Bansilal Ramnath Agarwal Charitable Trust's

Vishwakarma Institute of Technology

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

Structure & Syllabus of

Third Year B.Tech.

(Instrumentation and Control Engineering)

Pattern 'C21'

Effective from Academic Year 2021-22

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**

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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 a 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 systems.
2. Analyze real-world engineering problems in the area of Instrumentation and Control.
3. Design or Develop measurement / electronic / embedded and control systems with computational algorithms to provide practical solutions to multidisciplinary engineering problems.

Vishwakarma Institute of Technology
Title : Course Structure

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T.Y. B.Tech - Instrumentation and Control Engineering Structure for Pattern C-21, Module-5 with effect from Semester-1 of Academic Year 2021-22

Course Type	Course Code	Course Name	Teaching Learning Scheme (Hrs./Week)				Credits	Assessment Scheme (100 mark scale)								
			Th	Lab	Tut	Total		In Semester Assessment						End Semester Assessment		Total
								HA	Lab	CP	Seminar	GD	MSE	ESE	Viva	100
s1	IC3231	Process Instrumentation	3	2	1	6	5	10	10	10	15	15	10	10	20	100
s2	IC3233	Measurement Systems	3	2	1	6	5	10	10	10	15	15	10	10	20	100
s3	IC3235	Industrial Automation	3	2	1	6	5	10	10	10	15	15	10	10	20	100
s4	IC3237	Control Theory	3	2	0	5	4	10	10	10	15	15	10	10	20	100
s5	IC3241	Internet of Things	3	2	1	6	5	10	10	10	15	15	10	10	20	100
	IC3243	Artificial Intelligence and Machine Learning						10	10	10	15	15	10	10	20	100
	IC3245	Cyber Security						10	10	10	15	15	10	10	20	100
s6	IC3247	Software Development Project - III	0	6	0	6	3						30	70		100
s7	IC3249	Engineering Design and Innovation - V	0	8	0	8	4						30	70		100
		Total	**15**	**24**	**4**	**43**	**31**									

T.Y. B.Tech - Instrumentation and Control Engineering Structure for Pattern C-21, Module-5 with effect from Semester-2 of Academic Year 2021-22

Course Type	Course Code	Course Name	Teaching Learning Scheme (Hrs./Week)				Credits	Assessment Scheme (100 mark scale)								
								In Semester Assessment						End Semester Assessment		Total
			Th	Lab	Tut	Total		HA	Lab	CP	Seminar	GD	MSE	ESE	Viva	100
s1	IC3232	Web Technologies	3	2	1	6	5	10	10	10	15	15	10	10	20	100
s2	IC3234	Building and Process Automation	3	2	1	6	5	10	10	10	15	15	10	10	20	100
s3	IC3236	Computer Network	3	2	1	6	5	10	10	10	15	15	10	10	20	100
s4	IC3238	Database Management System	3	2	0	5	4	10	10	10	15	15	10	10	20	100
s5	IC3242	Internet of Things (Project)	0	2	0	2	5						30	70		100
	IC3244	Artificial Intelligence and Machine Learning (Project)											30	70		100
	IC3246	Cyber Security (Project)											30	70		100
s6	IC3248	Software Development Project - IV	0	6	0	6	3						30	70		100
s7	IC3250	Engineering Design and Innovation - VI	0	8	0	8	4						30	70		100
		Total	**12**	**24**	**3**	**39**	**31**									
		Proposed Audit Course														
S8	IC3220	Instrumentation Project Engineering	3				0	30						40	30	100
S8	IC3222	Batch Process Control	3				0	30						40	30	100

SEMESTER I

FF No. : 654

IC3231 :: PROCESS INSTRUMENTATION

Course Prerequisites: Fundamentals of Sensors and Transducers, Feedback control System.

Course Objectives:

1. To understand the basic concepts of process control loops.
2. To select, design, configure, install and calibrate the major and auxiliary process control components for given process conditions.
3. To understand the mathematical modeling and its importance in process control.
4. To apply suitable instrumentation and control schemes for different process equipment.
5. To analyze and design the multivariable controls and systems.

Credits: 5

Teaching Scheme Theory : 3 Hours/Week
Tut : 1 Hour/Week
Lab : 2 Hours/Week

Course Relevance:

This is a core control and instrumentation course, where the syllabus is designed according to the elements of the control system and integrating them to monitor and control process equipment in a plant. This course introduces the fundamental concepts, principles and application of major and auxiliary control components to the students. Then it goes deeper into the various aspects of process control along with balanced theories and practical knowledge. The topics cover the control strategies such as feed-forward controller, cascade control structure, ratio control, split-range control, selective control for various process equipment of plant and preliminary concepts of adaptive control and multi-loop multivariable control.

There are numerous industries that utilize process control equipment and instrumentation systems, including, oil and gas, mining, food & beverages, marine, chemical, petrochemical, fertilizers, pulp and paper, pharmaceuticals, power stations, water/wastewater, etc. so this course is very useful for the students, who wish to build carrier in the process control domain.

After completion of the course students will have the ability to explain working of process control components, their selection and design and configure them to control plants. They need to apply basic knowledge of science, mathematics and instrumentation engineering fundamentals to design or develop control schemes for various process equipment used in plants. Students should be able to calibrate, characterize the process component, auxiliary process components, design safety circuits, tune controllers for given process loops and find their performance specifications. In labs while performing practical and assessment viva, students exhibit their teamwork and communication skills.

This will develop core competency among the students in the field of process automation.

SECTION-1 : [IC3231_CO1, IC3231_CO2, IC3231_CO3]

Process Instrumentation Components

Fundamentals of process control

Types of control systems, feedback and feed forward control systems, Elements and variables involved in process control loop, Process Characteristics in detail, Process control loop representation using standard symbols. P&ID for process loops like temperature, flow, level, pressure, etc.

Transmitters and Convertors

Need of transmitter and standardization of current, voltage, and pressure control signals, Concept of field area and control room area, live and dead zero.

Types of transmitters: Two and four wire configurations, 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: Current to pressure and pressure to current converters.

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.

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 and 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.

SECTION-2 : [IC3231_CO4, IC3231_CO5, IC3231_CO6]

Process Instrumentation Applications

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 Blowdown, Furnace draft, Ratio control, Selective control, Split range control, Adaptive control. PID Tuning methods for boilers. Controller design strategies.

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 Tutorials: (Any Three)

1. Identification of different variables involved in Process control Loop.
2. To develop feedback or feed-forward control schemes for a given process.
3. To understand and develop the process control loops using standard ISA S5.1 for a given process.
4. Study and calibration of pressure to current converter, two–wire RTD and Thermocouple temperature transmitter.
5. Design of two-position controller for temperature / level control loop and Numerical examples on P, PI, PD, PID Controller.
6. Design of Control valves for given application and Numericals on valve characteristics.
7. Design of control valve actuators for given application.
8. Design of advance control scheme for single/multi effect evaporators.
9. Determine relative gain array of MIMO system.
10. Study the effect of tuning parameters on PID controller performance.
11. Study of Boiler Interlocks.

List of Practicals: (Any Six)

1. Study and calibration of current to pressure converter.
2. Study and calibration of pressure to current converter.
3. Study and implementation of Square root extractor.
4. Demonstration and study of alarm annunciator for different working modes.
5. Implementation and characterization of Flow Totalizer.
6. Study and characterization of intelligent two–wire RTD temperature transmitter.
7. Develop op-amp based ON-OFF controller for temperature control loop.
8. Tuning of PID controller for temperature/pressure control loop.
9. Study of control valve types, parts, accessories, actuators and Plot the installed characteristics of control valves.
10. Design of feedback controller by direct controller synthesis.
11. Design Feedforward controller for heat exchanger.
12. Design Cascade controller for Boiler
13. Determine Morari resiliency index of MIMO system.
14. Design and development of Feedback controller for given process
15. Design and development of Feedback + Feedforward controller for given process
16. Design and Development different boiler interlock using PLC/DCS
17. Design and development Cascade controller for given process
18. Design and development of decouple for MIMO system
19. Design and develop split range control for given process

List of Projects:

1. Design RTD signal conditioning circuit for temperature range 25°C to 100°C to 0 to 5 Vdc.
2. Design RTD signal conditioning circuit temperature range 25°C to 100°C to 4 to 20 mA.
3. Design Signal conditioning circuit for Thermocouple for temperature range 25°C to 100°C to 0 to 5 Vdc.
4. Design Signal conditioning circuit for Thermocouple for temperature range 25°C to 100°C to 4 to 20 mA.
5. Develop pressure transmitter for pressure range 0 to 2 Kg/cm^2.
6. Develop square root extractor circuit for voltage range / current range.
7. Develop and Simulate flow totalizer unit.
8. Develop high selector / low selector using opamp circuit.
9. Design of intrinsic safety circuit.
10. Develop alarm annunciator using digital logic circuits / ladder program of PLC
11. Tune PID controller for level control application. Use PC lab setup
12. Tune PID controller for flow control application. Use PC lab setup
13. Tune PID controller for pressure control application. Use PC lab setup
14. Tune PID controller for temperature control application. Use PI lab setup
15. Develop op-amp based ON-OFF controller for temperature control loop.
16. Demonstrate different types of positioners available in PI Lab.
17. Demonstrate different types of control valves available in PI lab.
18. Design of PID controller for a SOPDT system by Ziegler Nichols method.
19. Design of feedback system for industrial dryers
20. Design of feedback control scheme for distillation column
21. Determine Niederlinsky index of MIMO system.
22. Observing the effect of interaction in the MIMO system**.**

List of Course Group Discussion Topics:

1. Matching of control valve characteristics with the process characteristics.
2. Feedback versus Feed-forward control scheme
3. Selection of control actions according to process characteristics.
4. Which actuator is the best for the control valve?
5. Wired versus Wireless transmitters : Pros and Cons
6. Parameters to be considered for design of alarm annunciator.
7. How to get the most from the control valve.
8. Hazardous area classification and Intrinsic safety components
9. Conventional versus Smart transmitters.
10. Selection of Control Valve for applications.
11. Digital PID Controller Vs Analog PID Controller
12. Conventional Transmitter Vs Smart Transmitter
13. Continuous control Vs Discontinuous control
14. Furnace Draft Control
15. SISO Vs MIMO
16. Ratio control Vs Selective control
17. Decoupler
18. Distillation control

List of Course Seminar Topics:

1. System Modelling
2. Instrumentation for heat exchanger control
3. Control schemes for Dryer controls.
4. Instrumentation and control schemes for Boiler.
5. Evaporator controls.
6. Distillation Column control
7. Compressor controls
8. Instrumentation and control schemes for Pumps.
9. Multivariable control systems.
10. Instrumentation for tyre manufacturing.
11. Mathematical modeling of different process
12. Boiler drum level control methods
13. Application of control valve
14. Hazardous area classification
15. Burner management system
16. Instrumentation and control in Dryer
17. Instrumentation and control in Evaporator
18. Instrumentation and control in Distillation column
19. Multivariable control
20. Valve Actuators

List of Home Assignments:

Design:

1. Design of RTD/Thermocouple Signal conditioning circuit various temperature ranges.
2. Design and Simulation of PID controller for any one application.
3. Design of Control valve for given process using Standard ISA S75.01.
4. Design of Spring and Diaphragm type actuator for given application.
5. Design of intrinsic safety circuit.
6. Design of multivariable controls.
7. Automatic control of single capacity process
8. Automatic control of two capacity process
9. Design and develop feedback and feedforward control using different tool
10. Design and develop PID tuning for multivariable control system
11. Design and development of Boiler interlock using PLC/DCS

Case Study:

1. Development of P&ID for Ammonia/Petroleum refinery/Wastewater Treatment process plant.
2. Interfacing of smart D.P. transmitter for level loop and its calibration using hand-held configurator.
3. Tuning of PID controller for level/flow control loop.
4. Design a feedback controller for a system with delay / RHP zero by IMC strategy.
5. PID interfacing and Demonstration of Heat exchanger setup available in DCS Lab.
6. Implementation of PID Controller for Temperature control system
7. Implementation of ON/Off controller for Temperature control system

8. Different types of control valve
9. Distillation column control
10. Instrumentation and control in Dryer

Blog:

1. Communication aspects in Smart and wireless transmitters.
2. Controls of Interacting process.
3. Intrinsic safety.
4. SIL and SIS.
5. Advanced process controllers.
6. Boiler interlock
7. P & I D
8. Control in spray dryer
9. Control valve
10. Transmitter

Surveys:

1. Calibration of Flow/Temperature transmitters.
2. Intelligent features in transmitters.
3. Control valve for adverse process conditions.
4. Process calibrators.
5. Process Analyzers.
6. PID Tuning methods for MIMO
7. FOPDT Process
8. Mathematical modeling for different process
9. Automation in Boiler control
10 Control in Evaporator

Assessment Scheme:

Course Assessment: Total : 100 mks

1. Mid Semester Examination : 10 marks (Total : 30 marks based on Section I)
   30 marks converted to 10
2. End Semester Examination: 10 marks (Total : 30 marks based on Section II)
   30 marks converted to 10
3. Lab Assessment: Lab Assignments - 10 marks (10 assignments-10 marks each)
   (*100 marks converted to 10)*
4. Course Project : 10 marks (*100 marks converted to 10)*
5. Home Assignment : 10 mks (Total : 100 marks: Case study, Design work, Survey, Blog)
   100 marks converted to 10
6. Viva : 20 mks (at the end of semester); *100 marks converted to 20*
7. Seminar : 15 mks (Before the Mid of semester); *100 marks converted to 15*
8. Group Discussion: 15 mks (Before the End of semester); *100 marks converted to 15*

Text Books:

1. C. D. Johnson, "Process control and Instrument technology", TMH Publications.
2. N.A. Anderson, Boca Ratan, "Instrumentation for Process measurement and control", Radnor Pennsylvania, CRC Press.
3. Stephanopoulos George, "Chemical Process Control", PHI, New Delhi.
4. Lindsey D, "Boiler Control System", McGraw Hill Publishing Company.
5. W. L. Luyben, Process, Modeling, Simulation and Control for Chemical Engineers, MGH.
6. B. Wayne Bequette, Process Control: Modeling, Design and Simulation, PHI.

Reference Books:

1. B. G. Liptak, "Process Control", Instrument Engineering Handbook CRC Press.
2. B.G.Liptak, Process Control, Instrument Engineering Handbook, Chilton Book Company.
3. Considine, Handbook of Process Instrumentation, McGraw Hill Publishing Company.
4. B.A.Ogunnaike and W. H. Ray, Process dynamics, modeling, and control Oxford University Press.
5. "Tuning of industrial control systems", ISA.
6. "Control valve Handbook", ISA.

Moocs Links and additional reading material:

1. https://onlinecourses.nptel.ac.in/
2. https://nptel.ac.in/courses/103/103/103103037/
3. https://www.udemy.com/course/introduction-to-process-control-and-instrumentation
4. https://automationforum.in/t/free-online-instrumentation-courses/4783/1
5. swayam-chemical-process-instrumentation-9999
6. https://www.udemy.com/course/instrumentation-detailed-engineering-1-epc-job
7. https://www.online.colostate.edu/courses/CBE/CBE430.dot
8. https://ocw.mit.edu/courses/chemical-engineering/10-450-process-dynamics-operations-and-control

Course Outcomes:

1. IC3201_CO1: Demonstrate the working of major and auxiliary process loop components. [1] (PO-1, 2, 3, 9, 10 PSO-1, 3)
2. IC3201_CO2: Comprehend and Develop the process control loops from given process description. [3] (PO-1, 2, 3, 9, 10 PSO-1, 2, 3)
3. IC3201_CO3: Select and Design the control valve and actuators to solve a problem. [5] (PO-1, 2, 3, 4, 5, 9, 10 PSO-1, 2, 3)
4. IC3201_CO1: Build a mathematical model for a given process. [4] (PO-1, 2, 3, 4, 5, 9, 10 PSO-1, 2, 3)
5. IC3201_CO4: Develop instrumentation and control scheme for different process equipments. [4] (PO-1, 2, 3, 4, 5, 9, 10 PSO-1, 2, 3)
6. IC3201_CO5: Analyze multivariable controls and systems. [5] (PO-1, 2, 3, 4, 5, 9, 10 PSO-1, 2, 3)

CO PO Map:

CO	PO -1	PO-2	PO -3	PO -4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO -1	PSO -2	PSO -3
1	3	2	2	-	-	-	-	-	1	2	-	-	3	-	1
2	3	3	2	-	-	-	-	-	1	2	-	-	2	1	2
3	3	3	3	1	1	-	-	-	1	2	-	-	3	2	3
4	3	3	3	2	2	-	-	-	1	2	-	-	2	2	3
5	3	3	3	1	1	-	-	-	1	2	-	-	2	2	3
6	3	3	3	2	2	-	-	-	1	2	-	-	2	2	3

CO attainment levels

CO No.	IC3201_CO1	IC3201_CO2	IC3201_CO3	IC3201_CO4	IC3201_CO5	IC3201_CO6
Attainment Level	1	3	5	4	4	5

Future Courses Mapping:

Digital Control, Advanced Process Control, Process Dynamics and Optimisation**,** Multivariable Control System, etc.

Job Mapping:

Process control engineers are responsible for designing, developing, installing, managing and maintaining process instruments that are used to monitor and control process plants. There are numerous industries that utilize process control equipment and instrumentation systems, including, oil and gas, mining, food & beverages, marine, chemical, petrochemical, fertilizers, pulp and paper, pharmaceuticals, power stations, water/wastewater, etc.

After completion of the course, the student who wish to build a career in the process control domain can work as design engineer, application engineer, calibration engineer, control engineer, installation and commissioning engineer, maintenance engineer in above mentioned industry verticals and also with system integrators, consulting firms, project divisions, etc.

FF No. : 654

IC3233 :: MEASUREMENT SYSTEMS

Course Prerequisites: Knowledge of basic physics, mathematics, electrical and electronics

Course Objectives:

1. To understand principle and operations of various sensors and transducers
2. To understand the requirement of signal conditioning for various sensor and transducer
3. To get knowledge of various measurement systems for process parameter measurement
4. To understand type electromagnetic interferences and their reduction techniques
5. To understand various analytical instruments and their measurement techniques
6. To understand the operation and applications of various biomedical instruments

Course Relevance: This course is one of the important core subjects of instrumentation engineering. It deals with the study of various sensors, transducers and measurement system for physical, chemical and biomedical parameter measurements. These are extensively used in various industries, laboratories and diagnostics labs.

Credits: 5 **Teaching Scheme Theory : 3** Hours/Week
Tut : 1 Hour/Week
Lab : 2 Hours/Week

SECTION-1 : Sensors and signal conditioning

Basics of Measurements: Static and dynamic characteristic - Accuracy, sensitivity, linearity, Precision, resolution, reliability, repeatability, validity, Errors and their analysis, frequency response, Standards of measurement. Error analysis

Sensor classification and Selection criteria of following sensors

T**emperature measurement:** classification **,** principle, working of various temperature sensors such as Resistance temperature detectors (RTD), thermistor, Thermocouples, digital temperature sensor, semiconductor temperature sensor and requirement of Signal conditioning circuits

Pressure and load measurement: classification **,** principle, working , specifications of **Pressure sensors such as** bourdon gauge, diaphragm, bellows, Differential pressure sensor, digital pressure sensors, Vacuum pressure measurement. Load measurement using Strain Gauges. requirement of signal conditioning circuits

Flow measurement: classification**,** principle, working, specifications of flow sensors such as Orifice, venture-meter, pitot tube, Rotameter, Turbine, electromagnetic, ultrasonic flow measurement and requirement of signal conditioning circuits.

Level measurement: classification, principle, working, specifications of various level sensors such as Float, ultrasonic, capacitive, radar, resistance level sensors and requirement of signal conditioning circuits

EMIC/EMC – Introduction to EMI/EMC , sources of Noises, methods of EMI testing and noise elimination techniques

SECTION-2: Analytical and Biomedical Instrumentation

Analytical Instruments and Measurement: Introduction and classification of analytical instruments, qualitative and quantitative analysis, Electromagnetic spectrum, beer lamberts law, optical filters, monochromators, Filter photometer, colorimeter and spectrophotometers.
Environmental sensors: Measurement of PH, conductivity, humidity, Gas analyzers, Gas and liquid chromatography instruments

Biomedical Instrumentation Instruments and Measurement: Introduction to human physiology, Biopotential generation, sensors used for physiological measurement, Cardiovascular system and related instruments (Blood pressure measurement, ECG recorder, Blood flow measurement, blood volume measurement). Life saving devices like pacemaker, defibrillator, Brain system and EEG recorder, Respiratory system and spirometers.

List of Tutorials (any 3):

1. Flow and pressure Sensor applications
2. Temperature and level sensor applications
3. Measurement of intrinsic noise in electronic components.
4. Electrostatic Discharge causes and prevention
5. Measurement of concentration using a filter photometer.
6. Sensors requirement for physiological measurement
7. Cardiovascular signal processing techniques
8. Spirometer measurement techniques
9. Voltage and current measurements
10. Reliability analysis

List of Practical: (Any Six)

1. Design of signal conditioning of temperature sensor RTD/ thermistor
2. Design of signal conditioning ckt for weight measurement using Strain Gauge
3. Designing of ECG and EEG Instrumentation amplifier for a given application
4. Simulation of ECG recorder
5. Simulation of pacemaker and defibrillator
6. Simulation of Spectrophotometer
7. Frequency/time period measurement
8. Design of Filter for a given application
9. Design of signal conditioning of temperature sensor Thermocouple

List of Course projects:

1. Design of a system using semiconductor temperature sensor
2. Design of a system using digital pressure sensor
3. Design of a system using orifice sensor
4. Design of a system using thermocouple temperature sensor
5. Design of a digital voltmeter and ammeter
6. Design of frequency measurement system
7. Design of a system using capacitance level sensor
8. Design of a waveform generator
9. Design of weight measurement system
10. Design of a measurement system for a given parameter
11. Body temperature measurement system
12. Design of humidity measurement system

List of seminar:

1. Applications of automatic test equipment
2. Redundancy techniques in various equipment
3. Calculation of MTTF and MTBF of a system.
4. DSO specifications and selection
5. Virtual instruments
6. PCB making process
7. EMI testing techniques
8. Shielding and grounding techniques.
9. Smart energy meter
10. Lux meter
11. Gauss meter
12. IOT in biomedical instrumentation
13. vision based measurement system
14. fifth generation measurement system
15. electrical testing parameter and standards
16. non electrical testing parameter and standards
17. Uncertainty in measurement system
18. Precautions for biomedical parameter measurements

19. Imaging techniques like MRI
20. Imaging techniques like CT and xray
21. Imaging technique line sonograpy
22. Ventilator
23. Bone density measurement
24. Pulmonary function test
25. Xray diffractometer

List of Course Group Discussion Topics:

1. Selection of electronic instruments for waveform analysis
2. Design of an analog to digital converter
3. Design of an analog to digital converter
4. Problems in healthcare system and implementation
5. IOT implementation in biomedical system
6. Virtual training in Biomedical systems
7. Opportunities in biomedical system
8. Milliohm and micro ohm measurement techniques.
9. Weather parameter measurement and monitoring
10. Selection of electronic instruments for various electrical parameters
11. Precautions for biomedical parameter measurements
12. Imaging techniques like MRI
13. Imaging techniques like CT and xray
14. Imaging technique line sonograpy
15. Ventilator
16. Bone density measurement
17. Pulmonary function test
18. Soil measurement
19. Xray diffractometer
20. Soil erosion
21. Earthquacke measurement

List of Home Assignments:

Design:

1. Design of a DMM circuit.
2. IOT in measurement systems.
3. Various static and dynamic characteristics of measuring instruments.
4. Atomic absorption spectroscopy and applications
5. Design of a measurement system for a given parameter
6. Imaging technique line sonograpy
7. Ventilator
8. Bone density measurement
9. Pulmonary function test
10. Xray diffractometer

.**Case Study:**

1. Testing of SMPS for electromagnetic interference
2. IOT for biomedical applications
3. Applications of a spectrophotometer in a pathology lab.
4. Vehicle pollution measurement technique
5. Instruments in flight
6. Design of a waveform generator
7. Design of weight measurement system
8. Design of a measurement system for a given parameter
9. Body temperature measurement system
10. Design of humidity measurement system

Blog

1. Analog to digital converter techniques
2. Digital to analog converter techniques
3. True RMS multimeters
4. Flame photometer and applications
5. Spirometer

Surveys

1. IOT based measuring instruments
2. Various applications of a spectrophotometer
3. Types of oscilloscopes
4. ATE application in electronic industries
5. Virtual instruments

Assessment Scheme:

Course Assessment: Total : 100 mks

1. Mid Semester Examination : 10 marks (Total : 30 marks based on Section I)
   30 marks converted to 10
2. End Semester Examination: 10 marks (Total : 30 marks based on Section II)
   30 marks converted to 10
3. Lab Assessment: Lab Assignments - 10 marks (10 assignments-10 marks each)
   (*100 marks converted to 10)*
4. Course Project : 10 marks (*100 marks converted to 10)*
5. Home Assignment : 10 mks (Total : 100 marks: Case study, Design work, Survey, Blog)
   100 marks converted to 10
6. Viva : 20 mks (at the end of semester); *100 marks converted to 20*
7. Seminar : 15 mks (Before the Mid of semester); *100 marks converted to 15*
8. Group Discussion: 15 mks (Before the End of semester); *100 marks converted to 15*

Text Books:

1. Kalsi H S; Electronic Instrumentation; Tata McGraw-Hill.
2. A. J. Bowens; Digital Instrumentation; Tata McGraw-Hill.
3. Balagurusamy; Reliability Engineering; Tata McGraw-Hill
4. R S Khandpur; Handbook of Analytical Instruments; McGraw Hill Education; 2 edition

5. Willard, H. H., Merritt Jr, L. L., Dean, J. A., & Settle Jr, F. A. Instrumental methods of analysis. 7th edition. CBS Publishers & Distributors.
6. R.S. Khandpur; Handbook of Biomedical Instrumentation; Third Edition; 2014, McGraw Hill Education (India) Private Limited.

Reference Books:

1. Sawhney, A. K; Electrical and electronic Measurements and Instrumentation. Dhanpar Rai and Sons.
2. Ananda R. Natarajan; Biomedical Instrumentation and Measurements; PHI Learning.

Moocs Links and additional reading material:

1. www.nptelvideos.in
2. http://www.nptelvideos.in/2012/11/industrial-instrumentation.html

Course Outcomes: After completing the course the students will be able to

1. Interpret the specifications of sensors and measurement system
2. Apply a sensor for a given application
3. Contribute in the design or development of a measurement system
4. Select analytical instrument for a given application
5. Suggest a suitable measurement technique for environmental parameter
6. Understand the operation of various biomedical instruments

CO-PO map :

CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
1	2	2	2	2	1	2	2	2	1	1	1	2	2	1	1
2	2	2	2	2	1	2	2	1	2	2	2	2	3	2	2
3	1	2	1	1	1	2	1	1	1	2	1	1	0	1	1
4	2	1	1	1	1	1	1	1	1	1	1	1	1	2	1
5	2	1	1	1	1	1	2	1	0	2	1	1	1	1	1
6	2	1	2	2	1	3	2	1	1	2	1	2	2	2	2

CO No.	IC3203_CO1	IC3203_CO2	IC3203_CO3	IC3203_CO4	IC3203_CO5	IC3203_6
Attainment Level	2	3	1	2	2	2

Job Mapping:

Electronic instruments manufacturing industries. Electronic testing labs. Biomedical and analytical instruments manufacturing industries and services. Electronic industries, Electrical equipment manufacturing industries.

FF No. : 654

IC3235 :: INDUSTRIAL AUTOMATION

Credits: 5 **Teaching Scheme Theory : 3** Hours/Week
Tut : 1 Hour/Week
Lab : 2 Hours/Week

Course Objectives:

1. To understand the working of electrical, hydraulic, pneumatic, mechanical, PLC, drives, HMI and control panel components.
2. Develop electrical wiring diagrams, hydraulic, pneumatic circuits, PLC, SCADA, HMI programs for given application.

SECTION 1: [IC3235_CO1, IC3235_CO2, IC3235_CO3, IC3235_CO4, IC3235_CO6]

Industrial Control Devices (7 Hrs)

Switches: construction, working, application of toggle, slide, DIP, rotary, thumbwheel, selector, push button, micro, limit, emergency, process switches, symbols, specifications.

Relays: construction, working, terminologies and applications of Electro-mechanical relay, hermetically sealed relay, reed relay, solid-state relays and timing relay, specifications.

Contactors: construction, working, specifications and applications of contactors.

Motor control circuits: Development of electrical wiring diagram for starting, stopping, reversing, sequencing and interlocking for motors, braking, starting with variable speeds, jogging / inching, Motor Control Center: concept, **Protection of motors:** short circuit, over load protection, low / under voltage, phase reversal, over temperature protection.

Hydraulic Components (7 Hrs)

Hydraulics: principle, block diagram, advantages, disadvantages, applications, hydraulic fluid desirable properties, Types of hydraulic oil and its selection.

Hydraulic components: hydraulic power pack, hydraulic pumps, actuators, filters, piping, heat exchangers valves and motors.

Hydraulic circuits: development of hydraulic circuits using standard symbols, hydraulic circuits like meter in, meter out, reciprocating, speed control, sequencing of cylinders, direction control, deceleration, regenerative circuit, etc. troubleshooting in hydraulic circuits. Introduction to circuit design.

Pneumatic Components (4 Hrs)

Pneumatics: principle, block diagram, advantages, disadvantages, applications. Fluidic elements and its applications

Pneumatic components: pneumatic power Supply, types of pneumatic relay, FRL unit, pneumatic actuator (cylinders and air motors), pneumatic valves,

Pneumatic circuits: development of pneumatic circuits using standard symbols, sequence diagram (step-displacement) for implementing pneumatic circuits, different pneumatic circuits like reciprocating, sequencing, block transfer, speed regulation, job sorting, electro-pneumatic circuits, etc

Mechanical components : Springs and Gears **(2Hrs)**

SECTION 2 : [IC3235_CO1, IC3235_CO5, IC3235_CO6]

Programmable Logic Controllers (8 Hrs)

PLC Hardware : Types of Processes, Advantages, Architecture of PLC, Construction and signal processing of DI-DO-AI-AO Modules, working of PLC, Scan time, Source and sink Concepts ,Wiring different field Devices to the PLC.

PLC Programming: Development of PLC Programming languages as per IEC 61131-3 like LD, IL, ST, FBD, SFC, addressing, Instructions such as Set-Reset, Latching, Timers and Counters, Advanced PLC Instructions such as Comparison, Data movement, Logical, Mathematical, Program flow control, BIN-BCD, PID, etc and their applications.

PLC Interfacing to AC and DC Drives/HMI/Hydraulic/Pneumatic/Motion control (6 Hrs)

Stepper motor: principle, types, terminologies, half-stepping and micro-stepping techniques, characteristics, specifications, applications.

Servomotors: construction, working, features, advantages, disadvantages, characteristics of AC and DC servomotor, comparison with stepper motor. AC and DC position and speed control. Synchros for position measurement, position control and error detector.

DC Micro motors: types, construction, working, characteristics and applications.

Drives : Need, Types, Selection criteria, Advantages and disadvantages of drives. Working and construction of VFD, Interfacing of VFD, servo drives to PLC

HMI : Need, Advantages of using HMI, PLC-HMI interface

PLC Interface to Hydraulic/Pneumatic circuits.

SCADA and Control panels: (6 Hrs)

General definition and SCADA components. Need of SCADA system, application & benefits, PLCs Vs RTUs, RTU Block diagram, MTU communication interface, Types of SCADA System, Future trends, Internet based SCADA display system, Comparison of different SCADA packages. Trending, Historical data storage and Reporting, Alarm management. Programming techniques For: Creation of pages, Sequencing of pages, Creating graphics and Animation and development of application using SCADA System.

Control panels

Control Panel: Control panel basics, control room layout, Electric Power Systems, Instrument Power Requirements, Power Distribution, Control Room Lighting, Communication Systems

Control Panel Types, Flat face Panels, Breakfront Panels, Consoles, Comparison of Panel Types, Panel Layout, Control Panel Bid Specifications, Panel Inspections.

List of Practicals: *Students should perform at least 10 practicals out of following*:

1. Implementation of logic circuits using switches.
2. Implementation of relay logic electrical wiring for given application.
3. Implementation of latching, sequencing and interlocking electrical wiring for given application using contactor.
4. Implementation and testing of hydraulic circuit.
5. Implementation and testing of pneumatic circuit.
6. Testing of hydraulic logic circuit using H-simulator.
7. Testing of pneumatic logic circuit using P-simulator.

8. Develop and Simulate Ladder program for simple on-off, timer and counter applications.
9. Develop and Simulate Instruction list, Structure Text programming for given process.
10. Develop and Simulate SFC and FBD for given process.
11. Develop and Simulate applications in PLC using advanced instructions.
12. Interfacing PLC to hydraulic/Pneumatic circuits,
13. Interfacing PLC to HMI, VFD/Inverter, Motion Control/Servo systems to PLC
14. Creating and Configuring a Project and tags in SCADA
15. Develop and simulate the level control loop using SCADA
16. Study of Synchro Transmitter Receiver.
17. Implementation of various operational modes of stepper motor.
18. Study the characteristics of Servo motor.
19. Implementation of motor protection circuits.
20. Demonstration of MCC / control panel components.

List of Tutorials :

1. Develop logic circuits using switches / relays.
2. Develop logic circuits using contactor.
3. Design a Hydraulic circuit for given application.
4. Design a Pneumatic circuit for given application.
5. Develop a Ladder program for simple on-off, IL and ST applications.
6. Develop a Ladder program using timers and counters
7. Develop PLC program using FBD and SFC for given applications.
8. Develop PLC program using advanced instructions of LD for given applications.

List of Course Project areas

1. Industrial Control Devices
2. Hydraulics and Pneumatics
3. Programmable Logic Controllers
4. HMI and Drives
5. SCADA and control panels

List of Course Seminar Topics:

1. Industrial Control Devices
2. Electro-Hydraulics
3. Electro-Pneumatics
4. Advancements in Hydraulics and Pneumatics
5. Applications of Mechanical components
6. PLC Programming as per IEC 61131
7. Recent advancements and future trends in PLC
8. HMI and Drives
9. SCADA and control panels
10. PLC interface for VFD and Servo drives
11. PLC-HMI and PLC-SCADA interface
12. PLC communications.

List of Course Group Discussion Topics:

1. Recent trends in PLC technology
2. Communication protocols used in PLC
3. Comparison of PLC Programming languages
4. VFD verses Servo drives
5. Special purpose motors
6. Comparison of Control Panels
7. HMI verses SCADA
8. Control panel components
9. Control panel layout
10. PLC Hardware
11. AC-DC Drives

List of Home Assignments:

Design:

1. Design of Hydraulic actuator.
2. Design of Pneumatic actuator.
3. Design of contactor based application
4. Design of PLC based system.
5. Design of Control Panel.
6. Design of SCADA system

Case Study:

1. Case study - startup sequence of boiler
2. Development of Boiler interlocks
3. Heat Exchanger control using PLC
4. PLC for batch control application.
5. SCADA system for any process control application.

Blog:

1. Advancements in PLC
2. Advancements in Electro-hydraulics
3. Advancements in Electro-pneumatics
4. PLC communications.
5. Latest trends in SCADA / HMI / Drives

Surveys:

1. PLC Hardware
2. Recent Trends in PLC
3. Network devices and topology
4. AC-DC Drives
5. Control panel hardwares

Assessment Scheme:

Course Assessment: Total : 100 mks

1. Mid Semester Examination : 10 marks (Total : 30 marks based on Section I)
   30 marks converted to 10
2. End Semester Examination: 10 marks (Total : 30 marks based on Section II)
   30 marks converted to 10
3. Lab Assessment: Lab Assignments - 10 marks (10 assignments-10 marks each)
   (*100 marks converted to 10)*
4. Course Project : 10 marks (*100 marks converted to 10)*
5. Home Assignment : 10 mks (Total : 100 marks: Case study, Design work, Survey, Blog)
   100 marks converted to 10
6. Viva : 20 mks (at the end of semester); *100 marks converted to 20*
7. Seminar : 15 mks (Before the Mid of semester); *100 marks converted to 15*
8. Group Discussion: 15 mks (Before the End of semester); *100 marks converted to 15*

Text Books

1. F. D. Petruzella "Industrial Electronics", Glancor Publications.
2. Industrial Hydraulics and Pneumatics, Andrew Parr
3. Majumdar, "Pneumatic Systems: Principles and Maintenance", TMH Publications.
4. John Webb, "Programmable Logic Controllers", Prentice Hall of India.
5. B. L. Theraja, "Electrical Technology", S. Chand and Company.
6. Richard Cox, "Programmable Controllers", International Thomson Computer Press.

Reference Books

1. C.T. Kilian, "Modern Control Technology: Components & Systems", Thomson Learning Publications.
2. "Industrial Hydraulic Technology Parker Motion & Control, Training Department.
3. Festo Controls, "Fundamentals of Pneumatic Control Engineering", Banglore.
4. Frank D Petruzella "Programmable logic controller ", McGraw-Hill Education.
5. SCADA by Stuart A Boyer : ISA 1999

Course Outcomes

The student will be able to:

1. IC3235_CO1: Comprehend the working of electrical, hydraulic, pneumatic, mechanical, PLC, drives, HMI and control panel components. [1] (PO-1, 2, 3,4,10, PSO-1,2,3)
2. IC3235_CO2: Develop electrical wiring diagrams, hydraulic, pneumatic circuits for given application. [4] (PO-1, 2, 3,4, PSO-1,2,3)
3. IC3235_CO3: Select and size the electrical, mechanical, hydraulic and pneumatic components to solve a problem. [5] (PO-1, 2, 3, PSO-1,2,3)
4. IC3235_CO4: Identify, formulate and solve a problem using electrical, mechanical, hydraulic and pneumatic system. [4] (PO-1, 2, 3,4, PSO-1,2,3)
5. IC3235_CO5: Develop PLC, SCADA, HMI programs for given application. [4] (PO-1, 2, 3,4, PSO-1,2,3)
6. IC3235_CO6: Demonstrate practical knowledge, communication and team skills, by constructing models for real life applications [3] (PO-1, 2, 3,4,5,6,8,9,10,11,12, PSO-1,2,3)

FF No. : 654

IC3237 :: CONTROL THEORY

Credits: 5 **Teaching Scheme Theory : 3** Hours/Week
Tut : 1 Hour/Week
Lab : 2 Hours/Week

Section 1: [IC3237_CO1, IC3237_CO2, IC3237_CO3]

Unit 1: Introduction to basics of control systems Concepts of control systems with examples: Feed-back, Open-loop, closed loop , Representation of physical Systems-electrical and mechanical translational systems. Laplace transforms and properties, Differential equations and Transfer functions,

Unit II: Classical control actions as proportional, integral and derivative control, Signal Flow graphs. Time domain analysis of control systems Impulse response of a system, first order systems, second order systems and their response to impulse and step inputs, time domain specifications of first and second order systems, static error coefficients. Response of first order systems to ramp input, dynamic error coefficients.

Unit III: Stability analysis in s-plane Concept and classification of stability, Pole-zero plots, effects of addition of poles and zeros on stability, Hurwitz Criterion, Routh Array. Analysis of relative stability using Routh array. Root Locus: definition and properties, rules for constructing root locus, Lag, Lead, Lag-lead compensator design using root locus.

Section 2: [IC3237_CO4, IC3237_CO5, IC3237_CO6]

Unit IV: Frequency domain analysis of control systems Frequency response and frequency domain specifications, correlation between frequency and time domain specifications, Bode Plot, construction of actual and asymptotic Bode plots, stability analysis, Determination of transfer function from Bode plot. Determining value of gain for marginal stability gain and phase margins, Polar plots. Nyquist plots

Unit V:
Control system Analysis using State Variable methods
Introduction, State variable representation, conversion of state variable model to transfer function, conversion of transfer function to canonical state variable models, solution of state equations, concept of controllability and observability, Controllability and Observability tests.

Unit VI:
Controller Design
Stability improvement by state feedback, pole placement design, state regulator design, state observer design, Modern control strategies as MPC, optimal control.

List of Practicals:

1. Write a Program for obtaining a transfer function from the given poles and zeros and vice versa. Stability of the system from pole-zero plot.
2. Write a Program to obtain impulse, step, and ramp response of a transfer function.
3. Write a Program for obtaining transient response of a transfer function and compute time domain specifications of the same.
4. Derive transfer function of a typical RLC circuit, using MATLAB/SCILAB/PYTHON obtain its impulse and step response
5. For a RLC circuit analyze the step response for identifying damping (overdamped, underdamped, critically damped, undamped)of the system using MATLAB/SCILAB/PYTHON
6. Write a Program for obtaining root locus of a transfer function and observe the effect of addition of pole/zero.
7. Design Lag compensator using root locus. Compare the response of compensated and uncompensated system
8. Design Lead compensator using root locus. Compare the response of compensated and uncompensated system
9. Design Lag-Lead compensator using root locus. Compare the response of compensated and uncompensated system
10. Write a Program for obtaining Bode plot of a transfer function and compute frequency domain specifications of the same.
11. Write a program to obtain state space model and step response of the system

List of Tutorials :

1. For a physical system obtain the differential equation and the transfer function of the system.
2. For a electrical system using signal flow graph derive the transfer. Deriving closed loop transfer function of the given signal flow graph.
3. Compute the Impulse response of the given system. Compute the step response of the given system
4. Computation of time domain characteristics of the first and second order system.
5. Determining the system error for the given input.
6. Analyze the stability of the higher order systems.
7. Sketch the root locus of the given system.
8. Construct the Bode plot of the system and determine the frequency domain characteristics.
9. Identify the state variables of the system and convert to / from transfer function.
10. Determining controllability and observability of the system.

List of Project areas:

1. Deriving transfer function of a real life system- any process loop, DC motor, inverted pendulum
2. System identification of a typical process using MATLAB.
3. Simulation / Realization of closed loop control system using typical process loop components.
4. Design controller for different application

List of Home Assignments:

1. Finding transfer function of the process loops – temperature and flow
2. Tuning of PID controller by Zeigler Nicholes methods
3. Tuning of PID controller by Cohen Coo methods
4. Tuning of PID controller by IMC methods
5. PID Implementation for temperature loop
6. PID implementation for Flow loop
7. Obtain the controllability and Observability of given system
8. Obtain the stability of given system
9. Design of dead beat controller design
10. Stability analysis by describing function method
11. Controller design using fuzzy logic
12. Controller design using neural network

Assessment Scheme: Course Assessment: Total : 100 mks

1. Mid Semester Examination : 10 marks (Total : 30 marks based on Section I)
   30 marks converted to 10
2. End Semester Examination: 10 marks (Total : 30 marks based on Section II)
   30 marks converted to 10
3. Lab Assessment: Lab Assignments - 10 marks (10 assignments-10 marks each)
   (*100 marks converted to 10)*
4. Course Project : 10 marks (*100 marks converted to 10)*
5. Home Assignment : 10 mks (Total : 100 marks: Case study, Design work, Survey, Blog)
   100 marks converted to 10
6. Viva : 20 mks (at the end of semester); *100 marks converted to 20*
7. Seminar : 15 mks (at the end of Mid semester); *100 marks converted to 15*
8. Group Discussion: 15 mks (at the end of End semester); *100 marks converted to 15*

Text Books Reference Books

1. Modern Control Engineering By K Ogata
2. Control System Engineering by LJ.Nagrath and M. Gopal

Moocs Links and additional reading material:

1. https://nptel.ac.in/courses/108/106/108106098/

Course Outcomes The student will be able to

1. Utilization of Laplace transform for system analysis- finding system transfer function, system response, stability of the system [4](PO1,2,3,4,5, PSO 2)
2. Derive time domain specification and error coefficients for the given system. [3] (PO1,2,3,4,5, PSO 2)
3. Analyze the stability of the given system and obtain the root locus for the same. Design Lag/Lead compensator using Root Locus [5] (PO1,2,3,4,5, PSO 2)
4. Analyze the given system in frequency domain, derive and compute frequency domain specifications. Analysis of system using the bode plot, polar plot, Nyquist plot of the system [5](PO1,2,3,4,5, PSO 2)
5. Analysis of system using the state space domain.[5](PO1,2,3,4,5, PSO 2)
6. Design a control system using state feedback, MP, Optimal control [5] (PO1,2,3,4,5, PSO 2)

FF No. : 654

IC3241 :: INTERNET OF THINGS

Course Prerequisites: Basic programming language, Electronics basics

Course Objectives:

1. To understand the basics of the IOT
2. To understand the architecture of IOT
3. To understand the IOT Communication Technology
4. To understand Cloud communication
5. To understand the implementation of use cases

Credits: 5 **Teaching Scheme Theory : 3** Hours/Week

Tut : 1 Hour/Week

Lab : 2 Hours/Week

SECTION-1:

Physical Design of IOT, Logical Design of IOT, IOT Enabling technologies, IOT Levels & Deployment Templates, 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
Wireless Sensor Networks: WSN Architecture, the node, Connecting nodes, Networking Nodes, Securing Communication WSN specific IoT applications,

Connectivity Technologies and Communication Protocols in IOT RFID: Introduction, Principle of RFID, Components of an RFID system

Logical Design with Python

Embedded suite for IoT Physical device – Arduino / Raspberry Pi Interfaces,Hardware requirement of Arduino / Raspberry Pi

SECTION-2:

Protocol standardization of IOT

Protocols in IOT: CoAP, XMPP, AMQP, MQTT, Communication Protocols: IEEE 802.15.4, Zigbee, 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, IoT cloud providers - AWS IoT, Google Cloud and Azure

Fog Computing, Web Application Messaging Protocol (WAMP), SkyNet IoT Messaging Platform, SDN Cloud Storage Models

Python web application framework – Django

Data Anaytics for IOT: Overview of Hadoop Ecosystem, MapReduce Architecture

List of Tutorials: (Any Three)

1. OT basic building blocks
2. IOT Embedded suit
3. IOT ISO layers
4. IOT protocol suit
5. IOT device protocols
6. IOT securities
7. Smart city
8. Smart factory
9. Connected cars
10. SDN

List of Practicals: (Any Six)

1. Python programming – data type & data structure,
2. Python Programming - functions, File handling, control flow
3. Json format implementation
4. Arduino / Raspberry Pi interface to GSM module
5. Arduino / Raspberry Pi interface to Bluetooth module
6. Arduino / Raspberry Pi interface to Wi-fi module
7. MQTT protocol implementation
8. Django application development
9. Cloud interface
10. Zigbee protocol implementation

List of Projects:

1. IOT system for Agriculture system
2. IOT system for Smart Home automation
3. IOT system for irrigation system
4. Wireless weather monitoring system
5. IOT for SMART city
6. IOT for Retail system
7. IoT for smart parking
8. IOT for healthcare system
9. IOT for Smart building
10. IOT for energy sector

List of Course Group Discussion Topics:

1. IOT protocol standardization
2. IOT system implementation issues
3. IOT embedded requirement
4. Challenges in IOT healthcare system
5. Protocol requirements

List of Course Seminar Topics:

1. Wireless HART protocol
2. IOT Protocol security
3. IOT protocol standardization
4. IOT protocol – Zigbee
5. IOT in Healthcare system
6. WSN protocol and implementation
7. Django application
8. SDN system
9. IOT in retail system
10. Cyber security and IOT

List of Home Assignments:

Design:

1. Design of irrigation system
2. Design of RFID luggage tracking system
3. Design of Cloud system for sensor information tracking
4. Design for WSN for weather monitoring
5. Design of cloud system

Case Study:

1. MQTT used in agriculture
2. WSN used in health care system
3. RFID used in luggage tracking
4. AWS service Raspberry pi used in IOT
5. IOT in Industrial applications

Surveys

1. MQTT protocol used in Industry
2. WSN
3. RFID used in tracking ffered
4. Embedded suit for IOT
5. Cloud services offered

Assessment Scheme: Course Assessment: Total : 100 mks

1. Mid Semester Examination : 10 marks (Total : 30 marks based on Section I) *30 marks converted to 10*
2. End Semester Examination: 10 marks (Total : 30 marks based on Section II) *30 marks converted to 10*
3. Lab Assessment: Lab Assignments - 10 marks (10 assignments-10 marks each) (*100 marks converted to 10)*
4. Course Project : 10 marks (*100 marks converted to 10)*
5. Home Assignment : 10 mks (Total : 100 marks: Case study, Design work, Survey, Blog) *100 marks converted to 10*
6. Viva : 20 mks (at the end of semester); *100 marks converted to 20*
7. Seminar : 15 mks (Before the Mid of semester); *100 marks converted to 15*
8. Group Discussion: 15 mks (Before the End of semester); *100 marks converted to 15*

Text Books:

1. Arshdeep Bahga, Vijay Madisetti, "Internet of Things – A hands-on approach", Universities Press, 2015
2. Raj Kamal, "Internet of Things: Architecture and Design Principle,s", McGrawHill Education,2017

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 Hakima Chaouchi, " The Internet of Things Connecting Objects to the Web" ISBN : 978-1- 84821- 140-7, Willy Publications
3. 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
4. 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.
5. Fang Zhaho, Leonidas Guibas, "Wireless Sensor Network: An information processing approach", Elsevier, ISBN: 978-81-8147-642-5.
6. 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 7. Bernd Scholz-Reiter, Florian Michahelles, "Architecting the Internet of Things", ISBN 978-3-642-19156-5 e-ISBN 978-3-642-19157-2, Springer

Moocs Links and additional reading material:

1. www.nptelvideos.in

Course Outcomes:

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

CO PO Map:

CO1- (PO 1, 2, 3, 4, 12) (PSO 2, 3)
CO2- (PO 1, 2, 3, 4, 5, 12) (PSO 2, 3)
CO3-(PO 1, 2, 3, 4, 5, 12) (PSO 2, 3)
CO4- (PO 1, 2, 3, 4, 12) (PSO 2, 3)
CO5- (PO 1, 2, 3, 4, 5, 12) (PSO 2, 3)
CO6- PO 1, 2, 3, 4, 12) (PSO 2, 3)

CO attainment levels:

CO1- 1
CO2- 2
CO3- 3
CO4- 3
CO5- 4
CO6- 5

Future Courses Mapping:

1. Big Data Analytics
2. Cyber security
3. AR/VR
4. Data Analytics
5. AI

Job Mapping:

1. Process Industry
2. Manufacturing Industry
3. Software industry

FF No. : 654

IC3243 :: ARTIFICIAL INTELLEGIENCE AND MACHINE LEARNING

Credits: 5 **Teaching Scheme Theory : 3** Hours/Week
Tut : 1 Hour/Week
Lab : 2 Hours/Week

Section 1 :

[IC3243_CO1, IC3243_CO2, IC3243_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.

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

Section 2:

[IC3243_CO3, IC3243_CO4, IC3243_CO5, IC3243_CO6]

Linear Regression with One Variable: Concept of Linear regression, application of linear regression, cost function, introduction to the gradient descent method for learning. Logistic Regression: Classification, Hypothesis Representation, Decision Boundary, Cost Function, Simplified Cost Function and Gradient Descent,

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:

1. Experimentation to write a code for Forward chaining, backward chaining.
2. Write programme on Search, using heuristics, graph heuristics
3. Experimentation on algorithm for Game search
4. Experimentation on evaluating k-nearest neighbors
5. Evaluate neural nets for NLP application.
6. Evaluate a linear regression on a random data set with single regression
7. Evaluate a linear regression on a random data set with multiple regression
8. Implement Polynomial regression for given application
9. Implement logistic regression for given application

10. Validation of gradient descent algorithm
11. Evaluate the effect of changing the decision boundary for logistic regression
12. Back propagation algorithm for data classification
13. Develop algorithm for data classification
14. Implement feed-forward network in NN for given application
15. Implement back propagation algorithm in NN for given application
16. Application of neural networks to classification
17. Neural net for nonlinear process control application.
18. Analysis of SVM for OCR
19. 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

Assessment Scheme: Course Assessment: Total : 100 mks

1. Mid Semester Examination : 10 marks (Total : 30 marks based on Section I)
   30 marks converted to 10
2. End Semester Examination: 10 marks (Total : 30 marks based on Section II)
   30 marks converted to 10
3. Lab Assessment: Lab Assignments - 10 marks (10 assignments-10 marks each)
   (*100 marks converted to 10)*
4. Course Project : 10 marks (*100 marks converted to 10)*
5. Home Assignment : 10 mks (Total : 100 marks: Case study, Design work, Survey, Blog)
   100 marks converted to 10
6. Viva : 20 mks (at the end of semester); *100 marks converted to 20*
7. Seminar : 15 mks (Before the Mid of semester); *100 marks converted to 15*
8. Group Discussion: 15 mks (Before the End of semester); *100 marks converted to 15*

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
4. S. Rogers and M. Girolami, A First Course in Machine Learning, 2nd edition, Chapman & Hall/CRC 2016, ISBN: 9781498738484.
5. K. Murphy, "Machine Learning: A Probabilistic Perspective" MIT Press 2012.
6. D. Barber, Bayesian Reasoning and Machine Learning Cambridge University Press 2012.
7. C. Bishop, Pattern Recognition and Machine Learning, Springer 2011.

Course Outcomes :

The student will be able to -

1. IC3243_CO1: Examine the useful search techniques; learn their advantages, disadvantages [3] (PO1, PO3)
2. IC3243_CO2: Be able to develop intelligent systems. [2] (PO1, PO3)
3. IC3243_CO3: Learn the practical applicability of intelligent systems, specifically its applications. [3] (PO1, PO3)
4. IC3243_CO4: Understand important concepts like Expert Systems, AI applications[3] (PO1, PO3)
5. IC3243_CO5: Apply the ML algorithms for various applications [3] (PO1, PO3)
6. IC3243_CO6: Comprehend a wide variety of learning algorithms[4] (PO1, PO3)

FF No. : 654

IC3245 ::CYBER SECURITY

Credits: 5 **Teaching Scheme Theory : 3** Hours/Week
Tut : 1 Hour/Week
Lab : 2 Hours/Week

SECTION 1:

Unit I

What is cybersecurity? Need for cybersecurity? Components of cyber security for IT.
Introduction to networks, Network components, network architecture and topology, OSI and ISO models and functions, IEEE802.3, networking devices and servers
Basics of Computer Networks Security: Essential Terminology, Elements of Information Security, Types of Hackers, Steps for Ethical hacking, Types of Attacks, Steganography, Cryptography, Nice 2.0 Framework to be used as the guiding principle for Cyber Security

Unit II

Difference between OT and IT security. Understanding of IT and OT network. Purdue model defines OT mark, NIST cyber security recommended, Standards ISA 62443, AIC-OT, 800-py3
Zero trust- Communication from PLC to HMI due diligence.
Active information gathering, passive information gathering, Trace route, Interacting with DNS Servers, SNMP and SMTP attacks. Port Scanning, Target Enumeration and Port Scanning Techniques: Scanning for Open Ports and Services, Types of Port Scanning, Firewall/IDS Evading.
Penetration Testing types and tools
Physical Security Perimeter defenses, Asset management, asset security, Ex DCS-server in DCS system, Asset classification and handling, Next generation Firewalls – Multifactor authentication firewalls , Paulo alto, MODBUS: port opening

Unit III

Introduction to Attacks and Hacking: Vulnerabilities, Threats, Threat Modeling, Risk, attack and attack types, Avoiding attacks, Security services. Trustworthiness
Ethical issues and practices, Tradeoffs of balancing key security properties - Confidentiality, Integrity, and Availability. Protocol Vulnerabilities: DoS and DDoS, session hijacking, ARP spoofing, Pharming attack, Dictionary Attacks.
Software vulnerabilities: Phishing, buffer overflow, Cross-site scripting attack, Virus and Worm Features, Trojan horse, Social engineering attacks, ransomware, SYN-Flooding, SQL-injection, DNS poisoning, Sniffing

SECTION 2 :

Unit IV

Private key cryptography: Mathematical background for cryptography: modulo arithmetic, GCD (Euclids algorithm), algebraic structures (Groups, Rings, Fields, Polynomial Field). Role of random numbers in security, Importance of prime numbers

Data Encryption Standard: Block cipher, Stream cipher, Feistel structure, round function, block cipher modes of operation, S-DES, Attacks on DES, S-AES, AES.

Unit V

Public key cryptography: RSA: RSA algorithm, Key generation in RSA, attacks on RSA. Diffie-Hellman key exchange: Algorithm, Key exchange protocol, Attack. Elliptic Curve Cryptography (ECC): Elliptic Curve over real numbers, Elliptic Curve over Zp, Elliptic Curve arithmetic. Diffie-Hellman key exchange using ECC.

Security model: Bell Lapadola model

Unit VI

Authentication and Authorization:

OT authentication: Authentication, Access and what level of access, DID –Defense in depth Network Access Control, Extensible Authentication Protocol, SHA-512, Kerberos, X.509 authentication service IP Security, Database Security

Transport-Level Security: Web Security Considerations, Secure Sockets Layer, Transport Layer Security, HTTPS standard, Secure Shell (SSH) application

Cloud Security: PAAS, SAAS, IAAS, Platform as a service PAAS, IAAS, Example: AWS

Security Risk Management: Local Regulations, ethics in due care and diligence and risk management Ethics, Merger and acquisitions, Diligence, Liabilities, Policies and procedures-mission statement, flow of procedures, maintenance of industrial control system, disaster recovery policy and back up policy.

List of Labs: (Any 6)

1. Study the use of network tools like WHOIS, dig, traceroute, nslookup to gather information about networks and domain registrars.
2. Study of packet sniffer tools like wireshark, ethereal, tcpdump etc. Use the tools to do the following
   i Observer performance in promiscuous as well as non-promiscous mode.
   ii Show that packets can be traced based on different filters.
3. Download and install nmap. Use it with different options to scan open ports, perform OS fingerprinting, do a ping scan, tcp port scan, udp port scan, etc.
4. Detect ARP spoofing using open-source tool ARPWATCH.
5. Use the Nessus tool to scan the network for vulnerabilities
6. Implement a code to simulate buffer overflow attack.
7. Perform encryption, decryption using the following substitution techniques
   i. Ceaser cipher ii. Playfair cipher
   iii. Hill Cipher iv. Vigenere cipher

8. Perform encryption and decryption using following transposition techniques
   i. Rail fence ii. Row & Column Transformation
9. Implement RSA Algorithm using HTML and JavaScript
10. Implement the Diffie-Hellman Key Exchange algorithm for a given problem.
11. Automated Attack and Penetration Tools Exploring N-Stalker, a Vulnerability assessment Tool
12. Calculate the message digest of a text using the SHA-1 algorithm.
13. Develop a program for port scanning using any tool
14. Develop a program for penetrating testing using any tool
15. Implement and simulate different topology using any simulation tool
16. Implement port sniffing using any simulation tool

List of Course Seminar Topics:

1. Blockchain architecture and its implementation
2. Cloud Security
3. IoT and Security Issues/ Security Models for IoT
4. Docker Security
5. Access control methods for online social media and various organizations
6. Machine learning and SCADA Security
7. Security Applications for Smart Cities
8. IC62443 standard
9. Enterprise OT SOC
10. SIEM software
11. Build IC 6244C security
12. STUXNET- Case study Ex. Iran – Siemens
13. Detailing top cyber attacks in industrial domain
14. TRITAN emergency safety shut down systems
15. TOP 3 cyber attacks on OT
16. Block chain implementations in industry : White papers
17. OT Cyber security for building automation

List of Course Group Discussion Topics:

1. Security Issues in Android and IOS devices
2. Industry 4.0 and security
3. Blockchain and E-voting system
4. Security of Aadhar Card and other digital cards
5. Automated Home Appliances and Security
6. Programming Bugs and Malicious code in information security
7. Indian Cyber laws and Deficiencies
8. Social Media and Cyber Security
9. Child abuse on online social media and security
10. Need of cyber crime and security in school education.

List of Home Assignments:

Design:

1. Design a secure system using cryptography techniques for security of multimedia files.
2. Design a secure system using steganography for hiding data files in image/video
3. Design a system for educational institutes using authentication and authorization techniques, also give details about the access control policies that must be implemented for the design of system by various places.
4. Design a secure system using SSL/TLS/IPSec for the various organizations
5. Design a system for the analysis of cyber crime using various cyber forensic techniques and compare each technique with respect to integrity, confidentiality, availability

Case Study:

1. How to improve the security of social media? Write a detail case study
2. Find out the vulnerability issues in educational institutes websites/online systems and give solutions to these problem. Perform a detailed case study of the various issues.
3. Write a detail case study about the banking security flows and solutions to these flows.
4. Give a detail case study of the antivirus system giving the flows and solutions to it.
5. Perform the detail case study of various operating systems used for mobile devices and give a secure solution to one for widely used OS.

Blog:

1. Dark Web
2. Crypto currency and Economy
3. Cyber crime and solutions
4. Authentication and Access control for social media
5. Cyber forensic and Cyber laws

Surveys:

1. Survey on various blockchain related issues/ cryptocurrency/ application systems developed using blockchain
2. Survey on various authentication and access control methods for different applications
3. Steganography and Biometric Systems for authentication
4. Survey of various attacks and its effect on Indian economy and its analysis
5. Problems over Integer Lattices: A Study

Assessment Scheme: Course Assessment: Total : 100 mks

1. Mid Semester Examination : 10 marks (Total : 30 marks based on Section I)
   30 marks converted to 10
2. End Semester Examination: 10 marks (Total : 30 marks based on Section II)
   30 marks converted to 10
3. Lab Assessment: Lab Assignments - 10 marks (10 assignments-10 marks each)
   (*100 marks converted to 10)*
4. Course Project : 10 marks (*100 marks converted to 10)*
5. Home Assignment : 10 mks (Total : 100 marks: Case study, Design work, Survey, Blog)
   100 marks converted to 10
6. Viva : 20 mks (at the end of semester); *100 marks converted to 20*
7. Seminar : 15 mks (Before the Mid of semester); *100 marks converted to 15*
8. Group Discussion: 15 mks (Before the End of semester); *100 marks converted to 15*

Text Books:

1. William Stallings; "Cryptography and Network Security-Principles and Practices" 6th Edition , Pearson Education, 2014, ISBN13:9780133354690.
2. Bernard Menezes, "Network Security and Cryptography", 1st Edition, Cengage Learning, 2010, ISBN 81-315-1349-1.
3. Raef Meeuwisse, "Cybersecurity for Beginners", 2 nd Edition, Cyber Simplicity, 2017, ISBN- 9781911452157.

Reference Books:

1. M. Speciner, R. Perlman, C. Kaufman, "Network Security: Private Communications in a Public World", Prentice Hall, 2002
2. Michael Gregg, "The Network Security Test Lab: A Step-By-Step Guide", Dreamtech Press, 2015, ISBN-10:8126558148, ISBN-13: 978-8126558148.
3. Matt Bishop, "Computer Security: Art and Science", 1st Edition, Pearson Education, 2002, ISBN0201440997.
4. Charlie Kaufman, Radia Perlman and Mike Spencer, "Network security, private communication in a publicworld", 2nd Edition, Prentice Hall, 2002, ISBN 9780130460196.

Course Outcomes:

1. Understand the concept of cyber and network security
2. Understand the components for OT and IT information gathering
3. Understand the different types of attacks and ethical hacking
4. Apply the concept of cryptography
5. Understand the algorithms for cryptography
6. Understand different types of security for IT and OT

FF No. : 654

IC3247:: SOFTWARE DESIGN PROJECT– III

Guidelines to the students regarding Software Development Project Course

The objectives of these courses are to enhance coding skills and programming ability among the students. To cope up with rapid technology changes, these courses offer every student to learn new-age programming techniques and languages. The focus of these courses is on learning programming fundamentals and techniques.

- Software Development course would be conducted as single student activity.
- Students can choose any software projects to upgrade and enhance their coding skills using any open source tools.
- Complexity of the project should be sufficient and approved by course supervisor.
- Students are allowed to use libraries as needed.
- Major thrust areas of Software Development Project course are Artificial Intelligence / Machine Learning / Data Analytics / Vision based Automation
- A suggestive list of possible domains for SDP is given below
    1. Mobile app development
    2. Responsive Web development
    3. Database / Back end development
    4. MySQL / RDBMS
    5. Gamification
    6. GUI Development
- Mid-Semester review and End Semester Assessment would be conducted.

Course Outcomes: Students will be able to

1. Design solutions for given engineering problem **(1)**
2. Demonstrate practical knowledge by constructing models/algorithms for real time applications (**1)**
3. Express effectively in written and oral communication (**2)**
4. Exhibit the skills to work in a team **(2)**
5. Prepare a time chart and financial record for execution of the project **(3)**

CO-PO Mapping :

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	3	3	2	2	2	2	1	1	2	2	1	1	3
CO2	2	2	2	2	3	1	2	1	1	0	2	1	2	2	3
CO3	1	1	1	1	0	2	1	3	1	3	1	1	1	1	1
CO4	1	0	0	2	0	1	1	2	3	2	1	1	0	1	0
CO5	1	0	0	1	0	2	1	1	2	2	3	2	0	2	2

FF No. : 654

IC3249:: ENGINEERING DESIGN AND INNOVATION - V

Course Prerequisites: Electronic design, simulation, MATLAB, Labview, PCB design

Course Objectives: The student will be able to

1. Understand the importance of choosing socially relevant areas for project work
2. Understand the importance of Project centric learning
3. Plan and execute systematic strategy to complete the Project work
4. Document and present the completed project work in proper scientific format

Credits: 4 **Teaching Scheme Theory:** Hours/Week

Tut: Hours/Week

Lab: 8 Hours/Week

Course Relevance: This course will develop

1. Awareness about project centric learning will be quite useful in professional work in future
2. Self learning ability to up skill and upgrade once knowledge continuously
3. Ability to work in a Team and Team leadership which will be useful while doing B.Tech Major projects

Topics and Contents

It is based on Real time project implementation in the chosen specific defined area.
Agriculture Healthcare Automotive Process Control IoT

Basics for Projects

Importance of Project Centric Learning, Concept of Domains, Tools and Technology**,** Socially Relevant Project Areas

Domain Project Areas: Awareness and identification of appropriate areas for project work such as: Agriculture, Defense, Healthcare, Smart city, Smart energy, Security Systems, Automobile, Space, Green Earth, Automobiles, Assistive Aid, Water Management, Swachh Bharat (any other socially relevant research area)

Tools: *Self learning Activity* Learn and use latest engineering tools as per the project need. A few are listed below

Tools in Computer Engineering:

Programming / Coding Tools :- JavaScript, Python, Java, C#, C++, PHP, **Computer Vision Tools** :- OPENCV,MATLAB), **Single board computers:** Raspberry Pi, **Neural network simulators Tools:- Neural Lab, NEST , Machine Learning Tools:- Torch, TensorFlow, Data Science Tools :-** R language programming**,** SQL,

Tools in Electronics and Electronics & Telecommunication Engineering:

Electronic Design Simulation Integrated Circuit Tools:- VHDL, Xilinx, Modelsim , Cadence learn, **Embedded System Tools**:- AVR Studio, Arduino ,Kiel µvision, **Circuit Simulation Tools:-** Pspice, Simulink, Workbench, Tinkercad, ThingSpeak, Proteus, CircuitPro

,**Processor based integrated circuits** :Microcontroller, electronic prototype platforms: Arduino,**Networking Tools** :- Wired / Wireless and Ad-hoc Networking NS-2 , Packet Tracer, **Signal Processing Tools**:- Code Composer Studio along with Integrated circuits

Tools in Instrumentation and Control Engineering:-

System Automation Tools :- PLC , SCADA , PADS, ORCAD ,Eagle, Kicad,

Tools in Mechanical, Industrial, Production, Engineering:-

Engineering Design Tools:- AutoCAD, CATIA,COMSOL Multiphysics, Solidworks, Inventor, PTC Creo **Fluid Dynamics:-** Fluent, HyperWorks, **Finite Element/ Structural Analysis:-** Ansy's, Ansy's Free Student software **Thermal Simulation:-** FlowTherm, Ansys Icepak

Tools in Chemical Engineering :-

Chemical process simulator:- DWSIM - Open Source Process Simulator, **chemical simulation software:-** Schrödinger,

(any other suitable tool as per the project requirement)

Technology: Map the appropriate technology**:**

Emerging Technologies :- Artifical Intelligence, 5G networks, IoT, Serverless Computing, Blockchain , Virtual reality (VR)/Augmented reality (AR), Drone, Quantum Computing, Robotics

Interdisciplinary Technologies:- Nanotechnology, Nanomaterials, Nanoelectronics, Quantum Computing , Spintronics

Computer Technologies:- Big Data, Cloud Computing, Human Machine Interface (HMI),Cyber Security

Medical and Healthcare Technologies:- Biomedical Technology,

Energy Technologies :- Solar Energy Based Technologies, Wind energy, Green energy Technologies, Energy Storage

Electronics, Communication Technologies:- Wireless, GPS, Bluetooth, Mobile/social Internet Automation, Mobile Technologies, Voice Assistants, signal processing, image processing, Machine vision, Sensors, Optoelectronics,

Other imp Technologies:- Automobile ,3 D printing

(any other technology as per the project requirement)

Project Implementation: Selection of the domain area, Literature review, Identify and finalize the Problem Statement (student in consultation with Guide), Understand and select and use the appropriate tools, Map the technologies learned with the project needs (refer available online offline Resources, books, soft materials, relevant MOOCs, consult with domain expertise) Self Learning:- learn the required tools, skill sets, acquire knowledge to do the project

Designing & Testing: Designing of project prototype based on domain areas by incorporating appropriate tools and technology, validation and Testing of the prototype to give the best possible solution

Documentation and Final Assessment : Develop and demonstrate the optimized prototype /working model of project , Documentation of project report in stipulated standard format as per the preset norms i.e. IEEE Research paper format, Present Project work at final viva voce

Course Outcomes :

1. Design solutions for given engineering problem **(1)**
2. Demonstrate practical knowledge by constructing models/algorithms for real time applications (**1)**
3. Express effectively in written and oral communication (**2)**
4. Exhibit the skills to work in a team **(2)**
5. Prepare a time chart and financial record for execution of the project **(3)**

CO-PO Mapping :

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	3	3	2	2	2	2	1	1	2	2	1	1	3
CO2	2	2	2	2	3	1	2	1	1	0	2	1	2	2	3
CO3	1	1	1	1	0	2	1	3	1	3	1	1	1	1	1
CO4	1	0	0	2	0	1	1	2	3	2	1	1	0	1	0
CO5	1	0	0	1	0	2	1	1	2	2	3	2	0	2	2

SEMESTER II

FF No. : 654

IC3232:: WEB TECHNOLOGY

Credits: 5 **Teaching Scheme Theory : 3** Hours/Week
Tut : 1 Hour/Week
Lab : 2 Hours/Week

Course Objectives:

1. On completion of this course, a student will be familiar with all latest frame works.
2. Apply different modern technologies used for real-time client server application.
3. Develop different attractive and interactive web pages.
4. Familiar with different types of databases.
5. Write Server side code.

Course Relevance: Attractive web design, Client side validation, Server side coding

SECTION-1:

Introduction to HTML 5: New elements, New input types, new attributes, Local Storage, Session Storage, Server sent events, CSS3, Bootstrap JQuery: Introduction to JQuery, loading JQuery, selecting elements, changing styles, creating elements, appending elements, removing elements, handling events, Jquery. AJAX Server side technology and TOMCAT, introduction to servlet, need and advantages, servlet lifecycle, creating and testing of sample servlet, session management. JSP: introduction, advantages of JSP over Servlet, elements of JSP page: directives, comments, scripting elements, actions and templates, JDBC, MongoDB: Introduction, Environment, Create Database, Drop Database, Create Collection, Drop Collection, Read Operations, Write Operations, Data Modelling, Administration.

SECTION-2:

Topics and Contents Web Technology Frameworks: Express Framework: Introduction to Express Framework, Introduction to Nodejs, What is Nodejs, Getting Started with Express, First Express App, Express Routing, Implementing MVC in Express, Middleware, Using Template Engines, Error Handling , API Handling , Debugging, Developing Template Engines, Using Process Managers, Security & Deployment Angular JS: Overview, MVC architecture, Directives, Expression, Controllers, Filters, Tables, Modules, Forms, Includes, Views, Scopes, Services, Dependency injection, Custom directives, Internationalization, NodeJS: Getting started, Node Core, Node Modules, File System, Debugger, Automation and Deployment.

List of Practicals: (Any Six)

1. Design a web page to demonstrate the use of different HTML5 tags.
2. Design a web page to demonstrate the use of CSS3 tags.
3. Design CRUD (Create, Read, Update, and Delete) application using HTML and Jquery.
4. Design application using JQuery to process a simple quiz, checking if the user entered the correct answer and messaging the result.
5. Design a web page using AJAX methods.
6. Write a program to demonstrate the use of servlet request and response as well as doGet() And doPost() methods.

7. Design Registration form with following fields: First Name, Last Name, Username, Password, Address, Contact Number with JSP and using MVC architecture.
8. Design a simple application using Express framework.
9. Design a Login form using AngularJS
10. Build a web app where users can type in a city name and get real-time weather data instantly displayed on their screen using NodeJS and Express.

List of Projects:

Design and deploy web based application using HTML5, CSS, Bootstrap, JQuery, MobgoDB, AngularJS, Nodejs and Express framework.

1. Student Registration System
2. Library Management System
3. Tours and Travel System
4. Online Examination System
5. Online Hotel Management System
6. E-book shop
7. Online Reservation System
8. Online recruitment System
9. Movies management
10. E healthcare system

List of Course Seminar Topics:

1. EJB
2. Bootstrap
3. Spring Framework
4. Joomla
5. Progressive Web Apps
6. Servlet
7. Object Oriented PHP
8. Client side technology
9. Server side technology
10. Web Technology frameworks

List of Course Group Discussion Topics:

1. Cloud Service Models
2. Cloud computing vs. Cluster computing vs. Grid computing
3. Virtualization
4. Cloud file-systems
5. Cloud data stores
6. Databases on Cloud
7. Map-Reduce model for Cloud
8. Data security and Storage for Cloud
9. Application security for Cloud
10. Commercial and business risk and opportunities in Cloud

List of Home Assignments:

Design:
1. Online Banking System
2. School management System
3. Gym management System
4. Online food delivery System
5. Online Movie review management

Case Study:
1. EBay (Online Shopping Cart)
2. Linked in (Social networking site)
3. Uber (Online Cab booking)
4. Yahoo mail (A mail service)
5. Paypal (An online digital cash wallet)

Blog:
1. JSP vs Servlet
2. SQL vs Mongo DB
3. Node JS vs Angular JS
4. Servlet life cycle
5. AJAX

Surveys:
1. MVC Architecture
2. Express Framework
3. Types of Database Connectors
4. Different types of Servers
5. Mongo DB

Assessment Scheme:
Course Assessment: Total : 100 mks
1. Mid Semester Examination : 10 marks (Total : 30 marks based on Section I)
   30 marks converted to 10
2. End Semester Examination: 10 marks (Total : 30 marks based on Section II)
   30 marks converted to 10
3. Lab Assessment: Lab Assignments - 10 marks (10 assignments-10 marks each)
   (*100 marks converted to 10)*
4. Course Project : 10 marks (*100 marks converted to 10)*
5. Home Assignment : 10 mks (Total : 100 marks: Case study, Design work, Survey, Blog)
   100 marks converted to 10
6. Viva : 20 mks (at the end of semester); *100 marks converted to 20*
7. Seminar : 15 mks (Before the Mid of semester); *100 marks converted to 15*
8. Group Discussion: 10 mks (Before the End of semester); *100 marks converted to 15*

Text Books:

1. Thomas Black Book; " JDBC 4.2, Servlet 3.1 & JSP 2.3"; Dreamtech Press, 2016.
2. Adam Bretz & Colin J Ihrig; "Full Stack Javascript Development with MEAN";SPD, 1st Edition, Indian Reprint September 2015.
3. Brad Dayley,"Node.js, MongoDB, and AngularJS Web Development"; Addison-Wesley Professional 2014.
4. Azat Mardanov, Anatoliy Chakkaev;"Express.js Guide: The Comprehensive Book on Express.js: The Comprehensive Book on Express.js"; CreateSpace Independent Publishing Platform 2013

Reference Books:

1. Giulio Zambon; " Beginning JSP, JSF and Tomcat"; 2nd Edition, Apress Publication.
2. Sandeep Panda; "Angular JS: Novice To Ninja"; SPD, 1st Edition, Indian Reprint 2015.
3. Black book; "Web Technologies:HTML,JS,PHP,Java,JSP,ASP.NET,XML and AJAX" ; Dreamtech Press, 2016.
4. Robin Nixon; "Learning PHP, MySQL, JavaScript, CSS and HTML 5";4th Edition, O'Reilly publication.

Moocs Links and additional reading material:

1. JavaScript Tutorial for beginners by Navin Reddy- https://www.youtube.com/watch?V=uDwSnnhl1Ng&list=PLY-UbAd0uV4PnOuWei-D7uZYOxp_Ny7wo
2. Angular JS by Naresh Ithttps://www.youtube.com/watch?v=csG0pwe3O_M&list=PLVlQHNRLflP80qHYWmEFXwBn_3CobbX1q
3. Node JS Tutorials for Beginners by Naresh IT- https://www.youtube.com/watch?v=Yg6AdA5Axb0&list=PLVlQHNRLflP_Pd4-LtOg7OM_rUhJ5pC-I
4. Express JS Tutorial- Ganguly Tech-https://www.youtube.com/watch?v=Q6swmpfzcgY&list=PLNHw_0qv1zy_YmVPmRggL94HmI-3dlGm

Course Outcomes: The student will be able to –

1. Design reliable, efficient, scalable front end view of web pages with HTML5,CSS3 and Bootstrap
2. Apply Jquery concepts for responsive web frontend development.
3. Refine dynamic web pages with JSP, Servlet.
4. Implement frontend and backend scenarios to read, write and update data stored in MongoDB.
5. Build responsive web application using Express framework.
6. Develop front end application using Angular JS.

CO PO Map: CO1- PO3, CO2- PO2, CO3- PO1, CO4- PO11, CO5- PO4, CO6- PO5

CO attainment levels : CO1- 2, CO2-3, CO3-4, CO4-4, CO5-5, CO6-5.

Job Mapping: Web designer, Server side developer

FF No. : 654

IC3234 :: BUILDING AND PROCESS AUTOMATION

Course Prerequisites: Process Instrumentation

Credits: 5 **Teaching Scheme Theory : 3** Hours/Week
Tut : 1 Hour/Week
Lab : 2 Hours/Week

SECTION-1:

DCS Introduction: Location of DCS in Plant, advantages and limitations, Comparison of DCS with PLC, DCS components/ block diagram DCS Architecture Functional requirements at each level, Database management.

DCS Hardware: Controller Details Redundancy, I/O Card Details Junction Box and Marshalling Cabinets Operator Interface, Workstation Layout different types of control panels, types of Operating Station Programming as per IEC 61131-3, Database management, Historical data using in log, report and trend display. System status display.

Database and Alarm management Database management, Historical data using in log, report and trend display.

Network topology : bridges, routers and gateways, Instrumentation and control devices Explain functions of following network devices: Repeater, Hub, Bridge, Switch, Router, Gateway, Access point, Wireless Access points.

Serial data communications: Serial data communications interface standards, balanced and unbalanced transmission lines, RS-232 standard, RS-449 interface standard, RS-423 interface standard, RS-422 interface standard, Comparison.

HART Communication Protocol: Architecture – physical, data link, application layer, communication technique

SECTION-2:

Introduction Fieldbus and ProfiBus Introduction to Foundation Fieldbus : Physical layer and wiring rules Data Link layer Application layer User layer Wiring and installation practice with Fieldbus Termination Preparation ,Installation of the complete system. Introduction to ProfiBus standard: ProfiBus protocol stack Physical layer Data Link layer Application layer

Introduction of building automation: Introduction of Components used in building automation system. Concept and application of Building Management System and Automation. Communication protocols used in Building Automation.

Light Control System Need of Light control in Building Automation. Occupancy sensors and Daylight harvesting methods. Use of DALI communication protocol HVAC system Principles of HVAC system design and analysis. Different components of HVAC system like heating, cooling system, chillers, air circulation, humidifying and dehumidifying processes. Control systems and techniques.

Access Control & Security System Concept of automation in access control system for safety. Manual security system. RFID enabled access control with components like active, passive

cards, controllers, and antennas, Biometric Intrusion alarm system, Components of public access (PA) System like speakers, Indicators, control panels, switches. Design aspects of PA system.

Fire &Alarm System Different fire sensors, smoke detectors and their types.CO and CO2 sensors. Fire control panels. Design considerations for the FA system. Concept of IP enabled Fire & Alarm system. Design consideration of EPBX system and its components.

List of Tutorials: (Any Three)

1) PID tuning using DCS.
2) Design and development of cascade loop using FBD
3) Apply ratio control strategy on heat exchanger loop using FBD.
4) Develop different control strategy using DCS on boiler drum level control.
5) Develop interfacing serial card to DCS.
6) Study different serial communication protocols.
7) Study different HAVC system.
8) Study different access security system.
9) Study different fire security system.
10) Study different light control system.

List of Practicals: (Any Six)

1) Tune Delta –V PID control for any single loop process.
2) Develop feed forward control for SLPC using DCS.
3) Develop cascade control for process loop using DCS.
4) Develop override control for process loop using DCS.
5) Develop split range control for process loop using DCS.
6) Develop ratio control for process loop using DCS.
7) Develop three element drums level control using DCS
8) Develop different boiler interlock using DCS.
9) Develop boiler combustion control using DCS.
10) Develop interfacing serial communication using DCS.
11) Develop HART card communication using DCS.
12) Develop distillation column control using DCS.

List of Projects:

1) To Interfacing of Level/Temperature control loop using Delta-V 4.
2) To develop communication between HART/MODBUS to DCS system
3) To develop simulation of boiler control
4) To develop simulation of distillation column
5) Development of Light control systems
6) Development of Home automation systems
7) Development of Home Security systems
8) Development of CCTV system for Surveillance application
9) Development of Fire Alarm system.
10) Design of PA system for given application

List of Course Seminar Topics:

1. PLC advanced instructions
2. PLC verses DCS
3. DCS Hardware Details
4. DCS workstations
5. DCS alarm management
6. DCS Database management
7. DCS Network Topology
8. DCS Junction boxes and Marshalling cabinets
9. DCS Advanced Function Blocks
10. DCS PID configurations
11. Serial data communications
12. HART communication Protocol
13. Programming as per IEC 61131
14. Recent advancements and future trends in DCS
15. DCS and PLC for ESD

List of Course Group Discussion Topics:

1. Compare performance of foundation fieldbus and profibus
2. Light control in Building Automation
3. Fire & Alarm system automation
4. Compare HART and MODBUS communication for any one application
5. Compare DCS and PLC for Batch process control
6. Design considerations of HVAC system
7. Access Control & Security System automation
8. Latest technology in DCS manufacturing
9. Different mode communication between PLC and DCS
10. Trends in HART protocol
11. EPBX system and its components
12. Sensors used in Building Automation System
13. Actuators used in Building Automation System
14. Wired vs Wireless communication
15. Energy Management System (EMS) and Energy Management Control System (EMCS
16. Communication Protocols used in BAS

Assessment Scheme: Course Assessment: Total : 100 mks

1. Mid Semester Examination : 10 marks (Total : 30 marks based on Section I)
   30 marks converted to 10
2. End Semester Examination: 10 marks (Total : 30 marks based on Section II)
   30 marks converted to 10
3. Lab Assessment: Lab Assignments - 10 marks (10 assignments-10 marks each)
   (*100 marks converted to 10)*
4. Course Project : 10 marks (*100 marks converted to 10)*
5. Home Assignment : 10 mks (Total : 100 marks: Case study, Design work, Survey, Blog)
   100 marks converted to 10
6. Viva : 20 mks (at the end of semester); *100 marks converted to 20*
7. Seminar : 15 mks (Before the Mid of semester); *100 marks converted to 15*
8. Group Discussion: 15 mks (Before the End of semester); *100 marks converted to 15*

List of Home Assignments:

Design:

1. Design of Access control system for different applications
2. Design of Fire control system for different applications
3. Design of FA for different applications
4. Design of CCTV system for Surveillance application
5. Design of Access control system for different applications

Case Study:

1. Access Control & Security System
2. Fire & Alarm System
3. Communication Systems in Building automation
4. DCS Applications
5. Trends in DCS communication protocols

Blog

1. Network Devices
2. Serial data communications
3. MODBUS
4. HART Communication Protocol
5. Fieldbus

Surveys

1. Profibus
2. Components of Building Automation
3. DCS Advanced Function Blocks
4. Light Control System
5. HVAC system

Text Books

1. J. Sinopoli, Smart Buildings, Fairmont Press.
2. B. Capehart, Web Based Enterprise Energy and Building Automation Systems, C.E.M, Editor.
3. Computer Based Process Control", Krishna Kant, Prentice Hall of India.
4. Computer Networks Tannebaum Andrew Pearson, New Delhi, 5th Edition, 2011

Reference Books:

1. N. Budiardjo, Building Automation Beyond the Simple Web Server, Clasma Events, Inc.
2. P. Ehrlich, What is an Intelligent Building?, Building Intelligence.
2. Distributed Computer Control for Industrial Automation", Popovik-Bhatkar, Dekkar Publications

Moocs Links and additional reading material:

1. www.nptelvideos.in

Course Outcomes:

1. IC3234_CO1: Understand working of DCS system [1] (PO 1, 5, PSO 3)
2. IC3234_CO2: Select medium for various types of data transmission. [4]
   (PO 1, 5, 12, PSO 3)
3. IC3234_CO3:Understand the Serial data communications and HART protocol [3]
   (PO12, PSO 3)
4. IC3234_CO4: Choose different sensors and components used in building automation [4]
   (PO 1,2,3,7,11,12, PSO 1,2,3)
5. IC3234_CO2: Design of light control system for real world application automation [3]
   (PO 1,2,3,7,11,12, PSO 1,2,3)
6. IC3234_CO3: Explain the use of HVAC's for different applications [2]
   (PO 1,2,3,4,7, PSO 1,2)

Future Courses Mapping:

Advanced Process Control, Multivariable Control System, etc.

Job Mapping:

Automation engineers are responsible for designing, developing, installing, managing and maintaining process instruments that are used to monitor and control process plants. There are numerous industries that utilize process control equipment and instrumentation systems, including, oil and gas, mining, food & beverages, marine, chemical, petrochemical, fertilizers, pulp and paper, pharmaceuticals, power stations, water/wastewater, etc.

After completion of the course, the student who wish to build a career in the process automation and building automation domain can work as design engineer, application engineer, calibration engineer, control engineer, installation and commissioning engineer, maintenance engineer in above mentioned industry verticals and also with system integrators, consulting firms, project divisions, etc.

FF No. : 654

IC3236 :: COMPUTER NETWORKS

Prerequisites: Computer Fundamentals and C/C++ or Python Programming Language Course

Course Objectives:

1. The Students are expected to learn the basics of Computer network Technologies which will help them to build Network fundamentals.
2. The course is designed to let students demonstrate an understanding of the fundamentals of types of transmission mediums and interfacing standards along with the current edge of the data communication techniques.
3. The Student will learn flow control and error control techniques and Computer Network protocols at Conceptual level.
4. The Students will learn to implement the client Server Architecture as the current Internet needs.
5. Study of IoT wireless technologies and their use cases: LPWANs, Cellular (3G/4G/5G), Zigbee and Other Mesh Protocols, Bluetooth and BLE, Wi-Fi, RFID, Cloud storage / computing infrastructure
6. The Student will learn the Implementation of application levels protocols.

Credits: 5 **Teaching Scheme Theory : 3** Hours/Week
Tut : 1 Hour/Week
Lab : 2 Hours/Week

Course Relevance: This Computer Network Course will teach all the fundamentals about Computer Networking; from explaining Computer Networks basics, communication models and detailed lectures on Layers of a network

SECTION-1:

Unit 1: Overview of Data Communication and computer network

Basics of data communication, role of standards and protocols, important physical standards: typical serial data communications link, purpose of instrumentation and control system, important control devices: Graphical representation of data communications Baseband and broadband transmission, factors affecting transmission speed:

Basic components of a communication system

Digital Representations of Data, Synchronous and Asynchronous Data communication

Data Rate, Channel Capacity, Error Rate, Noise. Nyquist Sampling Rate, Shannon Channel Capacity, SNR.

Line Coding: Unipolar NRZ, Polar NRZ, NRZ Inverted, Bipolar Encoding, Manchester Encoding, Differential Manchester Encoding.

Introduction To Computer Networks, Definition, Types of Networks

Network Models: The OSI Reference Model, TCP/IP Model, Network Topologies, Types of Transmission Medium.
Network Architectures: Client-Server, Peer To Peer, Hybrid.
Network Devices: Bridge, Switch, Router, Gateway, Access Point.

Unit 2: Modems and Multiplexers

Modes of operation of a modem, Describe the different methods of modulation: AM, FM, PAM, PWM, PPM, PPM,ASK, FSK, PSK,
Components of a modem: transmitter and receiver
Data compression techniques Run length encoding, Adaptive frequency encoding, enhanced data compression, Huffman encoding
Multiplexing: TDM, FDM, etc. Frequency Hopping (FHSS) and Direct Sequence Spread Spectrum (DSSS).

Unit 3: Data Link Layer

Introduction, functions. Design Issues: Services to Network Layer, Framing.
ARQ strategies: Error Detection and correction, Parity Bits, Hamming Codes (11/12-bits) and CRC.
Flow Control Protocols: Unrestricted Simplex, Stop and Wait, Sliding Window Protocol.
WAN Connectivity: PPP and HDLC.
MAC Sub layer: Multiple Access Protocols: Pure and Slotted ALOHA, CSMA, WDMA, CSMA/CD, CSMA/CA,
Introduction to Ethernet IEEE 802.3

SECTION-2:

Unit 4: Wireless Communications Technologies and Networking

Radio spectrum international telecommunication union (ITU), Microwave basics, Wireless networking components, Introduction to satellite communication.
Types of IoT wireless technologies and their use cases: Low Power Wide Area Networks (LPWANs), Cellular Network 3G, 4G & 5G, Zigbee and Other Mesh Protocols, Bluetooth and BLE, Wi-Fi, RFID, IRDa.
Cloud storage /computing infrastructure

Unit V: Network Layer, Introduction: Functions of Network layer. Switching
Techniques: Circuit switching, Message Switching, Packet Switching. IP Protocol:
Classes of IP (Network addressing), IPv4 , IPv6, Network Address Translation, Sub-netting , CIDR. Network layer Protocols: ARP, RARP, ICMP, IGMP. Network
Routing and Algorithms: Static Routing, Dynamic Routing, Distance Vector Routing, Link State Routing, Path Vector. Routing Protocols: RIP, OSPF, BGP, MPLS. Routing in MANET: AODV, DSR, Mobile IP.

Unit VI: Transport & Application Layer

Transport Layer Process to Process Delivery, Services, Socket Programming. Elements of Transport Layer Protocols: Addressing, Connection establishment, Connection release, Flow control and buffering, Multiplexing, Congestion Control.
Transport Layer Protocols: TCP and UDP, SCTP, RTP, Congestion control and Quality of Service (QoS), Differentiated services, TCP and UDP for Wireless networks.

Application Layer

Introduction, Web Caching, Standard Client Server Protocols: World Wide Web and HTTP, FTP, Electronic Mail, Telenet, SSH, DNS. SMTP, MIME, POP3, Webmail, DHCP, Network Management: Introduction, SNMP.

List of Tutorials: (Any Three)

1) Examples and analysis of Unipolar NRZ, Polar NRZ, NRZ Inverted, Bipolar Encoding, Manchester Encoding, Differential Manchester Encoding
2) Examples and analysis on Modulation and demodulation techniques
3) Examples on network performance parameters : RTT, Delay, Bandwidth, Throughput and efficiency
4) Analyze packet formats of Ethernet, IP, TCP and UDP
5) Data Compression Algorithms
6) Frequency Hopping Spread Spectrum (FHSS) and Direct Sequence Spread Spectrum (DSSS) used in broadband communication
7) Home automation

List of Practicals: (Any Six)

1. Simulation of data communication using Cisco Packet tracer
2. Demonstration of modulation techniques
3. Demonstration Multiplexer techniques
4. Setting up small computer networks
5. Network simulation using Cloudsim
6. Linux Commands for testing connectivity and transfer rates
7. Setup a wired LAN using Layer 2 Switch. It includes preparation of cable, testing of cable using line tester, configuration machine using IP addresses, testing using PING utility and demonstrating the PING packets captured traces using Wireshark Packet Analyzer Tool
8. Demonstrate the different types of topologies and types of transmission media by using a packet tracer tool
9. Setup a WAN which contains wired as well as wireless LAN by using a packet tracer tool. Demonstrate transfer of a packet from LAN 1 (wired LAN) to LAN2 (Wireless LAN)
10. Write a program for error detection and correction for 7/8 bits ASCII codes using Hamming Codes or CRC
11. Write a program to simulate Go back N and Selective Repeat Modes of Sliding Window Protocol in Peer-to-Peer mode
12. Write a program to demonstrate Sub-netting and find subnet masks
13. Write a program to implement link state /Distance vector routing protocol to find suitable path for transmission
14. Use packet Tracer tool for configuration of 3 router network using one of the following protocol RIP/OSPF/BGP
15. Write a program using TCP socket for wired network for following: (a.) Say Hello to Each other (b.) File transfer (c.) Calculator

16. Write a program using UDP Sockets to enable file transfer (Script, Text, Audio and Video one file each) between two machines
17. Write a program using UDP Sockets to enable file transfer (Script, Text, Audio and Video one file each) between two machines
18. Study and Analyze the performance of HTTP, HTTPS and FTP protocol using Packet tracer tool
19. Capture packets using Wireshark

List of Projects:

1. Communication Systems Using Python
2. Python networking projects
3. Start Sending Data Over Long Distance using Arduino via Wired and Wireless Connection and extend Arduino Capabilities
4. Arduino SMS Sending Motion Detector using Python
5. CAN bus implementation or simulation
6. Power Line Data Communication
7. Cryptography / Steganography for secured data communication
8. Green Communications for Future Vehicular Networks
9. UAV-Assisted Data Collection
10. Vehicle speed measurement system
11. Vision based measurement system
12. MODBUS simulation
13. BLE simulation
14. Home automation
15. Develop a tool fox for modulation and demodulation methods
16. Implementation of RIP/OSPF/BGP using Packet Tracer
17. Simulation of routing protocol using Packet Tracer/ NS3/OMNet
18. USB to RS232 serial communication or vice versa
19. Simulation of modulation and demodulation for digital telephone lines
20. Simulation of modulation and demodulation for Ethernet Network
21. Simulation of modulation and demodulation for 3G/ 4G for mobile networks
22. Develop a tool for line encoding methods
23. Design and deploy TCP based Multithreaded HTTP client server
24. Design and deploy UDP based Multithreaded TFTP client server
25. Design and deploy TCP based Multithreaded SMTP and POP3 mail client server
26. Design and deploy TCP based Multithreaded Chat client server
27. Cloud Computing
28. Illustrate the steps for implementation of S/MIME email security through Microsoft® Office Outlook.
29. To study the SSL protocol by capturing the packets using Wireshark tool while visiting any SSL secured website (banking, e-commerce etc.).

List of Course Seminar Topics:

1. Real-Time Wireless Communications for Industrial Automation
2. Efficient use of cloud computing for geospatial data processing in the Internet of Things
3. Power line data communication
4. Drone enabled Data Communication for Internet of Things (DDC-IoT) as a data communication solution for IoT networks
5. Real-Time Air-To-Ground Data Communication Technology of Aeroengine Health Management System with Adaptive Rate in the whole Airspace
6. Orthogonal Chirp Division Multiplexing for Baseband Data Communication Systems
7. Optimised Routing and Compressive Sensing Based Data Communication in Wireless Sensor **Network**
8. LiFi
9. Emerging trends such as Time Sensitive Networking (TSN), Edge Computing, Virtualization and IIoT
10. Edge computing network
11. APP and IOT communication
12. Convergence of Networking and Cloud/Edge Computing: Status, Challenges, and Opportunities
13. Green Communications for Future Vehicular Networks: Data Compression Approaches, Opportunities, and Challenges
14. Joint Design of Sensing and Communication Systems for Smart Homes
15. Compute-Less Networking: Perspectives, Challenges, and Opportunities
16. UAV-Assisted Data Collection for Ocean Monitoring Networks
17. Energy-Efficient Monitoring of Fire Scenes for Intelligent Networks
18. AI-Empowered Maritime Internet of Things: A Parallel-Network-Driven Approach
19. data communication and networking issues in real world
20. A Secured Data Communication Scheme for Mobile Ad-Hoc Networks
21. Five Generation (5G) mobile wireless communication system
22. Ultra-Reliable and Low Latency Communications (URLLCs)
23. IP Addressing using IPv6
24. Implementation for campus network
25. Cloud Computing

List of Course Group Discussion Topics:

1. Energy-Efficient Architectures For Communication System
2. Satellite Communication System
3. Data Communication in Software Defined Networks
4. Cognitive Radios for Future Communication Frameworks
5. Fast Ethernet (Encoding Framing, Modulation, Multiplexing, Diameter etc)
6. Gigabit Ethernet (Encoding Framing, Modulation, Multiplexing, Diameter etc)
7. 10G Ethernet (Encoding Framing, Modulation, Multiplexing, Diameter etc)
8. IEEE 802.11b protocol based on HR-DSSS for wireless physical layer standard
9. IEEE 802.11g protocol based on ERP-OFDM for wireless physical layer standard
10. IEEE 802.11n protocol based on HT-OFDM for wireless physical layer standard

11. Enhanced Mobile Broadband (e-MBB) and massive Machine Type Communications (mMTC).
12. Industrial Network Considerations
13. Network operating systems and architectures
14. Cryptography / Steganography for secured data communication
15. MIMO Technology For Wi-Fi
16. Underground and underwater data Communications
17. Transmission technologies for 4G mobile networks
18. Transmission technologies for 5G mobile networks
19. Autonomous systems in the Internet
20. Hyperspectral Data Communication
21. Application Protocols and its security

List of Home Assignments:

Design:

1. Design a communication framework for irrigation system
2. Design a communication framework for automated car
3. Design a communication framework for smart city applications
4. RIP Routing Protocol for Intranet in VIT campus
5. OSPF Routing Protocol for Internet on India
6. BGP Routing Protocol for Asia continent
7. Hyperspectral Camera
8. Cloud Computing

Case Study:

1. WiTricity technology for industrial applications
2. Multiple access schemes implemented in 4G mobile networks
3. Ultra-Reliable and Low Latency Communications (URLLCs)
4. Transmission technologies for 4G mobile networks
5. Transmission technologies for 5G mobile networks
6. Hyperspectral Camera
7. Cloud Computing
8. 5G Cellular Network

Blog:

1. Journey of line encoding methods
2. Journey of modulation techniques
3. Internet Logical Addressing

4 Internet Routing Protocols

5. Ultra-Reliable and Low Latency Communications (URLLCs)
6. Cloud Computing

Surveys:

1. Analogy to digital transformations on communication systems
2. Routing protocols for MANET
3. IEEE 802.1 Physical layer standard for Internet
4. IEEE 802.15.4 standard for IoT applications

5. IEEE 802.11 Wireless Standards for Wi-FI
6. Hybrid Networks
7. Cloud Computing

Assessment Scheme:

Course Assessment: Total : 100 mks

1. Mid Semester Examination : 10 marks (Total : 30 marks based on Section I)
   30 marks converted to 10
2. End Semester Examination: 10 marks (Total : 30 marks based on Section II)
   30 marks converted to 10
3. Lab Assessment: Lab Assignments - 10 marks (10 assignments-10 marks each)
   (*100 marks converted to 10)*
4. Course Project : 10 marks (*100 marks converted to 10)*
5. Home Assignment : 10 mks (Total : 100 marks: Case study, Design work, Survey, Blog)
   100 marks converted to 10
6. Viva : 20 mks (at the end of semester); *100 marks converted to 20*
7. Seminar : 15 mks (Before the Mid of semester); *100 marks converted to 15*
8. Group Discussion: 15 mks (Before the End of semester); *100 marks converted to 15*

Text Books:

1. John Park, Steve Mackey, Edwin Wright, Practical Data Communications for Instrumentation and Control, Elsevier Publication
2. Fourauzan B., "Data Communications and Networking", 5th edition, Tata McGraw- Hill, Publications, 2006
3. Andrew S. Tanenbaum, “Computer Networks”,5th Edition, PHI, ISBN 81-203-2175-8.
4. Kurose, Ross “Computer Networking a Top Down Approach Featuring the Internet”, Pearson; 6th edition (March 5, 2012), ISBN-10: 0132856204

Reference Books:

1. Matthew S. Gast “802.11 Wireless Networks”, O’Reilly publications; 2nd Edition.
2. C. Siva Ram Murthy and B. S. Manoj, “Ad Hoc Wireless Networks: Architectures and Protocols” Prentice Hall, 2004
3. Holger Karl and Andreas Willig, “Protocols and Architectures for Wireless Sensor Networks”, Wiley, ISBN:0-470-09510-5
4. L. Peterson and B. Davie, “Computer Networks: A Systems Approach”, 5th Edition, Morgan-Kaufmann, 2012.
5. Douglas E. Comer & M.S Narayanan,”Computer Network & Internet”, Pearson Education

Moocs Links and additional reading material:

1. www.nptelvideos.in
2. https://www.udemy.com/
3. https://www.coursera.org/
4. https://swayam.gov.in/

Course Outcomes:

The students are able to:

CO1: Summarize fundamental concepts of Computer Networks, architectures, protocols and technologies

CO2: Illustrate the working and functions of data link layer

CO3: Analyze the working of different routing protocols and mechanisms

CO4: Implement client-server applications using sockets

CO5: Illustrate role of application layer with its protocols, client-server architectures

CO6: Select IoT wireless technologies for various applications

CO PO Map :

CO/ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	1	-	1	2	2	1	-	-	-	-	1	1	2	2	1
CO2	1	1	1	1	1	-	1	-	-	1	-	-	-	1	2
CO3	3	1	2	1	2	-	-	-	-	-	-	1	-	2	1
CO4	1	2	1	2	2	-	-	-	1	-	1	1	2	2	-
CO5	1	3	-	-	1	-	1	1	-	-	-	-	2	1	-
CO6	1	-	2	1	-	1	-	-	-	-	-	1	1	2	1

CO attainment levels :

CO NO	CO1	CO2	CO3	CO4	CO5	CO6
Attainment level	**2**	**1**	**2**	**2**	**1**	**3**

Future Courses Mapping:

High Speed Networks, Wireless Networks, Mobile Networks, Cyber Security, Network Security And Information System, Cloud Computing And Security

Job Mapping:

Data Communication Engineer, Network Analyst, Communication Associate, IT Service Delivery Manager, Hardware and Network Engineer, Network Stack Developers, Application Developer, Data Engineer, Computer Network Architect, Line Data Engineer, Network Administrator

FF No. : 654

IC3238 :: DATABASE MANAGEMENT SYSTEMS

Prerequisites: Data structures

Credits: 5

Teaching Scheme Theory : 3 Hours/Week
Tut : 1 Hour/Week
Lab : 2 Hours/Week

SECTION-1 :

Unit 1: Introduction and Data Models

Introduction: Need of Database Management System, Evolution, Data Abstraction, Data Independence, System Architecture of DBMS; Data Models: Entity Relationship (ER) Model, Extended ER Model, Relational Data Model, Object Oriented Data model, Semi-structured Data Model: DTD or XML Schema, Spreadsheet Model, Codd's Twelve Rules for Relational DBMS, Life Cycle of a Relational Database

Unit 2: Database Design Theory

Normalization: Need, Functional Dependency, Inference Rules, FD Closure, Minimal Cover, Decomposition Properties, Normal Forms (upto BCNF), Multi-valued Dependency (4NF), Relational Synthesis Algorithm , Join and Inclusion Dependency, 5NF, DKNF, Trade - off

Unit 3: Query Languages

Formal Relational Query Languages: Relational Algebra, Tuple Relational Calculus; SQL: DDL, DML, Select Queries, Join Queries, Sub-queries; PL/SQL: Procedure, Function, Trigger; Query by Example; Domain Relational Calculus, DCL-Security and Authorization, Date-Timestamp, String and Numerical Functions, Mapping of Relational Algebra to SQL

SECTION-2 :

Unit 4: Storage and Querying

Storage: Storage and File structure, Files with Fixed / Variable Length Records, Hashed Files; Indexing: Indexed Files, Single Level and Multi Level Indexes, B+ Trees; Query Processing: Steps, Algorithms for Selection, Join Operation; Query Optimization: Transformation of Relational Expressions, Choice of Evaluation Plans; Query Execution Cost; SAN, Files with Sparse / Dense Index; Query Processing: Sort Operation, Impact of Indices on Query Performance;

Unit 5&6: Transaction Management and Emerging Trends

Transaction: ACID Properties, Concurrency Control Protocols: Lock-based, Multiple Granularity, Multiversion Scheme; Failure and Recovery; NoSQL: RDBMS vs NoSQL, BASE properties, NoSQL Categories; NewSQL; Emerging Trends: Distributed Databases, Distributed Data Storage, Distributed Query Processing; Parallel Databases, Architectures, Speedup and Scaleup, Decomposition, Data Replication; Time Series Databases, Spatial and Geographic Databases; Design of Core DBMS Functions, Timestamp based Concurrency Control Protocol, ARIES Recovery Technique, Personal Databases

List of Practicals

1. Choose a database system you propose to work on throughout the course. Perform requirements analysis in detail for design of the database. Design an entity-relationship (ER) data model for the selected database system.

2. Convert above ER model to relational model, semi_structured data model. List functional dependencies. Normalize these relations up to 3NF/BCNF.

3. Consider a different database system. List functional dependencies [Include complex business logic.] Apply bottom - up approach using Relational Synthesis Algorithm for design of relational model for the chosen system. Verify decomposition properties.

4. Create tables with appropriate constraints for the relational schema. Create views, indices, and sequence. Alter the schema by adding/removing columns and constraints. Write DML queries.

5. Execute 'SELECT' queries using order by, group by, aggregate functions, having clause, and set operators. Use SQL single row functions for date, time, string etc.

6. Write equijoin, non equijoin, self join and outer join queries. Write queries containing single row / multiple row / corelated subqueries using operators like =, in, any, all, exists etc. Write DML queries containing subqueries. Study a set of query processing strategies.

7. Write meaningful stored procedures in PL/SQL. Make use of cursors and different arguments. Write useful stored functions to perform complex computation. Write row level and statement level triggers in PL/SQL.

8. Implement a small database application for the above system using suitable front end and back end tool. Create a transaction by embedding SQL into an application program. Generate different useful reports.

9. Implementation of a small databse using NoSQL and/or New SQL database system.

Assessment Scheme: Course Assessment: Total : 100 mks

1. Mid Semester Examination : 10 marks (Total : 30 marks based on Section I)
   30 marks converted to 10
2. End Semester Examination: 10 marks (Total : 30 marks based on Section II)
   30 marks converted to 10
3. Lab Assessment: Lab Assignments - 10 marks (10 assignments-10 marks each)
   (*100 marks converted to 10)*
4. Course Project : 10 marks (*100 marks converted to 10)*
5. Home Assignment : 10 mks (Total : 100 marks: Case study, Design work, Survey, Blog)
   100 marks converted to 10
6. Viva : 20 mks (at the end of semester); *100 marks converted to 20*
7. Seminar : 15 mks (Before the Mid of semester); *100 marks converted to 15*
8. Group Discussion: 15 mks (Before the End of semester); *100 marks converted to 15*

Text Books

1. "Database System Concepts", Silberschatz, Korth, Sudarshan, McGraw Hill International Edition, ISBN- 0-07-228363-7, 5th Edition.

2. "Fundamentals of Database Systems", Elmasri, Navathe, Pearson Education, ISBN 81-297-0228- 2, 5th Edition.

3. "Database Systems", Thomas Connolly, Carolyn Begg, Pearson Education, ISBN, 81-7808-861- 4, 3rd Edition.

Reference Books

1. "Database Management Systems", Ramakrishnan, Gehrke, McGraw-Hill International Edition, ISBN 0-07-115110-9, 3rd Edition.

2. "Introduction to database systems", C. J. Date, Narosa Publishing House: 1995, 3rd Edition.

3. "Getting Started with NoSQL: Your guide to the world and technology of NoSQL", by Gaurav Vaish

4. "Understanding the New SQL: A Complete Guide (The Morgan Kaufmann Series in Data Management Systems)", Jim Melton, Alan R. Simon

Course Outcomes: Upon completion of the course, graduates will be able to –

1. Develop a database system using relational database query languages, PL/SQL and NoSQL.

2. Construct refined logical database model with consideration of data semantics and dependency.

3. Design data models to enforce data requirements and operational constraints of an organization.

4. Describe techniques used by a DBMS for data storage, access and query processing.

5. Describe various database system architectures and their functionalities.

6. Formulate alternative queries for given data requirement considering the query evaluation plan.

FF No. : 654

IC3242:: INTERNET OF THINGS

Course Prerequisites: Internet of Things fundamentals

Course Objectives: The student will be able to

1. Understand the importance of choosing socially relevant areas for project work
2. Understand the importance of Project centric learning
3. Plan and execute systematic strategy to complete the Project work
4. Document and present the completed project work in proper scientific format

Credits: 5 **Teaching Scheme Theory : -** Hours/Week
Tut : - Hour/Week
Lab : 10 Hours/Week

Course Relevance: This course will develop

1. Awareness about project centric learning will be quite useful in professional work in future
2. Self learning ability to up skill and upgrade once knowledge continuously
3. Ability to work in a Team and Team leadership

Topics and Contents:
It is based on Real time project implementation in the area of Internet of Things

Course Outcomes :

1. Design solutions for given engineering problem **(1)**
2. Demonstrate practical knowledge by constructing models/algorithms for real time applications (**1)**
3. Express effectively in written and oral communication (**2)**
4. Exhibit the skills to work in a team **(2)**
5. Prepare a time chart and financial record for execution of the project **(3)**

CO-PO Mapping :

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	3	3	2	2	2	2	1	1	2	2	1	1	3
CO2	2	2	2	2	3	1	2	1	1	0	2	1	2	2	3
CO3	1	1	1	1	0	2	1	3	1	3	1	1	1	1	1
CO4	1	0	0	2	0	1	1	2	3	2	1	1	0	1	0
CO5	1	0	0	1	0	2	1	1	2	2	3	2	0	2	2

FF No. : 654

IC3244:: ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

Course Prerequisites: AI-ML fundamentals

Course Objectives: The student will be able to

1. Understand the importance of choosing socially relevant areas for project work
2. Understand the importance of Project centric learning
3. Plan and execute systematic strategy to complete the Project work
4. Document and present the completed project work in proper scientific format

Credits: 5 **Teaching Scheme Theory : -** Hours/Week
Tut : - Hour/Week
Lab : 10 Hours/Week

Course Relevance: This course will develop

1. Awareness about project centric learning will be quite useful in professional work in future
2. Self learning ability to up skill and upgrade once knowledge continuously
3. Ability to work in a Team and Team leadership

Topics and Contents:
It is based on Real time project implementation in the area of AI-ML.

Course Outcomes :

1. Design solutions for given engineering problem **(1)**
2. Demonstrate practical knowledge by constructing models/algorithms for real time applications (**1)**
3. Express effectively in written and oral communication (**2)**
4. Exhibit the skills to work in a team **(2)**
5. Prepare a time chart and financial record for execution of the project **(3)**

CO-PO Mapping :

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	3	3	2	2	2	2	1	1	2	2	1	1	3
CO2	2	2	2	2	3	1	2	1	1	0	2	1	2	2	3
CO3	1	1	1	1	0	2	1	3	1	3	1	1	1	1	1
CO4	1	0	0	2	0	1	1	2	3	2	1	1	0	1	0
CO5	1	0	0	1	0	2	1	1	2	2	3	2	0	2	2

FF No. : 654

IC3246:: CYBER SECURITY

Course Prerequisites: Cyber security fundamentals

Course Objectives: The student will be able to

1. Understand the importance of choosing socially relevant areas for project work
2. Understand the importance of Project centric learning
3. Plan and execute systematic strategy to complete the Project work
4. Document and present the completed project work in proper scientific format

Credits: 5

Teaching Scheme Theory : - Hours/Week
Tut : - Hour/Week
Lab : 10 Hours/Week

Course Relevance: This course will develop

1. Awareness about project centric learning will be quite useful in professional work in future
2. Self learning ability to up skill and upgrade once knowledge continuously
3. Ability to work in a Team and Team leadership

Topics and Contents:
It is based on Real time project implementation in the area of Cyber Security.

Course Outcomes :

1. Design solutions for given engineering problem **(1)**
2. Demonstrate practical knowledge by constructing models/algorithms for real time applications (**1)**
3. Express effectively in written and oral communication (**2)**
4. Exhibit the skills to work in a team **(2)**
5. Prepare a time chart and financial record for execution of the project **(3)**

CO-PO Mapping :

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	3	3	2	2	2	2	1	1	2	2	1	1	3
CO2	2	2	2	2	3	1	2	1	1	0	2	1	2	2	3
CO3	1	1	1	1	0	2	1	3	1	3	1	1	1	1	1
CO4	1	0	0	2	0	1	1	2	3	2	1	1	0	1	0
CO5	1	0	0	1	0	2	1	1	2	2	3	2	0	2	2

FF No. : 654

IC3248:: SOFTWARE DESIGN PROJECT– IV

Guidelines to the students regarding Software Development Project Course

The objectives of these courses are to enhance coding skills and programming ability among the students. To cope up with rapid technology changes, these courses offer every student to learn new-age programming techniques and languages. The focus of these courses is on learning programming fundamentals and techniques.

- Software Development course would be conducted as single student activity.
- Students can choose any software projects to upgrade and enhance their coding skills using any open source tools.
- Complexity of the project should be sufficient and approved by course supervisor.
- Students are allowed to use libraries as needed.
- Major thrust areas of Software Development Project course are Artificial Intelligence / Machine Learning / Data Analytics / Vision based Automation
- A suggestive list of possible domains for SDP is given below
    1. Mobile app development
    2. Responsive Web development
    3. Database / Back end development
    4. MySQL / RDBMS
    5. Gamification
    6. GUI Development
- Mid-Semester review and End Semester Assessment would be conducted.

Course Outcomes: Students will be able to

1. Design solutions for given engineering problem **(1)**
2. Demonstrate practical knowledge by constructing models/algorithms for real time applications (**1)**
3. Express effectively in written and oral communication (**2)**
4. Exhibit the skills to work in a team **(2)**
5. Prepare a time chart and financial record for execution of the project **(3)**

CO-PO Mapping :

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	3	3	2	2	2	2	1	1	2	2	1	1	3
CO2	2	2	2	2	3	1	2	1	1	0	2	1	2	2	3
CO3	1	1	1	1	0	2	1	3	1	3	1	1	1	1	1
CO4	1	0	0	2	0	1	1	2	3	2	1	1	0	1	0
CO5	1	0	0	1	0	2	1	1	2	2	3	2	0	2	2

FF No. : 654

IC3249:: ENGINEERING DESIGN AND INNOVATION - V

Course Prerequisites: Electronic design, simulation, MATLAB, Labview, PCB design

Course Objectives: The student will be able to

1. Understand the importance of choosing socially relevant areas for project work
2. Understand the importance of Project centric learning
3. Plan and execute systematic strategy to complete the Project work
4. Document and present the completed project work in proper scientific format

Credits: 4 **Teaching Scheme Theory:** Hours/Week

Tut: Hours/Week

Lab: 8 Hours/Week

Course Relevance: This course will develop

1. Awareness about project centric learning will be quite useful in professional work in future
2. Self learning ability to up skill and upgrade once knowledge continuously
3. Ability to work in a Team and Team leadership which will be useful while doing B.Tech Major projects

Topics and Contents

It is based on Real time project implementation in the chosen specific defined area.
Agriculture Healthcare Automotive Process Control IoT

Basics for Projects
Importance of Project Centric Learning, Concept of Domains, Tools and Technology**,** Socially Relevant Project Areas

Domain Project Areas: Awareness and identification of appropriate areas for project work such as: Agriculture, Defense, Healthcare, Smart city, Smart energy, Security Systems, Automobile, Space, Green Earth, Automobiles, Assistive Aid, Water Management, Swachh Bharat (any other socially relevant research area)

Tools: *Self learning Activity* Learn and use latest engineering tools as per the project need. A few are listed below

Tools in Computer Engineering:
Programming / Coding Tools :- JavaScript, Python, Java, C#, C++, PHP, **Computer Vision Tools** :- OPENCV,MATLAB), **Single board computers:** Raspberry Pi, **Neural network simulators Tools:- Neural Lab, NEST , Machine Learning Tools:- Torch, TensorFlow, Data Science Tools :-** R language programming**,** SQL,

Tools in Electronics and Electronics & Telecommunication Engineering:
Electronic Design Simulation Integrated Circuit Tools:- VHDL, Xilinx, Modelsim , Cadence learn, **Embedded System Tools**:- AVR Studio, Arduino ,Kiel µvision, **Circuit**

Simulation Tools:- Pspice, Simulink, Workbench, Tinkercad, ThingSpeak, Proteus, CircuitPro **Processor based integrated circuits** :Microcontroller, electronic prototype platforms: Arduino,**Networking Tools** :- Wired / Wireless and Ad-hoc Networking NS-2 , Packet Tracer, **Signal Processing Tools**:- Code Composer Studio along with Integrated circuits

Tools in Instrumentation and Control Engineering:-

System Automation Tools :- PLC , SCADA , PADS, ORCAD ,Eagle, Kicad,

Tools in Mechanical, Industrial, Production, Engineering:-

Engineering Design Tools:- AutoCAD, CATIA,COMSOL Multiphysics, Solidworks, Inventor, PTC Creo **Fluid Dynamics:-** Fluent, HyperWorks, **Finite Element/ Structural Analysis:-** Ansy's, Ansy's Free Student software **Thermal Simulation:-** FlowTherm, Ansys Icepak

Tools in Chemical Engineering :-

Chemical process simulator:- DWSIM - Open Source Process Simulator, **chemical simulation software:-** Schrödinger,

(any other suitable tool as per the project requirement)

Technology: Map the appropriate technology**:**

Emerging Technologies :- Artifical Intelligence, 5G networks, IoT, Serverless Computing, Blockchain , Virtual reality (VR)/Augmented reality (AR), Drone, Quantum Computing, Robotics

Interdisciplinary Technologies:- Nanotechnology, Nanomaterials, Nanoelectronics, Quantum Computing , Spintronics

Computer Technologies:- Big Data, Cloud Computing, Human Machine Interface (HMI),Cyber Security

Medical and Healthcare Technologies:- Biomedical Technology,

Energy Technologies :- Solar Energy Based Technologies, Wind energy, Green energy Technologies, Energy Storage

Electronics, Communication Technologies:- Wireless, GPS, Bluetooth, Mobile/social Internet Automation, Mobile Technologies, Voice Assistants, signal processing, image processing, Machine vision, Sensors, Optoelectronics,

Other imp Technologies:- Automobile ,3 D printing

(any other technology as per the project requirement)

Project Implementation: Selection of the domain area, Literature review, Identify and finalize the Problem Statement (student in consultation with Guide), Understand and select and use the appropriate tools, Map the technologies learned with the project needs (refer available online offline Resources, books, soft materials, relevant MOOCs, consult with domain expertise) Self Learning:- learn the required tools, skill sets, acquire knowledge to do the project

Designing & Testing: Designing of project prototype based on domain areas by incorporating appropriate tools and technology, validation and Testing of the prototype to give the best possible solution

Documentation and Final Assessment : Develop and demonstrate the optimized prototype /working model of project , Documentation of project report in stipulated standard format as per the preset norms i.e. IEEE Research paper format, Present Project work at final viva voce

Course Outcomes :

1. Design solutions for given engineering problem **(1)**
2. Demonstrate practical knowledge by constructing models/algorithms for real time applications (**1)**
3. Express effectively in written and oral communication (**2)**
4. Exhibit the skills to work in a team **(2)**
5. Prepare a time chart and financial record for execution of the project **(3)**

CO-PO Mapping :

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	3	3	2	2	2	2	1	1	2	2	1	1	3
CO2	2	2	2	2	3	1	2	1	1	0	2	1	2	2	3
CO3	1	1	1	1	0	2	1	3	1	3	1	1	1	1	1
CO4	1	0	0	2	0	1	1	2	3	2	1	1	0	1	0
CO5	1	0	0	1	0	2	1	1	2	2	3	2	0	2	2

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IC3220 :: INSTRUMENTATION PROJECT ENGINEERING

Credits: Audit course **Teaching Scheme:** Theory: 3 Hours/Week

Section 1 : [IC3220_CO1, IC3220_CO2, IC3220_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 : [IC3220_CO2, IC3220_CO3, IC3220_CO4, IC3220_CO5, IC3220_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 Home Assignments:

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"
   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. IC3220_CO1: Describe the concept of project engineering and management. [1] (PO-1, 11, PSO-1)
2. IC3220_CO2: Comprehend the Project Engineering and Management documents [2](PO-1, 3,11, PSO-1,3)
3. IC3220_CO3: Develop Project Engineering and Management documents. [5] (PO-1, 3,11, PSO-1,3)
4. IC3220_CO4: Discuss the procurement and construction activities of project.[3] (PO-2,11, PSO-2)
5. IC3220_CO5: Understand the importance of management and financial functions and tools. [4] (PO-2,11,PSO-2)
6. IC3220_CO6: Explain different codes and standards used for instrumentation and control [4] (PO-1, 3,11, PSO-1,3)

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IC3222 :: BATCH PROCESS CONTROL

Credits: Audit course **Teaching Scheme:** Theory: 3 Hours/Week

Section 1 : [IC3222_CO1, IC3222_CO2, IC3222_CO3]

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.

Section 2: [IC3222_CO4, IC3222_CO5, IC3222_CO6]

Design of batch control systems: Batch management, recipe management, production scheduling & information management. Batch control system design, system requirements, system hardware/reliability requirement.

Specifications and data management: Batch control system specifications and implementation, Information/display requirements, cost justification and benefits, data management, Generic implementation of batch processes, case study of batch control system implementation for applications in food and beverages, pharmaceuticals etc.

List of Home Asssignments:

1. Generic study for implementation of batch process
2. Design of standards for the given batch process
3. Development of control strategy for the batch process
4. Development of P&I diagram for the given process
5. Development of system requirement for the given process
6. Design of batch management system
7. Design of specifications and cost estimate Reliability aspects for the given process.
8. Study of the tutorial of control requirement on DCS
9. Study of the tutorial of batch management on DCS
10. Study of the tutorial of recipe management on DCS

Text Books:

1. Thomas .G. Fisher William M. Hawkins, ―Batch Control Systems, ISA series, 1st ed., 2008
2. Process/ Industrial Instruments and Controls Handbook, Gregory K. Macmillan, MCGrawHill

Reference Books:

1. Thomas .G. Fisher, William M. Hawkins, ―Batch Control Systems, ISA series, 2nd ed., 2012

Course Outcomes:

The student will be able to –

1. IC3222_CO1: Understand the fundamentals of batch process [1] (PO-1, 11,12 PSO-1,2)
2. IC3222_CO2: Understand the role of standards for batch process [2] (PO-1,11,12 PSO-1,2)
3. IC3222_CO3: Comprehend the control and management aspects of batch processes [3] (PO- 1,2,3,4,5 PSO-1,2,3)
4. IC3222_CO4: Comprehend control strategies to a given batch processes [3] (PO-1,2,3,4,5 PSO-1,2,3)
5. IC3222_CO5: Specify controls and data management system [4] (PO-1,2,3,4,5 PSO-2,3)
6. IC3222_CO6: Case study of any batch process [5] (PO-1,2,3,4,5,6,7,11,12 PSO-1,2,3)