to
CO-1: Appreciate the power generation technique used in different types of power plants
CO-2: Appreciate different parameters and their control in the power plant
CO-3: Understand and standby the saying "one watt saved = two watts generated"
CO-4: Understand the concepts of nuclear power plants

UNIT-I:
An Overview of Power Generation: Introduction, various sources of Electrical Energy , Non-conventional Energy sources, Wind power, solar power, tidal power, geothermal power, magnetohydrodynamic (MHD) Power, Fuel Cells, Biomass Power, Conventional energy sources, hydropower, nuclear power, gas power, steam power (Thermal Power), comparison of various conventional power plants, Importance of instrumentation and control in power Generation – Classification of Instruments in a power plant, objectives of Instrumentation and control.
Piping and Instrumentation diagram (P and I Diagram) – Examples of ISA Instrumentation diagram symbols, examples of SAMA instrumentation diagram symbols, examples of ISA and SAMA diagram, piping and instrumentation diagramming, Cogeneration of Power back pressure turbine, pass out turbine process heat unit, control rooms, thermal or boiler control room, electrical control room, plan of control rooms.

UNIT-II:
Instrumentation and Control in Water Circuit: Water circuit, boiler feed water circulation, natural circulation, forced circulation, combined circulation, Measurements in Water Circuit, Water Flow Measurement, Differential Pressure transmitter (DPT), steam flow measurement, water and steam pressure measurements, water and steam temperature measurements, drum water level measurement.
Controls in water circuit, boiler drum level control, superheated steam temperature control, steam pressure control, impurities in water and steam, impurities in Raw Water, Effects of Impurities, Measurement of Impurities, feed water treatment.

UNIT – III:
Instrumentation and Control in Air-Fuel Circuit: Air-Fuel Circuit – Fuels, combustion air, flue gases, waste gases, Measurements in Air-Fuel Circuit – Measurement of flow/quantity, Measurement of Pressures, Measurement of Temperatures, Measurement of level.
Controls in Air-Fuel Circuit – Combustion control, furnace Draft Control, Analytical Measurement – Oxygen Measurement in Flue Gas, Measurement of carbon dioxide in flue gas, combustibles analyser (CO+H2), Infrared flue gas analyser, smoke detector, dust monitor, closed circuit television, fuel analysers, chromatography, pollution monitoring instruments.

UNIT-IV:

Power Plan Management: Introduction – master control, combustion process – boiler efficiency- calculations, maintenance of measuring instruments – types of maintenance, maintenance cost, life cycle cost, intrinsic and electrical safety, interlocks for boiler operation, computer based control and data logging system, distributed control system.

UNIT-V:

Turbine Monitoring and Control: Introduction – Classification, instrumentation control points of View, Principal parts of steam turbines, Turbine Steam Inlet System – Inlet valve arrangements, inlet measurements, Governors, Turbine Measurements – Process Parameters, mechanical parameters, electrical parameters, Turbine control system – safety control systems, process control systems, Lubrication for turbo, alternator – Lubrication system, Controls in Lubrication system, Turbo, Alternator Cooling System – Lube Oil cooling system, Alternator/Generator cooling system.

UNIT-VI:

Nuclear Power Plant Instrumentation: Introduction – Instrumentation and Control for Nuclear Power Plant , Important Components of I&C System , Evolution of I&C in NPP – Reactor Control – Methods of Control, Control loops, Functions of control system, Pressurized water reactor (PWR) controls, boiler water reactor (BWR) controls, Liquid metal cooled reactor (LMCR) Control, role of reactor controls during start-up, normal operation and shut down.

Digital Architectures in Nuclear Power Plants - System, level Instrumentation and control architecture, safety related systems, non, safety, related systems, man machine interface system (MMIS), Instrumentation and controls architecture platform.

Radiation protection and monitoring – accident at three mile Island, USA, disaster at Chernobyl nuclear power plant, Ukraine, calamity at Fukushima, Daiichi nuclear power plant, Japan, Radiation Units, Biological Effects of Radiation, Radiation Monitoring, Nuclear Reactor Safety, Reactor protection system, Reactor Tripping, Engineered Safety Features, Surveillance, Diagnostics and Prognostics – Surveillance, Diagnosis, Prognosis.

TEXT BOOKS:

1. Modern Power Station Practice, Vol. 6, Instrumentation, Controls and Testing, Pergamon Press, Oxford, 1971
2. Power Plant Technology, Wakil M. M., McGraw-Hill

REFERENCES:

1. Standard Boiler Operations-Questions and Answers, Elonka S. M. and Kohal A. L., Tata McGraw-Hill, New Delhi, 1994
2. Power Plant Instrumentation, K. Krishna Swamy, New Age International

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

M.Tech. III Semester (E & I)	**L**	**T/P**	**C**
	3	**0**	**3**

(A18PE1LI14) IoT TECHNOLOGIES

COURSE OBJECTIVES:

- To understand the new paradigm of objects interacting with people, information systems and with other objects
- To introduce various IoT protocols
- To understand the issues in developing specific real time system on various IoT platforms

COURSE OUTCOMES: After completion of the course, students should be able to

CO-1: Identify and describe different kinds of internet-connected products developed on IoT platforms

CO-2: Appreciate the challenges involved in establishing user-interaction with connected-objects

CO-3: Develop prototype IoT applications using Arduino

UNIT-I:

Introduction to Internet of Things (IoT): Physical Design, Logical Design, IoT Enabling Technologies, Domain Specific IoT- Home automation, Cities, Environment, Energy and Industry.

UNIT-II:

IoT Protocols-Functionality based IoT Protocol Organization: Connectivity (6LoWPAN, RPL), Identification (EPC, uCode, IPv6, URIs), Communication(WiFi, Bluetooth, LPWAN); Discovery (Physical Web, mDNS, DNS-SD); Data Protocols (MQTT, CoAP, AMQP, Websocket, Node); Device Management (TR-069, OMA-DM); Semantic (JSON-LD, Web Thing Model); Multi-layer Frameworks (Alljoyn, IoTivity, Weave, Homekit)

UNIT-III:

Communication Protocols: IEEE 182.15.4, Zigbee, 6LoWPAN, Wireless HART, Z-wave, ISA100, Bluetooth, NFC, RFID.

UNIT-IV:

Sensor Networks: Wireless Sensor Networks, Basic components of sensor nodes, sensor web, Node behavior in WSN, Detection and connectivity re-establishment. Application of Sensor networks in Mines, Healthcare and Agriculture.

UNIT-V:

Introduction to Arduino Programming: Features, Arduino IDE overview, Sketch, Data types, Function Libraries, Operators, Control statements, Loops, Arrays, Strings, Math Library, Random Numbers, Interrupts. Integration of sensors and actuators with Arduino, Examples.

UNIT-VI:

Software Defined Networks: Overview of current network, limitations. SDN architecture, Basic Concepts, Components/Attributes, Challenges present in SDN, Rule Placement with Open Flow. API's in SDN, Integrating SDN with IoT.

TEXT BOOKS:

1. Internet of Things: Hands-on Approach, A. Bahaga, V. Madisetti, VPT Publisher, 2014
2. Internet of Things, Enabling Technologies, Platforms and Use Cases, Pethu Raj, Anupama C. Raman, CRC Press, Taylor and Francis Group

REFERENCES:

1. Designing the Internet of Things, A. McEwen, H. Cassimally, Wiley, 2013
2. The Internet of Things in the Cloud: A Middleware Perspective, Honbo Zhou, CRC Press, 2012
3. Architecting the Internet of Things, Dieter Uckelmann, Mark Harrison, Florian Michahelles (Eds.), Springer, 2011
4. The Internet of Things–Key Applications and Protocols, Olivier Hersent, David Boswarthick, Omar Elloumi, Wiley, 2012
5. The Internet of Things: Applications to the Smart Grid and Building Automation, Olivier Hersent, Omar Elloumi and David Boswarthick, Wiley, 2012

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

M.Tech. III Semester (E & I)	**L**	**T/P**	**C**
	3	**0**	**3**

(A18PE1LI15) PRINCIPLES AND APPLICATIONS OF NANO SCIENCES

COURSE OBJECTIVES:

- To introduce the multidisciplinary nature of nanotechnology and its applications
- To outline various nanomaterials and methods to modify these materials for wide variety of applications
- To introduce instrumentation for nanoscale measurements
- To enumerate specific applications of nanotechnology to electronics and medicine

COURSE OUTCOMES: After completion of the course, students should be able to

CO-1: Evaluate the design considerations for nanoscale materials, devices, and structures in a general variety of applications

CO-2: Gain theoretical knowledge to synthesize, modify, and characterize, and use nanomaterials for typical applications

CO-3: Appreciate the need for specialized metrology for nanoscale measurements and familiarize with various commonly used instruments for nanoscale measurements

CO-4: Identify the applications of nanotechnology to electronics

CO-5: Learn the advancements in the field of medicine due to the advent of nanotechnology

UNIT-I:

Introduction to Nanotechnology: Introduction & History: Overview of atomic physics; Chemistry of atoms and molecules; Overview of quantum mechanics; Feynman's perspective of nanoscience; Social impact of nanotechnology; Motivation, Top-down vs. Bottom-up approaches

Applications: Electronics, instrumentation, medicine, environmental sciences.

Considerations: Size constraints on measurements; Optical, Electronic, and Magnetic Properties at Nanoscale.

UNIT-II:

Nanomaterials: Introduction to Nanomaterials: Metal Nanomaterials, Semiconductor nanomaterials, Quantum Dots, Quantum Wells, 2-terminal Quantum Wires, Buckyballs, Carbon Nanotubes, Nano Peapods, Nano Rods, Polymer-based Nanostructures, Gold Nanostructures: Nano-rods, Nano-cages, Nano-shells; Aerogels and porous materials for nanoscience applications, Nano-powders and Nanocrystalline Powders, Dendrimers.

UNIT-III:

Nanofabrication: Fabrication Techniques: Top-down approach Nanolithography, CVD and Metal-Oxide CVD (MOCVD); Bottom-up approach sol-gel process, chemical synthesis, wet deposition techniques, RF sputtering, Self-assembly and Layer-by-layer assembly (LbL).

UNIT-IV:

Nanoscale Measurements: Instrumentation: Principle of working, Operational aspects, Limitations, and Applications for: SEM, TEM, STM, SPM, AFM, Fluorescence microscopy; X-ray techniques: X-ray Diffraction (XRD), X-ray Absorption Spectroscopy, Small-angle X-ray scattering

UNIT-V:

Nanoelectronics Overview: Materials: Graphene, Boron Nitride Nano-mesh, III-V compounds: GaAs, GaN, AlGaN, InGaAs, High-K/Metal-Gate applications for non-Si nanoelectronics

Devices: Silicon nanowires, Single- and Multi-Walled Carbon Nanotubes, III-V Quantum Wells, Ballistic deflection transistors (BDT)

Applications: Printed electronics, Molecular electronics, Spintronics, Nano Optoelectronics: displays, Memory devices, Electronics modelled after living systems.

UNIT-VI:

Nanomedicine Overview: Nano printing of DNA, RNA, and proteins; Drug delivery and targeting tumors; Cytotoxicity of Nanoparticles; Nanotechnology in regenerative therapy; Nanotechnology in cancer treatment; NEMS sensors and biosensors; Lab on a Chip (LoC)

TEXT BOOKS:

1. Introduction to Nanotechnology, Poole C., Owens F., Wiley, 2007 (ISBN: 978,8126510993)
2. Nano Science and Nanotechnology: Fundamentals to Frontiers, Ramachandra M. S., Singh S., Wiley India Pvt. Ltd., 2013 (ISBN: 978,8126542017)
3. Nano: The Essentials: Understanding Nanoscience and Nanotechnology, Pradeep T., McGraw-Hill India, 2007 (ISBN: 978,0070617889)

REFERENCES:

1. Springer Handbook of Nanotechnology, Bhushan B. (Ed.), Springer, 2006 (ISBN: 978,3540298557)
2. Nanotechnology: Basic Calculations for Engineers and Scientists, Theodore L., Wiley India Pvt. Ltd., 2011 (ISBN: 978,8126529667)
3. Nanotechnology: An Introduction to Synthesis, Properties and Applications of Nanomaterials, Varghese, T., Balakrishna K. M., Atlantic, 2012 (ISBN: 978,8126916382)

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

M.Tech. III Semester (E & I)	**L**	**T/P**	**C**
	3	**0**	**3**

(A18OE1CN01) BUSINESS ANALYTICS

COURSE OBJECTIVES:

- To understand the role of business analytics within an organization and to analyze data using statistical and data mining techniques and understand relationships between the underlying business processes of an organization
- To gain an understanding of how managers use business analytics to formulate and solve business problems and to support managerial decision making and to become familiar with processes needed to develop, report, and analyze business data
- To use decision-making tools/Operations research techniques and to manage business process using analytical and management tools
- To analyze and solve problems from different industries such as manufacturing, service, retail, software, banking and finance, sports, pharmaceutical, aerospace etc.

COURSE OUTCOMES: After completion of the course, students should be able to
CO-1: Apply knowledge of data analytics
CO-2: Think critically in making decisions based on data and deep analytics
CO-3: Use technical skills in predicative and prescriptive modeling to support business decision-making
CO-4: Translate data into clear, actionable insights

UNIT-I:
Business Analytics: Overview of Business analytics, Scope of Business analytics, Business Analytics Process, Relationship of Business Analytics Process and organization, competitive advantages of Business Analytics.
Statistical Tools: Statistical Notation, Descriptive Statistical methods, Review of probability distribution and data modelling, sampling and estimation methods overview.

UNIT-II:
Trendiness and Regression Analysis: Modelling Relationships and Trends in Data, simple Linear Regression. Important Resources, Business Analytics Personnel, Data and models for Business analytics, problem solving, Visualizing and Exploring Data Business Analytics Technology.

UNIT-III:
Organization Structures of Business analytics, Team management, Management Issues, Designing Information Policy, Outsourcing, Ensuring Data Quality, Measuring contribution of Business analytics, Managing Changes.
Descriptive Analytics, predictive analytics, predicative Modelling, Predictive analytics analysis, Data Mining, Data Mining Methodologies, Prescriptive analytics and its step in the business analytics Process, Prescriptive Modelling, nonlinear Optimization.

UNIT-IV:
Forecasting Techniques: Qualitative and Judgmental Forecasting, Statistical Forecasting Models, Forecasting Models for Stationary Time Series, Forecasting Models for Time Series with a Linear Trend, Forecasting Time Series with Seasonality, Regression Forecasting with Casual Variables, Selecting Appropriate Forecasting Models.
Monte Carlo Simulation and Risk Analysis: Monte Carle Simulation Using Analytic Solver Platform, New-Product Development Model, Newsvendor Model, Overbooking Model, Cash Budget Model.

UNIT-V:

Decision Analysis: Formulating Decision Problems, Decision Strategies without Outcome Probabilities, Decision Trees, The Value of Information, Utility and Decision Making.

UNIT-VI:

Recent trends in Embedded and collaborative business intelligence, Visual data recovery, Data Storytelling and Data journalism.

TEXT BOOKS:

1. Business Analytics-Principles, Concepts, and Applications, Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, Pearson FT Press
2. Business Analytics, James Evans, Pearson Education
3. Business Analytics, Purba Halady Rao, PHI, 2013

REFERENCES:

1. Business Analytics for Managers: Taking Business Intelligence Beyond Reporting, Gert H. N. Laursen, Jesper Thorlund, 2nd Edition, Wiley Publications
2. Business Analytics: Data Analysis & Decision Making, S. Christian Albright, Wayne L. Winston 5th Edition, 2015
3. Business Intelligence Guidebook: From Data Integration to Analytics, Rick Sherman Elsevier, 2014

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

M.Tech. III Semester (E & I)	**L**	**T/P**	**C**
	3	**0**	**3**

(A18OE1AM01) INDUSTRIAL SAFETY

COURSE PRE-REQUISITES: Elements of Mechanical, Civil, Electrical and Industrial Engineering

COURSE OBJECTIVES:

- To achieve an understanding of principles, various functions and activities of safety management
- To communicate effectively information on Health safety and environment facilitating collaboration with experts across various disciplines so as to create and execute safe methodology in complex engineering activities
- To anticipate, recognize, and evaluate hazardous conditions and practices affecting people, property and the environment, develop and evaluate appropriate strategies designed to mitigate risk
- To develop professional and ethical attitude with awareness of current legal issues by rendering expertise to wide range of industries

COURSE OUTCOMES: After completion of the course, students should be able to

CO-1: Apply risk management principles to anticipate, identify, evaluate and control physical, chemical, biological and psychosocial hazards

CO-2: Communicate effectively on health and safety matters among the employees and with society at large

CO-3: Demonstrate the use of state-of-the-art occupational health and safety practices in controlling risks of complex engineering activities and understand their limitations

CO-4: Interpret and apply legislative / Legal requirements, industry standards, and best practices in accident prevention programmes in a variety of workplaces

UNIT-I:

Safety Management: Evaluation of modern safety concepts – Safety management functions – safety organization, safety department – safety committee, safety audit - performance measurements and motivation – employee participation in safety and productivity.

UNIT-II:

Operational Safety: Hot metal Operation – Boiler, pressure vessels – heat treatment shop - gas furnace operation-electroplating-hot bending pipes – Safety in welding and cutting. Cold-metal Operation- Safety in Machine shop-Cold bending and chamfering of pipes – metal cutting – shot blasting, grinding, painting – power press and other machines

UNIT-III:

Safety Measures: Layout design and material handling - Use of electricity – Management of toxic gases and chemicals – Industrial fires and prevention – Road safety– Safety of sewage disposal and cleaning – Control of environmental pollution – Managing emergencies in industrial hazards.

UNIT-IV:

Accident Prevention: Human side of safety – personal protective equipment – Causes and cost of accidents. Accident prevention programmes - Specific hazard control strategies - HAZOP – Training and development of employees – First Aid – Firefighting devices – Accident reporting investigation.

UNIT-V:

Safety, Health, Welfare & Laws: Safety and health standards – Industrial hygiene – occupational diseases prevention - Welfare facilities – History of legislations related to safety–

pressure vessel act- Indian boiler act- The environmental protection act – Electricity act - Explosive act.

UNIT-VI:

Safe Handling and Storage: Material Handling, Compressed Gas Cylinders, Corrosive Substances, Hydrocarbons, Waste Drums and Containers

TEXT BOOKS:

1. Safety Management, John V. Grimaldi and Rollin H. Simonds, All India Travellers Bookseller, New Delhi, 1989.
2. Safety Management in Industry, Krishnan N. V., Jaico Publishing House, 1996.

REFERENCES:

1. Occupational Safety Manual, BHEL
2. Industrial Safety and The Law, P. M. C. Nair Publisher's, Trivandrum
3. Managing Emergencies in Industries, Loss Prevention of India Ltd., Proceedings, 1999
4. Safety Security and Risk Management, U. K. Singh & J. M. Dewan, A. P. H. Publishing Company, New Delhi, 1996
5. Industrial Safety Management: Hazard Identification and Risk Control, L. M. Deshmukh, McGraw-Hill Education (India) Private Limited, 2005

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

M.Tech. III Semester (E & I)	**L**	**T/P**	**C**
	3	**0**	**3**

(A18OE1AM02) OPERATIONS RESEARCH

COURSE PRE-REQUISITES: Mathematics, Industrial Engineering

COURSE OBJECTIVES:
- To analyze linear programming models in practical and their practical use
- To apply the transportation, assignment and sequencing models and their solution methodology for solving problems
- To apply the theory of games, replacement, inventory and queuing models and their solution methodology for solving problems
- To evaluate the dynamic programming and simulation models

COURSE OUTCOMES: After completion of the course, students should be able to
CO-1: Apply and solve the dynamic programming problems
CO-2: Apply the concept of non-linear programming
CO-3: Carry out sensitivity analysis
CO-4: Model the real-world problem and simulate it

UNIT-I:
Introduction to Operations Research-Definitions of OR, Characteristics of OR, Scope of OR, Classification of Optimization Techniques, models in OR, General L.P Formulation, Graphical solution, Simplex Techniques.

UNIT-II:
Revised simplex method - duality theory - dual simplex method – sensitivity or post optimality analysis - parametric programming

UNIT-III:
Nonlinear programming problem - Kuhn-Tucker condition, min cost flow problem - max flow problem - CPM/PERT

UNIT-IV:
Scheduling and sequencing, Inventory models, deterministic inventory, models - Probabilistic inventory control models - Geometric Programming.

UNIT-V:
Waiting line Models, Single and Multi-channel Problems, Dynamic Programming, Game Theory, Simulation.

UNIT-VI:
Introduction to Genetic Algorithms, Operators, applications to engineering optimization, Problems.

TEXT BOOKS:
1. Operations Research, S. D. Sharma, Kedarnath Ramnath, Meerut, New Delhi
2. Engineering Optimization, S. S. Rao, New Age International Publications, 2014
3. Introduction to Genetic Algorithms, S. N. Sivanandam, Springer

REFERENCES:
1. Operations Research-An Introduction, H. A. Taha, PHI, 2008
2. Principles of Operations Research, H. M. Wagner, PHI, Delhi, 1982
3. Introduction to Optimization: Operations Research, J. C. Pant, Jain Brothers, Delhi, 2008

4. Operations Research, Hitler Liebermann McGraw-Hill Pub., 2009
5. Operations Research, Pannerselvam, Prentice Hall of India, 2010

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M.Tech. III Semester (E & I)	**L**	**T/P**	**C**
	3	**0**	**3**

(A18OE1AM03) COMPOSITE MATERIALS

COURSE PRE-REQUISITES: Maths, Physics, Chemistry, Engineering Mechanics, Mechanics of Solids

COURSE OBJECTIVES:
- To understand composite materials and their properties, relationship between them and manufacturing methods
- To understand the principles of material science applied to composite materials
- To study the equations to analyze problems by making good assumptions and learn systematic engineering methods to solve practical composite mechanics problems

COURSE OUTCOMES: After completion of the course, students should be able to
CO-1: Apply fundamental knowledge of mathematics to modeling and analysis of composite materials
CO-2: Understand the manufacturing methods of various composite materials
CO-3: Analyze the failure modes of composites

UNIT-I:
Introduction: Definition – Classification and characteristics of Composite materials. Advantages and application of composites. Functional requirements of reinforcement and matrix. Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.

UNIT-II:
Reinforcements: Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers. Properties and applications of whiskers, particle reinforcements.
Mechanical Behavior of Composites: Rule of mixtures, Inverse rule of mixtures. Isostrain and Isostress conditions.

UNIT-III:
Manufacturing of Metal Matrix Composites: Casting – Solid State diffusion technique, Cladding – Hot isostatic pressing. Properties and applications.
Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration – Liquid phase sintering. Manufacturing of Carbon – Carbon composites: Knitting, Braiding, Weaving. Properties and applications.

UNIT-IV:
Manufacturing of Polymer Matrix Composites: Preparation of Moulding compounds and prepregs – hand layup method – Autoclave method – Filament winding method – Compression moulding – Reaction injection moulding. Properties and applications, Introduction to Machining of Composites.

UNIT-V:
Elastic Behavior of Laminate: Basic assumptions, Strain-displacement relations, Stress-strain relation of layer within a laminate, Force and moment resultant, General load–deformation relations, Analysis of different types of laminates

UNIT-VI:
Strength: Laminar Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hygrothermal failure. Laminate first ply failure-insight

strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.

TEXT BOOKS:

1. Material Science and Technology, Vol. 13–Composites, R. W. Cahn – VCH, West Germany
2. Analysis and Performance of Fiber Composites, Third Edition, B. D. Agarwal, Wiley Publishers

REFERENCES:

1. Mechanics of Composite Materials, Second Edition. Robert M. Jones, Scripta Book Company
2. Materials Science and Engineering-An Introduction, W. D. Callister Jr., Adapted by R. Bala Subramaniam, John Wiley & Sons, NY, Indian Edition, 2007
3. Composite Materials, K. K. Chawla
4. Composite Materials Science and Applications, Deborah D. L. Chung
5. Composite Materials Design and Applications, Danial Gay, Suong V. Hoa and Stephen W. Tasi

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

M.Tech. III Semester (E & I)	**L**	**T/P**	**C**
	3	**0**	**3**

(A18OE1PS01) WASTE TO ENERGY

COURSE PRE-REQUISITES: None

COURSE OBJECTIVES:
- To create awareness in students of energy conservation
- To identify the use of different types of Bio waste energy resources
- To understand different types of bio waste energy conservations
- To detect different waste conversion into different forms of energy

COURSE OUTCOMES: After completion of the course, students should be able to
CO1: Find different types of energy from waste to produce electrical power
CO2: Estimate the use of bio waste to produce electrical energy
CO3: Understand different types of bio waste and its energy conversions
CO4: Analyze the bio waste utilization to avoid the environmental pollution

UNIT-I:
Introduction to Energy from Waste: Classification of waste as fuel, Agro based, Forest residue, Industrial waste, MSW (Municipal solid waste) – Conversion devices – Incinerators, Gasifiers, Digestors

UNIT-II:
Biomass Pyrolysis: Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods - Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.

UNIT-III:
Biomass Gasification: Gasifiers – Fixed bed system – Downdraft and updraft gasifiers – Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.

UNIT-IV:
Biomass Combustion: Biomass stoves – Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.

UNIT-V:
Biogas: Properties of biogas (Calorific value and composition) - Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion.

UNIT-VI:
Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production - Urban waste to energy conversion - Biomass energy programme in India.

TEXT BOOKS:
1. Biogas Technology-Transfer and Diffusion, M. M. EL-Halwagi, Elsevier Applied Science Publisher, New York, 1984
2. Introduction to Biomass Energy Conversions, Sergio Capareda

REFERENCES:

1. Non-Conventional Energy, Desai Ashok V., Wiley Eastern Ltd., 1990
2. Biogas Technology - A Practical Handbook, Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw-Hill Publishing Co. Ltd., 1983
3. Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991
4. Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

M.Tech. III Semester (E & I)	**L**	**T/P**	**C**
	0	**16**	**8**

(A18PW4LI03) PROJECT PART-I

M.Tech. IV Semester (E & I)	**L**	**T/P**	**C**
	0	**28**	**14**

(A18PW4LI04) PROJECT PART-II

COURSE OUTCOMES: After completion of the course, students should be able to
CO-1: Identify and formulate the problem (Industry/technical/societal)
CO-2: Analyze, design and develop a solution to industry/technical/societal problems
CO-3: Implement and execute the solution
CO-4: Demonstrate effective communication skills through oral presentation
CO-5: Engage in effective written communication through project report

COURSE OUTLINE:

- M.Tech. project work shall be for a minimum duration of 40 weeks spread over two semesters i.e., Project Part-I in III semester and Project Part-II in IV semester.
- A student shall be permitted to register for the major project after satisfying the attendance requirement in all the courses, i.e., theory and practical courses.
- Project reviews namely Project Review I and Project Review II in III semester and Project Review III and Project Pre-submission Seminar in IV semester shall be conducted during the course of Project work.
- A Project Review Committee (PRC) consisting of the Head of the Department as Chairperson and PG Coordinator, Project Supervisor and one senior faculty member of the Department offering the M. Tech. programme as members shall evaluate the progress of project work.
- In Project Review I, a student, in consultation with his Project Supervisor, shall present the title, objective and plan of action of his/her project work to the PRC for approval within four weeks from the commencement of III semester.
- A student can initiate the project work only after obtaining the approval of the PRC.
- The work on the project shall be initiated at the beginning of the III semester.
- Project Review II shall be conducted and evaluated at the end of the III semester.
- Project Review III shall be conducted during IV semester to examine the overall progress of the project work.
- A project pre-submission seminar shall be conducted to decide whether or not the project is eligible for final submission.
- After approval from the PRC, a soft copy of the thesis shall be submitted for PLAGIARISM check to the Examination Branch.
- At the end of IV semester upon fulfilling the above conditions, project viva-voce shall be conducted.
- A student shall submit project progress in prescribed report format during each of the project reviews.