Bansilal Ramnath Agarwal Charitable Trust's

Vishwakarma Institute of Technology

(*An Autonomous Institute affiliated to Savitribai Phule Pune University*)

Structure & Syllabus of

B.Tech. (Instrumentation and Control Engineering)

Pattern 'C-19'
Effective from Academic Year 2019-20
(T.Y. B.Tech.)

Prepared by: - Board of Studies in Instrumentation & Control Engineering

Approved by: - Academic Board, Vishwakarma Institute of Technology, Pune

Signed by

Chairman – BOS **Chairman – Academic Board**

Content

Vision statement of Institute

To be globally acclaimed Institute in Technical Education and Research for holistic Socio-economic development

Mission statement of Institute

- To endure that 100% students are employable in Industry, Higher studies, Become Entrepreneurs, Civil/Defense Services / Government Jobs and other areas like Sports and Theatre.
- To strengthen Academic Practices in terms of Curriculum, Pedagogy, Assessment and Faculty Competence.
- Promote Research Culture amongst Students and Faculty through Projects and Consultancy.
- To make students Socially Responsible Citizen.

Core Values

- Faculty Centric Initiatives
- Academic Practices
- Research Culture
- Use of Technology for Social and National Development

Vision statement of Department

To be recognized as leading contributor in imparting technical education and research in Instrumentation & Control engineering for development of the society.

Mission statement of Department

- To deliver knowledge of Instrumentation and Control Engineering by strengthening involvement of Research institutions and industries in academics
- To build conducive environment for advanced learning through participation of faculty and students in collaborative research, consultancy projects, student exchange programs and internships
- To develop competent Engineers with entrepreneurial skills to address socio-economic needs.

Program Educational Objectives (PEO)

Programme: B. Tech. (Instrumentation and Control Engineering)

The Graduates would demonstrate

1. Core competency in Instrumentation and Control Engineering to cater to the industry and research needs.
2. Multi-disciplinary skills, team spirit and leadership qualities with professional ethics, to excel in professional career and/or higher studies.
3. Preparedness to learn and apply contemporary technologies for addressing impending challenges for the benefit of organization/society.
4. Knowledge of recommended standards and practices to design and implement automation solutions.

Program Outcomes

Engineering Graduates will be able to:

1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems**: Use research –based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and teamwork**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes (PSOs)

Graduates shall have the ability to:

1. Evaluate the performance of suitable sensors / Process components/ Electronic / Electrical components for building complete automation system.
2. Analyze real-world engineering problems in the area of Instrumentation and Control.
3. Design or Develop measurement / electronic / embedded and control system with computational algorithms to provide practical solutions to multidisciplinary engineering problems.

Vishwakarma Institute of Technology Issue 01 : Rev No. 1 : Dt. 01/07/18
Title : Course Structure FF No. 653

T.Y. B.Tech - Instrumentation and Control Engineering Structure Pattern C-19
with effect from Academic Year 2019-20 Semester –I

Course Code	Course Type	Course Name	Teaching Learning Scheme					Assessment Scheme (100 mark scale)					
								Continuous Assessment				MSE	ESE
			Th	Lab	Tut	Hrs./ Week	Credits	Assignments (10%)	Lab (30%)	GD/PPT (10%)	Viva (20%)	-50 marks converted to 15	-50 marks converted to 15
IC3001	S1-CE1	Process Control Components	3	2		5	4	10	30	10	20	15	15
IC3021		Image Processing and Pattern Recognition											
IC3008	S2-CE2	Electronic Instrumentation	3	2		5	4	10	30	10	20	15	15
IC3023		Machine Learning											
IC3009	S3-SE1	Analytical and Biomedical Instrumentation	3	2		5	4	10	30	10	20	15	15
IC3025		Introduction to Algorithms											
IC3007	S4-SE2	Process Control and Optimization	3	2		5	4	10	30	10	20	15	15
IC3027		Operating Systems											
IC3041	S5-EDI1	Engineering Design and Innovation 1	1	6		7	4		20			30	50
		Total	**13**	**14**		**27**	**20**						

Vishwakarma Institute of Technology Issue 01 : Rev No. 1 : Dt. 01/07/18
Title : Course Structure FF No. 653

T.Y. B.Tech - Instrumentation and Control Engineering Structure Pattern C-19
with effect from Academic Year 2019-20 Semester –II

Course Code	Course Type	Course Name	Teaching Learning Scheme					Assessment Scheme (100 mark scale)					
								Continuous Assessment				MSE	ESE
			Th	Lab	Tut	Hrs./ Week	Credits	Assignments (10%)	Lab (30%)	GD/PPT (10%)	Viva (20%)	-50 marks converted to 15	-50 marks converted to 15
IC3002	S1-CE3	Instrumentation Project Engineering	3	2		5	4	10	30	10	20	15	15
IC3022		Artificial Intelligence											
IC3004	S2-CE4	Process Instrumentation and Control	3	2		5	4	10	30	10	20	15	15
IC3024		Machine Vision and Robotics											
IC3018	S3-SE3	Digital Control	3	2		5	4	10	30	10	20	15	15
IC3026		Big Data Analytics											
IC3010	S4-SE4	Internet of Things	3	2		5	4	10	30	10	20	15	15
IC3042	S5-EDI2	Engineering Design and Innovation 2	1	6		7	4		20			30	50
IC3032	S6-GP3	General Proficiency 3											
		Total	**13**	**14**		**27**	**20**						

SEMESTER I

FF No. : 654

IC3001 :: PROCESS CONTROL COMPONENTS

Credits: 04 **Teaching Scheme:** Theory: 3 Hours/Week
Lab : 2 Hours/Week

Section 1 : [IC3001_CO1, IC3001_CO2, IC3001_CO3, IC3001_CO4]

Fundamentals of process control

Elements of process control loop: Concept of process variables, set point, controlled variable, manipulated variable, load variable. Representation of process loop components using standard symbols (basics with reference to control loop), P & ID for process loops like temperature, flow, level, pressure, etc.

Process Characteristics: Process equation, capacity, self – regulation, interacting types of disturbances, plant lags like measurement lag, control lag, process lag, distance/velocity lag (dead time) and transfer lag.

Transmitters and Convertors

Introduction: Need of transmitter (concept of field area and control room area), need for standardization of signals, current, voltage, and pressure signal standards, concept of live and dead zero.

Types of transmitters: Two and four wire transmitters, electronic and pneumatic transmitters, Transmitter circuits

Electronic Differential Pressure Transmitter: Types, installation, calibration setup, application of DPT for level and flow measurement, zero elevation and suppression,

SMART: Comparison with conventional transmitter, block schematic, Specifications of DPT and Smart transmitter

Converters: Difference between converter and transmitter, current to pressure converter, pressure to current converter

Control Actions

Discontinuous: Two position, time-proportional control modes

Continuous: Proportional, integral, derivative, proportional-integral, proportional- derivative, proportional- integral-derivative (PID) control modes.

Reset windup, rate before reset, bumpless transfer, effect of process characteristics on PID combination, tuning of controller.

Digital PID controllers: Block schematic, faceplate of Digital controller.

Section 2: [IC3001_CO3, IC3001_CO4, IC3001_CO5, IC3001_CO6]

Control Valves

Necessity and comparison with other final control elements.

Control valve terminology: rangeability, turndown, valve capacity, distortion coeff., AO, AC, fail-safe conditions, cavitation, flashing and noise, their effects and remedies.

Control valve characteristics: inherent and installed.

Control valve classification, their construction, advantages, disadvantages and applications of globe, 3-way, diaphragm, rotary, ball, butterfly.

Designing control valve for gas, vapor and liquid services: valve sizing by ANSI/ISA 75.01 std., high temperature-pressure service valves.

Control valve accessories and Actuators

Control valve accessories: Need of accessories, volume boosters, pressure boosters, solenoid valves, air lock, limit switches, hand wheel. positioners: Need, applications, types, effect on performance of control valve.

Actuators: Types, construction, advantages, disadvantages and applications of spring and diaphragm, piston cylinder (power cylinder), pneumatic, hydraulic, electric, electro-hydraulic and smart actuators. Design of spring and diaphragm actuators.

Auxiliary process components

Auxiliary process components like Square root extractor, seals and snubbers, flow totalizer, High/low selectors, Alarm annunciator, Feeders, dampers, hazardous area classification, Intrinsic safety and components.

List of Practicals Students should perform at least 12 practicals from given list.

1. Study and calibration of current to pressure converter.
2. Study and calibration of pressure to current converter.
3. Calibrate and plot the characteristics of square root extractor.
4. Demonstration and study of alarm annunciator.
5. Study of analog two–wire RTD and Thermocouple temperature transmitter.
6. Calibration and characterization of intelligent temperature transmitter.
7. Study of smart D.P. transmitter and calibrate it using hand-held configurator for level.
8. Study and calibration of Flow Totalizer.
9. Study of Two-position control mode for temperature control loop.
10. Tuning of PID controller for temperature/pressure control loop.
11. Tuning of PID controller for level/flow control loop.
12. Study of control valve cut section, accessories, actuators and various types of valves
13. Plot installed characteristics of control valve.
14. Design of intrinsic safety circuit.

List of Project areas

1. Process Characteristics
2. P & ID using ISA S 5.1
3. Transmitters and Convertors
4. PID Controller
5. Alarm Annunciator
6. Control Valve Applications
7. Hazardous Area and Intrinsic Safety

Text Books

1. C. D. Johnson, “Process control and Instrument technology”, Tata McGraw Hill Publications.
2. N.A. Anderson, Boca Ratan, “Instrumentation for Process measurement and control”, Radnor Pennsylvania, CRC Press.

Reference Books

1. B. G. Liptak, "Process Control", Instrument Engineering Hand book CRC Press.
2. "Tuning of industrial control systems", ISA.
3. "Control valve Handbook", ISA.

Course Outcomes

The student will be able to:

1. IC3001_CO1: Comprehend the fundamentals of process control loop. [1] (PO-1, 2,3 PSO-1,3)
2. IC3001_CO2: Develop and represent process control loops using standard ISA S5.1. [5] (PO-3, PSO-1,2)
3. IC3001_CO3: Explain the working of major process loop components. [2] (PO-1, 2,3 PSO-1,3)
4. IC3001_CO4: Identify, formulate and solve a problem using control actions. [3] (PO-1, 2,3,4, PSO-1,2,3)
5. IC3001_CO5: Select and size the control valve and actuators to solve a problem. [5] (PO-1, 2,3, PSO-1,3)
6. IC3001_CO6: Demonstrate the working of auxiliary process loop components. [4] (PO-1, 2,3 PSO-1,3)

FF No. : 654

IC3021 :: IMAGE PROCESSING AND PATTERN RECOGNITION

Credits: 04 **Teaching Scheme:** Theory: 3 Hours/Week
Lab : 2 Hours/Week

Section 1 [IC3021_CO1, IC3021_CO2, IC3021_CO3, IC3021_CO4]

Image Processing: Intensity transformations, contrast stretching, histogram equalization, Correlation and convolution, Smoothing filters, sharpening filters, gradient and Laplacian. Fourier Transforms and properties, Convolution, Correlation, 2-D sampling, Discrete Cosine Transform, Frequency domain filtering. **Image Segmentation:** Boundary detection based techniques, Point, line detection, Edge detection, Edge linking, local processing, regional processing, Hough transform, Thresholding, Iterative thresholding, Otsu's method, Moving averages, Multivariable thresholding, Region-based segmentation. **Image Analysis**: 2D discrete transforms. Wavelets and multiresolution processing. Image compression:, error-free compression, lossy compression. Introduction to Image restoration and reconstruction.

Section 2 [IC3021_CO5, IC3021_CO6]

Introduction and mathematical preliminaries: What is Pattern recognition; representations of Patterns and Classes; Applications and Examples; Clustering vs. Classification; supervised vs. unsupervised; Basics of Estimation theory; Decision Boundaries, Decision region / Metric spaces/ distances. **Classification:** Normal Distribution; Bayes decision rule, Error probability; Linear Discriminant Function (equal covariance matrices); Non-linear Decision Boundaries (unequal covariance matrices); Mahalanobis Distance; K-NN Classifier; Fisher's LDA; Single Layer Perceptron; Multi-layer Perceptron; Training set, test set;. Literature survey on selected classifiers. **Feature Extraction and selection**: Feature Extraction by PCA, Kernel PCA. Feature selection: Problem statement and Uses, **Recent advances in Pattern Recognition:** Structural PR, SVMs, FCM, Soft-computing and Neuro-fuzzy techniques, and real-life examples

List of Practicals

1. Demonstrate and analyse the image enhancement using Log operator and histogram
2. Compute and verify the Fourier transform of image consisting of various geometrical objects/shapes
3. Demonstrate the effect of down-sampling on image quality using Fourier transform
4. Compute and analysis the wavelet transform of image
5. Compute the gradient matrix of image and analyse the same
6. Demonstrate the effect of translation , rotation and scale on image using Fourier transform
7. Demonstrate and analyse the use of L2 norm as classifier for image having pixels of two distinct class
8. Demonstrate and analyse the use of polynomial classifier for image consisting of various gray levels
9. Compute the Principle components of image and analyse how it could use for compression
10. Demonstrate the use of Bays rule for image classification

11. Design a algorithm for classification of object.
12. Design a algorithm for object colour base classification

List of Project areas

1. Machine intelligence applications
2. Pattern recognition applications in object recognition.
3. Image processing in character recognition/biometrics etc.

Text Books

1. R. C. Gonzalez, R. E. Woods. Digital Image Processing. Addison Wesley Longman, Inc., 1992.
2. A. K. Jain. Fundamentals of Digital Image Processing. Prentice-Hall, 1989.

Reference Books

1. R. M. Haralick, L. G. Shapiro. Computer and Robot Vision. Addison-Wesley, 1993.
   A. Rosenfeld, A. C. Kak, Digital Picture Processing. Addison-Wesley, 1983
2. C. R. Giardina, E. R. Dougherty. Morphological Methods in Image and Signal 4. Processing. Prentice-Hall, Englewood Cliffs, New Jersey, 1988.
3. R. J. Schalkoff. Digital Image Processing and Computer Vision. John Wiley & Sons, Singapore, 1989.
4. W. K. Pratt. Digital Image Processing (Second Edition). John Wiley & Sons, New York, 1991.
5. D. H. Ballard, C. M. Brown. Computer Vision. Prentice-Hall, Englewood Cliffs, 1982.
6. G. C. Stockman, L. G. Shapiro. Computer Vision. Prentice-Hall, 2001.
7. O. Faugeras. Three-Dimensional Computer Vision: A Geometric Viewpoint. MIT Press.
8. R. Kasturi, R. C. Jain. Computer Vision: Principles. IEEE Computer Society Press Tutorial, 1991.
9. A. K. Jain, R. C. Dubes. Algorithms For Clustering Data. Prentice-Hall, 1988.
10. R. Gose, R. Johnsonbaugh, S. Jost. Pattern Recognition and Image Analysis. Prentice-Hall, 1996.

Course Outcomes

The student will be able to –

1. IC3021_CO1: Review the fundamental concepts of a digital image processing system. [3] (PO1,3,4,5, PSO2)
2. IC3021_CO2: Analyze images in the frequency domain using various transforms. [3] (PO1,3,5, PSO2)
3. IC3021_CO3: Evaluate the techniques for image enhancement and image restoration. [3] (PO1,2,4,5, PSO2,3)
4. IC3021_CO4: Interpret image segmentation and representation techniques. [4] (PO1,3,4, PSO2)
5. IC3021_CO5: Able to understand and evaluate various classifiers [4] (PO1,2,3,4, PSO2,3)
6. IC3021_CO6: Able to build a pattern recognition system [5] (PO1,2,3,4,5, PSO3)

FF No. : 654

IC3008 :: ELECTRONIC INSTRUMENTATION

Credits: 04 **Teaching Scheme:** Theory: 3 Hours/Week
Lab : 2 Hours/Week

Section 1 : [IC3008_CO1, IC3008_CO2, IC3008_CO3]
Introduction to moving coil and moving iron instrument for measurement for AC voltage, static and dynamic characteristics of analog instruments, Operation, specifications and application of various types of digital instruments for measurement of electrical parameters and testing electronic components. Measurement techniques for electronic components, Operation, specifications and application of various types of electronic instruments

Section 2 : [IC3008_CO4, IC3008_CO5, IC3008_CO6]
Various types of interference and noises, Electromagnetic (EMI/EMC) interference measurement techniques, electrostatic discharge: effect and remedial measures, Guidelines and techniques for PCB design in relation to interference and noises, Various types of instrument testing: environmental and mechanical testing, Reliability and redundancy study and techniques for higher reliability design, Introduction to automatic test equipments (ATE) and various type of Computer based testing

List of Practicals

1. Measurement of input impedance and frequency response of a DMM
2. Measurements of electrical parameters using analog oscilloscope
3. Demonstration of operation and various features of a digital storage oscilloscope
4. Distortion measurement using a distortion meter
5. Measurement of signal parameters using a universal counter.
6. Testing of electronic components using electronic instruments
7. Extension of an analog voltmeter range
8. Extension of an analog ammeter range
9. Design of a printed circuit board
10. Testing of insulation using an insulation tester
11. Testing the effect of temperature on electronic components.
12. Study of automatic test equipments.

List of Project areas

1. Measurement system design
2. Testing instrument design
3. Agriculture instrumentation
4. Signal and waveform generation.
5. Testing and reliability engineering
6. Electrical parameter measurement.

Text Books

1. A. K. Sawhney, "Electrical and Electronic Measurements and Instrumentation", Dhanpat Rai and Sons Publications, 2002.
2. " Automtic test equipment" ,Keith brindley, Elsevier publication, 1991, ISBN 9781483101156
3. "Reliability engineering", by Balguruswamy, TMH, volume 6, 2008
4. "Electronic instrument", by MMS Anand, PHI publication
5. "Digital instrumentation" by Bowens

Reference Books

1. W. D. Cooper & A. D. Helfrick, 'Electronic Instrumentation and Measurement Techniques', PHI, 4th e/d, 1987.

Course Outcomes

The student will be able to –

1. IC3008_CO1: Understand working of electrical parameter measurement circuit. [1] (PO- 1, 2, 3 PSO-1)
2. IC3008_CO2: Use of proper measurement systems device for any application.[2] (PO- 1, 2, 3 PSO-1,2)
3. IC3008_CO3: Apply electronic instruments like DSO, Counters, Distortion meter, Spectrum Analyzer for testing the instruments [2] (PO- 1, 2, 3,4,5 PSO-1,2)
4. IC3008_CO4: Understand the error in instrumentation systems associated with noise and effective noise minimization technique [3] (PO- 1, 2, 3 PSO-1,2)
5. IC3008_CO5: Understand the basic concepts of systems reliability [5] (PO- 1, 2, 3 PSO-1)
6. IC3008_CO6: Infer different automatic component testing method [4] (PO- 1, 2, 3,4,5 PSO-1,2)

FF No. : 654

IC3023:: MACHINE LEARNING

Credits: 04 **Teaching Scheme:** Theory: 3 Hours/Week
Lab : 2 Hours/Week

Section 1 [IC3023_CO1, IC3023_CO2, IC3023_CO5, IC3023_CO6]
Linear Regression with One Variable: Concept of Linear regression, application of linear regression, cost function, introduction to the gradient descent method for learning.
Linear Regression with multiple Variables: Gradient Descent algorithm for Multiple Variables, Feature Scaling, Learning Rate, Features and Polynomial Regression, Normal Equation. Normal Equation Non-invertibility
Logistic Regression: Classification, Hypothesis Representation, Decision Boundary, Cost Function, Simplified Cost Function and Gradient Descent,

Section 2 [IC3023_CO3, IC3023_CO4, IC3023_CO5, IC3023_CO6]
Regularization: The Problem of Over fitting, Cost Function, Regularized Linear Regression, Neural Networks representation and learning: Introduction to Neural networks, architecture, applications of Neural networks, Learning, back propagation algorithm, learn parameters for a neural network, implementation.
Support Vector Machines: Support vector machines learning algorithm for classification, Optimization Objective, Large Margin Intuition, applications of Support vector machines, implementation.

List of Practicals Students should perform at least 12 practicals from given list.
1. Evaluate a linear regression on a random data set with single regression
2. Evaluate a linear regression on a random data set with multiple regression
3. Implement Polynomial regression for given application
4. Implement logistic regression for given application
5. Validation of gradient descent algorithm
6. Evaluate the effect of changing the decision boundary for logistic regression
7. Back propagation algorithm for data classification
8. Develop algorithm for data classification
9. Implement feedforward network in NN for given application
10. Implement back propagation algorithm in NN for given application
11. Application of neural networks to classification
12. Neural net for nonlinear process control application.
13. Analysis of SVM for OCR
14. Application of SVM for classification

List of Project areas
1. Videos Surveillance
2. Social Media Services
3. Online Customer Support

4. Email Spam and Malware Filtering
5. Medical Diagnosis

Text Books

1. S. Rogers and M. Girolami, A First Course in Machine Learning, 2nd edition, Chapman & Hall/CRC 2016, ISBN: 9781498738484.
2. K. Murphy, "Machine Learning: A Probabilistic Perspective" MIT Press 2012.
3. D. Barber, Bayesian Reasoning and Machine Learning Cambridge University Press 2012.
4. C. Bishop, Pattern Recognition and Machine Learning, Springer 2011.
5. R. Duda, P. Hart, D. Stork, Pattern Recognition (2nd Edition) Wiley 2000.
6. Goodfellow, Bengio and Courville, "Deep learning". Available for free on the web. In print from MIT press on Amazon.

Course Outcomes:

The student will be able to

1. Understand the basic theory underlying machine learning [4] (PO-1,2,12,PSO-1)
2. Apply the concept of regression [3] (PO-1,2,3,4,10,12,PSO-1,2)
3. Understand regularization theory and its application [4] (PO-1,2,3,5,12,PSO-1)
4. Comprehend a wide variety of learning algorithms [3] (PO-1,2,3,4,10,12,PSO-1,2)
5. Apply ML algorithms for classification [4] (PO-1,2,3,10,12,PSO-3)
6. Be able to formulate machine learning problems corresponding to different applications [3] (PO-1,2,3,4,12,PSO-1,2)

FF No. : 654

IC3009 :: ANALYTICAL AND BIOMEDICAL INSTRUMENTATION

Credits: 04 **Teaching Scheme:** Theory: 3 Hours/Week
Lab : 2 Hours/Week

Section 1: Biomedical Instrumentation : [IC3009_CO1, IC3009_CO2, IC3009_CO3]

Bioelectric signal generation, Human physiology, Importance of Biomedical Instrumentation, Electrode theory and types, Sensors and electronics for Biological parameter measurement

Cardiovascular system and related instruments: design approach, issues and advancements, Electrocardiograph, Phonocardiograph, blood flow measurement, blood volume measurement, Cardiac Pacemakers, Defibrillators, Heart Lung Machine

Nervous system and related instruments: design approach, issues and advancements, Electroencephalograph, Evoked response

Respiratory system: design approach, issues and advancements, Spirometry and Respiratory gas analyzers

Clinical Lab Instrumentation: Blood components and its functioning, Blood cell counter

Instrumentation involved in Bio Image modalities Xray ,CT, MRI, Ultrasound

Section 2: Analytical Instrumentation: [IC3009_CO4, IC3009_CO5, IC3009_CO6]

Importance of Analytical Instruments and its basics , Instrument classification, Laws of photometry, Laws of photometry (Beer and Lambrt's Law), Introduction to Electro analytical methods, Electromagnetic spectrum and different Optical sources with their characteristic, Different types of Optical detectors, Filters, Gratings, Prisms, Infrared sources, semiconductor laser, photo multipliers, Solar cells, UV and VIS instruments: Colorimeters, spectrophotometers, monochromatic systems, IR spectrophotometers, Flame photometry, Gas Analyzers, Chromatograph, Gas analyzers for measurement of Oxygen, NO2, carbon dioxide and Vehicle exhaust emission gas analyzer

Application based analytical sensors and instruments: working and design aspect.

List of Practicals

1. Automation of blood pressure measurement.
2. Design of 50Hz Notch filter for rejection supply noise interference.
3. Design of ECG amplifier.
4. Develop an EEG Amplifier circuit.
5. Design 1 mV calibration pulse for ECG system calibration.
6. ECG analysis by using DFT.
7. Implementation of FFT algorithm for bio-signal analysis
8. Sample analysis using Colorimeter.
9. Sample analysis using UV spectrophotometer.
10. Sample analysis using flame photometer.
11. Determination of COD from waste water
12. Visit to analytical lab.

List of Project areas

1. Design of Body temperature measurement system
2. Design of basic colorimeter

Text Books

1. Carr & Brown, "Biomedical Instrumentation & Measurement" Pearson Publications.
2. Leslie Cromwell, Fred J. Weibell, Erich A. Pfeiffer, "Biomedical Instrumentation and Measurement", Prentice-Hall India.
3. R.S. Khandpur, "Handbook of Biomedical Instrumentation", Tata McGraw Hill
4. R. S. Khandpur, "Handbook of Analytical Instruments", Tata McGraw–Hill Publications, Second ed., 2006.
5. Willard, Merritt, John Aurie Dean, "Instrumental Methods of Analysis", CBS Publishers; Distributors, New Delhi, Seventh ed., 1988.

Reference Books

1. John G. Webster, "Medical Instrumentation application and design", Wiley Publications.
2. Sanjay Guha, "Medical Electronics and Instrumentation", University Publications.
3. S. C. Richard Cobbold, "Transducers for Biomedical measurements", Krieger
4. Bela G Liptak, "Analytical Instrumentation Handbook", Chilton, Second ed., 1994.

Course Outcomes

The student will be able to –

1. IC3009_CO1: Employ different biomedical sensors and equipments for Cardiovascular system [2] (PO-1,2,3,4,5 PSO-1,2,3)
2. IC3009_CO2: Apply different biomedical sensors and equipments for Nervous system [3] (PO-1, 2, 3, 4, 5 PSO-1,2)
3. IC3009_CO3: Append different biomedical sensors, equipments for respiratory and to execratory and pathological Systems [4] (PO-1, 2, 3, 4,5 PSO-1,2,3)
4. IC3009_CO4: Understand various components in analytical instruments [2] (PO-1, 2, 3, 4, 5 PSO-1,2,3)
5. IC3009_CO5: Comprehend. various methods for analyzing material composition [3] (PO-1, 2, 3, 4, 5 PSO-1,2,3)
6. IC3009_CO6: Apply of various sensing methods for different application [4] (PO-1, 2, 3, 4, 5 PSO-1,2,3)

FF No. : 654

IC3025:: INTRODUCTION TO ALGORITHMS

Credits: 04 **Teaching Scheme:** Theory: 3 Hours/Week
Lab : 2 Hours/Week

Section 1 [IC3025_CO1, IC3025_CO2, IC3025_CO3]
Basic introduction, time complexity analysis, Divide and Conquer Asymptotic notations (Big Oh, small oh, Big Omega, Theta notations). Best case, average case, and worst case time and space complexity of algorithms. Adversary lower bounds Using Recurrence relations and Mathematical Induction to get asymptotic bounds on time complexity. Master's theorem and applications. Proving correctness of algorithms. Divide and Conquer: Analyzing Quick sort, Randomized Quick sort, Merge sort, Counting Inversions, Finding majority element, Finding Median, Efficient algorithms for Integer arithmetic

Section 2 [IC3025_CO4, IC3025_CO5, IC3025_CO6]
Analysis and Optimization of Uninformed Search algorithms
Formulation of real world problems, Breadth First Search, Depth First Search, Depth Limited Search, Iterative Deepening Depth First Search, Bidirectional Search, Comparison of Uninformed search Strategies, Searching with partial information, Sensorless problems, Contingency problems
Analysis and Optimization of Informed Search algorithms
complexity analysis of algorithms: Generate & test, Hill Climbing, Best First Search, A* and AO* Algorithm, Constraint satisfaction, Game playing: Minimax Search, Alpha-Beta Cutoffs, Waiting for Quiescence,
Greedy Analysis and correctness proof of minimum spanning tree and shortest path algorithms, Huffman coding, conflict free scheduling, fractional knapsack.

List of Practicals : Students should perform at least 12 practicals from given list. Students are expected to write C program on following applications

1. Quick Sort
2. Insertion sort
3. Median Finding
4. Recurrence Relation
5. Closest pair of points
6. All pair shortest path
7. DFS
8. BFS
9. Informed search techniques
10. Best first search
11. Viterbi Algorithm
12. Huffman Coding
13. Ford Fulkerson Algorithm
14. Augmenting Path algorithm for maximum matching

List of Project areas

1. Application of Network Flows in image segmentation
2. Approximation algorithm for metric TSP
3. Hill climbing technique
4. Game playing
5. Chessboard problem
6. AO* problem

Text Books

1. Cormen, Leiserson, Rivest and Stein "Introduction to Algorithm" ,PHI 3nd edition, 2009. ISBN 81-203- 2141-3
2. Jon Kleinberg, Eva Tardos "Algorithm Design", Pearson, 1st edition, 2005. ISBN 978-81-317-0310-6 Reference Books:
3. Bressard, Bratley "Fundamentals of Algorithmics." ,PHI, 2nd Edition, 1996, ISBN 81-203-1131-0
4. Horowitz, Sahani, "Fundamentals of computer Algorithms", Galgotia. 2nd Edition, 1998.ISBN 81-7515- 257-5

Course Outcomes:

Upon completion of the course the student will be able to –

1. IC3025_CO1: Formulate computational problems in abstract and mathematically precise manner. [2] (PO-1,2,3,4,5 PSO-1,2,3)
2. IC3025_CO2: Design efficient algorithms for computational problems using appropriate algorithmic paradigm. [5](PO-1,2,3,4,5 PSO-1,2,3)
3. IC3025_CO3: Analyze asymptotic complexity of the algorithm for a complex computational problem using suitable mathematical techniques. [2](PO-1,2,3,4,5 PSO-1,2,3)
4. IC3025_CO4: Formulate computational problem as linear program and apply LP, network flow, based techniques to design efficient algorithms for them.[3] (PO-1,2,3,4,5 PSO-1,2,3)
5. IC3025_CO5: Establish NPcompleteness of some decision problems, grasp the significance of the notion of NPcompleteness and its relation with intractability of the decision problems and design efficient approximation algorithms for standard NPoptimization problems.[4] (PO-1,2,3,4,5 PSO-1,2,3)
6. IC3025_CO6: Incorporate appropriate data structures, algorithmic paradigms to craft innovative scientific solution for a complex computing problems.[5] (PO-1,2,3,4,5 PSO-1,2,3)

FF No. : 654

IC3007 :: PROCESS CONTROL AND OPTIMIZATION

Credits: 04 **Teaching Scheme:** Theory: 3 Hours/Week
Lab : 2 Hours/Week

Section 1 : [IC3007_CO1, IC3007_CO2, IC3007_CO3]
Introduction to process optimization, Basic concepts of optimization, Optimization of unconstrained functions: One dimensional search, Unconstrained multivariable optimization, Linear programming and applications, Nonlinear programming with constraints

Section 2 : [IC3007_CO4, IC3007_CO5, IC3007_CO6]
Standards and control system of Batch Process
Batch control system terminology, characteristics of batch processes, hierarchical batch model, control structure for batch systems
Standards for Batch Process: Role of standards in batch control systems, study of International Standards and Practices such as S 88, S 95, USA FDA regulation, 21CFR 11 etc.
Control of batch Process: General control requirements, safety interlocking, regulatory & discrete controls, sequential control of batch processes, control activities and process management, information handling for a batch process.
Design of batch control systems: Batch management, recipe management, production scheduling & information management. Batch control system design, system requirements, system hardware/reliability requirement

List of Practicals
1. Formulation of a optimization problem
2. Optimization of a Manufacturing problem
3. Minimization of a function using MATLAB programming
4. Examining the properties and constraints for a function for analyzing the optimization problem using MATLAB
5. Minimization of quadratic function using Quasi Netwon
6. Optimizationing recovery of waste heat
7. Optimization of Evaporator design
8. Study of S-88 Standard.
9. Designing of control variables for a given batch process
10. Development of a P&ID for given batch process
11. Case study for food processing plant
12. Case study for paint manufacturing plant

List of Project areas

1. Heat Transfer and Energy Conservation
2. Fluid Flow System
3. Chemical Reactor Design and Operation
4. Integrated Planning, Scheduling, and Control in the Process Industries

Text Books

1. Optimization of chemical processes by T F Edgar and DM Himmelblau, L Ladson, McGRaw Hill, ISBN 0-07-118977-7.
2. Optimization: Theory and Practice by MC Joshi and K M Moudgalya, Narosa Publishing
3. Singiresu S. Rao, Engineering Optimization Theory and Practice, Willy

Reference Books

1. B. Roffel, B. H. L. Betlem ,"Advanced Practical Process Control", Springer.
2. B. S. Grewal, "Higher Engineering Mathematics", Khanna Publications.
3. J. Malley, "Practical Process Instrumentation and Control", McGraw Hill
4. Arun K. Tangirala, Principles of System Identification: Theory and Practice, CRC Press

Course Outcomes

The student will be able to –

1. IC3007_CO1: Develop theoretical models of physical and chemical processes. [2] (PO-1, 2,3, 12, PSO-1)
2. IC3007_CO2: Develop experimental models of physical and chemical processes. [4] (PO-1, 2, 3, 12, PSO-1,3).
3. IC3007_CO3: Select and use numerical methods for solving algebraic and differential equations. [5] (PO-1, 2, 4, 12, PSO-1)
4. IC3007_CO4: Understand the fundamentals of batch process [1] (PO-1, 11,12 PSO-1,2)
5. IC3007_CO5: Understand the role of standards for batch process [2] (PO-1,11,12 PSO-1,2)
6. IC3007_CO6: Comprehend the control and management aspects of batch processes [3] (PO- 1,2,3,4,5 PSO-1,2,3)

FF No. : 654

IC3027 :: OPERATING SYSTEMS

Credits: 04 **Teaching Scheme:** Theory: 3 Hours/Week
Lab : 2 Hours/Week

Section 1 [IC3027_CO2, IC3027_CO3, IC3027_CO5, IC3027_CO6]
Introduction to operating systems, Computer System Structures, Operating System structures. Process: concept, scheduling, operations on Process, Interprocess communication, Threads: Overview, multithreading models, threading issues, CPU scheduling, Deadlocks: characterization, handling, Prevention. Memory management: Swapping, contiguous memory allocation, paging, segmentation, segmentation with paging. Virtual memory: Demand paging, page replacement, allocation of frames, thrashing. File System Interface: File concept, access methods, directory structure, file system mounting and sharing File System Implementation: file system structure, implementation, directory implementation, allocation methods, free space management, recovery, NFS

Section 2 [IC3027_CO1, IC3027_CO4, IC3027_CO5, IC3027_CO6]
I/O systems: overview, I/O hardware, Application I/O interface, kernel I/O subsystems, transforming I/O to hardware operations. Mass Storage structure: disk structure, disk scheduling, disk management, swap space management Protection: goals and domain of protection, access matrix, implementation of access matrix, revocation of access rights, capability based systems, language based protection Security: security problem, user authentication, program threats, systems threats, securing systems and facilities, intrusion detection, cryptography, computer security classification.
Introduction to RTOS, Embedded Linux

List of Practicals Students should perform at least 12 practicals from given list.

1. CPU scheduling algorithms FCFS, SJF, RR
2. Pipe processing using IPC
3. C program for process system call and I/O system call
4. Implement algorithm to avoid deadlock .
5. Memory management technique MVT and MFT
6. Contiguous memory allocation techniques a) Worst-fit b) Best-fit c) First-fit
7. Page replacement algorithm FIFO
8. Page replacement algorithm LRU
9. File allocation: Sequential, Indexed ,linked file
10. Write a C program to simulate producer-consumer problem using semaphores
11. POSIX standard for RTOS scheduling
12. Disk scheduling algorithm FCFS, SSTF
13. freeRTOS LCD/LED interface with LPC 2148

List of Project areas

1. Compiling of Embedded Linux – Kernel creation
2. Development of MicroOS
3. System protection and security
4. Mobile OS

Text Books

1. Silberschatz A., Galvin P., Gagne G.; "Operating System Concepts", 9th Edition, John Wiley and Sons.

Reference Books

1. Stalling William; "Operating Systems", 6th Edition, Pearson Education.
2. Achyut S. Godbole , Atul Kahate; "Operating Systems", 3rd Edition, McGraw Hill.

Course Outcomes

The student will be able to –

1. Examine the functions of a contemporary Operating system with respect to convenience, efficiency and the ability to evolve. [5] (PO 1,5,10, PSO 2)
2. Demonstrate knowledge in applying system software and tools available in modern operating system (such as threads, system calls, semaphores, etc.) for software development. [4] (PO 1,4,5, PSO 1,3)
3. Apply various CPU scheduling algorithms to construct solutions to real world problems. [3] (PO 1,2,5, PSO 3)
4. Understand Security systems and functions [1] (PO 1,4,5,6,10, PSO 2)
5. Understand the organization of memory and memory management hardware. [1] (PO 1,2,5, PSO 2,3)
6. Analyze I/O and file management techniques for better utilization of secondary memory. [2](PO 1,2,5, PSO 3)

FF No. : 654

IC3041:: ENGINEERING DESIGN AND DEVELOPMENT 1

Credits: 04 **Teaching Scheme:** Theory: 1 Hours/Week
Lab : 6 Hours/Week

[IC3041_CO1, IC3041_CO2, IC3041_CO3, IC3041_CO4, IC3041_CO5]
It is based on Real time project implementation in the chosen specific defined area.

- Areas : Agriculture
- Healthcare
- Automotive
- Process
- Control

It is having Group formation, discussion with faculty advisor, formation of the project statement, resource requirement, identification and implementation and Time scheduling of the project.

- Decide the Area
- Decide the live problem
- Find out the scope of the project
- Do the literature survey and Finalize the building blocks of the project
- Decide the costing and time scheduling
- Finalize the technology required.
- Study and practice the given technology

Technology:

- Embedded
- Signal Processing tools like MATLAB, LabView
- PLC, DCS, SCADA etc.
- Front end /Data base Management softwares etc.
- Field visits
- Expert discussions

Project to be completed with detailed design, implementation, test case preparations, testing and demonstration
continuous assessment for the activities mentioned has been carried out throughout the semester
The student should prepare a consolidated report in LaTeX /word and submit it before term end.
Project consists of presentation and oral examination based upon the project work demonstration of the fabricated/designed equipment or software developed for simulation. The said examination will be conducted by a panel of examiners, consisting of preferably guide working as internal examiners and another external examiner preferably from an industry or university.

List of Project areas

1. Control
2. Sensor
3. Embedded
4. Automotive
5. Automation (PLC, SCADA)
6. Process Instrumentation
7. Healthcare
8. Signal Processing
9. Image processing
10. Artificial Intelligence

11. IOT
12. Software Development
13. Machine learning and Computer vision

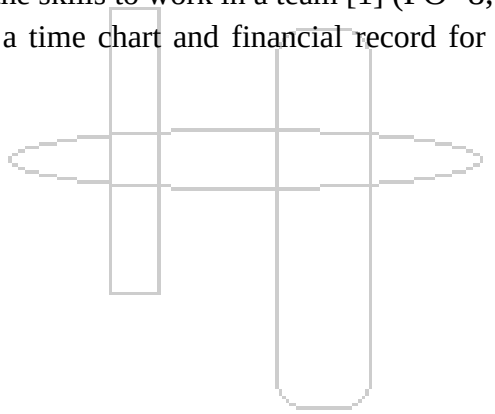
Text Books As per the requirement of the project

1. Sensor Handbook, Bela Liptak
2. Operational Amplifiers, Ramakant Gikwad
3. Microcontroller Applications by Mazidi
4. Process Instrumentation by Shinsky
5. PLC by C.D.Johnson

Course Outcomes

Students will be able to

1. IC3041_CO1: Design solutions for given engineering problem [5] (PO-1,2,3,4,5,6,7 PSO-1,2,3)
2. IC3041_CO2: Demonstrate practical knowledge by constructing models/algorithms for real time applications [3] (PO-1,2,3,4,5,6,7 PSO- 1,2,3)
3. IC3041_CO3: Express effectively in written and oral communication[2] (PO- 8,10,12 PSO- 1)
4. IC3041_CO4: Exhibit the skills to work in a team [1] (PO- 8,9,12 PSO-2)
5. IC3041_CO5: Prepare a time chart and financial record for execution of the project[2] (PO-8,11,12 PSO-3)



SEMESTER II

FF No. : 654

IC3002 :: INSTRUMENTATION PROJECT ENGINEERING

Credits: 04 **Teaching Scheme:** Theory: 3 Hours/Week
Lab : 2 Hours/Week

Section 1 : [IC3002_CO1, IC3002_CO2, IC3002_CO3]

Concept study & definition of Project Engineering & Management

Type of Standards and its studies as applicable to instrumentation and control engineering, Basics of Project Management, Degree of Automation, Organization Structure, Interdepartmental, Inter-organizational and Multi agency interaction involved in Project and their co ordination Project statement. Methods of tagging and nomenclature scheme based on ANSI / ISA std. (S-5.1), P & ID symbols for process loops like temperature, flow, level, pressure, etc.

Project engineering documents, drawing and softwares

Statement of Project (SOP), Process Flow Diagram, Material Balance Diagram, Pressure and Temperature Diagram, P & I diagram, Process Data sheet, Instrument Index, Specification sheet (S-20 Format) for Local and Primary Instruments, Transmitting and Secondary instruments and Final control devices for process and analytical parameters., Plant layouts and General arrangement drawing (Plans and Elevation), Isometric of instrument piping, Cable schedules Loop wiring diagrams, Field installation sketches, BOM and MBOM. Project engineering softwares.

Detailed Project engineering

Plant layouts and general arrangement drawing (Plans and Elevation), isometric of instrument piping. Cable engineering (class of conductors, Types, Specification and Application), Selection of cables with respect to specific application, Cable identification schemes, Cable trays. Loop wiring diagrams, Installation sketches of field instrument, Development of BOM and MBOM.

Section 2 : [IC3002_CO2, IC3002_CO3, IC3002_CO4, IC3002_CO5, IC3002_CO6]

Procurement activities

Vendor registration, Tendering and bidding process, Bid evaluation, Pre-Qualification Evaluation of Vendor, Purchase orders, Kick-off meeting, Vendor documents, drawing and reports as necessary at above activities.

Construction activities: Site conditions and planning, Front availability, Installation and commissioning activities and documents require at this stage, Installation sketches, Contracting, Cold Commissioning and Hot commissioning, Performance trials, As-built Drawings and Documentations and final hand over. Factory Acceptance Test (FAT), Customer Acceptance Test (CAT) and Site Acceptance Test (SAT).

Project Management

Project Management, Planning and Scheduling Life cycle phases, Statement of work (SOW), Project Specification, milestone scheduling, Work breakdown structure.

Cost and estimation: Types of estimates, pricing process, salary overheads, labor hours, materials and support costs. Program evaluation and review techniques (PERT) and Critical path method (CPM), S-curve concept and crash time concepts, software's used in project management; software features, classification, evaluation and implementation.

Codes and standards

Meaning of codes and standards, Codes and standards for Instrumentation and Control, ANSI / ISA, API, NAMUR, IEC, IEEE, ISO, NPFA, EEMUA, CENELEC, NORSOK, Hazardous area classification, comparison of methods of protections, NEMA ratings, understanding markings, certification process, etc.

List of Project areas

1. Development of P&ID for given process
2. Study of PFD, P&T diagrams of a project.
3. Development of enquiry sheet of an instrument.
4. Development of specification sheets.
5. Development of Loop Wiring diagram.
6. Development of Cable scheduling.
7. Preparation of GA and mimic diagram of a control panel.
8. Development of Bar charts for certain project.
9. Preparation of Inquiry, Quotation, Comparative statement, Purchase orders,
10. Preparation of SAT, FAT and CAT, Inspection reports for control panel / transmitter/ control valve / recorder.
11. Hands on experience for Project Engineering & management software such as IN Tools, MS Project, and Primavera
12. Project proposal writing

Text Books

1. Andrew & Williams, "Applied instrumentation in process industries", Gulf Publications.
2. N.A. Anderson "Instrumentation for Process measurement and control"
3. Considine, "Process measurement and control".

Reference Books

1. John Bacon, "Management systems", ISA Publications.
2. "Instrument Installation Project Management", ISA Publications.
3. B. G. Liptak, "Process control Instrument Engineers Hand book".

Course Outcomes

The students will have ability to:

1. IC3002_CO1: Describe the concept of project engineering and management. [1] (PO-1, 11, PSO-1)
2. IC3002_CO2: Comprehend the Project Engineering and Management documents [2](PO-1, 3,11, PSO-1,3)
3. IC3002_CO3: Develop Project Engineering and Management documents. [5] (PO-1, 3,11, PSO-1,3)
4. IC3002_CO4: Discuss the procurement and construction activities of project.[3] (PO-2,11, PSO-2)
5. IC3002_CO5: Understand the importance of management and financial functions and tools. [4] (PO-2,11,PSO-2)
6. IC3002_CO6: Explain different codes and standards used for instrumentation and control [4] (PO-1, 3,11, PSO-1,3)

FF No. : 654

IC3022 :: ARTIFICIAL INTELLEGIENCE

Credits: 04 **Teaching Scheme:** Theory: 3 Hours/Week
Lab: 2 Hours/Week

Section 1 [IC3022_CO1, IC3022_CO2, IC3022_CO3]
Introduction, Brief history, Agents and rationality, task environments, agent architecture types, Search and Knowledge representation, Search spaces, Hill climbing, simulated annealing, genetic algorithms, Logic based representations and inference, Prolog, Rule based representations, forward and backward chaining, matching algorithms., Probabilistic reasoning and uncertainty., Bayes nets and reasoning with them, Uncertainty and methods to handle it.

Section 2 [IC3022_CO4, IC3022_CO5, IC3022_CO6]
Learning, Forms of learning, Statistical methods: naive-Bayes, nearest neighbor, kernel, neural network models, noise and over fitting., Decision trees, inductive learning, Clustering - basic agglomerative, divisive algorithms based on similarity/dissimilarity measures, Applications to NLP, vision, robotics, etc.

List of Practicals
1. Python programming for symbolic algebra
2. Experimentation to write a code for Forward chaining,
3. Experimentation to write a code for backward chaining.
4. Write programme on Search, using heuristics, graph heuristics
5. Write program for Hill climbing
6. Experimentation on algorithm for Game search
7. Experimentation on evaluating k-nearest neighbors
8. Experiment on Neural net for application for artificial intelligence application
9. Evaluate neural nets for NLP application.
10. Write a program for SVM
11. Write a program for DT
12. Write a program for naïve-bayes algorithm

List of Project areas
1. Natural language processing.
2. Machine vision applications.
3. Gaming and search applications
4. Searching techniques
5. Data Handling& interpretation

Text Books
1. Artificial Intelligence, Elaine Rich & Kevin Knight, TMH Publication
2. Introduction to Turbo PROLOG, Carl Townsend, BPB Publication
3. Introduction to AI & Expert Systems, Dan W. Patterson, PHI Publication

Course Outcomes

The student will be able to -

1. IC3022_CO1: Examine the useful search techniques; learn their advantages, disadvantages [3] (PO1 PO3 PO5 PS2 PS3)
2. IC3022_CO2: Be familiar with Artificial Intelligence, its foundation and principles. [2] (PO1 PO2 PO3 PS2 PS3)
3. IC3022_CO3: Be able to develop intelligent systems. [3] (PO1 PO2 PO3 PO5 PS2)
4. IC3022_CO4: Learn the practical applicability of intelligent systems, specifically its applications. [3] (PO1 PO2 PO3 PO5 PS2)
5. IC3022_CO5: Be exposed to the role of AI in different areas like NLP, Pattern Recognition etc. [3] (PO2 PO4 PO5 PS2)
6. IC3022_CO6: Understand important concepts like Expert Systems, AI applications. [4] (PO1 PO3 PO5 PS2)

FF No. : 654

IC3004 :: PROCESS INSTRUMENTATION AND CONTROL

Credits: 04 **Teaching Scheme:** Theory: 3 Hours/Week
Lab : 2 Hours/Week

Section 1 :
[IC3004_CO1, IC3004_CO2, IC3004_CO3]

Fundamental and empirical models

Balance equations: Material and energy balance (Examples: isothermal CSTR, heated mixing tank and non-isothermal CSTR), linearization of nonlinear models, FOPDT and SOPDT empirical models using step test data.

Instrumentation for heat exchanger and dryer

Operation of heat exchanger, controlled and manipulated variables in heat exchanger control problem, Degrees of freedom analysis, instrumentation for feedback, feed-forward, feedback-Feed forward control, cascade control strategies for heat exchanger, types and operation of dryers, controlled and manipulated variables in dryer control problem, instrumentation for feedback and feed-forward control of various types of dryers.PID Tuning methods for heat exchangers.

Boiler Instrumentation and control

Operation of boiler, manipulated and controlled variables in boiler control, safety interlocks and burner management system, instrumentation for boiler pressure controls, Air to fuel ratio controls, boiler drum level controls, steam temperature control, optimization of boiler efficiency, Boiler Blow down, Furnace draft, Ratio control, Selective control, Split range control, Adaptive control. PID Tuning methods for boilers. Controller design strategies.

Section 2 :
[IC3004_CO4, IC3004_CO5, IC3004_CO6]

Instrumentation for Evaporators and Distillation

Types and operation of evaporators, Controlled and manipulated variables in evaporator control problem, instrumentation for feedback, feed-forward, cascade control strategies for evaporators, Operation of distillation column, manipulated and controlled variables in distillation column control, instrumentation for flow control of distillate, top and bottom composition control, reflux ratio control, pressure control schemes. Degree of freedom analysis. Different methods to control distillation with case study.

Analysis of Multivariable Systems

Concept of Multivariable Control: Interactions and its effects, block representation and transfer function matrix of two input two output systems, interaction, relative gain array, resiliency, Morari resiliency index, Niederlinsky index, Inverse Nyquist array.

Multivariable control

Structure Of multi-loop SISO and multivariable controllers, decoupler, and decoupler design: ideal decoupler, simplified decoupler and static decoupler. Concept of decentralized control, Tuning methods for multivariable control like BLT tuning.

List of Practicals Students should perform at least 12 practicals from given list.

1. Observing effect of tuning parameters for First order system on system performance.
2. Observing effect of tuning parameters for Second order system on system performance.
3. Design of PID controller for a SOPDT system by Ziegler Nichols method.
4. Design of feedback controller by direct controller synthesis.
5. Design a feedback controller for system with delay / RHP zero by IMC strategy.
6. Design Feedforward controller for heat exchanger
7. Design Cascade controller for Boiler
8. Design of feedback system for industrial dryers
9. Design of advance control scheme for single/multi effect evaporators
10. Design of feedback control scheme for distillation column
11. Determine relative gain array of MIMO system.
12. Determine Morari resiliency index of MIMO system.
13. Determine Niederlinsky index of MIMO system
14. Observing the effect of interaction in MIMO system

List of Project areas

1. Controller design for Heat Exchanger/ Boiler/ Evaporator using Lab view/Simulink
2. Hardware/Software implementation of Boiler interlocks
3. Analysis of Multivariable system
4. Design of Cascade control for Heat Exchanger/ Boiler/ Evaporator /Distillation column using Lab view/Simulink
5. Design of Feed-Forward control for Heat Exchanger/Boiler/Evaporator using Lab view/Simulink
6. Design of Decoupler for MIMO system using Lab view / Simulink
7. Performance comparison of different feedback and feedforward controllers for Boiler/ Evaporators/Heat Exchangers of given Model

Text Books

1. Stephanopoulos George, “Chemical Process Control”, PHI, New Delhi.
2. Lindsey D, “Boiler Control System”, McGraw Hill Publishing Company.
3. W.L.Luyben, Process, Modeling, Simulation and Control for Chemical Engineers, MGH.
4. B. Wayne Bequette, Process Control: Modeling, Design and Simulation, PHI

Reference Books

1. B.G.Liptak, Process Control, Instrument Engineering Hand book, Chilton Book Company, 1985.
2. Considine, Hand book of Process Instrumentation, McGraw Hill Publishing Company.
3. B.A.Ogunnaike and W. H. Ray, Process dynamics, modeling, and control Oxford University Press.

Course Outcomes

The student will be able to –

1. IC3004_CO1: Derive mathematical models for process [4] (PO-1, 3, 4, 12 PSO-1, 3)
2. IC3004_CO2: Apply control strategies for Heat exchanger and dryers [3] (PO-1, 2, 3, 4, 5, PSO-1, 2, 3)
3. IC3004_CO3: Develop and design instrumentation and control for Boiler [3] (PO-1, 2, 3, 4, 5, PSO-1, 2, 3)
4. IC3004_CO4: Develop and implementation of control scheme for Evaporator and Distillation column [3] (PO-1, 2, 3, 4, 5, PSO-1, 2, 3)
5. IC3004_CO5: Analyze multivariable systems [4] (PO-1, 2, 4, 5, PSO-1, 2,)
6. IC3004_CO6: Design and controller tuning for multivariable systems [4] (PO-1, 2, 3, 4, 5, PSO-1, 2, 3)

FF No. : 654

IC3024 :: MACHINE VISION AND ROBOTICS

Credits: 04 **Teaching Scheme:** Theory: 3 Hours/Week
Lab : 2 Hours/Week

Section 1

[IC3024_CO2, IC3024_CO 3, IC3024_CO6]

Two-dimensional visual geometry, Three dimensional image geometry, More than one camera, Vision at a single pixel, Connecting pixels, Texture, Dense Object Recognition, Sparse Object Recognition, Shape Analysis

Estimation of translation, rotation and scale using Geometrical Transformation, Affine, Protective and Ransac, Computation of TRS invariant features as SIFT, HOGetc, Motion detection, optical flow, object tracking, motion capture, Camera model, intrinsic and extrinsic camera parameters, camera calibration

Section 2

[IC3024_CO1, IC3024_CO4, IC3024_CO5]

Position and orientation of a rigid body, Homogeneous transformations, Representation of joints, link representation using D-H parameters, Examples of D-H parameters and link transforms, different kinds of actuators,

Kinematics of robots

Introduction, Direct and inverse kinematics problems, Degrees-of-freedom, Kinematic chains

Forward kinematics, Inverse kinematics: analytical method, Differential kinematics: Jacobian computation, singular configurations, Configuration space operation

Motion planning in robotics

Joint and Cartesian space trajectory planning and generation, Classical control concepts using the example of control of a single link, Independent joint PID control, Control of a multi-link manipulator, Non-linear model based control schemes

List of Practicals

1. Develop a program to determine the dominant points in the given input image.
2. Develop a program to perform edge detection techniques (Sobel, Laplace and Canny)
3. Develop a program to estimate translation, rotation and scale
4. Develop a program for Non-affine image transformation
5. Develop a program for Hough Transform
6. Develop a program for Template Matching
7. Develop a program for Feature Extraction
8. To identify the geometric relationship between input and output motion parameters of a robotic arm or simulate the same
9. Develop a program for Homogeneous Transformation
10. Forward kinematics: Formation of the transformation matrix though which a relationship is established between different links of the manipulator for a robotic arm or simulate the same
11. Inverse Kinematics: To verify the robot configuration for a particular set of the joint solution. Simulate the robot motion for various inputs of the manipulator position.

12. Implement an algorithm for determining for path planning.
13. Implement an algorithm for trajectory planning.

List of Project areas

1. On board real time image registration.
2. On board video processing and motion detection.
3. Design vision based automation solution for a typical application.

Text Books

1. Solomon and Breckon, Fundamentals of Digital Image Processing, Wiley-Blackwell, 2010, ISBN 978-0470844731
2. Robin R. Murphy, Introduction to AI Robotics, MIT Press, 2000, ISBN: 0262133830, Recommended, suppementary for Robotics
3. 2. A. K. Jain. Fundamentals of Digital Image Processing. Prentice-Hall, 1989. 2. A. K. Jain. Fundamentals of Digital Image Processing. Prentice-Hall, 1989.
4. A. K. Jain. Fundamentals of Digital Image Processing. Prentice-Hall, 1989.
5. Fundamentals of Robotic Mechanical Systems: Theory, Methods, and Algorithms

Course Outcomes

Upon completion of this course the students will be able to -

1. IC3024_CO1: Develop object recognition techniques by analyzing shape and geometry of the objects. [3] (PO-1, 3, 4, 12 PSO-1, 3)
2. IC3024_CO2: Derive translation, rotation and scale invariant features for image registration. [2] (PO-1, 3, 4, 12 PSO-1, 3)
3. IC3024_CO3: Analyze the video streams for detecting motion and computation of associated parameters. [3] (PO-1, 3, 4, 12 PSO-1, 3)
4. IC3024_CO4: Develop D-H representation of joints and links. [4] (PO-1, 3, 4, 12 PSO-1, 3)
5. IC3024_CO5: Analyze the forward and inverse kinematics of the given configuration. [2] (PO-1, 3, 4, 12 PSO-1, 3)
6. IC3024_CO6: Design algorithm to determine the shortest path and subsequent trajectory planning in Cartesian space. [5] (PO-1, 3, 4, 12 PSO-1, 3)

FF No. : 654

IC3018 :: DIGITAL CONTROL

Credits: 04 **Teaching Scheme:** Theory: 3 Hours/Week
Lab: 2 Hours/Week

Section 1

[IC3018_CO1, IC3018_CO2, IC3018_CO3, IC3018_CO4]

State space representation of continuous time systems

Terminology of state space representation, advantages of state space representation over classical representation, Realization of different forms (companion I/II), conversion of state model to transfer function. Solution of State Equation

Analysis and design of control system in state space

Lyapunov stability analysis, state controllability, state Observability, similarity transformation for obtaining controllable canonical form of plant matrix. State feedback, Pole placement design, Design of servo systems, State observers, Design of regulator systems with observers, Design of Control systems with observers

Introduction to Discrete Time Control System

Building blocks of Discrete time Control system, Z transform, Discretization of continuous time state space equations, Solution of discrete time state space, PTF of Closed Loop systems, PTF of Digital PID controller, Forms of Digital PID Controller

Section 2

[IC3018_CO2, IC3018_CO3, IC3018_CO5, IC3018_CO6]

Design of Discrete Time Control System

Design based on the root locus method, Deadbeat Controller Design, Effects of adding Poles and Zeros to open loop transfer function

State Space Analysis of Discrete Time Control System

Controllability & Observability of LTI discrete-data systems, Concept of stability in discrete time control systems: Jury Stability Test, bilinear transformation, Effect of Sampling on stability, Lyapunov stability analysis of discrete time control systems. Design via pole placement, State observers design

Optimal Control

Quadratic Optimal Control, Optimal state regulator through the matrix riccati equations, Steady State Quadratic Optimal Control

List of Practicals Students should perform at least 12 practicals from given list.

1. To obtain state model of a given transfer function and vice-versa.
2. To obtain state transition matrix of a given continuous time system.
3. Obtain the solution of state equation using different methods.
4. To investigate controllability and Observability of a continuous time system.
5. To investigate the stability of continuous time systems using Lyapunov stability
6. Develop a program for pole placement design using conventional approach
7. Develop a program for pole placement design using Ackermann's formula

8. Design of State Observer for continuous time system
9. To obtain impulse and step response of discrete time control systems
10. To obtain unit step response of Discrete Time Control System using Digital PID controller
11. To obtain the range of gain for the stability of discrete time system.
12. To obtain the range of sampling time for the stability of discrete time system
13. Design of LQR controller for discrete time system

List of Project areas

1. Digital Temperature Control System Design.
2. Digital Position Control System Design.
3. Single-Axis Satellite Attitude Control.
4. A Servomechanism for Antenna Azimuth Control.
5. Control of a Pressurized Box
6. Design of deadbeat controller for Discrete Time Control System
7. Design of Digital control system using Pole Placement
8. Design of digital control system using Root Locus
9. Design of State Observer for Discrete Time systems
10. Controller design for given discrete time control system
11. Design of controller for coupled mass system/mechanical system
12. Design of controller for Inverted Pendulum model

Text Books

1. K. Ogata, “Modern Control Engineering”, Pearson education India.
2. K. Ogata “Discrete Time Control systems", Prentice Hall of India.
3. M. Gopal, “Digital Control and State Variable Method” Tata McGraw Hill.

Reference Books

1. B. C. Kuo “Automatic control systems”, , Prentice Hall of India.
2. Norman S. Nise “Control systems engineering”, John Wiley and sons, Inc, Singapore.
3. J. David Powell, Michael Workman, G. F. Franklin, “Digital control of Dynamic Systems", Addison Wesley.

Course Outcomes

The student will be able to –

1. IC3018_CO1: Represent State Space models for given applications [4] (PO-1, 3, 4, 12 PSO-1, 3)
2. IC3018_CO2: Examine Controllability, Observability and Stability of systems. [3] (PO-1, 3, 4, 12 PSO-1, 3)
3. IC3018_CO3: Design control system using pole placement and observer design. [5] (PO-1, 3, 4, 12 PSO-1, 3)
4. IC3018_CO4: Comprehend Z transform for discrete time system. [4] (PO-1, 3, 4, 12 PSO-1, 3)
5. IC3018_CO5: Design controllers like dead-beat controllers. [4] (PO-1, 3, 4, 12 PSO-1, 3)
6. IC3018_CO6: Design control system using optimal control.[4] (PO-1, 3, 4, 12 PSO-1, 3)

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IC3026:: BIG DATA ANALYSIS

Credits: 04 **Teaching Scheme:** Theory: 3 Hours/Week
Lab: 2 Hours/Week

Section 1

[IC3026_CO1, IC3026_CO2, IC3026_CO3, IC3026_CO4, IC3026_CO5, IC3026_CO6]
Introduction to Data Warehousing, multi-dimensional modelling, data cube, OLAP, What is Big Data? Hadoop Architecture, HDFS.
Introduction to Big Data Platforms, Overview of Apache Spark, YARN, Introduction to MapReduce, MapReduce Programming Model with Spark, MapReduce Example: Word Count, PageRank etc.

Section 2

[IC3026_CO1, IC3026_CO2, IC3026_CO3, IC3026_CO4, IC3026_CO5, IC3026_CO6]
Market basket analysis: Association Rule Learning, Introduction of Big data Machine learning with Spark,Big Data Machine Learning Algorithms in Spark. Overview of Big Data Machine Learning, Mahout Introduction, Big Data Machine learning Algorithms in Mahout- kmeans, Naïve Bayes etc. Visualizations - Visual data analysis techniques- interaction techniques - Systems and applications. Introduction to Spark GraphX.

List of Practicals Students should perform at least 12 practicals from given list.

1. Study of Hadoop ecosystem
2. Programming exercises on Hadoop
3. Programming exercises in No SQL
4. Implement the file management tasks in Hadoop like Adding files and directories, Retrieving files and Deleting files
5. Implementing simple algorithms in Map- Reduce (3) - Aggregates, joins, sorting, searching etc.
6. Implementing any one Frequent Itemset algorithm using Map-Reduce
7. Implementing any one Clustering algorithm using Map-Reduce
8. Implementing data streaming algorithm using Map-Reduce
9. Install, Deploy & configure Apache Spark Cluster. Run apache spark applications using Scala/python
10. Develop classification algorithm in machine learning using Spark
11. Develop regression algorithm in machine learning using Spark
12. Develop clustering algorithm in machine learning using Spark/Mahout
13. Getting started with R. Implement some basic programs in R
14. Using R for data preprocessing
15. Using R for data visualization
16. Data analysis case study using R for a readily available data set
17. Study of Spark GraphX

List of Project areas

1. Data analytics from Social media
2. HR Analytics
3. Investments
4. Retail Sales Predictions
5. E-commerce

Text Books

1. Business Analytics, by James R Evans, Pearson.
2. Tom White, " Hadoop: The Definitive Guide" Third Edit on, O'reily Media, 2012.
3. Seema Acharya, Subhasini Chellappan, "Big Data Analytics" Wiley 2015.

Reference Books

1. Montgomery, Douglas C., and George C. Runger. Applied statistics and probability for engineers. John Wiley & Sons, 2010
2. Data Mining: Concepts and Techniques, Jiawei Han and Micheline Kamber, Morgan Kaufman, ISBN 978-81-312-0535-8, 2nd Edition
3. Fundamentals of Business Analytics‖, by R. N. Prasad, Seema Acharya, ISBN: 978-81-256-3203-2,Wiley-India
4. Business Intelligence for Dummies

Course Outcomes

The student will be able to –

1. IC3026_CO1 : Understand the process of converting data into a required format required for particular analysis. [2] (PO-1,2, PSO-1,2)
2. IC3026_CO2 : Apply various techniques to solve real-world data analysis problems [3] (PO-1,2, PSO-1,2)
3. IC3026_CO3 : Utilize data visualization tools in deriving insights from data. [3] (PO-1,2, PSO-1,2)
4. IC3026_CO4 : Apply analytic techniques and algorithms (including statistical and data mining approaches) to large data sets to extract meaningful insights. [4] (PO-1,2, PSO-1,2)
5. IC3026_CO5 : Use appropriate resources to research, develop and contribute to advances and trends within the field of Data Science. [4] (PO-1,2, PSO-1,2)
6. IC3026_CO6 : Interpret and present visually, orally and in written form, valid conclusions drawn from data analysis. [5] (PO-1,2, PSO-1,2)

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IC3010:: INTERNET OF THINGS

Credits: 04 **Teaching Scheme:** Theory: 3 Hours/Week
Lab : 2 Hours/Week

Section 1 [IC3010_CO1, IC3010_CO2, IC3010_CO3]

Introduction to Internet of Things – Definition & Characteristics, Physical Design of IOT, Logical Design of IOT, IOT Enabling technologies, IOT Levels & Deployment Templates
Domain specific IOTs – Home automation, Cities, Environment, Energy, Retail, Logistics, Agriculture, Industry, Health & Lifestyle
IoT and M2M, IoT System Management with NETCONF-YANG,

IOT Platform Design Methodology – Purpose & Requirements Specification, Process Specification, Domain Model Specification, Information model Specification, Service specification, IOT level Specifications, Functional View Specifications, Operational View Specification, device and component integration, application development, case study on IOT system for weather monitoring

Embedded suite for IoT

Physical device – Arduino / Raspberry Pi Interfaces, Hardware requirement of Arduino / Pi, Connecting remotely to the Arduino /Raspberry Pi , GPIO Basics, Controlling GPIO Outputs Using a Web Interface,– Programming , APIs / Packages, Arduino Interfaces, Integration of Sensors and Actuators with Arduino, Introduction to Python programming – Python data types & data structure, Control flow (if, for, while, range, break/continue, pass), Functions, Modules, packages, file handling, date/time operations, classes, Python packages of interest for IOT

Section 2 [IC3010_CO4, IC3010_CO5, IC3010_CO6]

Connectivity Technologies and Communication Protocols in IOT

RFID: Introduction, Principle of RFID, Components of an RFID system, Wireless Sensor Networks: WSN Architecture, the node, Connecting nodes, Networking Nodes, Securing Communication WSN specific IoT applications,

Protocols in IOT: CoAP, XMPP, AMQP, MQTT, Communication Protocols: IEEE 802.15.4, Zig-bee, 6LoWPAN, Bluetooth, WirelessHART

IOT Physical Server and Cloud Offerings

cloud architecture standards and interoperability- Cloud types; IaaS, PaaS, SaaS. Benefits and challenges of cloud computing, public, private clouds community cloud, Fog Computing, SDN
Cloud Storage Models & Communication APIs, Web Application Messaging Protocol (WAMP), Python web application framework – Django, Developing Application with Django, Developing REST web services, SkyNet IoT Messaging Platform

Case Studies Illustrating IOT Design – Smart lighting, Home Intrusion Detection, Smart Parking, Weather Monitoring System, Weather Report Bot, Air Pollution Monitoring, Forest fire Detection, Smart Irrigation, IoT Printer

List of Practicals

1. Python programming : data type
2. Python Programming : data structure
3. Python Programming : Control statements
4. Python Programming : functions
5. Python Programming : modules
6. Python Programming : File handling

7. Arduino / Raspberry Pi interface Sensor
8. Arduino / Raspberry Pi interface to to GSM module
9. Arduino / Raspberry Pi interface to Wi-fi module
10. Arduino / Raspberry Pi interface Bluetooth module
11. Cloud interfacing and programming like Thingspeak
12. Sensor data acquisition on Mobile / Developing Application with Django

List of Project areas

1. IoT Based Humidity and Temperature Monitoring Using Arduino Uno
2. IoT System for agriculture
3. IoT system for smart lighting
4. IoT Based Intelligent Traffic Management System
5. IoT based Smart Irrigation system
6. IoT based Smart parking system

Text Books

1. Arshdeep Bahga, Vijay Madisetti, "Internet of Things – A hands-on approach", Universities Press, 2015

Reference Books

1. Pethuru Raj, Anupama C. Raman, The Internet of Things Enabling Technologies, Platforms, and Use Cases, CRC Press Taylor & Francis Group, International Standard Book Number-13: 978-1-4987-6128-4
2. Rajkumar Buyya, Amir Vahid Dastjerdi Internet of Things – Principals and Paradigms, Morgan Kaufmann is an imprint of Elsevier, ISBN: 978-0-12-805395-9
3. Hakima Chaouchi, " The Internet of Things Connecting Objects to the Web" ISBN : 978-1-84821-140-7, Willy Publications
4. Olivier Hersent, David Boswarthick, Omar Elloumi, The Internet of Things: Key Applications and Protocols, ISBN: 978-1-119-99435-0, 2 nd Edition, Willy Publications
5. Daniel Kellmereit, Daniel Obodovski, "The Silent Intelligence: The Internet of Things",. Publisher: Lightning Source Inc; 1 edition (15 April 2014). ISBN-10: 0989973700, ISBN-13: 978- 0989973700.
6. Fang Zhaho, Leonidas Guibas, "Wireless Sensor Network: An information processing approach", Elsevier, ISBN: 978-81-8147-642-5.
7. Daniel Minoli, "Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications", ISBN: 978-1-118-47347-4, Willy Publications
8. Bernd Scholz-Reiter, Florian Michahelles, "Architecting the Internet of Things", ISBN 978-3-642-19156-5 e-ISBN 978-3-642-19157-2, Springer

Course Outcomes

The student will be able to –

1. IC3010_CO1: Learn and demonstrate concepts of Internet of Things [1] (PO 1, 2, 3, 4, 12) (PSO 2, 3)
2. IC3010_CO2: Develop and demonstrate embedded tools usage for IOT. [2] (PO 1, 2, 3, 4, 5, 12) (PSO 2, 3)
3. IC3010_CO3: Demonstrate Python programming skills for IOT [3] (PO 1, 2, 3, 4, 5, 12) (PSO 2, 3)
4. IC3010_CO4: Understand, develop and demonstrate the connectivity technologies and protocols in IOT, Demonstrate Cloud technology concepts [3] (PO 1, 2, 3, 4, 12) (PSO 2, 3)
5. IC3010_CO5: Develop Web Application framework using Django [5] (PO 1, 2, 3, 4, 5, 12) (PSO 2, 3)
6. IC3010_CO6: Illustrate IOT design for application of Home automation, Smart Parking, Environment, Agriculture, Productivity applications etc [4] (PO 1, 2, 3, 4, 12) (PSO 2, 3)

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IC3042:: ENGINEERING DESIGN AND DEVELOPMENT 2

Credits: 04 **Teaching Scheme:** Theory: 1 Hours/Week
Lab : 6 Hours/Week

[IC3042_CO1, IC3042_CO2, IC3042_CO3, IC3042_CO4, IC3042_CO5]
It is based on Real time project implementation in the chosen specific defined area.

- Agriculture
- Healthcare
- Automotive
- Process
- Control

It is having Group formation, discussion with faculty advisor, formation of the project statement, resource requirement, identification and implementation and Time scheduling of the project.

- Decide the Area
- Decide the live problem
- Find out the scope of the project
- Do the literature survey and Finalize the building blocks of the project
- Decide the costing and time scheduling
- Finalize the technology required.
- Study and practice the given technology

Technology:

- Embedded
- Signal Processing tools like MATLAB, LabView
- PLC, DCS, SCADA etc.
- Front end /Data base Management softwares etc.
- Field visits
- Expert discussions

Project to be completed with detailed design, implementation, test case preparations, testing and demonstration

Continuous assessment for the activities mentioned has been carried out throughout the semester

The student should prepare a consolidated report in LaTeX /word and submit it before term end.

Project consists of presentation and oral examination based upon the project work demonstration of the fabricated/designed equipment or software developed for simulation. The said examination will be conducted by a panel of examiners, consisting of preferably guide working as internal examiners and another external examiner preferably from an industry or university.

List of Project areas

1. Control
2. Sensor
3. Embedded
4. Automotive
5. Automation (PLC, SCADA)
6. Process Instrumentation

7. Healthcare
8. Signal Processing
9. Image processing
10. Artificial Intelligence
11. IOT
12. Software Development
13. Machine learning and Computer vision

Text Books

As per the requirement of the project

1. Sensor Handbook, Bela Liptak
2. Operational Amplifiers, Ramakant Gikwad
3. Microcontroller Applications by Mazidi
4. Process Instrumentation by Shinsky
5. PLC by C.D.Johnson

Course Outcomes

Students will be able to

1. IC3042_CO1: Design solutions for given engineering problem [5] (PO-1,2,3,4,5,6,7 PSO-1,2,3)
2. IC3042_CO2: Demonstrate practical knowledge by constructing models/algorithms for real time applications [3] (PO-1,2,3,4,5,6,7 PSO- 1,2,3)
3. IC3042_CO3: Express effectively in written and oral communication[2] (PO- 8,10,12 PSO- 1)
4. IC3042_CO4: Exhibit the skills to work in a team [1] (PO- 8,9,12 PSO-2)
5. IC3042_CO5: Prepare a time chart and financial record for execution of the project[2] (PO-8,11,12 PSO-3)

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IC3032 :: GENERAL PROFECIENCY

Credits: Audit Course

Third Year Students are expected to actively participate in any one or more of the following approved activities for a minimum duration of 40 hours:

Identified Areas:

1. **Technical & Allied Activities**: (Department level Student Chapters, Technical Forums, Related Club Activities, Events – In & outside Institute, etc.)
2. **Social Activities**: (Aatmabodh, Blood Donation, Organ Donation Drive, Drishti, NSS Camp, Social Awareness through Street Plays, etc.)
3. **Sport Activities:** (Organize, Conduct, Participate in sports competitions (at institute-, district-, state-, national- , and international level), workshops, programs, etc.)
4. **Extra-Curricular Activities:** (Organize, Conduct, Participate in related club activities, extra-curricular related competitions (at institute-, district-, state-, national- , international level), workshops, etc.)
5. **Managerial & Leadership Skills Related Activities:** Activities related with planning, organizing, staffing, executing & controlling events, programs, etc.

Student is expected to prepare and submit a report under the supervision of Guardian faculty on Vishwakarma Online Learning Platform.

Classification of Club Activities				
Technical	Social	Self-Development	Cultural	Sports
• Antariksh (Astronomy Club) • The Robotics Forum • Programmer's Hub • GCC (Coder's Club) • SAE Collegiate Club • (Baja, Supra, Effi-cycle, Go-karting, Endurance, Veloce) • Ekasutram (Maths Club) • Aero Modeling • Student Chapters (IEEE, ISA, ASHRAE, IETE, CHESA, PIESA) • TEDx • Trident Labs • Technocrats	• DIVA (Women Empowerment) • VIT Socials (Aatmabodh, Blood Donation, Drushti, NSS Camp, Police Mitra) • Model United Nations	• V-Click (The Photography Club) • Speakers Club • Personality Development Club • Civil Services Study Circle • EDC • Abhivriddhi (Students Training & Development) • Investment Forum	• MIRAGE (Film Appreciation Club) • Zephyr (The Dance Club) • VIKULP • Pi-Editorial Board • VIT Poets Society	• Let's Trek
Vishwakarandak Melange	Vishwakarandak Melange	Vishwakarandak Melange	Vishwakarandak Melange Vishwotsav	Vishwakarandak Melange

Conditions for Passing GP3 course:

To pass this course a student needs to do cumulative 40 hours activity (from First year to Third Year) as given above and submit its detail report along with photographs.

If a student does the social activity but fails to submit the report within the given deadlines, student will not pass the GP3 course.