



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 'C26'

Effective from Academic Year 2026-27

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

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

Signed by

Chairman – BOS

Dean Academics

Chairman – Academic Board



**Syllabus of TY BTech (Instrumentation and Control) offered by B.O.S. in Instrumentation Engineering
for Academic Year 2026-27**

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	8.15	MD3202	S5	Digital Marketing	96
	8.16	MD3203	S5	Entrepreneurship	98
	8.17	MD3204	S5	Management	99
	8.18	MM1407A	S6	Automotive Instrumentation	101
	8.19	MM1407B	S6	Computer Network and Web Technology	105
	8.20	IC3262	S7	Design Thinking-4	111
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Vision statement of Institute

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

Mission statement of Institute

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

Core Values

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

Vision statement of Department

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

Mission statement of Department

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

Program Educational Objectives (PEO)

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

The Graduates would demonstrate

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

Program Outcomes

Engineering Graduates will be able to:

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

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

Program Specific Outcomes (PSOs)

Graduates shall have the ability to:

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

Vishwakarma Institute of Technology

Title : Course Structure

Issue 01 : Rev No. 00 : Dt. 01/08/22

FF No. 653

T.Y. B.Tech - Instrumentation and Control Engineering Structure for Pattern C-26, Module-5 with effect from Semester-1 of Academic Year 2026-27

Course Type	Course Code	Course Name	Teaching Learning Scheme (Hrs./Week)				Credits	Assessment Scheme (100 mark scale)														
			Th	Lab	Tut	Total		In Semester Assessment									End Semester Assessment					Total
								LA	CP	T1 MCQ	MSE Written	MSE Review	Seminar / GD / HA			ESE			T2 MCQ	ESE Review	CVV	
													Seminar	GD	HA	Written	MCQ	Pract+cvv				
S1	IC3231	Process Instrumentation	3	2	0	5	4									40		40+20				100
S2	IC3237	Control Theory	2	2	0	4	3	10	30							40					20	100
S3	IC3233	Measurement Systems	3	2	0	5	4		40					20	20						20	100
S4	MD3101	IBM Full Stack Software Develop	3	0	0	3	3													100		100
S4	MD3102	Meta Back-End Developer																				
S4	MD3106	Microsoft Power BI Data Analyst																				
S4	MD3112	Google Cybersecurity																				
S4	MD3113	Google Data Analytics																				
S4	MD3118	IBM Data Science																				
S4	MD3119	Fractal Data Science																				
S4	MD3121	IBM DevOps and Software Engineering																				
S4	MD3141	AWS Cloud Technology Consultant																				
S4	MD3147	Deep Learning-AI Deep Learning																				
S5	MD3201	Fintech	4	0	0	4	4													100		100
S5	MD3202	Digital Marketing																				
S5	MD3203	Entrepreneurship																				
S5	MD3204	Management																				
S6	MM1407A	Automotive Instrumentation	2	0	1	3	3		30				20		10	40						100
	MM1407B	Computer Network and Web Technology																				

S7	IC3261	Design Thinking-3	0	0	1	1	1												100		100
S8	IC3239	Engineering Research and Innovation-1	0	4	0	4	2					30							70		100
		Total	17	10	2	29	24	10	100			30	20	20	30	120		60	370	40	800

Course Name Nomenclature as per NEP

PCC : Program Core Courses (S1 & S2)
PEC : Program Elective Courses (S3 & S4)
OE : Open Elective (S5)
MDC : Multi-Disciplinary Course (S6)
VSEC : Vocational and Skill Enhancement courses (S7)
FP : Field Project (S8)

Nomenclature for Teaching Scheme

Th : Theory
Lab : Laboratory
Tut : Tutorial

Nomenclature for Assessment Scheme

Lab : Laboratory Continuous Assessment
CP : Course Project
T1 / T2: Online Test
CT1/ CT2 : Class Test
MSE : Mid Semester Examination
ESE : End Semester Examination

HA : Home Assignment
CVV : Comprehensive Viva Voce
GD : Group Discussion
HA : Home Assignment
Pract : Practical Exam
MCQ : Multiple Choice Questions

Issue 01 : Rev No. 00 : Dt. 01/08/22

FF No. 653

Course Type	Course Code	Course Name	Teaching Learning Scheme (Hrs./Week)				Credits	Assessment Scheme (100 mark scale)														
			Th	Lab	Tut	Total		In Semester Assessment									End Semester Assessment					Total
								LA	CP	T1 MCQ	MSE Written	MSE Review	Seminar / GD / HA	ESE			T2 MCQ	ESE Review	CVV	100		
														Seminar	GD	HA					Written	MCQ
S1	IC3234	Building and Process Automation	3	2	0	5	4									40		40+20				100
S2	IC3243	Artificial Intelligence and Machine Learning	2	2	0	4	3	10	30							40					20	100
S3	IC3260	Instrumentation Project Engineering	3	2	0	5	4		40					20	20						20	100
S4	MD3101	IBM Full Stack Software developer	3	0	0	3	3													100		100
S4	MD3102	Meta Back-End Developer																				
S4	MD3106	Microsoft Power BI Data Analyst																				
S4	MD3112	Google Cybersecurity																				
S4	MD3113	Google Data Analytics																				
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S4	MD3121	IBM DevOps and Software Engineering																				
S4	MD3141	AWS Cloud Technology Consultant																				
S4	MD3147	Deep Learning-AI Deep Learning																				
S5	MD3201	Fintech	4	0	0	4	4													100		100
S5	MD3202	Digital Marketing																				
S5	MD3203	Entrepreneurship																				
S5	MD3204	Management																				

S6	MM1407A	Automotive Instrumentation	2	0	1	3	3	30				20	10	40							100
	MM1407B	Computer Network and Web Technology																			
S7	IC3262	Design Thinking-4	0	0	1	1	1												100		100
S8	IC3240	Engineering Research and Innovation-2	0	4	0	4	2				30								70		100
S9	IC3222	Batch Process Control	2	0	0	2	0												100		100
Total			17	10	2	29	24	10	100		30	20	20	30	120		60		370	40	800

Course Name Nomenclature as per NEP

PCC : Program Core Courses (S1 & S2)

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OE : Open Elective (S5)

MDC : Multi-Disciplinary Course (S6)

VSEC : Vocational and Skill Enhancement courses (S7)

FP : Field Project (S8)

Audit : Audit Course (S9)

Nomenclature for Teaching Scheme

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Nomenclature for Assessment Scheme

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Pract : Practical Exam

MCQ : Multiple Choice Questions

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 : 3 Hours/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 (7 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 (7 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 (7 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 (7 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 (7 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 (7 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 Practicals: (Any Ten)

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 for voltage range / current range.
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 / Thermocouple temperature transmitter.
7. Study and characterization of Level / Flow / Pressure transmitter.
8. Develop op-amp based ON-OFF controller for temperature control loop.
9. Tuning of PID controller for Temperature / Pressure / Flow / Level control loop.

10. Identification of control valve types, parts, accessories, actuators and Plot the installed characteristics of given control valve.
11. Study of Limiters and Selectors.
12. Design RTD signal conditioning circuit for the given temperature range to 0 to 5 Vdc / 4 to 20 mA.
13. Design Signal conditioning circuit for Thermocouple for the given temperature range to 0 to 5 Vdc / 4 to 20 mA.
14. Develop Signal conditioning circuit for pressure transmitter for given pressure range.
15. Design of intrinsic safety circuit.

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](https://www.udemy.com/course/instrumentation-detailed-engineering-1-epc-job)
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. Comprehend the fundamentals of process control loop.
2. Demonstrate the working of controller and solve a problem using control actions.
3. Select and Design the control valve and actuators to solve a problem.
4. Build a mathematical model and auxiliary process loop components.
5. Develop different control schemes for the Boiler.
6. 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.	CO1	CO2	CO3	CO4	CO5	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

IC3237:: CONTROL THEORY**Credits:** 03**Teaching Scheme:**

Theory: 2 Hours/Week

Lab : 2 Hours/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.

Text Books and Reference Books :

1. Modern Control Engineering by K. Ogata
2. Control System Engineering by L. J. Nagrath and M. Gopal

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, etc.

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

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 sensors and transducers
3. To get knowledge of various measurement systems for process parameter measurement
4. To understand 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: 3 Hours/Week****Lab : 2 Hours/Week****SECTION-1:**

Electrical and Electronic Measuring Instruments: Analog instruments such as PMMC and moving iron type AC / DC voltmeter and ammeter. Digital multimeter (DMM) construction, measurement techniques, specifications and applications. Introduction to cathode ray oscilloscope CRO, digital storage oscilloscope (DSO), operating modes, sampling techniques, specifications and applications. Instruments for waveform analysis such as distortion meter and spectrum analyzer. Insulation testers and LCR meters. Timers / counters techniques, operating modes, specifications and applications.

Electromagnetic Interference and Electromagnetic Compatibility: EMI/EMC, intrinsic and extrinsic noise, effects on instruments and minimization technique. ESD, causes, Human ESD model, minimization techniques H/W and S/W protection against ESD.

Reliability Engineering: Introduction to reliability of systems. Bathtub curve. Various causes of failure. Techniques for improvement of reliability. Redundancy techniques.

SECTION-2:

Analytical Instruments and Measurement: Introduction and classification of analytical instruments, qualitative and quantitative analysis. Electromagnetic spectrum, Beer Lambert's law, optical filters and monochromators. Filter photometer, colorimeter and spectrophotometers. Gas analyzers. Gas and liquid chromatography instruments. Measurement of pH, viscosity, conductivity, humidity and turbidity.

Biomedical Instrumentation: Introduction to human physiology, Bio-potential 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, heart lung system. Brain system and EEG recorder. Respiratory system and spirometers, IOT in Biomedical system.

List of Practical: (Any Six)

1. Extension of analog voltmeter and ammeter ranges
2. Electronics components testing using a DMM
3. Demonstration of the operation of a analog and digital storage oscilloscopes
4. Measurement of waveform distortion using a distortion meter
5. Insulation measurement using an insulation tester
6. Frequency and time period measurement using a universal counter
7. Demonstration of the working of a colorimeter or filter photometer
8. Blood pressure measurement using VI lab
9. Design of a filter circuit for ECG or EEG
10. Design of an amplifier for ECG or EEG

List of Course projects:

1. Design a voltmeter or an ammeter using a galvanometer
2. Design of a digital voltmeter or ammeter
3. Design of a temperature measurement system
4. Design of pressure measurement system
5. Design of humidity measurement system
6. Design of a simple capacitance meter
7. Design of a frequency counter
8. Design of an instrument for a given parameter measurement
9. Body temperature measurement system
10. PH measurement system
11. Measurement system for magnetic field strength measurement
12. Any other project based on the topics covered in the syllabus

List of Group Discussion Topics:

1. Applications of automatic test equipment
2. Redundancy techniques in various equipment
3. Calculation of MTTF and MTBF of a system
4. DSO specifications and selection
5. Virtual instruments
6. PCB making process
7. EMI testing techniques
8. Shielding and grounding techniques
9. Surface mount devices SMD
10. Smart energy meter
11. Lux meter
12. Gauss meter
13. IR spectroscopy and applications
14. AAS, MRI, NMR, ESR
15. Any other topic related to the subject

Text Books:

1. Kalsi H S; Electronic Instrumentation; Tata McGraw-Hill.
2. A. J. Bowens; Digital Instrumentation; Tata McGraw-Hill.
Reliability
3. R S Khandpur; Handbook of Analytical Instruments; McGraw Hill Education; 2 edition
4. Willard, H. H., Merritt Jr, L. L., Dean, J. A., & Settle Jr, F. A. Instrumental methods of analysis. 7th edition. CBS Publishers & Distributors.

Reference Books:

1. Sawhney, A. K., Electrical and electronic Measurements and Instrumentation. Dhanpat 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. Demonstrate the working and use analog instruments for electrical measurements.
2. Select and use suitable digital instruments for electronic measurements.
3. Students will understand apply EMI /EMC concepts while designing measurement systems.
4. Students will be able to apply reliability engineering knowledge for electronic system design.
5. Students will be able to demonstrate the working of analytical instruments.
6. Students will understand the principle and working of 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 attainment levels:

CO No.	CO1	CO2	CO3	CO4	CO5	CO6
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

COURSERA PROFESSIONAL CERTIFICATE COURSES**MD3101 :: IBM FULL STACK SOFTWARE DEVELOPER****Credits: 3****Teaching Scheme Theory: 3 Hours/Week****Professional Certificate - 15 course series**

1. **Introduction to Software Engineering**
Course 1•14 hours•4.7(1,477 ratings)
2. **Introduction to Cloud Computing**
Course 2•12 hours•4.6(6,376 ratings)
3. **Introduction to HTML, CSS, & JavaScript**
Course 3•10 hours•4.4(176 ratings)
4. **Getting Started with Git and GitHub**
Course 4•10 hours•4.6(1,207 ratings)
5. **Developing Front-End Apps with React**
Course 5•14 hours•4.3(490 ratings)
6. **Developing Back-End Apps with Node.js and Express**
Course 6•13 hours•4.4(410 ratings)
7. **Python for Data Science, AI & Development**
Course 7•25 hours•4.6(37,177 ratings)
8. **Developing AI Applications with Python and Flask**
Course 8•11 hours•4.4(738 ratings)
9. **Django Application Development with SQL and Databases**
Course 9•14 hours•4.5(243 ratings)
10. **Introduction to Containers w/ Docker, Kubernetes & OpenShift**
Course 10•17 hours•4.4(811 ratings)
11. **Application Development using Microservices and Serverless**
Course 11•14 hours•4.6(277 ratings)
12. **Full Stack Application Development Capstone Project**
Course 12•16 hours•4.5(143 ratings)
13. **Full Stack Software Developer Assessment**
Course 13•6 hours•4.7(211 ratings)
14. **Generative AI: Elevate your Software Development Career**
Course 14•17 hours•4.7(56 ratings)
15. **Software Developer Career Guide and Interview Preparation**
Course 15•11 hours•4.7(139 ratings)

Course Outcomes:

After completing the course, the students will be able to:

1. Demonstrate proficiency in programming languages
2. Understand and apply fundamental data structures and algorithms
3. Develop the ability to analyze datasets using statistical methods and visualize results
4. Gain foundational knowledge of cryptographic techniques, security protocols and their application to information and network security
5. Acquire skills in web development, build basic web applications or understand web structures.
6. Understand relational database concepts and database design principles, to manage and retrieve information from databases.

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

CO attainment levels:

CO No.	CO1	CO2	CO3	CO4	CO5	CO6
Attainment Level	3	3	2	4	3	3

FF No.: 654

MD3102 :: META BACK-END DEVELOPER**Credits: 3****Teaching Scheme Theory: 3 Hours/Week****Professional Certificate - 9 course series****1. Introduction to Back-End Development**

Course 1•18 hours•4.7(3,171 ratings)

2. Programming in Python

Course 2•44 hours•4.6(1,439 ratings)

3. Version Control

Course 3•13 hours•4.6(3,247 ratings)

4. Introduction to Databases for Back-End Development

Course 4•27 hours•4.6(570 ratings)

5. Django Web Framework

Course 5•45 hours•4.7(519 ratings)

6. APIs

Course 6•20 hours•4.4(280 ratings)

7. The Full Stack

Course 7•24 hours•4.6(178 ratings)

8. Back-End Developer Capstone

Course 8•20 hours•4.5(130 ratings)

9. Coding Interview Preparation

Course 9•11 hours•4.6(527 ratings)

Course Outcomes:

After completing the course, the students will be able to:

1. Demonstrate proficiency in programming languages
2. Understand and apply fundamental data structures and algorithms
3. Develop the ability to analyze datasets using statistical methods and visualize results
4. Gain foundational knowledge of cryptographic techniques, security protocols and their application to information and network security
5. Acquire skills in web development, build basic web applications or understand web structures.
6. Understand relational database concepts and database design principles, to manage and retrieve information from databases.

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

CO attainment levels:

CO No.	CO1	CO2	CO3	CO4	CO5	CO6
Attainment Level	3	3	2	4	3	3

FF No.: 654

MD3106 :: MICROSOFT POWER BI DATA ANALYST**Credits: 3****Teaching Scheme Theory: 3 Hours/Week****Professional Certificate - 9 course series****1. Power BI: Data Analysis, Reporting, and Connecting**

Course 1, 5 hours

2. Power BI: Data Cleaning, Transformation, and Visualization

Course 2, 6 hours

3. Power BI: Modeling, Filtering, and Advanced Analysis

Course 3, 6 hours

4. Power BI: Dashboards, Collaboration, and Optimization

Course 4, 5 hours

Course Outcomes:

After completing the course, the students will be able to:

1. Demonstrate proficiency in programming languages
2. Understand and apply fundamental data structures and algorithms
3. Develop the ability to analyze datasets using statistical methods and visualize results
4. Gain foundational knowledge of cryptographic techniques, security protocols and their application to information and network security
5. Acquire skills in web development, build basic web applications or understand web structures.
6. Understand relational database concepts and database design principles, to manage and retrieve information from databases.

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

CO attainment levels:

CO No.	CO1	CO2	CO3	CO4	CO5	CO6
Attainment Level	3	3	2	4	3	3

FF No.: 654

MD3112 :: GOOGLE CYBERSECURITY**Credits: 3****Teaching Scheme Theory: 3 Hours/Week****Professional Certificate - 9 course series**

1. **Foundations of Cybersecurity**
Course 1, 10 hours
2. **Play It Safe: Manage Security Risks**
Course 2, 9 hours
3. **Connect and Protect: Networks and Network Security**
Course 3, 12 hours
4. **Tools of the Trade: Linux and SQL**
Course 4, 23 hours
5. **Assets, Threats, and Vulnerabilities**
Course 5, 19 hours
6. **Sound the Alarm: Detection and Response**
Course 6, 18 hours
7. **Automate Cybersecurity Tasks with Python**
Course 7, 25 hours
8. **Put It to Work: Prepare for Cybersecurity Jobs**
Course 8, 11 hours
9. **Accelerate Your Job Search with AI**
Course 9, 6 hours

Course Outcomes:

After completing the course, the students will be able to:

1. Demonstrate proficiency in programming languages
2. Understand and apply fundamental data structures and algorithms
3. Develop the ability to analyze datasets using statistical methods and visualize results
4. Gain foundational knowledge of cryptographic techniques, security protocols and their application to information and network security
5. Acquire skills in web development, build basic web applications or understand web structures.
6. Understand relational database concepts and database design principles, to manage and retrieve information from databases.

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

CO attainment levels:

CO No.	CO1	CO2	CO3	CO4	CO5	CO6
Attainment Level	3	3	2	4	3	3

FF No.: 654

MD3113 :: GOOGLE DATA ANALYTICS**Credits: 3****Teaching Scheme Theory: 3 Hours/Week****Professional Certificate - 9 course series**

1. **Foundations: Data, Data, Everywhere**
Course 1•13 hours
2. **Ask Questions to Make Data-Driven Decisions**
Course 2•15 hours
3. **Prepare Data for Exploration**
Course 3•19 hours
4. **Process Data from Dirty to Clean**
Course 4•16 hours
5. **Analyze Data to Answer Questions**
Course 5•26 hours
6. **Share Data Through the Art of Visualization**
Course 6•19 hours
7. **Introduction to Data Analysis Using Python**
Course 7•27 hours
8. **Google Data Analytics Capstone: Complete a Case Study**
Course 8•11 hours
9. **Accelerate Your Job Search with AI**
Course 9•6 hours

Course Outcomes:

After completing the course, the students will be able to:

1. Demonstrate proficiency in programming languages
2. Understand and apply fundamental data structures and algorithms
3. Develop the ability to analyze datasets using statistical methods and visualize results
4. Gain foundational knowledge of cryptographic techniques, security protocols and their application to information and network security
5. Acquire skills in web development, build basic web applications or understand web structures.
6. Understand relational database concepts and database design principles, to manage and retrieve information from databases.

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

CO attainment levels:

CO No.	CO1	CO2	CO3	CO4	CO5	CO6
Attainment Level	3	3	2	4	3	3

FF No.: 654

MD3118 :: IBM DATA SCIENCE**Credits: 3****Teaching Scheme Theory: 3 Hours/Week****Professional Certificate - 14 course series**

- 1. What is Data Science?**
Course 1, 12 hours
- 2. Tools for Data Science**
Course 2, 16 hours
- 3. Data Science Methodology**
Course 3, 9 hours
- 4. Python for Data Science, AI & Development**
Course 4, 24 hours
- 5. Python Project for Data Science**
Course 5, 7 hours
- 6. Databases and SQL for Data Science with Python**
Course 6, 18 hours
- 7. Data Analysis with Python**
Course 7, 16 hours
- 8. Data Visualization with Python**
Course 8, 19 hours
- 9. Machine Learning with Python**
Course 9, 20 hours
- 10. Applied Data Science Capstone**
Course 10, 14 hours
- 11. Generative AI: Elevate Your Data Science Career**
Course 11, 14 hours
- 12. Data Scientist Career Guide and Interview Preparation**
Course 12, 9 hours

Course Outcomes:

After completing the course, the students will be able to:

1. Demonstrate proficiency in programming languages
2. Understand and apply fundamental data structures and algorithms
3. Develop the ability to analyze datasets using statistical methods and visualize results
4. Gain foundational knowledge of cryptographic techniques, security protocols and their application to information and network security
5. Acquire skills in web development, build basic web applications or understand web structures.
6. Understand relational database concepts and database design principles, to manage and retrieve information from databases.

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

CO attainment levels:

CO No.	CO1	CO2	CO3	CO4	CO5	CO6
Attainment Level	3	3	2	4	3	3

FF No.: 654

MD3119 :: FRACTAL DATA SCIENCE**Credits: 3****Teaching Scheme Theory: 3 Hours/Week****Professional Certificate - 8 course series****1. Structured Approach to Problem Solving**

Course 1, 15 hours

2. Data Analysis Using SQL

Course 2, 17 hours

3. Insights of Power BI

Course 3, 14 hours

4. Python for Data Science

Course 4, 40 hours

5. Human Decision Making and its Biases

Course 5, 14 hours

6. Foundations of Machine Learning

Course 6, 25 hours

7. Advanced Machine Learning Algorithms

Course 7, 21 hours

8. Data Storytelling

Course 8, 12 hours

Course Outcomes:

After completing the course, the students will be able to:

1. Demonstrate proficiency in programming languages
2. Understand and apply fundamental data structures and algorithms
3. Develop the ability to analyze datasets using statistical methods and visualize results
4. Gain foundational knowledge of cryptographic techniques, security protocols and their application to information and network security
5. Acquire skills in web development, build basic web applications or understand web structures.
6. Understand relational database concepts and database design principles, to manage and retrieve information from databases.

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

CO attainment levels:

CO No.	CO1	CO2	CO3	CO4	CO5	CO6
Attainment Level	3	3	2	4	3	3

FF No.: 654

MD3121 : IBM DEVOPS AND SOFTWARE ENGINEERING**Credits: 3****Teaching Scheme Theory: 3 Hours/Week****Professional Certificate - 15 course series****1. Introduction to DevOps**

Course 1, 9 hours

2. Introduction to Cloud Computing

Course 2, 12 hours

3. Introduction to Agile Development and Scrum

Course 3, 13 hours

4. Introduction to Software Engineering

Course 4, 15 hours

5. Getting Started with Git and GitHub

Course 5, 11 hours

6. Hands-on Introduction to Linux Commands and Shell Scripting

Course 6, 17 hours

7. Python for Data Science, AI & Development

Course 7, 24 hours

8. Developing AI Applications with Python and Flask

Course 8, 12 hours

9. Introduction to Containers w/ Docker, Kubernetes & OpenShift

Course 9, 17 hours

10. Application Development using Microservices and Serverless

Course 10, 16 hours

11. Introduction to Test and Behavior Driven Development

Course 11, 21 hours

12. Continuous Integration and Continuous Delivery (CI/CD)

Course 12, 15 hours

13. Application Security for Developers and DevOps Professionals

Course 13, 17 hours

14. Monitoring and Observability for Development and DevOps

Course 14, 16 hours

15. DevOps Capstone Project

Course 15, 20 hours

Course Outcomes:

After completing the course, the students will be able to:

1. Demonstrate proficiency in programming languages
2. Understand and apply fundamental data structures and algorithms
3. Develop the ability to analyze datasets using statistical methods and visualize results
4. Gain foundational knowledge of cryptographic techniques, security protocols and their application to information and network security
5. Acquire skills in web development, build basic web applications or understand web structures.
6. Understand relational database concepts and database design principles, to manage and retrieve information from databases.

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

CO attainment levels:

CO No.	CO1	CO2	CO3	CO4	CO5	CO6
Attainment Level	3	3	2	4	3	3

FF No.: 654

MD3141 : AWS CLOUD TECHNOLOGY CONSULTANT**Credits: 3****Teaching Scheme Theory: 3 Hours/Week****Professional Certificate - 9 course series**

1. **Introduction to Information Technology and AWS Cloud**
Course 1, 6 hours
2. **AWS Cloud Technical Essentials**
Course 2, 21 hours
3. **Providing Technical Support for AWS Workloads**
Course 3, 7 hours
4. **Developing Applications in Python on AWS**
Course 4, 10 hours
5. **Skills for Working as an AWS Cloud Consultant**
Course 5, 10 hours
6. **DevOps on AWS and Project Management**
Course 6, 9 hours
7. **Automation in the AWS Cloud**
Course 7, 8 hours
8. **Data Analytics and Databases on AWS**
Course 8, 9 hours
9. **Capstone: Following the AWS Well Architected Framework**
Course 9, 11 hours

Course Outcomes:

After completing the course, the students will be able to:

1. Demonstrate proficiency in programming languages
2. Understand and apply fundamental data structures and algorithms
3. Develop the ability to analyze datasets using statistical methods and visualize results
4. Gain foundational knowledge of cryptographic techniques, security protocols and their application to information and network security
5. Acquire skills in web development, build basic web applications or understand web structures.
6. Understand relational database concepts and database design principles, to manage and retrieve information from databases.

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

CO attainment levels:

CO No.	CO1	CO2	CO3	CO4	CO5	CO6
Attainment Level	3	3	2	4	3	3

FF No.: 654

MD3147 : DEEP LEARNING-AI DEEP LEARNING**Credits: 3****Teaching Scheme Theory: 3 Hours/Week****Professional Certificate - 5 course series****1. Neural Networks and Deep Learning**

Course 1, 25 hours

2. Improving Deep Neural Networks: Hyperparameter Tuning, Regularization and Optimization

Course 2, 24 hours

3. Structuring Machine Learning Projects

Course 3, 7 hours

4. Convolutional Neural Networks

Course 4, 36 hours

5. Sequence Models

Course 5, 37 hours

Course Outcomes:

After completing the course, the students will be able to:

1. Demonstrate proficiency in programming languages
2. Understand and apply fundamental data structures and algorithms
3. Develop the ability to analyze datasets using statistical methods and visualize results
4. Gain foundational knowledge of cryptographic techniques, security protocols and their application to information and network security
5. Acquire skills in web development, build basic web applications or understand web structures.
6. Understand relational database concepts and database design principles, to manage and retrieve information from databases.

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

CO attainment levels:

CO No.	CO1	CO2	CO3	CO4	CO5	CO6
Attainment Level	3	3	2	4	3	3

FF No.: 654

MD3201 : FINTECH**Credits: 3****Teaching Scheme Theory: 3 Hours/Week****Professional Certificate - 4 course series****1. FinTech Foundations and Overview**

Course 1, 15 hours

2. FinTech Security and Regulation (RegTech)

Course 2, 15 hours

3. FinTech Risk Management

Course 3, 15 hours

4. FinTech Disruptive Innovation: Implications for Society

Course 4, 13 hours

Course Outcomes:

After completing the course, the students will be able to:

1. Demonstrate proficiency in programming languages
2. Understand and apply fundamental data structures and algorithms
3. Develop the ability to analyze datasets using statistical methods and visualize results
4. Gain foundational knowledge of cryptographic techniques, security protocols and their application to information and network security
5. Acquire skills in web development, build basic web applications or understand web structures.
6. Understand relational database concepts and database design principles, to manage and retrieve information from databases.

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

CO attainment levels:

CO No.	CO1	CO2	CO3	CO4	CO5	CO6
Attainment Level	3	3	2	4	3	3

FF No.: 654

MD3202 : DIGITAL MARKETING**Credits: 3****Teaching Scheme Theory: 3 Hours/Week****Professional Certificate - 8 course series**

1. **Foundations of Digital Marketing and E-commerce**
Course 1, 12 hours
2. **Attract and Engage Customers with Digital Marketing**
Course 2, 14 hours
3. **From Likes to Leads: Interact with Customers Online**
Course 3, 21 hours
4. **Think Outside the Inbox: Email Marketing**
Course 4, 19 hours
5. **Assess for Success: Marketing Analytics and Measurement**
Course 5, 18 hours
6. **Make the Sale: Build, Launch, and Manage E-commerce Stores**
Course 6, 15 hours
7. **Satisfaction Guaranteed: Develop Customer Loyalty Online**
Course 7, 15 hours
8. **Accelerate Your Job Search with AI**
Course 8, 6 hours

Course Outcomes:

After completing the course, the students will be able to:

1. Demonstrate proficiency in programming languages
2. Understand and apply fundamental data structures and algorithms
3. Develop the ability to analyze datasets using statistical methods and visualize results
4. Gain foundational knowledge of cryptographic techniques, security protocols and their application to information and network security
5. Acquire skills in web development, build basic web applications or understand web structures.
6. Understand relational database concepts and database design principles, to manage and retrieve information from databases.

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

CO attainment levels:

CO No.	CO1	CO2	CO3	CO4	CO5	CO6
Attainment Level	3	3	2	4	3	3

FF No.: 654

MD3203 : ENTREPRENEURSHIP**Credits: 3****Teaching Scheme Theory: 3 Hours/Week****Professional Certificate - 4 course series****1. Developing Innovative Ideas for New Companies: The First Step in Entrepreneurship**

Course 1, 5 hours

2. Innovation for Entrepreneurs: From Idea to Marketplace

Course 2, 7 hours

3. New Venture Finance: Startup Funding for Entrepreneurs

Course 3, 14 hours

4. Entrepreneurship Capstone

Course 4•10 hours

Course Outcomes:

After completing the course, the students will be able to:

1. Demonstrate proficiency in programming languages
2. Understand and apply fundamental data structures and algorithms
3. Develop the ability to analyze datasets using statistical methods and visualize results
4. Gain foundational knowledge of cryptographic techniques, security protocols and their application to information and network security
5. Acquire skills in web development, build basic web applications or understand web structures.
6. Understand relational database concepts and database design principles, to manage and retrieve information from databases.

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

CO attainment levels:

CO No.	CO1	CO2	CO3	CO4	CO5	CO6
Attainment Level	3	3	2	4	3	3

FF No.: 654

MD3204 : MANAGEMENT**Credits: 3****Teaching Scheme Theory: 3 Hours/Week****Professional Certificate - 7 course series**

1. **Foundations of Project Management**
Course 1, 13 hours
2. **Project Initiation: Starting a Successful Project**
Course 2, 15 hours
3. **Project Planning: Putting It All Together**
Course 3, 23 hours
4. **Project Execution: Running the Project**
Course 4, 26 hours
5. **Agile Project Management**
Course 5, 20 hours
6. **Capstone: Applying Project Management in the Real World**
Course 6, 39 hours
7. **Accelerate Your Job Search with AI**
Course 7, 6 hours

Course Outcomes:

After completing the course, the students will be able to:

1. Demonstrate proficiency in programming languages
2. Understand and apply fundamental data structures and algorithms
3. Develop the ability to analyze datasets using statistical methods and visualize results
4. Gain foundational knowledge of cryptographic techniques, security protocols and their application to information and network security
5. Acquire skills in web development, build basic web applications or understand web structures.
6. Understand relational database concepts and database design principles, to manage and retrieve information from databases.

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

CO attainment levels:

CO No.	CO1	CO2	CO3	CO4	CO5	CO6
Attainment Level	3	3	2	4	3	3

Course Objectives:

To develop an understanding of the modern vehicle as a distributed network of electronic control systems. Students learn a single organizing pattern — sensors and actuators, in-vehicle communication, and the electronic control unit — and then apply it to real automotive sub-systems (battery management, charging, ADAS), before studying how these sub-systems are integrated (VCU), how the architecture is evolving (software-defined vehicle), and how systems are diagnosed and reprogrammed (UDS and bootloader). The course spans both ICE and EV contexts, with functional safety (ISO 26262) woven through the safety-critical sub-systems.

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

SECTION 1 :

Unit 1: Automotive I/O — Sensors, Actuators & Drivers (5 Hrs)

- Automotive sensor categories and what makes a sensor “automotive” — the operating environment and integration, building on transducer fundamentals from prerequisite courses.
- Automotive actuators as the ECU’s output stage: injectors, electronic throttle bodies, solenoid/valve actuators, motor-driven actuators, EV contactors.
- The driver concept in both senses: the hardware driver stage (power switching — low/high-side drivers, H-bridges) and the software driver layer through which an ECU reads sensors and commands actuators.
- Automotive EMI/EMC: the vehicle electrical environment, transients, grounding, and harness considerations.

Unit 2: In-Vehicle Communication (5 Hrs)

- Controller Area Network (CAN) in detail: physical layer, frame structure, message-based arbitration, priority, and error handling.
- CAN FD (Flexible Data-rate): motivation, higher payload and bandwidth, and its role in modern powertrain/body networks.
- LIN and FlexRay at awareness level; positioning relative to CAN.
- Automotive Ethernet (awareness level): why higher-bandwidth backbones exist and what ADAS and software-defined architectures demand of the network.

Unit 3: The Electronic Control Unit (ECU) & Software Architecture (5 Hrs)

- ECU fundamentals and specifications: processing, memory, I/O, and real-time constraints.
- ECU internal architecture and types: function-specific controllers versus domain controllers
- Engine/vehicle management concepts: fuel injection, ignition, and representative control functions.
- AUTOSAR software architecture (concept level): the layered model — MCAL → Basic Software (BSW) →

Runtime Environment (RTE) → application — and why layering makes application software portable across hardware.

SECTION 2:

Unit 4: Energy Sub-systems — BMS & Charging (5 Hrs)

- Battery Management System (BMS) as a worked instance of the pattern: sensing (cell voltage, current, temperature), communication, and its own controller deciding on cell balancing, SoC/SoH estimation, thermal management, and contactor control.
- Charging systems: 12V charging (alternator, battery, regulator) and EV traction-battery charging (onboard charger, DC fast charging, charging communication such as ISO 15118). The 12V and EV cases are distinguished explicitly.
- Functional safety (ISO 26262): introduction to functional safety, ASIL classification (severity × exposure × controllability), and the safety lifecycle — introduced via the BMS as a high-ASIL system.

First instantiation of the sensor → communication → ECU template, and the natural home to introduce functional safety concretely.

Unit 5: ADAS & Safety-Critical Sub-systems (5 Hrs)

- ADAS as an instance of the pattern: sensing modalities (radar, camera, ultrasonic, LiDAR — introductory), communication (where the Unit 2 Ethernet backbone is relevant), and the ECU/domain controller that fuses inputs to decide.
- A second short instance — braking/ABS or stability control — reinforcing that the same template continues to apply.
- Functional safety applied (ISO 26262): ASIL determination for ADAS and braking as archetypal high-ASIL functions, deepening the Unit 4 introduction.

Reinforces the pattern across further sub-systems and establishes functional safety as the constraint binding the safety-critical ones.

Unit 6: Integration, Evolution & Servicing (5 Hrs)

- Vehicle Control Unit (VCU) — the integrator: the controller that coordinates the individual sub-system ECUs met earlier; a hardware/role concept (“which box is in charge”). The moment isolated sub-systems become one vehicle.
- Software-Defined Vehicle (SDV) — the evolution: consolidation of many ECUs onto fewer high-performance computers, decoupling of software from hardware, and over-the-air updates. Presented as the trend reversing the one-ECU-per-sub-system model, with a brief callback to the AUTOSAR architecture from Unit 3 (Adaptive AUTOSAR as an SDV enabler).

List of Tutorials

1. Automotive sensor and actuator study: characterising a sensor output and driving an actuator through a driver stage.
2. Study of automotive EMI/EMC effects on sensor signals (measurement or simulation).
3. CAN protocol communication between two nodes.
4. CAN FD frame analysis and comparison with classic CAN (tool or simulation).

5. ECU interfacing exercise: reading a sensor and commanding an actuator via a microcontroller/ECU platform.
6. Introduction to AUTOSAR layered architecture (conceptual/tool-based walkthrough).
7. EV battery monitoring system: a basic BMS model (cell voltage / temperature monitoring, SoC estimation).
8. Charging system study: alternator/regulator testing (ICE) or onboard-charger concept (EV).
9. ADAS sensor study: radar/camera/ultrasonic characteristics (demonstration or simulation).
10. Functional safety exercise: ASIL determination for a given sub-system hazard (case study).
11. Vehicle diagnostics using an OBD-II / UDS scan tool: reading fault codes and live data.
12. UDS diagnostic session and ECU reprogramming (bootloader) concept exercise.
13. Automotive dashboard / instrument cluster simulation.

Textbooks:

1. W. B. Ribbens, Understanding Automotive Electronics, 7th ed., Butterworth-Heinemann, 2012.
2. M. Kathiresh and R. Neelaveni, Automotive Embedded Systems: Key Technologies, Innovations, and Applications, Springer, 2021.
3. Robert Bosch GmbH, Bosch Automotive Handbook, 10th ed., Wiley, 2018.
4. S. Bhattacharya, A. K. Agarwal, O. Prakash, and S. Singh, Sensors for Automotive and Aerospace Applications, Springer, 2019.
5. J. Fraden, Handbook of Modern Sensors: Physics, Designs, and Applications, 5th ed., Springer, 2016.

Standards & Supplementary Resources:

1. ISO 26262: Road Vehicles — Functional Safety, International Organization for Standardization, 2018.
2. Vector Informatik, CAN / CAN FD / UDS tutorials — <https://www.vector.com>
3. AUTOSAR, Layered Software Architecture and Adaptive Platform specifications — <https://www.autosar.org>
4. Texas Instruments, Automotive Sensor and Signal Conditioning Application Notes — <https://www.ti.com>
5. NPTEL, Automotive Engineering / Sensors and Actuators — <https://nptel.ac.in>
6. MATLAB Documentation, Automotive System Simulation — <https://www.mathworks.com>

Course Outcomes: After completion of the course, students will be able to:

1. Identify automotive sensors and actuators and explain the hardware and software driver layers through which an ECU interfaces with them.
2. Analyse in-vehicle communication protocols — CAN and CAN FD in detail, with awareness of LIN, FlexRay, and automotive Ethernet — and their role in connecting sensors to ECUs.

3. Describe ECU specifications, architecture, and types, and explain the layered AUTOSAR software architecture and its purpose.
4. CO4. Apply the sensor–communication–ECU pattern to analyse vehicle sub-systems, including the Battery Management System and charging systems in ICE and EV contexts.
5. CO5. Explain ADAS and safety-critical sub-systems and apply functional-safety concepts (ISO 26262, ASIL) to their design context.
6. CO6. Explain vehicle-level integration via the VCU, the software-defined-vehicle evolution, and the diagnosis and reprogramming of ECUs using UDS and the bootloader.

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

FF No. : 654

MM1407B :: COMPUTER NETWORKS AND WEB TECHNOLOGIES

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

- 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 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.

List of Course Seminar Topics:

1. Real-Time Wireless Communications for Industrial Automation
2. Efficient use of cloud computing for geospatial data processing in the Internet of Things
3. Power line data communication
4. Drone enabled Data Communication for Internet of Things (DDC-IoT) as a data communication solution for IoT networks
5. Real-Time Air-To-Ground Data Communication Technology of Aeroengine Health Management System with Adaptive Rate in the whole Airspace
6. Orthogonal Chirp Division Multiplexing for Baseband Data Communication Systems
7. Optimised Routing and Compressive Sensing Based Data Communication in Wireless Sensor Network
8. LiFi
9. Emerging trends such as Time Sensitive Networking (TSN), Edge Computing, Virtualization and IIoT
10. Edge computing network
11. Convergence of Networking and Cloud/Edge Computing: Status, Challenges, and Opportunities
12. Green Communications for Future Vehicular Networks: Data Compression Approaches, Opportunities, and Challenges

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 Gallager "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. Summarize fundamental concepts of Computer Networks, architectures, protocols and technologies
2. 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
6. 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

IC3261 :: DESIGN THINKING -3**Course Prerequisites:** Problem Based Learning, Project Centric Learning**Course Objective:**

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

Credits: 1**Teaching Scheme Tut: 1 Hours/Week****Section 1: Topics/Contents**

What is research?

Importance of Paper Publication 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

Section 2: Topics/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 Outcome: [Publication of paper or patent]

The student will be able to

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

CO-PO Map:

CO	Program Outcomes (PO)												PSO		
CO/PO	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	PSO3
CO1	1	1	1	1	1	--	--	--	--	--	--	1	1	2	2
CO2	1	1	1	1	1	--	--	--	--	--	--	1	2	1	1
CO3	2	2	3	3	2	2	1	2	2	3	--	1	2	2	3
CO4	3	3	3	3	3	2	1	2	2	3	1	1	-	-	2
CO5	1	1	1	1	1	--	--	--	--	--	--	1	-	-	1
CO6	2	2	2	2	2	2	1	3	2	3	--	1	2	2	2
CO7	1	1	1	1	1	--	--	--	--	--	--	1	1	1	1
Average	1.57	1.57	1.71	1.71	1.57	2.0	1.0	2.33	2.0	3.0	1.0	1.0	1.66	1.66	1.71

CO attainment levels

CO No.	CO1	CO2	CO3	CO4	CO5	CO6	CO7
Attainment Level	2	2	3	6	2	3	2

FF No. : 654

IC3239:: ENGINEERING RESEARCH AND INNOVATION-1**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:-** Ansys's, Ansys'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 :- Artificial 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. Analyse solutions for given engineering problem
2. Design solutions for given engineering problem
3. Demonstrate practical knowledge by constructing models/algorithms for real time applications
4. Express effectively in written and oral communication
5. Exhibit the skills to work in a team
6. 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

IC3234 :: BUILDING AND PROCESS AUTOMATION**Credits: 4****Teaching Scheme Theory: 3 Hours/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 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.

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 Tanenbaum 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

IC3243 :: ARTIFICIAL INTELLIGENCE 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: 3**Teaching Scheme :** **Theory:** 2 Hours/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

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

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. Comprehend concept of Artificial Intelligence and intelligent agents
2. Examine the useful search techniques
3. Analyze learning models for AI
4. Apply machine learning techniques to given applications
5. Formulate neural networks for given application
6. 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

IC3260 :: INSTRUMENTATION PROJECT ENGINEERING**Credits:** 4**Teaching Scheme:** Theory: 3 Hours/Week
Lab : 2 Hours/Week**SECTION 1 :****Unit-1 : Concept study & definition of Project Engineering & Management (7 Hrs)**

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 (7 Hrs)

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 (7 Hrs)

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 :**Unit-4 : Procurement activities (7 Hrs)**

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 (7 Hrs)

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 (7 Hrs)

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 Practicals:

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

Text Books:

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

Reference Books:

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

Course Outcomes:

The students will have ability to:

1. Describe the concept of project engineering and management. [1]
2. Comprehend the Project Engineering and Management documents. [2]
3. Develop Project Engineering and Management documents. [5]
4. Discuss the procurement and construction activities of project. [3]
5. Understand the importance of management and financial functions and tools. [4]
6. Explain different codes and standards used for instrumentation and control. [4]

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.	CO1	CO2	CO3	CO4	CO5	CO6
Attainment Level	2	4	5	4	3	2

FF No. : 654

COURSERA PROFESSIONAL CERTIFICATE COURSES**MD3101 :: IBM FULL STACK SOFTWARE DEVELOPER****Credits: 3****Teaching Scheme Theory: 3 Hours/Week****Professional Certificate - 15 course series**

1. **Introduction to Software Engineering**
Course 1•14 hours•4.7(1,477 ratings)
2. **Introduction to Cloud Computing**
Course 2•12 hours•4.6(6,376 ratings)
3. **Introduction to HTML, CSS, & JavaScript**
Course 3•10 hours•4.4(176 ratings)
4. **Getting Started with Git and GitHub**
Course 4•10 hours•4.6(1,207 ratings)
5. **Developing Front-End Apps with React**
Course 5•14 hours•4.3(490 ratings)
6. **Developing Back-End Apps with Node.js and Express**
Course 6•13 hours•4.4(410 ratings)
7. **Python for Data Science, AI & Development**
Course 7•25 hours•4.6(37,177 ratings)
8. **Developing AI Applications with Python and Flask**
Course 8•11 hours•4.4(738 ratings)
9. **Django Application Development with SQL and Databases**
Course 9•14 hours•4.5(243 ratings)
10. **Introduction to Containers w/ Docker, Kubernetes & OpenShift**
Course 10•17 hours•4.4(811 ratings)
11. **Application Development using Microservices and Serverless**
Course 11•14 hours•4.6(277 ratings)
12. **Full Stack Application Development Capstone Project**
Course 12•16 hours•4.5(143 ratings)
13. **Full Stack Software Developer Assessment**
Course 13•6 hours•4.7(211 ratings)
14. **Generative AI: Elevate your Software Development Career**
Course 14•17 hours•4.7(56 ratings)
15. **Software Developer Career Guide and Interview Preparation**
Course 15•11 hours•4.7(139 ratings)

Course Outcomes:

After completing the course, the students will be able to:

1. Demonstrate proficiency in programming languages
2. Understand and apply fundamental data structures and algorithms
3. Develop the ability to analyze datasets using statistical methods and visualize results
4. Gain foundational knowledge of cryptographic techniques, security protocols and their application to information and network security
5. Acquire skills in web development, build basic web applications or understand web structures.
6. Understand relational database concepts and database design principles, to manage and retrieve information from databases.

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

CO attainment levels:

CO No.	CO1	CO2	CO3	CO4	CO5	CO6
Attainment Level	3	3	2	4	3	3

FF No.: 654

MD3102 :: META BACK-END DEVELOPER**Credits: 3****Teaching Scheme Theory: 3 Hours/Week****Professional Certificate - 9 course series****1. Introduction to Back-End Development**

Course 1•18 hours•4.7(3,171 ratings)

2. Programming in Python

Course 2•44 hours•4.6(1,439 ratings)

3. Version Control

Course 3•13 hours•4.6(3,247 ratings)

4. Introduction to Databases for Back-End Development

Course 4•27 hours•4.6(570 ratings)

5. Django Web Framework

Course 5•45 hours•4.7(519 ratings)

6. APIs

Course 6•20 hours•4.4(280 ratings)

7. The Full Stack

Course 7•24 hours•4.6(178 ratings)

8. Back-End Developer Capstone

Course 8•20 hours•4.5(130 ratings)

9. Coding Interview Preparation

Course 9•11 hours•4.6(527 ratings)

Course Outcomes:

After completing the course, the students will be able to:

1. Demonstrate proficiency in programming languages
2. Understand and apply fundamental data structures and algorithms
3. Develop the ability to analyze datasets using statistical methods and visualize results
4. Gain foundational knowledge of cryptographic techniques, security protocols and their application to information and network security
5. Acquire skills in web development, build basic web applications or understand web structures.
6. Understand relational database concepts and database design principles, to manage and retrieve information from databases.

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

CO attainment levels:

CO No.	CO1	CO2	CO3	CO4	CO5	CO6
Attainment Level	3	3	2	4	3	3

FF No.: 654

MD3106 :: MICROSOFT POWER BI DATA ANALYST**Credits: 3****Teaching Scheme Theory: 3 Hours/Week****Professional Certificate - 9 course series****1. Power BI: Data Analysis, Reporting, and Connecting**

Course 1, 5 hours

2. Power BI: Data Cleaning, Transformation, and Visualization

Course 2, 6 hours

3. Power BI: Modeling, Filtering, and Advanced Analysis

Course 3, 6 hours

4. Power BI: Dashboards, Collaboration, and Optimization

Course 4, 5 hours

Course Outcomes:

After completing the course, the students will be able to:

1. Demonstrate proficiency in programming languages
2. Understand and apply fundamental data structures and algorithms
3. Develop the ability to analyze datasets using statistical methods and visualize results
4. Gain foundational knowledge of cryptographic techniques, security protocols and their application to information and network security
5. Acquire skills in web development, build basic web applications or understand web structures.
6. Understand relational database concepts and database design principles, to manage and retrieve information from databases.

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

CO attainment levels:

CO No.	CO1	CO2	CO3	CO4	CO5	CO6
Attainment Level	3	3	2	4	3	3

FF No.: 654

MD3112 :: GOOGLE CYBERSECURITY**Credits: 3****Teaching Scheme Theory: 3 Hours/Week****Professional Certificate - 9 course series**

1. **Foundations of Cybersecurity**
Course 1, 10 hours
2. **Play It Safe: Manage Security Risks**
Course 2, 9 hours
3. **Connect and Protect: Networks and Network Security**
Course 3, 12 hours
4. **Tools of the Trade: Linux and SQL**
Course 4, 23 hours
5. **Assets, Threats, and Vulnerabilities**
Course 5, 19 hours
6. **Sound the Alarm: Detection and Response**
Course 6, 18 hours
7. **Automate Cybersecurity Tasks with Python**
Course 7, 25 hours
8. **Put It to Work: Prepare for Cybersecurity Jobs**
Course 8, 11 hours
9. **Accelerate Your Job Search with AI**
Course 9, 6 hours

Course Outcomes:

After completing the course, the students will be able to:

1. Demonstrate proficiency in programming languages
2. Understand and apply fundamental data structures and algorithms
3. Develop the ability to analyze datasets using statistical methods and visualize results
4. Gain foundational knowledge of cryptographic techniques, security protocols and their application to information and network security
5. Acquire skills in web development, build basic web applications or understand web structures.
6. Understand relational database concepts and database design principles, to manage and retrieve information from databases.

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

CO attainment levels:

CO No.	CO1	CO2	CO3	CO4	CO5	CO6
Attainment Level	3	3	2	4	3	3

FF No.: 654

MD3113 :: GOOGLE DATA ANALYTICS**Credits: 3****Teaching Scheme Theory: 3 Hours/Week****Professional Certificate - 9 course series**

1. **Foundations: Data, Data, Everywhere**
Course 1•13 hours
2. **Ask Questions to Make Data-Driven Decisions**
Course 2•15 hours
3. **Prepare Data for Exploration**
Course 3•19 hours
4. **Process Data from Dirty to Clean**
Course 4•16 hours
5. **Analyze Data to Answer Questions**
Course 5•26 hours
6. **Share Data Through the Art of Visualization**
Course 6•19 hours
7. **Introduction to Data Analysis Using Python**
Course 7•27 hours
8. **Google Data Analytics Capstone: Complete a Case Study**
Course 8•11 hours
9. **Accelerate Your Job Search with AI**
Course 9•6 hours

Course Outcomes:

After completing the course, the students will be able to:

1. Demonstrate proficiency in programming languages
2. Understand and apply fundamental data structures and algorithms
3. Develop the ability to analyze datasets using statistical methods and visualize results
4. Gain foundational knowledge of cryptographic techniques, security protocols and their application to information and network security
5. Acquire skills in web development, build basic web applications or understand web structures.
6. Understand relational database concepts and database design principles, to manage and retrieve information from databases.

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

CO attainment levels:

CO No.	CO1	CO2	CO3	CO4	CO5	CO6
Attainment Level	3	3	2	4	3	3

FF No.: 654

MD3118 :: IBM DATA SCIENCE**Credits: 3****Teaching Scheme Theory: 3 Hours/Week****Professional Certificate - 14 course series**

- 1. What is Data Science?**
Course 1, 12 hours
- 2. Tools for Data Science**
Course 2, 16 hours
- 3. Data Science Methodology**
Course 3, 9 hours
- 4. Python for Data Science, AI & Development**
Course 4, 24 hours
- 5. Python Project for Data Science**
Course 5, 7 hours
- 6. Databases and SQL for Data Science with Python**
Course 6, 18 hours
- 7. Data Analysis with Python**
Course 7, 16 hours
- 8. Data Visualization with Python**
Course 8, 19 hours
- 9. Machine Learning with Python**
Course 9, 20 hours
- 10. Applied Data Science Capstone**
Course 10, 14 hours
- 11. Generative AI: Elevate Your Data Science Career**
Course 11, 14 hours
- 12. Data Scientist Career Guide and Interview Preparation**
Course 12, 9 hours

Course Outcomes:

After completing the course, the students will be able to:

1. Demonstrate proficiency in programming languages
2. Understand and apply fundamental data structures and algorithms
3. Develop the ability to analyze datasets using statistical methods and visualize results
4. Gain foundational knowledge of cryptographic techniques, security protocols and their application to information and network security
5. Acquire skills in web development, build basic web applications or understand web structures.
6. Understand relational database concepts and database design principles, to manage and retrieve information from databases.

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

CO attainment levels:

CO No.	CO1	CO2	CO3	CO4	CO5	CO6
Attainment Level	3	3	2	4	3	3

FF No.: 654

MD3119 :: FRACTAL DATA SCIENCE**Credits: 3****Teaching Scheme Theory: 3 Hours/Week****Professional Certificate - 8 course series****1. Structured Approach to Problem Solving**

Course 1, 15 hours

2. Data Analysis Using SQL

Course 2, 17 hours

3. Insights of Power BI

Course 3, 14 hours

4. Python for Data Science

Course 4, 40 hours

5. Human Decision Making and its Biases

Course 5, 14 hours

6. Foundations of Machine Learning

Course 6, 25 hours

7. Advanced Machine Learning Algorithms

Course 7, 21 hours

8. Data Storytelling

Course 8, 12 hours

Course Outcomes:

After completing the course, the students will be able to:

1. Demonstrate proficiency in programming languages
2. Understand and apply fundamental data structures and algorithms
3. Develop the ability to analyze datasets using statistical methods and visualize results
4. Gain foundational knowledge of cryptographic techniques, security protocols and their application to information and network security
5. Acquire skills in web development, build basic web applications or understand web structures.
6. Understand relational database concepts and database design principles, to manage and retrieve information from databases.

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

CO attainment levels:

CO No.	CO1	CO2	CO3	CO4	CO5	CO6
Attainment Level	3	3	2	4	3	3

FF No.: 654

MD3121 : IBM DEVOPS AND SOFTWARE ENGINEERING**Credits: 3****Teaching Scheme Theory: 3 Hours/Week****Professional Certificate - 15 course series****1. Introduction to DevOps**

Course 1, 9 hours

2. Introduction to Cloud Computing

Course 2, 12 hours

3. Introduction to Agile Development and Scrum

Course 3, 13 hours

4. Introduction to Software Engineering

Course 4, 15 hours

5. Getting Started with Git and GitHub

Course 5, 11 hours

6. Hands-on Introduction to Linux Commands and Shell Scripting

Course 6, 17 hours

7. Python for Data Science, AI & Development

Course 7, 24 hours

8. Developing AI Applications with Python and Flask

Course 8, 12 hours

9. Introduction to Containers w/ Docker, Kubernetes & OpenShift

Course 9, 17 hours

10. Application Development using Microservices and Serverless

Course 10, 16 hours

11. Introduction to Test and Behavior Driven Development

Course 11, 21 hours

12. Continuous Integration and Continuous Delivery (CI/CD)

Course 12, 15 hours

13. Application Security for Developers and DevOps Professionals

Course 13, 17 hours

14. Monitoring and Observability for Development and DevOps

Course 14, 16 hours

15. DevOps Capstone Project

Course 15, 20 hours

Course Outcomes:

After completing the course, the students will be able to:

1. Demonstrate proficiency in programming languages
2. Understand and apply fundamental data structures and algorithms
3. Develop the ability to analyze datasets using statistical methods and visualize results
4. Gain foundational knowledge of cryptographic techniques, security protocols and their application to information and network security
5. Acquire skills in web development, build basic web applications or understand web structures.
6. Understand relational database concepts and database design principles, to manage and retrieve information from databases.

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

CO attainment levels:

CO No.	CO1	CO2	CO3	CO4	CO5	CO6
Attainment Level	3	3	2	4	3	3

FF No.: 654

MD3141 : AWS CLOUD TECHNOLOGY CONSULTANT**Credits: 3****Teaching Scheme Theory: 3 Hours/Week****Professional Certificate - 9 course series**

1. **Introduction to Information Technology and AWS Cloud**
Course 1, 6 hours
2. **AWS Cloud Technical Essentials**
Course 2, 21 hours
3. **Providing Technical Support for AWS Workloads**
Course 3, 7 hours
4. **Developing Applications in Python on AWS**
Course 4, 10 hours
5. **Skills for Working as an AWS Cloud Consultant**
Course 5, 10 hours
6. **DevOps on AWS and Project Management**
Course 6, 9 hours
7. **Automation in the AWS Cloud**
Course 7, 8 hours
8. **Data Analytics and Databases on AWS**
Course 8, 9 hours
9. **Capstone: Following the AWS Well Architected Framework**
Course 9, 11 hours

Course Outcomes:

After completing the course, the students will be able to:

1. Demonstrate proficiency in programming languages
2. Understand and apply fundamental data structures and algorithms
3. Develop the ability to analyze datasets using statistical methods and visualize results
4. Gain foundational knowledge of cryptographic techniques, security protocols and their application to information and network security
5. Acquire skills in web development, build basic web applications or understand web structures.
6. Understand relational database concepts and database design principles, to manage and retrieve information from databases.

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

CO attainment levels:

CO No.	CO1	CO2	CO3	CO4	CO5	CO6
Attainment Level	3	3	2	4	3	3

FF No.: 654

MD3147 : DEEP LEARNING-AI DEEP LEARNING**Credits: 3****Teaching Scheme Theory: 3 Hours/Week****Professional Certificate - 5 course series****1. Neural Networks and Deep Learning**

Course 1, 25 hours

2. Improving Deep Neural Networks: Hyperparameter Tuning, Regularization and Optimization

Course 2, 24 hours

3. Structuring Machine Learning Projects

Course 3, 7 hours

4. Convolutional Neural Networks

Course 4, 36 hours

5. Sequence Models

Course 5, 37 hours

Course Outcomes:

After completing the course, the students will be able to:

1. Demonstrate proficiency in programming languages
2. Understand and apply fundamental data structures and algorithms
3. Develop the ability to analyze datasets using statistical methods and visualize results
4. Gain foundational knowledge of cryptographic techniques, security protocols and their application to information and network security
5. Acquire skills in web development, build basic web applications or understand web structures.
6. Understand relational database concepts and database design principles, to manage and retrieve information from databases.

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

CO attainment levels:

CO No.	CO1	CO2	CO3	CO4	CO5	CO6
Attainment Level	3	3	2	4	3	3

FF No.: 654

MD3201 : FINTECH**Credits: 3****Teaching Scheme Theory: 3 Hours/Week****Professional Certificate - 4 course series****1. FinTech Foundations and Overview**

Course 1, 15 hours

2. FinTech Security and Regulation (RegTech)

Course 2, 15 hours

3. FinTech Risk Management

Course 3, 15 hours

4. FinTech Disruptive Innovation: Implications for Society

Course 4, 13 hours

Course Outcomes:

After completing the course, the students will be able to:

1. Demonstrate proficiency in programming languages
2. Understand and apply fundamental data structures and algorithms
3. Develop the ability to analyze datasets using statistical methods and visualize results
4. Gain foundational knowledge of cryptographic techniques, security protocols and their application to information and network security
5. Acquire skills in web development, build basic web applications or understand web structures.
6. Understand relational database concepts and database design principles, to manage and retrieve information from databases.

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

CO attainment levels:

CO No.	CO1	CO2	CO3	CO4	CO5	CO6
Attainment Level	3	3	2	4	3	3

FF No.: 654

MD3202 : DIGITAL MARKETING**Credits: 3****Teaching Scheme Theory: 3 Hours/Week****Professional Certificate - 8 course series**

1. **Foundations of Digital Marketing and E-commerce**
Course 1, 12 hours
2. **Attract and Engage Customers with Digital Marketing**
Course 2, 14 hours
3. **From Likes to Leads: Interact with Customers Online**
Course 3, 21 hours
4. **Think Outside the Inbox: Email Marketing**
Course 4, 19 hours
5. **Assess for Success: Marketing Analytics and Measurement**
Course 5, 18 hours
6. **Make the Sale: Build, Launch, and Manage E-commerce Stores**
Course 6, 15 hours
7. **Satisfaction Guaranteed: Develop Customer Loyalty Online**
Course 7, 15 hours
8. **Accelerate Your Job Search with AI**
Course 8, 6 hours

Course Outcomes:

After completing the course, the students will be able to:

1. Demonstrate proficiency in programming languages
2. Understand and apply fundamental data structures and algorithms
3. Develop the ability to analyze datasets using statistical methods and visualize results
4. Gain foundational knowledge of cryptographic techniques, security protocols and their application to information and network security
5. Acquire skills in web development, build basic web applications or understand web structures.
6. Understand relational database concepts and database design principles, to manage and retrieve information from databases.

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

CO attainment levels:

CO No.	CO1	CO2	CO3	CO4	CO5	CO6
Attainment Level	3	3	2	4	3	3

FF No.: 654

MD3203 : ENTREPRENEURSHIP**Credits: 3****Teaching Scheme Theory: 3 Hours/Week****Professional Certificate - 4 course series****1. Developing Innovative Ideas for New Companies: The First Step in Entrepreneurship**

Course 1, 5 hours

2. Innovation for Entrepreneurs: From Idea to Marketplace

Course 2, 7 hours

3. New Venture Finance: Startup Funding for Entrepreneurs

Course 3, 14 hours

4. Entrepreneurship Capstone

Course 4•10 hours

Course Outcomes:

After completing the course, the students will be able to:

1. Demonstrate proficiency in programming languages
2. Understand and apply fundamental data structures and algorithms
3. Develop the ability to analyze datasets using statistical methods and visualize results
4. Gain foundational knowledge of cryptographic techniques, security protocols and their application to information and network security
5. Acquire skills in web development, build basic web applications or understand web structures.
6. Understand relational database concepts and database design principles, to manage and retrieve information from databases.

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

CO attainment levels:

CO No.	CO1	CO2	CO3	CO4	CO5	CO6
Attainment Level	3	3	2	4	3	3

FF No.: 654

MD3204 : MANAGEMENT**Credits: 3****Teaching Scheme Theory: 3 Hours/Week****Professional Certificate - 7 course series**

1. **Foundations of Project Management**
Course 1, 13 hours
2. **Project Initiation: Starting a Successful Project**
Course 2, 15 hours
3. **Project Planning: Putting It All Together**
Course 3, 23 hours
4. **Project Execution: Running the Project**
Course 4, 26 hours
5. **Agile Project Management**
Course 5, 20 hours
6. **Capstone: Applying Project Management in the Real World**
Course 6, 39 hours
7. **Accelerate Your Job Search with AI**
Course 7, 6 hours

Course Outcomes:

After completing the course, the students will be able to:

1. Demonstrate proficiency in programming languages
2. Understand and apply fundamental data structures and algorithms
3. Develop the ability to analyze datasets using statistical methods and visualize results
4. Gain foundational knowledge of cryptographic techniques, security protocols and their application to information and network security
5. Acquire skills in web development, build basic web applications or understand web structures.
6. Understand relational database concepts and database design principles, to manage and retrieve information from databases.

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

CO attainment levels:

CO No.	CO1	CO2	CO3	CO4	CO5	CO6
Attainment Level	3	3	2	4	3	3

Course Objectives:

To develop an understanding of the modern vehicle as a distributed network of electronic control systems. Students learn a single organizing pattern — sensors and actuators, in-vehicle communication, and the electronic control unit — and then apply it to real automotive sub-systems (battery management, charging, ADAS), before studying how these sub-systems are integrated (VCU), how the architecture is evolving (software-defined vehicle), and how systems are diagnosed and reprogrammed (UDS and bootloader). The course spans both ICE and EV contexts, with functional safety (ISO 26262) woven through the safety-critical sub-systems.

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

SECTION 1 :

Unit 1: Automotive I/O — Sensors, Actuators & Drivers (5 Hrs)

- Automotive sensor categories and what makes a sensor “automotive” — the operating environment and integration, building on transducer fundamentals from prerequisite courses.
- Automotive actuators as the ECU’s output stage: injectors, electronic throttle bodies, solenoid/valve actuators, motor-driven actuators, EV contactors.
- The driver concept in both senses: the hardware driver stage (power switching — low/high-side drivers, H-bridges) and the software driver layer through which an ECU reads sensors and commands actuators.
- Automotive EMI/EMC: the vehicle electrical environment, transients, grounding, and harness considerations.

Unit 2: In-Vehicle Communication (5 Hrs)

- Controller Area Network (CAN) in detail: physical layer, frame structure, message-based arbitration, priority, and error handling.
- CAN FD (Flexible Data-rate): motivation, higher payload and bandwidth, and its role in modern powertrain/body networks.
- LIN and FlexRay at awareness level; positioning relative to CAN.
- Automotive Ethernet (awareness level): why higher-bandwidth backbones exist and what ADAS and software-defined architectures demand of the network.

Unit 3: The Electronic Control Unit (ECU) & Software Architecture (5 Hrs)

- ECU fundamentals and specifications: processing, memory, I/O, and real-time constraints.
- ECU internal architecture and types: function-specific controllers versus domain controllers
- Engine/vehicle management concepts: fuel injection, ignition, and representative control functions.
- AUTOSAR software architecture (concept level): the layered model — MCAL → Basic Software (BSW) →

Runtime Environment (RTE) → application — and why layering makes application software portable across hardware.

SECTION 2:

Unit 4: Energy Sub-systems — BMS & Charging (5 Hrs)

- Battery Management System (BMS) as a worked instance of the pattern: sensing (cell voltage, current, temperature), communication, and its own controller deciding on cell balancing, SoC/SoH estimation, thermal management, and contactor control.
- Charging systems: 12V charging (alternator, battery, regulator) and EV traction-battery charging (onboard charger, DC fast charging, charging communication such as ISO 15118). The 12V and EV cases are distinguished explicitly.
- Functional safety (ISO 26262): introduction to functional safety, ASIL classification (severity × exposure × controllability), and the safety lifecycle — introduced via the BMS as a high-ASIL system.

First instantiation of the sensor → communication → ECU template, and the natural home to introduce functional safety concretely.

Unit 5: ADAS & Safety-Critical Sub-systems (5 Hrs)

- ADAS as an instance of the pattern: sensing modalities (radar, camera, ultrasonic, LiDAR — introductory), communication (where the Unit 2 Ethernet backbone is relevant), and the ECU/domain controller that fuses inputs to decide.
- A second short instance — braking/ABS or stability control — reinforcing that the same template continues to apply.
- Functional safety applied (ISO 26262): ASIL determination for ADAS and braking as archetypal high-ASIL functions, deepening the Unit 4 introduction.

Reinforces the pattern across further sub-systems and establishes functional safety as the constraint binding the safety-critical ones.

Unit 6: Integration, Evolution & Servicing (5 Hrs)

- Vehicle Control Unit (VCU) — the integrator: the controller that coordinates the individual sub-system ECUs met earlier; a hardware/role concept (“which box is in charge”). The moment isolated sub-systems become one vehicle.
- Software-Defined Vehicle (SDV) — the evolution: consolidation of many ECUs onto fewer high-performance computers, decoupling of software from hardware, and over-the-air updates. Presented as the trend reversing the one-ECU-per-sub-system model, with a brief callback to the AUTOSAR architecture from Unit 3 (Adaptive AUTOSAR as an SDV enabler).

List of Tutorials

1. Automotive sensor and actuator study: characterising a sensor output and driving an actuator through a driver stage.
2. Study of automotive EMI/EMC effects on sensor signals (measurement or simulation).
3. CAN protocol communication between two nodes.
4. CAN FD frame analysis and comparison with classic CAN (tool or simulation).

5. ECU interfacing exercise: reading a sensor and commanding an actuator via a microcontroller/ECU platform.
6. Introduction to AUTOSAR layered architecture (conceptual/tool-based walkthrough).
7. EV battery monitoring system: a basic BMS model (cell voltage / temperature monitoring, SoC estimation).
8. Charging system study: alternator/regulator testing (ICE) or onboard-charger concept (EV).
9. ADAS sensor study: radar/camera/ultrasonic characteristics (demonstration or simulation).
10. Functional safety exercise: ASIL determination for a given sub-system hazard (case study).
11. Vehicle diagnostics using an OBD-II / UDS scan tool: reading fault codes and live data.
12. UDS diagnostic session and ECU reprogramming (bootloader) concept exercise.
13. Automotive dashboard / instrument cluster simulation.

Textbooks:

1. W. B. Ribbens, Understanding Automotive Electronics, 7th ed., Butterworth-Heinemann, 2012.
2. M. Kathiresh and R. Neelaveni, Automotive Embedded Systems: Key Technologies, Innovations, and Applications, Springer, 2021.
3. Robert Bosch GmbH, Bosch Automotive Handbook, 10th ed., Wiley, 2018.
4. S. Bhattacharya, A. K. Agarwal, O. Prakash, and S. Singh, Sensors for Automotive and Aerospace Applications, Springer, 2019.
5. J. Fraden, Handbook of Modern Sensors: Physics, Designs, and Applications, 5th ed., Springer, 2016.

Standards & Supplementary Resources:

1. ISO 26262: Road Vehicles — Functional Safety, International Organization for Standardization, 2018.
2. Vector Informatik, CAN / CAN FD / UDS tutorials — <https://www.vector.com>
3. AUTOSAR, Layered Software Architecture and Adaptive Platform specifications — <https://www.autosar.org>
4. Texas Instruments, Automotive Sensor and Signal Conditioning Application Notes — <https://www.ti.com>
5. NPTEL, Automotive Engineering / Sensors and Actuators — <https://nptel.ac.in>
6. MATLAB Documentation, Automotive System Simulation — <https://www.mathworks.com>

Course Outcomes: After completion of the course, students will be able to:

1. Identify automotive sensors and actuators and explain the hardware and software driver layers through which an ECU interfaces with them.
2. Analyse in-vehicle communication protocols — CAN and CAN FD in detail, with awareness of LIN, FlexRay, and automotive Ethernet — and their role in connecting sensors to ECUs.
3. Describe ECU specifications, architecture, and types, and explain the layered AUTOSAR software architecture and its purpose.
4. CO4. Apply the sensor–communication–ECU pattern to analyse vehicle sub-systems, including the Battery Management System and charging systems in ICE and EV contexts.
5. CO5. Explain ADAS and safety-critical sub-systems and apply functional-safety concepts (ISO 26262, ASIL) to their design context.
6. CO6. Explain vehicle-level integration via the VCU, the software-defined-vehicle evolution, and the diagnosis and reprogramming of ECUs using UDS and the bootloader.

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

FF No. : 654

MM1407B :: COMPUTER NETWORKS AND WEB TECHNOLOGIES

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

- 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
 - e) Classful IP and CIDR : Subnetting, IP Prefixes
 - f) NAT Mapping: Public to Private IP and Port Mapping
 - g) Packet Delivery in Internetwork : Packets traversing through different subnetworks with different MTU and Speeds
 - h) Packet Dropping Probabilities of Routers
- 8) Examples of Network Layer Routing
 - f) Shortest Path and Spanning Tree
 - g) Dijkstra's Algorithm
 - h) Distance Vector Routing
 - i) Link State Routing
 - j) ECMP
- 9) Examples of Transport Layer
 - f) TCP Connection Establishment: SYN and ACK, Normal Packets
 - g) Flow Control : Calculating Optimal Size of Sliding Window
 - h) Cumulative ACK scheme
 - i) Smoothed RTT
 - j) Slow Start and Additive Increase
- 10) Examples of Application Layer
 - d) DNS: URL Domain Processing
 - e) Performance of HTTP1.0 and HTTP1.1
 - f) 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 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.

List of Course Seminar Topics:

1. Real-Time Wireless Communications for Industrial Automation
2. Efficient use of cloud computing for geospatial data processing in the Internet of Things
3. Power line data communication
4. Drone enabled Data Communication for Internet of Things (DDC-IoT) as a data communication solution for IoT networks
5. Real-Time Air-To-Ground Data Communication Technology of Aeroengine Health Management System with Adaptive Rate in the whole Airspace
6. Orthogonal Chirp Division Multiplexing for Baseband Data Communication Systems
7. Optimised Routing and Compressive Sensing Based Data Communication in Wireless Sensor Network
8. LiFi
9. Emerging trends such as Time Sensitive Networking (TSN), Edge Computing, Virtualization and IIoT
10. Edge computing network
11. Convergence of Networking and Cloud/Edge Computing: Status, Challenges, and Opportunities
12. Green Communications for Future Vehicular Networks: Data Compression Approaches, Opportunities, and Challenges

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 Gallager "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/106/105/106105183>
3. Computer Networks, IIT Madras: <https://nptel.ac.in/courses/106/106/106106091>
4. <https://www.udemy.com/>
5. <https://www.coursera.org/>

Course Outcomes:

The students are able to:

1. Summarize fundamental concepts of Computer Networks, architectures, protocols and technologies
2. 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
6. 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

IC3262 :: DESIGN THINKING -4**Course Prerequisites:** Problem Based Learning, Project Centric Learning**Course Objective:**

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

Credits: 1**Teaching Scheme Tut: 1 Hours/Week****Section 1: Topics/Contents**

What is research?

Importance of Paper Publication 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

Section 2: Topics/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 Outcome: [Publication of paper or patent]

The student will be able to

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

CO-PO Map:

CO	Program Outcomes (PO)												PSO		
CO/PO	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	PSO3
CO1	1	1	1	1	1	--	--	--	--	--	--	1	1	2	2
CO2	1	1	1	1	1	--	--	--	--	--	--	1	2	1	1
CO3	2	2	3	3	2	2	1	2	2	3	--	1	2	2	3
CO4	3	3	3	3	3	2	1	2	2	3	1	1	-	-	2
CO5	1	1	1	1	1	--	--	--	--	--	--	1	-	-	1
CO6	2	2	2	2	2	2	1	3	2	3	--	1	2	2	2
CO7	1	1	1	1	1	--	--	--	--	--	--	1	1	1	1
Average	1.57	1.57	1.71	1.71	1.57	2.0	1.0	2.33	2.0	3.0	1.0	1.0	1.66	1.66	1.71

CO attainment levels

CO No.	CO1	CO2	CO3	CO4	CO5	CO6	CO7
Attainment Level	2	2	3	6	2	3	2

FF No. : 654

IC3240:: ENGINEERING RESEARCH AND INNOVATION-2**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:-** Ansys's, Ansys'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 :- Artificial 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. Analyse solutions for given engineering problem
2. Design solutions for given engineering problem
3. Demonstrate practical knowledge by constructing models/algorithms for real time applications
4. Express effectively in written and oral communication
5. Exhibit the skills to work in a team
6. 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

FF No. : 654

IC3222 :: BATCH PROCESS CONTROL**Credits:** Audit course**Teaching Scheme:** Theory: 2 Hours/Week**SECTION 1 :****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:

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 Assignments:

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, McGraw Hill

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. Understand the fundamentals of batch process
2. Understand the role of standards for batch process
3. Comprehend the control and management aspects of batch processes
4. Comprehend control strategies to a given batch processes
5. Specify controls and data management system
6. Case study of any batch process

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.	CO1	CO2	CO3	CO4	CO5	CO6
Attainment Level	2	4	5	4	3	2