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 'C23'

Effective from Academic Year 2023-24

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**

Contents

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.

T.Y. B.Tech - Instrumentation and Control Engineering Structure for Pattern C-23, Module-5 with effect from Semester-1 of Academic Year 2023-24

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		Lab 10	CP 20	MSE-MCQ 30	MSE Review 30	Seminar / GD / HA 20			ESE 30			ESE Review 70	CVV 20	100
												Seminar	GD	HA	Written	MCQ	Practical			
S1	IC3231	Process Instrumentation	2	2	1	5	4	10	20				20			30			20	100
S2	IC3233	Measurement Systems	2	2	1	5	4	10	20			20			30				20	100
S3	IC3237	Control Theory	2	2	1	5	4	10	20			20			30				20	100
S4	IC3243	Artificial Intelligence and Machine Learning	2	2	1	5	4	10	20					20		30			20	100
S5	IC3255	Design Thinking - 5	0	0	1	1	1													Graded
S6	IC3256	Engineering Design and Innovation - 3	0	12	0	12	6				30							70		100
		Total	**8**	**20**	**5**	**33**	**23**	**40**	**80**		**30**	**40**	**20**	**20**	**60**	**60**		**70**	**80**	**500**

T.Y. B.Tech - Instrumentation and Control Engineering Structure for Pattern C-23, Module-6 with effect from Semester-2 of Academic Year 2023-24

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		Lab 10	CP 20	MSE-MCQ 30	MSE Review 30	Seminar / GD / HA 20			ESE 30			ESE Review 70	CVV 20	100
												Seminar	GD	HA	Written	MCQ	Practical			
S1	IC3232	Web Technologies	2	2	1	5	4	10	20								50		20	100
S2	IC3234	Building and Process Automation	2	2	1	5	4	10	20				20			30			20	100
S3	IC3236	Computer Network	2	2	1	5	4	10	20				20		30				20	100
S4	IC3259	Cyber Security	2	2	1	5	4	10	20			20			30				20	100
S5	IC3257	Design Thinking - 6	0	0	1	1	1													Graded
S6	IC3258	Engineering Design and Innovation - 4	0	12	0	12	6				30							70		100
		Total	**8**	**20**	**5**	**33**	**23**	**40**	**80**		**30**	**20**	**40**	**0**	**60**	**30**	**50**	**70**	**80**	**500**
		Audit Courses																		
S7	IC3220	Instrumentation Project Engineering	3				0							30		40			30	100
S7	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.

Credits: 4

Teaching Scheme Theory : 2 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 :

Process Instrumentation Components

Unit 1 : Fundamentals of process control (5 Hrs)

Types of control systems: open loop, closed loop, 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: working, application of DPT for level and flow measurements, installation and calibration, 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.

Unit 2 : Control Actions (5 Hrs)

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. faceplate of Digital PID controller and its specifications.

Unit 3 : Control Valves and Actuators (5 Hrs)

Necessity and comparison with other final control elements.

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

Control valve characteristics: inherent and installed.

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

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

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.

SECTION-2 :

Unit 4 : Auxiliary process components and Modeling (4 Hrs)

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

Hazardous area classification and Intrinsic safety components.

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.

Unit 5 : Process Instrumentation Applications

Boiler Instrumentation and control (5 Hrs)

Types and operation of boiler, boiler components, instrumentation, boiler drum level controls, steam temperature controls, boiler pressure controls, Draught System, Furnace draft controls, safety interlocks and burner management system, Air to fuel ratio controls, steam pressure control, boiler efficiency calculations by direct and indirect method, Boiler Blowdown, Ratio control, Selective control, Split range control, Adaptive control.

Unit 6 : Instrumentation for heat exchanger, dryer, evaporator and distillation column controls (6 Hrs)

Operation of heat exchanger, classification, types, selection criteria, controlled, manipulated and load variables, Degrees of freedom analysis, instrumentation for feedback, feed-forward, feedback-Feed forward control, cascade and integrated control strategies.

Types and operation of dryers, controlled, manipulated and load variables, instrumentation for feedback and feed-forward, inferential control of various types of dryers.

Types and operation of evaporators, controlled, manipulated and load variables, instrumentation for feedback, feed-forward, cascade, selective control strategies.

Types, components and operation of distillation column, controlled, manipulated and load variables, Instrumentation for distillation column control, top and bottom composition control, Tray temperature control, Feed controls, pressure control and reflux ratio control.

List of Tutorials: (Any Six)

1. Identification of different variables involved in Process control Loop.
2. To understand and develop the process control loops using standard ISA S5.1 for a given process.
3. Design of two-position controller and Numerical examples on P, PI, PD, PID Controller.
4. Design of control valves for given application and Numericals on valve characteristics.
5. Review of control valve accessories and actuators and Design of control valve actuators for given application.
6. Develop model for heated mixing tank, CSTR, FOPDT and SOPDT processes.
7. Develop instrumentation and control scheme for distillation column.

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 conventional and intelligent two–wire RTD temperature transmitter.
7. Study and characterization of Level transmitter.
8. Develop op-amp based ON-OFF controller for temperature control loop.
9. Tuning of PID controller for temperature/pressure/Level control loop.
10. Study of control valve types, parts, accessories, actuators and Plot the installed characteristics of control valves.
11. Study of Limiters and Selectors

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. Configure the D.P. transmitter and calibrate it using hand-held configurator for level.

List of Course Group Discussion Topics:

1. Feedback versus Feed-forward control scheme.
2. Wired versus Wireless transmitters: Pros and Cons.
3. Conventional versus Smart transmitters.

4. Continuous control Vs Discontinuous control actions.
5. Selection of control actions according to process characteristics.
6. Digital PID Controller Vs Analog PID Controller
7. Matching of control valve characteristics with the process characteristics.
8. How to get the most from the control valve?
9. Which actuator is the best for the control valve?
10. Selection of Control Valve for applications.
11. Parameters to be considered for design of alarm annunciator.
12. Hazardous area classification and Intrinsic safety components
13. System Modeling
14. Instrumentation for heat exchanger control
15. Instrumentation and control schemes for Boiler.
16. Furnace Draft Control
17. Ratio control Vs Selective control
18. Control schemes for Dryer controls.
19. Evaporator Instrumentation and controls.
20. Distillation Column controls
21. Compressor controls
22. Instrumentation and control schemes for Pumps.

Assessment Scheme:

Course Assessment: Total : 100 mks

1. End Semester Examination: 30 marks (ESA-MCQ, *30 marks*)
2. Course Project : 20 marks (ISA, *100 marks converted to 20*)
3. Lab Assignment : 10 mks (ISA, *100 marks converted to 10)*
4. Viva : 20 mks (ESA, *100 marks converted to 20)*
5. Group Discussion: 20 mks (ISA, *100 marks converted to 20)*

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. IC3231_CO1: Comprehend the fundamentals of process control loop.
2. IC3231_CO2: Demonstrate the working of controller and solve a problem using control actions.
3. IC3231_CO3: Select and Design the control valve and actuators to solve a problem.
4. IC3231_CO4: Build a mathematical model and auxiliary process loop components.
5. IC3231_CO5: Develop different control schemes for the Boiler.
6. IC3231_CO6: Develop instrumentation and control scheme for different process equipments.

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	1	1	-	1	2	2	1	1	3	1	1
2	3	3	3	2	1	1	1	1	2	2	1	1	3	2	2
3	3	3	3	2	2	1	1	1	2	2	1	1	3	2	3
4	3	3	3	2	2	1	1	1	2	2	1	1	3	2	3
5	3	2	3	2	1	1	1	1	2	2	1	1	3	2	3
6	3	2	3	2	1	1	1	1	2	2	1	1	3	2	3

CO attainment levels

CO No.	IC3201_CO1	IC3201_CO2	IC3201_CO3	IC3201_CO4	IC3201_CO5	IC3201_CO6
Attainment Level	1	2	5	4	3	3

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, analytical laboratories and diagnostics labs.

Credits: 4 **Teaching Scheme Theory: 2** Hours/Week
Tut : 1 Hour/Week
Lab : 2 Hours/Week

SECTION-1:

Unit-1: Basics of measurement systems: Static characteristic such as accuracy, error sensitivity, threshold, linearity, precision, resolution, reliability, repeatability, reproducibility, span, rangeability etc. Types of errors in measurement. Dynamic characteristics such as transient and frequency responses. Standards of measurements.

Unit-2: T**emperature pressure and load measurement:** classification **,** principle, working of various temperature sensors such as resistance temperature detectors (RTD), thermistors, Thermocouples, digital temperature sensor, semiconductor temperature sensor and requirement of signal conditioning circuits. Classification**,** principle, working and specifications of various pressure sensors such as bourdon gauge, diaphragm, bellows, Differential pressure sensor, Vacuum pressure measurement.. Load measurement using strain gauges and signal conditioning circuit.

Unit-3: Flow and level 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. classification, principle, working, specifications of various level sensors such as float, ultrasonic, capacitive, radar, resistance level sensors and requirement of signal conditioning circuits.

SECTION-2:

Unit-4: EMI/EMC: Introduction to EMI/EMC. Electromagnetic interference in electronic systems. Types and classification of noise sources. Methods of reducing noise in electronic systems. Introduction to electrostatic discharge (ESD), Human ESD model and prevention techniques.

Unit-5: 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

Unit-6: 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 Six):

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/ thermistors
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
13. Design of milliohm and micro ohm measurement techniques
14. Weather parameter measurement and monitoring system

List of Course Seminar Topics:

1. Applications of automatic test equipment
2. Redundancy techniques in various equipment
3. DSO specifications and selection
4. Virtual instruments
5. PCB making process
6. EMI testing techniques
7. Shielding and grounding techniques.
8. Smart energy meter
9. IOT in biomedical instrumentation
10. Vision based measurement system
11. Electrical testing parameters and standards
12. Precautions for biomedical parameter measurements
13. Imaging techniques like MRI
14. Imaging techniques like CT and xray
15. Imaging techniques for biomedical applications.
16. Bone density measurement
17. Selection of electronic instruments for waveform analysis
18. Problems in healthcare system and implementation
19. IOT implementation in biomedical system
20. Virtual training in Biomedical systems
21. Opportunities in biomedical system
22. Selection of electronic instruments for various electrical parameters

Assessment Scheme:

Course Assessment: Total : 100 marks.

1. Lab Assignment : 10 marks (ISA, *100 marks converted to 10)*
2. Course Project : 20 marks (ESA, *100 marks converted to 20)*
4. Course Seminar: 20 marks (ISA, *100 marks converted to 20)*
5. Viva: 20 marks (ESA, *100 marks converted to 20)*
6. End Semester Examination: 30 marks (ESA, *100 marks converted to 30)*

Text Books:

1. Rangan, Sharma and Mani; Instrumentation: Devices and Systems. Tata McGraw-Hill.
2. Earnest O. Doebelin; Measurement Systems. 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. https://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. Select a suitable 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. Explain and 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	1	1	1	1	0	0	0	0	0	0	0	1	3	0	1
2	1	2	1	2	1	1	1	0	0	0	0	2	3	1	2
3	2	2	2	2	3	1	1	0	0	0	0	2	1	2	3
4	1	2	3	2	1	1	0	0	0	0	0	1	0	1	1
5	1	2	2	2	1	1	1	0	0	0	0	1	1	1	1
6	2	1	1	1	2	1	0	0	0	0	0	1	0	0	1

CO No.	IC3203_CO1	IC3203_CO2	IC3203_CO3	IC3203_CO4	IC3203_CO5	IC3203_6
Attainment Level	1	3	4	2	2	3

Job Mapping:

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

FF No.: 654

IC3237:: CONTROL THEORY

Credits: 04

Teaching Scheme:
Theory: 2 Hours/Week
Lab : 2 Hours/Week
Tutorial: 1 Hour /Week

Section 1 :

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 Laplace transforms and properties, Differential equations and Transfer functions,

Unit 2: 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 3: 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

Section 2:

Unit 4: 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, Determining value of gain for marginal stability gain and phase margins

Unit 5:
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 6:
Controller Design
Stability improvement by state feedback, pole placement design,

List of Practicals

1. For a given Electrical system obtain the transfer function of the system, pole zero plot, impulse response, and step response

2. For given various transfer functions of the system, analysis the stability of the system using pole zero plot and impulse response of the system

3. Transient Response Analysis of second order system - For a RLC circuit analyze the step response for identifying damping (overdamped, underdamped, critically damped, undamped) of the system using MATLAB/SCILAB/PYTHON
4. Write a Program for obtaining root locus of a transfer function and observe the effect of addition of pole/zero.
5. Write a Program for obtaining Bode plot of a transfer function and compute frequency domain specifications of the same.
6. 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. Compute the Impulse response of the given system. Compute the step response of the given system
3. For a electrical system using signal flow graph derive the transfer. Deriving closed loop transfer function of the given signal flow graph.
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. (Routh Hurwitz Stability)
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.

Text Books and Reference Books

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

Assessment Scheme:

Course Assessment: Total : 100 mks

1. End Semester Examination: 30 marks (ESA, 100 marks converted to 30)
2. Course Project : 20 marks (ISA, 100 marks converted to 20)
3. Lab Assignment : 10 mks (ISA, 100 marks converted to 10)
4. Viva : 20 mks (ESA, 100 marks converted to 20)
5. Course Seminar: 20 mks (ISA, 100 marks converted to 20)

Course Project

Deriving transfer function of a real life system, Simulation / Realization of closed loop control, Analysis of closed loop control system, Design controller for different application - any process loop, DC motor, inverted pendulum, drone system

Course Outcomes The student will be able to

1. Utilization of Laplace transform for system analysis- finding system transfer function, system response. [4]
2. Determine time domain specification and error coefficients for the given system. [3]
3. Analyze the stability of the given system and obtain the root locus for the same. [5]
4. Analyze the given system in frequency domain, derive and compute frequency domain specifications. Analysis of system using the bode plot, [5]
5. Analysis of system using the state space domain.[5]
6. Design a control system using state feedback [5]

Mooc's Links and additional reading material:

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

CO PO Map:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PS O1	PSO 2	PSO 3
CO1	3	3	3	3	3	1	1	1	1	3	1	1	1	3	1
CO2	3	3	3	3	3	1	1	1	1	3	1	1	1	3	1
CO3	3	3	3	3	3	1	1	1	1	3	1	1	1	3	1
CO4	3	3	3	3	3	1	1	1	1	3	1	1	1	3	1
CO5	3	3	3	3	3	1	1	1	1	3	1	1	1	3	1
CO6	3	3	3	3	3	1	1	1	1	3	1	1	1	3	1

FF No. : 654

IC3243 :: ARTIFICIAL INTELLEGIENCE AND MACHINE LEARNING

Course Prerequisites: Fundamentals of Linear Algebra, Probability and Statistics

Course Objectives:

1. To understand the basic concepts of artificial intelligence and machine learning.
2. To be able to comprehend intelligent systems
3. To be able to analyse real time applications in artificial intelligence and machine learning
4. To be able to implement suitable application of intelligent system.

Credits: 4 **Teaching Scheme :** **Theory**: 2 Hours/Week
Tut : 1 Hour/Week
Lab : 2 Hours/Week

Course Relevance:

The course introduces the variety of concepts in the field of artificial intelligence and machine learning. It discusses the philosophy of AI, and how to model a new problem as an AI problem. It describes a variety of models such as search, logic, Bayes nets, model a new problem. It also teaches many first algorithms and machine learning techniques to solve each formulation. The course prepares a student to take a variety of focused, advanced courses in various subfields of AI and machine learning. Course will help students to analyse and implement various real time intelligent applications.

Section 1 :

Unit 1

Introduction, Brief history, Agents and rationality, task environments, agent architecture types, Search and Knowledge representation, Search spaces, Hill climbing, simulated annealing, genetic algorithms

Unit 2

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.

Unit 3

Learning, Forms of learning, Statistical methods: naive-Bayes, nearest neighbor, kernel, Decision trees, inductive learning, Clustering - basic agglomerative, divisive algorithms based on similarity/dissimilarity measures, Applications to NLP, vision, robotics, etc

Section 2:

Unit 4

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

Unit 5

Support Vector Machines: Support vector machines learning algorithm for classification, Optimization Objective, Large Margin Intuition, applications of Support vector machines, implementation.

Unit 6

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.

List of Practicals: (Any Six)

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 neighbour's
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 Tutorials

1. Illustrations of agent types and their descriptions
2. Case study of task environments and their characteristics
3. Heuristic function design for Tic-Tac-Toe
4. Heuristicfunctiondesignfor8-puzzle /or given problem
5. Trace of A*algorithmfor8-puzzle
6. Trace of AO* algorithm fora given problem
7. Conversion to clause form
8. Resolution in predicate logic
9. Resolution in propositional logic
10. Using inference rules in predicate logic
11. Perceptron learning for2 class classification

List of Home Assignments

Design:

1. Heuristic function design for a specific search application
2. Knowledge base design for a small expert system for real application
3. Design of fuzzy sets for a given application
4. Designing Neural network architecture for pattern recognition
5. Design of a reasoning system for the shape matching of objects

Case Study:

1. PROLOG expert system
2. Alexa
3. Google Assistant
4. Page ranking algorithm
5. Emotion detection

Blog:

1. Future of AI
2. Deep Learning Architectures
3. AI in healthcare
4. AI in finance
5. Neural network classification

Surveys:

1. HCR algorithms
2. Face recognition
3. Thumb print recognition
4. Image captioning
5. Data sampling techniques

Project areas in Computer Vision and Deep learning

1. Image Classification
2. Visual tracking system
3. Face detection system
4. Hand written Digit Recognition System
5. Image caption generator
6. Traffic sign classification
7. Human Pose Estimation

Project areas for Biomedical and deep learning

1. Malaria detection using machine learning
2. Diabetic Retinopathy detection using deep learning and machine learning
3. Covid 19 detection using Chest X ray
4. Covid 19 detection using CT
5. Brain Tumor Detection using machine learning

Project areas in audio signal processing

1. Audio Data Analysis Using Deep Learning
2. Audio Fingerprinting
3. Automatic Music Tagging
4. Audio Segmentation

5. Automatic speech recognition
6. Automatic speaker recognition
7. Music Retrieval
8. Gender Recognition Using Voice

Project areas in Sentiment analysis

1. Social Media Sentiment Analysis using Machine Learning
2. Twitter Sentiment Analysis using Machine Learning
3. Depression analysis using Tweets on social media
4. Emotion analysis and recognition using machine learning
5. Sentiment analysis for movie classification

Project areas in Artificial Intelligence

1. Next Word Predictor
2. Chatbot using AIML
3. Fake Product Review Monitoring System
4. Price Negotiator Ecommerce Chatbot System
5. AI Bot to Play Snake Game
6. Hand Gesture Recognition
7. Vehicle Counting and Classification
8. Gender and Age Detection
9. Human Activity Recognition with Video Classification
10. Language Translator

Assessment Scheme:

Course Assessment: Total : 100 mks

1. End Semester Examination: 30 marks (ESA, MCQ 30 marks)
2. Course Project : 20 marks (ISA, 100 marks converted to 20)
3. Home Assignment : 20 mks (ISA, Case study, Design work, Survey, Blog) (100 marks converted to 20)
4. Viva : 20 mks (ESA, 100 marks converted to 20)
5. Lab Assignment: 10 mks (ISA, 100 marks converted to 10)

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.

Reference Books:

1. D. Barber, Bayesian Reasoning and Machine Learning Cambridge University Press 2012.
2. C. Bishop, Pattern Recognition and Machine Learning, Springer 2011.

Mooc's Links and additional reading material:

1. https://onlinecourses.nptel.ac.in/
2. https://www.udemy.com/course/
3. https://ocw.mit.edu/
4. https://coursera.org

Course Outcomes:

The student will be able to -

1. IC_3243_CO1: Comprehend concept of Artificial Intelligence and intelligent agents
2. IC_3243_CO2: Examine the useful search techniques
3. IC_3243_CO3: Analyze learning models for AI
4. IC_3243_CO4: Apply machine learning techniques to given applications
5. IC_3243_CO5: Formulate neural networks for given application
6. IC_3243_CO6: Implement the practical applicability of intelligent systems and machine learning algorithms to real world applications

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	3	2	1	1	1	1	1	0	2	0	2	2
2	3	1	2	2	2	0	0	0	1	1	0	1	0	1	1
3	3	3	3	2	2	1	1	0	1	1	0	2	0	2	1
4	3	3	3	3	2	1	1	0	1	1	0	2	0	2	3
5	3	3	3	3	2	1	1	0	1	1	0	2	0	2	3
6	3	3	3	3	2	1	1	0	1	1	0	2	0	2	3

CO attainment levels

CO No.	IC3243_CO1	IC3243_CO2	IC3243_CO3	IC3243_CO4	IC3243_CO5	IC3243_CO6
Attainment Level	3	2	3	3	3	5

Future Courses Mapping:

Deep Learning, Big Data Analytics, Data analytics

Job Mapping:

After completing the course students have the opportunity to apply for the following job roles Big Data Engineer, Business Intelligence Developer, Data Scientist, Machine Learning Engineer, Research Scientist, AI Data Analyst, AI Engineer, Robotics Scientist

FF No. : 654

IC3255:: DESIGN THINKING -5

Course Objectives:

To provide ecosystem for students and faculty for paper publication and patent filing.

Credits: 1 **Teaching Scheme : Tut:** 1 Hours/Week

- What is Research?
- Importance of Paper Publications and Patents
- Structure of Paper
- Journal Publication
- Publication in Conference
- Literature Review
- Research Paper Writing
- Journal Ratings and Evaluation (How to rate a Journal?)
- Intellectual property (IP)
- Research Ethics
- Entrepreneurship

Course Outcomes:

The student will be able to

1. IC3251_CO1 Understand the importance of doing Research
2. IC3251_CO2 Interpret and distinguish different fundamental terms related to Research
3. IC3251_CO3 Apply the methodology of doing research and mode of its publication
4. IC3251_CO4 Write a Research Paper based on project work
5. IC3251_CO5 Understand Intellectual property rights
6. IC3251_CO6 Use the concepts of Ethics in Research
7. IC3251_CO7 Understand the Entrepreneurship and Business Planning

CO-PO Mapping :

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	1	1	1	0	0	0	0	0	0	1	0	1	1
CO2	1	1	1	1	1	0	0	0	0	0	0	1	0	1	1
CO3	2	2	3	3	2	2	1	2	2	3	0	1	1	1	1
CO4	3	3	3	3	3	2	1	2	2	3	1	1	1	1	1
CO5	1	1	1	1	1	0	0	0	0	0	0	0	0	0	1
CO6	2	2	2	2	2	2	1	3	2	3	0	1	0	0	1
CO7	1	1	1	1	1	0	0	0	0	0	0	1	0	0	1

CO attainment levels :

CO No.	IC3255_CO1	IC3255_CO2	IC3255_CO3	IC3255_CO4	IC3255_CO5	IC3255_CO6	IC3255_CO7
Attainment Level	2	2	3	6	2	3	2

FF No. : 654

IC3256:: ENGINEERING DESIGN AND INNOVATION - 3

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: 6 **Teaching Scheme Theory:** Hours/Week

Tut: Hours/Week

Lab: 12 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. IC3256_CO1 Analyse solutions for given engineering problem
2. IC3256_CO2 Design solutions for given engineering problem
3. IC3256_CO3 Demonstrate practical knowledge by constructing models/algorithms for real time applications
4. IC3256_CO4 Express effectively in written and oral communication
5. IC3256_CO5 Exhibit the skills to work in a team
6. IC3256_CO6 Prepare a time chart and financial record for execution of the project

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	3	3	3	2	2	2	2	1	1	2	2	1	1	3
CO3	2	2	2	2	3	1	2	1	1	0	2	1	2	2	3
CO4	1	1	1	1	0	2	1	3	1	3	1	1	1	1	1
CO5	1	0	0	2	0	1	1	2	3	2	1	1	0	1	0
CO6	1	0	0	1	0	2	1	1	2	2	3	2	0	2	2

CO attainment levels :

CO No.	IC3256_CO1	IC3256_CO2	IC3256_CO3	IC3256_CO4	IC3256_CO5	IC3256_CO6
Attainment Level	2	3	2	2	3	5

SEMESTER II

FF No. : 654

IC3232: WEB TECHNOLOGY

Credits: 4 **Teaching Scheme Theory: 2** 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 and Server-side code

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

SECTION-1:

Unit -1 **(5 Hrs)**

Introduction to HTML 5: New elements, New input types, new attributes, Local Storage, Session Storage, Server sent events, CSS3, Bootstrap

Unit-2: **(5 Hrs)**

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.

Unit-3: **(5 Hrs)**

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:

Unit-4: **(5 Hrs)**

Introduction to Nodejs, What is Nodejs, NodeJS: Getting started, Node Core, Node Modules, File System, Debugger, Automation and Deployment.

Unit-5: **(5 Hrs)**

Topics and Contents Web Technology Frameworks: Express Framework: Introduction to Express Framework, 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

Unit-6 **(5 Hrs)**

Angular JS: Overview, MVC architecture, Directives, Expression, Controllers, Filters, Tables, Modules, Forms, Includes, Views, Scopes, Services, Dependency injection, Custom directives, Internationalization

List of Tutorials:

1. Visit 10 websites and summarize all (at least 2) the good things of the web page design you liked and features of the web page design which you did not appreciate.
2. Go to 5 websites you frequent often. View the source code of the page. (You can usually do this by right-clicking on the page and choosing & quot; View Page Source & quot;). Search through the code. Did the web developer use semantic tags, e.g. header, footer, nav, section, etc. Write a report on the same.
3. Go to http://wave.webaim.org/ and enter the URL of a website of your choice. Then select the & quot;No Styles". How much harder is it to perceive the contents of the page when you just have the HTML?
4. Go to one of the websites you frequent often. Hit the tab button to see how you would navigate through the page. Is it easy to get to the information you want?
5. Create HTML Page with JavaScript which takes Integer number as input and tells whether the number is ODD or EVEN.
6. Study and Implementation of Various HTML tags
7. Study and Implementation of Bootstrap
8. Study and Implementation of Node js
9. Study and Implementation of No SQL
10. Understand use of JavaScript objects in web page designing

List of Practicals:

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

Assessment Scheme:

Courses with Programming activity

1. Laboratory Assessment: 100 Marks converted to 10 equivalent Marks
2. Course Project: 100 Marks converted to 20 equivalent Marks
3. Comprehensive Viva Voce : 100 Marks converted to 20 equivalent Marks
4. Programming Practical End Semester Assessment :100 Marks converted to 50 Marks

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:

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	1	1	3	0	3	0	0	0	0	0	0	3	0	0	3
2	1	1	3	0	3	0	0	0	0	0	0	3	0	0	3
3	1	1	3	0	3	0	0	0	0	0	0	3	0	0	3
4	1	1	3	0	3	0	0	0	0	0	0	3	0	0	3
5	1	1	3	0	3	0	0	0	0	0	0	3	0	0	3
6	3	3	3	0	3	0	0	0	0	0	0	3	0	0	3

CO attainment levels :

CO No.	IC3232_CO1	IC3232_CO2	IC3232_CO3	IC3232_CO4	IC3232_CO5	IC3232_CO6
Attainment Level	2	3	4	4	5	5

Job Mapping: Web designer, Server side developer

FF No. : 654

IC3234 :: BUILDING AND PROCESS AUTOMATION

Credits: 4 **Teaching Scheme Theory: 2** Hours/Week
Tut : 1 Hour/Week
Lab : 2 Hours/Week

Course Prerequisites: Process Instrumentation

Course Objectives:

1. To understand working of DCS system.
2. To know the communication aspects used in process and building automation.
3. To comprehend the different building automation systems.

SECTION-1:

Unit-1

DCS Introduction: History of computer controls with their merits and demerits, Location of DCS in Plant, advantages and limitations, Comparison of DCS with PLC, DCS block diagram/ Architecture, components, Functional requirements at each level.
DCS Hardware: DCS System Layout, Loop wiring, Controller Details, Redundancy, I/O Card Details, Junction Boxes and Marshalling Cabinets, Electronic Marshalling, Characterization Modules, System cabinet, Operator Interface, DCS Workstation and their Types, Type of displays, Guided Transmission Media, Device Signal Tags, DCS Selection criteria.

Unit-2
Database and Alarm management: Database management, Historical data using in log, report and trend display, Types of alarm, Alarm management, DCS Programming.
Network topology: Star, Bus, Ring, Tree, Mesh, Hybrid topology, wireless topologies, OSI model, Repeater, Hub, Bridge, Switch, Router, Gateway, Access point, Wireless Access points. Smart switches.

Unit-3
Serial data communications: Methods of Serial data transmission, Synchronous, Asynchronous serial protocol, Serial data communications interface standards, RS-232, RS-422, RS-485 interface standard, their comparison, MODBUS Serial Communication.
HART Communication Protocol: Architecture, FSK, physical, data link, application layer, communication modes, HART Networks, commands, benefits, revisions.
Introduction to Fieldbus: types, classes, benefits of Fieldbus.
Actuator Sensor Interface: AS-i advantages, types of integration, components, signal coding, As-i extensions.

SECTION-2:

Unit-4

ProfiBus and Foundation Fieldbus: Profibus: variants, it's location, architecture, physical layer and wiring, data link layer, communication, application layer, Profibus PA, DP, FMS in detail, advantages.

Foundation Fieldbus: characteristics, variants, comparison with Profibus, advantages, disadvantages, components, physical layer, data link layer, communication layers, User layer, Link Active Scheduler, application layer, function blocks.

Unit-5

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

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.

Unit-6

HVAC system: HVAC processes, components, Central vs Local systems, Duct Configurations, Air Handling Unit, Fan Coil Unit, components, controls, Constant Air-Variable Air Volume System, Chiller configurations and controls.

Public access (PA) System: Components like microphones, speakers, amplifiers, mixers, Design aspects of PA system. EPBX system and its components.

Access Control & Security System: types, components, Modern Electronic Security Devices, Surveillance Systems, Electronic Access Control Systems, and Intrusion Detection System.

List of Tutorials: (Any Six)

1. PLC/DCS programming for simple applications.
2. Development of FBD program for given application.
3. Development of SFC program for given application.
4. Development of IL/ST/LD program for given application.
5. Design and development of cascade loop using FBD
6. Apply ratio control strategy on heat exchanger loop using FBD.
7. Develop different control strategy using DCS on boiler drum level control.
8. Develop interfacing serial card to DCS.

List of Practicals: (Any Six)

1. Develop feedback control for SLPC using DCS.
2. Tune PID controller for any single loop process.
3. Develop feed forward control for SLPC using DCS.
4. Develop cascade control for process loop using DCS.
5. Develop override control for process loop using DCS.
6. Develop valve position control for process loop using DCS.
7. Develop split range control for process loop using DCS.
8. Develop ratio control for process loop using DCS.
9. Develop Dryer controls using DCS.
10. Develop three element drums level control using DCS
11. Develop different boiler interlock using DCS.
12. Develop boiler combustion control using DCS.
13. Develop interfacing serial communication /HART using DCS.
14. Develop distillation column control using DCS.
15. Process characterization of given process.

List of Projects:

1. Heat Exchanger control using DCS.
2. Dairy plant Simulation using DELTA –V DCS.
3. Upgradation of Utilities and Offsite Project
4. PROFIBUS Simulator
5. Duty Standby Pump automation using Delta V DCS
6. Development of Home automation systems
7. Model Predictive Control for Multivariable process.
8. Three Element Drum Level Control
9. Batch Chemical Reactor
10. Continuous Chemical Reactor
11. Power Boiler Combustion Control
12. Distillation column control
13. Ammonia Plant H/N Control
14. Simulation of boiler control using PLC/DCS
15. Development of Fire Alarm system.
16. Implementation for cascade control for CSTR.
17. Pressure control using DCS.
18. OTS configuration for Crude column.
19. Heat recovery and Steam generation plant control using DCS
20. FPSO 2Stage Separation Process Simulation in Delta-V.
21. Nuclear Reactor Control using DCS.
22. DCS and PLC Communication for Emergency Shutdown system
23. Development of Home Security systems
24. Development of Light control systems
25. Development of CCTV system for Surveillance application

List of Course Group Discussion Topics:

1. Selection criteria of DCS
2. DCS workstations
3. Advancements in junction boxes and marshalling racks
4. Actuators for Building Automation
5. HART and MODBUS communication protocol
6. Network topologies
7. Access control devices in Building Automation
8. Performance of Sensors used in Fire and Alarm system
9. Profibus variants
10. AHU Vs FCU in HVAC system
11. Types of Cables
12. DCS communications
13. DCS and PLC for process control applications
14. DCS Database management
15. Sensors for Building Automation
16. Performance for foundation fieldbus and profibus
17. OSI model
18. Security system devices in Building Automation
19. Actuator Sensor Interface
20. Foundation Fieldbus variants
21. CAV vs VAV in HVAC system
22. PA system and its components
23. Latest trends in DCS
24. PLC and DCS Hardware
25. DCS Alarm management
26. Lighting control in Building Automation
27. Wired vs Wireless communication
28. Network devices
29. Communication protocols for building automation
30. Serial Communication
31. Trends in HART protocol
32. HVAC chiller system controls
33. EPBX system and its components

Assessment Scheme:

Course Assessment: Total : 100 mks

1. End Semester Examination: 20 marks (ESA, MCQ 30 marks)
2. Course Project : 20 marks (ESA, 100 marks converted to 20)
3. Lab Assignment : 10 mks (ISA, 100 marks converted to 10)
4. Viva : 20 mks (ESA, 100 marks converted to 20)
5. Group Discussion: 20 mks (ISA, 100 marks converted to 20)

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.
3. 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: Demonstrate the working of DCS system [1]
2. IC3234_CO2: Comprehend the Database and Alarm management system and Network topologies. [3]
3. IC3234_CO3: Contrast the performance of Serial data communications, HART and ASI protocol [2]
4. IC3234_CO4: Analyze the performance of ProfiBus and Foundation Fieldbus [4]
5. IC3234_CO5: Design the lighting control / fire alarm system for building automation problem. [3]
6. IC3234_CO6: Develop instrumentation and control scheme for HVAC system. [5]

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	3	2	3	1	-	1	2	2	1	1	2	1	2
2	2	2	3	2	3	1	-	1	2	2	1	1	2	1	2
3	2	2	3	2	2	1	-	1	2	2	1	1	3	1	3
4	2	2	3	2	2	1	-	1	2	2	1	1	2	1	2
5	2	2	3	2	2	1	2	1	2	2	1	1	3	1	3
6	2	2	3	2	2	1	2	1	2	2	1	1	3	1	3

CO attainment levels:

CO No.	IC3201_CO1	IC3201_CO2	IC3201_CO3	IC3201_CO4	IC3201_CO5	IC3201_CO6
Attainment Level	1	3	2	4	3	5

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

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

Course Objectives:

1. Summarize fundamental concepts of Computer Networks, architectures, protocols and technologies
2. The Illustrate the working and functions of data link layer
3. Describe and analyze network layer protocols
4. Understand the services of transport layer.
5. Know Responsibilities, services offered and protocol used at application layer of network The
6. To learn advanced topics in computer networking

Credits: 4 **Teaching Scheme Theory: 2** Hours/Week
Tut: 1 Hour/Week
Lab: 2 Hours/Week

Course Relevance:

The key technology of the information age is communications. Data communications and networking is a truly global area of study, both because the technology enables global communication over telephone lines and Internet. Data communication and networking is the backbone of all IT infrastructures in the world. These technologies and applications often emerge in communication within countries of countries and spread rapidly around the world.

SECTION-1

Unit 1: Data communication networking and physical layer

Communication Model, Motivation: goals of networking, Well-known Applications networking,

Transmission Configurations: Point to Point and Multipoint. Transmission Modes: Synchronous and Asynchronous. Transmission Methods: Serial and Parallel. Communication. Communication Modes: Simplex, Half Duplex, and Full Duplex. Review of Line Coding techniques, Review of analog and digital Modulation

Networking Fundamentals: Types of Computer Networks: LAN, MAN, WAN, PAN, Internet, internet and Intranet. Network Architectures: Client-Server; Peer To Peer. Network Architecture Modes: Infrastructure and Ad-hoc mode. Network Topologies: Mesh, Star and Hierarchical.

Reference Models: need for a layered architecture, OSI, TCP/IP. Design Issues for Layers.

Host-to-host communication: RS-232, RS-485 over serial line

Physical Layer: Transmission Mediums: Networking Devices Wired and Wireless: NIC Repeater, Bridge, Switch, Modem, Router, Gateways and Access Point. **[5 Hrs]**

Unit-2: Data Link Layer and MAC sub layer

Data Link Layer: Design Issues: Services to Network Layer, Framing, Error Control: Parity Bits, Hamming Codes and CRC. Flow Control Protocols: Unrestricted Simplex, Stop and Wait, Sliding Window Protocol, WAN Connectivity: PPP and HDLC. Data Link Layer Service Primitives – Forwarding, - Channel Access Protocols, Ethernet and wireless networks **[5 Hrs]**

Unit-3: Network Layer:

Network Layer: Introduction: Functions of Network layer Switching Techniques: Circuit, Message and 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. **[5 Hrs]**

SECTION-II

Unit 4: Transport 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, Real Time Support Protocols: Real Time Transport protocol(RTP), TCP and UDP for Wireless networks. **[5 Hrs]**

Unit 5: Application Layer

Introduction, Web Caching, Standard Client Server Protocols: World Wide Web (WWW), Hyper Text Transfer Protocol (HTTP) and HTTPS, FTP, Electronic Mail, Telenet, SSH, DNS. SMTP, MIME, POP3, Webmail, Dynamic Logical Addressing: Dynamic Host Control Protocol (DHCP), Network Management: Introduction, SNMP. **[5 Hrs]**

Unit 6: Advanced topics computer networking

Advanced topics (any 2 of the following): Wireless networks and mobile computing; network management systems; security threats and solutions; IPv6; ATM; Multimedia applications and its impact on networking, Overlay networks and virtualization, network design and management, network simulation and performance analysis **[5 Hrs]**

List of Tutorials: (Any Three)

1) Examples and analysis of Unipolar NRZ, Polar NRZ, NRZ Inverted, Bipolar Encoding, Manchester Encoding, Differential Manchester Encoding

2) Line coding, Channel Encoding and modulations Techniques: used in IEEE 802.3 standard and its extensions, IEEE 802.11 standards and its extensions for 100 Mbps, 1 GbE, 1 Gbps, 2.5 Gbps, 5 Gbps, 10 Gbps, 25Gbps, 40 Gbps, 100 Gbps networks. Chanel Encodings in 3G, 4G and 5G Mobile Networks

3) Examples on Network Performance parameters: RTT, Delay, Bandwidth, Throughput and efficiency

4) PHY and MAC Layer IEEE 802.3 Standards For Copper: Overview of 10 Mbps Ethernet, Fast Ethernet, GbE -Gigabit Ethernet, 2.5 Gigabit Ethernet, 5 Gigabit Ethernet, 10 Gigabit Ethernet, 25 Gigabit Ethernet,40 Gigabit Ethernet, 100 Gigabit Ethernet

5) PHY and MAC Layer IEEE 802.3 Standards For Optical Fiber: 100 Mbps Fast Ethernet, GbE -Gigabit Ethernet, 2.5 Gigabit Ethernet, 5 Gigabit Ethernet, 10 Gigabit Ethernet, 25 Gigabit Ethernet,40 Gigabit Ethernet, 100 Gigabit Ethernet

6) PHY and MAC Layer IEEE 802.11 Wireless LAN Standards: IEEE 802.11, Wi-Fi 1/IEEE 802.11a, Wi-Fi 2/IEEE 802.11b, Wi-Fi 3/IEEE 802.11g, Wi-Fi 4/IEEE 802.11n, Wi-Fi 5/IEEE 802.11ac, IEEE 802.11ad (WiGig), IEEE 802.11ah (HaLow), Wi-Fi 6/IEEE 802.11ax, Wi-Fi 6/IEEE 802.11ay, Wi-Fi 6/IEEE 802.11by, Wi-Fi 7/IEEE 802.11be

7) Examples of Network Layer Logical Addressing
   a) Classful IP and CIDR : Subnetting, IP Prefixes
   b) NAT Mapping: Public to Private IP and Port Mapping
   c) Packet Delivery in Internetwork : Packets traversing through different subnetworks with different MTU and Speeds
   d) Packet Dropping Probabilities of Routers

8) Examples of Network Layer Routing
   a) Shortest Path and Spanning Tree
   b) Dijkstra's Algorithm
   c) Distance Vector Routing
   d) Link State Routing
   e) ECMP

9) Examples of Transport Layer
   a) TCP Connection Establishment: SYN and ACK, Normal Packets
   b) Flow Control : Calculating Optimal Size of Sliding Window
   c) Cumulative ACK scheme
   d) Smoothed RTT
   e) Slow Start and Additive Increase

10) Examples of Application Layer
   a) DNS: URL Domain Processing
   b) Performance of HTTP1.0 and HTTP1.1
   c) CDN

11) Examples and analysis on Modulation and demodulation techniques

12) Examples on network performance parameters : RTT, Delay, Bandwidth, Throughput and efficiency

13) Analyze packet formats of Ethernet, IP, TCP and UDP

14) Data Compression Algorithms

List of Practical: (Any Six)

1) Write a program in C++/JAVA to implement - Unipolar NRZ, Polar NRZ, NRZ Inverted, Bipolar Encoding, Manchester Encoding and Differential Manchester Encoding.

2) Setting up small computer networks and Hands on networking commands:
Set up a small wired and wireless network of 2 to 4 computers using Hub/Switch/Access point. It includes installation of LAN Cards, Preparation of Cables/ Installation and Configuration ofAccess Point, Assigning unique IP addresses and use of ping utility. Hands on for networkcommands - ping, pathping, ipconfig/ifconfig, arp, netstat, nbtstat, nslookup, route, traceroute/tracert, nmap.

3) Write a program for error detection and correction for 7/8 bits ASCII codes using Hamming Codes or CRC. Demonstrate the packets captured traces using Wireshark Packet Analyzer Tool for peer to peer mode.(50% students will perform Hamming Code and others will perform CRC). Further extend it to real implementation of CRC over Ethernet standard.

4) Write a program to simulate Go back N and Selective Repeat Modes of Sliding Window Protocol in peer to peer mode and demonstrate the packets captured traces using Wireshark

Packet Analyzer Tool for peer to peer mode. Further extend it to real implementation of Flow Control over TCP protocol.

5) Write a program to find the shortest path using Dijkstra Equation for Link State Routing Protocol which is used by Open Shortest Path First Protocol (OSPF) in the Internet for the networkflow provided by instructor.

6) Write a program using TCP Berkeley socket primitives for wired /wireless network for following

a) Say Hello to Each other (For all students)
b) File transfer (For all students)
c) Calculator (Arithmetic) (50% students)
d) Calculator (Trigonometry) (50% students)

Demonstrate the packets captured traces using Wireshark Packet Analyzer Tool for peer to peer mode.

7) Write a program using UDP Berkeley Sockets for wired/wireless network to enable file transfer (Script, Text, Audio and Video one file each) between two machines. Demonstrate the packets captured traces using Wireshark Packet Analyzer Tool for peer to peer mode.

8) Understanding protocol stack of Intranet Analyze packet formats of Ethernet, IP, TCP and UDP captured through Wireshark for wired networks.

9) Develop a client-server to demonstrate the behavior of HTTP1.0, HTTP1.1, HTTP1.2 and HTTP2.0 protocols.

10) Simulation of data communication using Cisco Packet tracer
11) Network simulation using Cloudsim
12) Linux Commands for testing connectivity and transfer rates
13) Demonstrate the different types of topologies and types of transmission media by using a packet tracer tool
14) 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)
15) Write a program to demonstrate Sub-netting and find subnet masks
16) Write a program to implement link state /Distance vector routing protocol to find suitable path for transmission
17) Use packet Tracer tool for configuration of 3 router network using one of the following protocol RIP/OSPF/BGP
18) Write a program using UDP Sockets to enable file transfer (Script, Text, Audio and Video one file each) between two machines
19) Write a program using UDP Sockets to enable file transfer (Script, Text, Audio and Video one file each) between two machines
20) Study and Analyze the performance of HTTP, HTTPS and FTP protocol using Packet tracer tool

List of Projects:

1.. Simulation of modulation and demodulation for digital telephone lines
2. Simulation of modulation and demodulation for 100 Mbps Ethernet Network
3. Simulation of modulation and demodulation for Gigabit Ethernet Network
4. Simulation of modulation and demodulation for 10Gigabit Ethernet Networks
5. Simulation of modulation and demodulation for 3G for mobile networks
6. Simulation of modulation and demodulation for 4G mobile networks
7. Develop a tool fox for line encoding methods
8. Develop a tool fox for modulation and demodulation methods
9. Design and deploy TCP based Multithreaded HTTP client server for accessing student activity data in the institute.
10. Design and deploy TCP based Multithreaded FTP client server to share institute level notices.
11. Design and deploy UDP based Multithreaded TFTP client server for your class
12. Design and deploy TCP based Multithreaded SMTP and POP3 mail client server for your campus.

13. Design and deploy TCP based Multithreaded Chat client server for your class.
14. Design and deploy UDP based Multithreaded Chat client server for your class.
15. Design and deploy UDP based Multithreaded Audio Conferencing client server for computer engineering department.
16. Design and deploy UDP based Multithreaded Video Conferencing client server for computer
17. Communication Systems Using Python
18. Python networking projects
19. Start Sending Data Over Long Distance using Arduino via Wired and Wireless Connection and extend Arduino Capabilities
20. CAN bus implementation or simulation
21. Power Line Data Communication
22. Cryptography / Steganography for secured data communication
23. Green Communications for Future Vehicular Networks
24. MODBUS simulation
25. Implementation of RIP/OSPF/BGP using Packet Tracer
26. Simulation of routing protocol using Packet Tracer/ NS3/OMNet
27. Simulation of modulation and demodulation for Ethernet Network
28. Cloud Computing
29. Illustrate the steps for implementation of S/MIME email security through Microsoft® Office Outlook.
30. 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 Group Discussion 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. Convergence of Networking and Cloud/Edge Computing: Status, Challenges, and Opportunities
12. Green Communications for Future Vehicular Networks: Data Compression Approaches, Opportunities, and Challenges
13. Joint Design of Sensing and Communication Systems for Smart Homes
14. Compute-Less Networking: Perspectives, Challenges, and Opportunities
15. UAV-Assisted Data Collection for Ocean Monitoring Networks
16. Energy-Efficient Monitoring of Fire Scenes for Intelligent Networks
17. AI-Empowered Maritime Internet of Things: A Parallel-Network-Driven Approach
18. data communication and networking issues in real world
19. A Secured Data Communication Scheme for Mobile Ad-Hoc Networks
20. Five Generation (5G) mobile wireless communication system
21. Ultra-Reliable and Low Latency Communications (URLLCs)
22. IP Addressing using IPv6
23. Implementation for campus network
24. Cloud Computing
25. MIMO Technology For Wi-Fi
26. Underground and underwater data Communications
27. Transmission technologies for 4G mobile networks
28. Transmission technologies for 5G mobile networks
29. Autonomous systems in the Internet
30. IP Addressing using IPv6
31. RIP implementation for campus network
32. OSPF implementation in Internet
33. BGP implementation in Internet
34. Simple Network Management Protocol implementation in Internet

Assessment Scheme:

Course Assessment: Total : 100 mks

1. End Semester Examination: 30 marks (ESA, 100 marks converted to 30)
2. Course Project : 20 marks (ISA, 100 marks converted to 20)
3. Lab Assignment : 10 mks (ISA, 100 marks converted to 10)
4. Viva : 20 mks (ESA, 100 marks converted to 20)
5. Group Discussion: 20 mks (ISA, 100 marks converted to 20)

Text Books:

1. Fourauzan B., "Data Communications and Networking", 5th edition, Tata McGraw- Hill, Publications, 2006
2. Andrew S. Tanenbaum, “Computer Networks”,5th Edition, PHI, ISBN 81-203-2175-8.
3. Kurose, Ross “Computer Networking a Top Down Approach Featuring the Internet”, Pearson; 6th edition (March 5, 2012), ISBN-10: 0132856204
4. Peterson & Davie, "Computer Networks, A Systems Approach", 3rd ed, Harcourt, 2005
5. Bertsekas and Gallagher “Data Networks, PHI, 2000 4.William Stallings, “Data and Computer Communications,” 5th edition, PHI, 2005

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
6. John Park, Steve Mackey, Edwin Wright, Practical Data Communications for Instrumentation and Control, Elsevier Publication

Moocs Links and additional reading material:

1. Computer Networks IIT Kharagpur: *https://nptel.ac.in/courses/106/105/106105081/*
2. Computer Networks and Internet Protocol, IIT Kharagpur: *https://nptel.ac.in/courses/106105183*
3. Computer Networks, IIT Madras: https://nptel.ac.in/courses/106106091
4. https://www.udemy.com/
5. https://www.coursera.org/

Course Outcomes:

The students are able to:

1. CO1: Summarize fundamental concepts of Computer Networks, architectures, protocols and technologies
2. CO2: Illustrate the working and functions of data link layer
3. CO3: Describe and analyze network layer protocols
4. CO4: Understand the services of transport layer
5. CO5: Know Responsibilities, services offered and protocol used at application layer of network
6. CO6: To learn advanced topics in computer networking

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	2	1	-	-	2	1	-	-	-	-	-	1	2	2	1
CO2	1	1	1	-	1	-	1	-	-	1	-	-	-	1	2
CO3	3	1	2	1	2	1	1	1	1	-	-	1	1	2	-
CO4	1	2	-	1	1	-	-	-	1	-	1	1	1	1	-
CO5	1	2	-	1	-	-	1	1	-	2	-	-	2	1	-
CO6	1	1	1	1	-	1	2	1	-	1	-	1	1	2	1

CO attainment levels :

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

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

IC3259 ::CYBER SECURITY

Credits: 4 **Teaching Scheme Theory : 2** 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

Assessment Scheme:

Course Assessment: Total : 100 mks

1. End Semester Examination: 30 marks (ESA, 100 marks *converted to 30)*
2. Course Project: 20 marks (ESA, *100 marks converted to 20)*
3. Lab Assignment: 10 mks (ISA, *100 marks converted to 10)*
4. Viva : 20 mks (ESA, *100 marks converted to 20)*
5. Course Seminar : 20 mks (ISA, *100 marks converted to 20)*

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

IC3257:: DESIGN THINKING -6

Course Objectives:

To provide ecosystem for students and faculty for paper publication and patent filing.

Credits: 1 **Teaching Scheme Theory:** Hours/Week

Tut: 1 Hours/Week

Topics and Contents

- Structure of The paper
- Journal List (Top 50 Journals)
- Selection of the journal
- Use of various online journal selection tools
- Plagiarism checking
- Improving contents of the paper
- Patent drafting
- Patent search
- Filing of patent
- Writing answers to reviewer questions
- Modification in manuscript
- Checking of publication draft

Course Outcomes:

The student will be able to

1. IC3252_CO1 Understand the importance of doing Research
2. IC3252_CO2 Interpret and distinguish different fundamental terms related to Research
3. IC3252_CO3 Apply the methodology of doing research and mode of its publication
4. IC3252_CO4 Write a Research Paper based on project work
5. IC3252_CO5 Understand Intellectual property rights
6. IC3252_CO6 Use the concepts of Ethics in Research
7. IC3252_CO7 Understand the Entrepreneurship and Business Planning

CO-PO Mapping :

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	1	1	1	0	0	0	0	0	0	1	0	1	1
CO2	1	1	1	1	1	0	0	0	0	0	0	1	0	1	1
CO3	2	2	3	3	2	2	1	2	2	3	0	1	1	1	1
CO4	3	3	3	3	3	2	1	2	2	3	1	1	1	1	1
CO5	1	1	1	1	1	0	0	0	0	0	0	0	0	0	1
CO6	2	2	2	2	2	2	1	3	2	3	0	1	0	0	1
CO7	1	1	1	1	1	0	0	0	0	0	0	1	0	0	1

CO attainment levels :

CO No.	IC3257_CO1	IC3257_CO2	IC3257_CO3	IC3257_CO4	IC3257_CO5	IC3257_CO6	IC3257_CO7
Attainment Level	2	2	3	6	2	3	2

FF No. : 654

IC3258 :: ENGINEERING DESIGN AND INNOVATION-4

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: 6 **Teaching Scheme Theory:** Hours/Week

Tut: Hours/Week

Lab: 12 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. IC3258_CO1 Analyse solutions for given engineering problem
2. IC3258_CO2 Design solutions for given engineering problem
3. IC3258_CO3 Demonstrate practical knowledge by constructing models/algorithms for real time applications
4. IC3258_CO4 Express effectively in written and oral communication
5. IC3258_CO5 Exhibit the skills to work in a team
6. IC3258_CO6 Prepare a time chart and financial record for execution of the project

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	3	3	3	2	2	2	2	1	1	2	2	1	1	3
CO3	2	2	2	2	3	1	2	1	1	0	2	1	2	2	3
CO4	1	1	1	1	0	2	1	3	1	3	1	1	1	1	1
CO5	1	0	0	2	0	1	1	2	3	2	1	1	0	1	0
CO6	1	0	0	1	0	2	1	1	2	2	3	2	0	2	2

CO attainment levels :

CO No.	IC3258_CO1	IC3258_CO2	IC3258_CO3	IC3258_CO4	IC3258_CO5	IC3258_CO6
Attainment Level	2	3	2	2	3	5

FF No. : 654

IC3220 :: INSTRUMENTATION PROJECT ENGINEERING

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

Section 1 : [IC3220_CO1, IC3220_CO2, IC3220_CO3]

Unit-1 : 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.

Unit-2 : 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.

Unit-3 : 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]

Unit-4 : 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).

Unit-5 : 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.

Unit-6 : 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)

FF No. : 654

IC3222 :: BATCH PROCESS CONTROL

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

Section 1 : [IC3222_CO1, IC3222_CO2, IC3222_CO3]

Unit-1 : Standards and control system of Batch Process
Batch control system terminology, characteristics of batch processes, hierarchical batch model, control structure for batch systems
Unit-2 : 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.
Unit-3: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]

Unit-4 : Design of batch control systems: Batch management, recipe management, production scheduling & information management. Batch control system design, system requirements, system hardware/reliability requirement.
Unit-5 : 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)