



Bansilal Ramnath Agarwal Charitable Trust's
Vishwakarma Institute of Technology

(An Autonomous Institute affiliated to Savitribai Phule Pune University)

Structure & Syllabus of
Second Year B.Tech.
(Instrumentation and Control Engineering)
Pattern 'B26'

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 SY BTech (instrumentation and Control) offered by B.O.S. in Instrumentation Engineering for Academic Year 2026-27

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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.

Knowledge and Attitude Profile (WK)

1. WK1: A systematic, theory-based understanding of the natural sciences applicable to the discipline and awareness of relevant social sciences.
2. WK2: Conceptually-based mathematics, numerical analysis, data analysis, statistics and formal aspects of computer and information science to support detailed analysis and modelling applicable to the discipline.
3. WK3: A systematic, theory-based formulation of engineering fundamentals required in the engineering discipline.
4. WK4: Engineering specialist knowledge that provides theoretical frameworks and bodies of knowledge for the accepted practice areas in the engineering discipline; much is at the forefront of the discipline.
5. WK5: Knowledge, including efficient resource use, environmental impacts, whole-life cost, re-use of resources, net zero carbon, and similar concepts, that supports engineering design and operations in a practice area.
6. WK6: Knowledge of engineering practice (technology) in the practice areas in the engineering discipline.
7. WK7: Knowledge of the role of engineering in society and identified issues in engineering practice in the discipline, such as the professional responsibility of an engineer to public safety and sustainable development.

8. WK8: Engagement with selected knowledge in the current research literature of the discipline, awareness of the power of critical thinking and creative approaches to evaluate emerging issues.
9. WK9: Ethics, inclusive behavior and conduct. Knowledge of professional ethics, responsibilities, and norms of engineering practice. Awareness of the need for diversity by reason of ethnicity, gender, age, physical ability etc. with mutual understanding and respect, and of inclusive attitudes.

Program Outcomes (POs)

1. **PO1: Engineering Knowledge:** Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization as specified in WK1 to WK4 respectively to develop to the solution of complex engineering problems.
2. **PO2: Problem Analysis:** Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development. (WK1 to WK4)
3. **PO3: Design/Development of Solutions:** Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required. (WK5)
4. **PO4: Conduct Investigations of Complex Problems:** Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions. (WK8).

5. **P05: Engineering Tool Usage:** Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems. (WK2 and WK6)
6. **P06: The Engineer and The World:** Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment. (WK1, WK5, and WK7).
7. **P07: Ethics:** Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws. (WK9)
8. **P08: Individual and Collaborative Team work:** Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.
9. **P09: Communication:** Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences
10. **P010: Project Management and Finance:** Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.
11. **P011: Life-Long Learning:** Recognize the need for, and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change. (WK8)

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

S.Y. B.Tech - Instrumentation and Control Engineering Structure for Pattern B-26, Module-3 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	IC2303	Sensors and Transducers	3	2	0	5	4		20							40		40				100
S2	IC2301	Data Science	2	2	0	4	3	10	30							40					20	100
S3	IC2305	Object Oriented Programming	2	2	0	4	3	10	30							40					20	100
S4	IC2307	Data Base Management System	2	2	0	4	3	10	30		40										20	100
S5	MM1405	Healthcare Analytics	2	0	1	3	3		20		40				20						20	100
	MM1408	Microcontroller and Applications																				
S6	HS2002	From Campus to Corporate-1	2	0	0	2	2					50								50		100
S7	IC2311	Design Thinking-1	0	0	1	1	1														100	100
S8	HS2001	Reasoning and Aptitude Development-3	1	0	0	1	1														100	100
S9	IC2313	Engineering Design and Innovation – 1	0	4	0	4	2					30									70	100
		Total	14	12	2	28	22	30	130		80	80			20	120		40		320	80	900

Course Name Nomenclature as per NEP

PCC : Program Core Courses (S1 to S4)

MDC : Multi-Disciplinary Course (s5)

HSSM : Humanities Social Science and Management (s6)

VSEC : Vocational and Skill Enhancement courses (s7)

AEC : Ability Enhancement courses (s8)

FP : Field Project(s9)

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

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S.Y. B.Tech - Instrumentation and Control Engineering Structure for Pattern B-26, Module-4 with effect from Semester-2 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	IC2308	Industrial Automation	3	2	0	5	4		20							40		40				100
S2	IC2320	Signal and Image Processing	2	2	0	4	3	10	30							40					20	100
S3	IC2302	Data Structures	2	2	0	4	3	10	30							40					20	100
S4	IC2304	Internet of Things	2	2	0	4	3	10	30		40										20	100
S5	MM1405	Healthcare Analytics	2	0	1	3	3		20		40			20						20		100
	MM1408	Microcontroller and Applications																				
S6	HS2003	From Campus to Corporate-2	2	0	0	2	2					50								50		100
S7	IC2316	Design Thinking-2	0	0	1	1	1													100		100
S8	HS2002	Reasoning and Aptitude Development-4	1	0	0	1	1													100		100
S9	IC2317	Engineering Design and Innovation - 2	0	4	0	4	2					30								70		100
		Total	14	12	2	28	22	30	130		80	80			20	120		40		320	80	900

Course Name Nomenclature as per NEP	Nomenclature for Teaching Scheme	Nomenclature for Assessment Scheme
PCC : Program Core Courses (S1 to S4) MDC : Multi-Disciplinary Course (s5) HSSM : Humanities Social Science and Management (s6) VSEC : Vocational and Skill Enhancement courses (s7) AEC : Ability Enhancement courses (s8) FP : Field Project(s9)	Th : Theory Lab : Laboratory Tut : Tutorial	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

SEMESTER I

IC2304 :: SENSORS AND TRANSDUCERS

Teaching Scheme	Examination Scheme
Credits : 4	CP: 30 Marks
Lectures : 3 Hrs/week	Lab: 10 Marks
Practical : 2 Hrs/week	CVV: 20 Marks
	ESE (W): 40 Marks

Prerequisites:	
● Basic Physics and chemistry laws.	
Course Objectives:	
● Able to evaluate characteristics of sensors and transducers	
● Analyzing different temperature sensor	
● Select flow sensor for application	
● Compare different pressure sensor	
● Understand different level sensors for different applications	
● Evaluate different speed and noncontact type of sensors	
● Able to evaluate characteristics of sensors and transducers	
● Analyzing different temperature sensor	
Course Outcomes:	
	After completion of the course, student will be able to
1.	Understand the fundamentals of sensors and transducers for mechanical parameters
2.	Demonstrate the working of sensors and transducers for mechanical parameters.
3.	Analyze the mathematical equation and solve different example of sensors and transducers for mechanical parameters
4.	Comprehend the fundamentals of sensors and transducers for process parameters.
5.	Demonstrate the working of sensors and transducers for process parameters
6.	Analyze the mathematical equation and solve different example of sensors and transducers for process parameters

Section1:	Topics/Contents
	Unit-1: Displacement Measurement system: Transducer definition, classification, and performance characteristics. Resistive: Potentiometer Pie-resistive, equivalent circuits, charge and voltage sensitivity. Inductive: LVDT, RVDT, variable reluctance, self-inductance and mutual inductance. Capacitive: single plate, differential capacitance cell and measurement circuits. Digital transducers: encoders – types of translational and rotary encoders. Proximity sensors: inductive, capacitive, optical, ultrasonic, hall-effect and magnetic. Flapper nozzle: sensitivity, characteristics, its applications in air gauging, Thickness measurement - magnetic, dielectric, ,capacitive, ultrasonic and LVDT. Specifications of sensors, static and dynamic characteristics calculations, selection criteria for sensors. (8 Hours) Unit-2: Speed and force Measurement: Digital transducers: encoders – types of translational and rotary encoders. Proximity sensors: inductive, capacitive, optical, ultrasonic, hall-effect and magnetic. Strain measurement: principle, strain gauge, types, gauge factor, AC and DC tachometers: Hall Effect, proximity pickup, photoelectric, photo-reflective, Stroboscopes, toothed

rotor, eddy current.

Strain measurement: principle, strain gauge Force measurement: basic methods of force measurement, strain gauges, piezoelectric. LVDT Weight measurement: load cells - electromagnetic, vibrating string, magneto-restrictive, magneto-elastic and cantilever beam. LVDT, strain gauge, inductive, piezo-electric principles. comparison of pneumatic, hydraulic and electronic Load cell

(6 Hours)

Unit-3: Temperature Measurement: Scales, units and relations, classification of temperature sensors. Mechanical: bimetallic thermometer, its working principle Electrical: Resistance temperature detectors, its types and comparison, circuits for lead wire compensation, Thermocouple: laws of thermoelectricity, terminologies, types (B, E, J, K, R/, S, T), characteristics, study of thermocouple tables, lead wire compensation, cold junction compensation techniques, protection (Thermowell), EMF Measurement methods, Thermistor: its types (NTC, PTC), measuring circuits, thermopiles.

(6 Hours)

Section2:	Topics/Contents
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Unit-4: Flow Measurement : Units, Newtonian and non-newtonian fluids, Reynolds's number, laminar and turbulent flows, velocity profile, Bernoulli's equation for incompressible flow, density, Beta ratio, Reynolds's number correction, square root relation. Head type flow meters: Orifice (eccentric, segmental, concentric), different pressure taps, venture-meter, pitot tube, Dahl tube, Variable area type: Rotameter Other flow meters: Turbine, target, electromagnetic, ultrasonic (Doppler, transit time), vortex shedding, positive displacement, anemometers (hot wire, laser). Mass flow meters: Coriolis, angular momentum, thermal flow meters.

(8 Hours)

Unit-5: Pressure measurement : Pressure scales, units and relations, manometers – U tube, well type, inclined tube. Elastic – bourdon, diaphragm, bellows and their types. High pressure measurement– bulk modulus cell, Differential pressure measurement: force balance, motion balance, capacitance delta cell. Vacuum measurement: Units and relations, thermal conductivity (Pirani Gauge, Thermocouple), Calibrating Instruments – Dead Weight Tester (Pressure, Vacuum).

(6 Hours)

Unit-6: Level Measurement:

Direct (Gauges): Hook type, sight glass: tubular, transparent and reflex, float and tape. Indirect: Hydrostatic pressure, bubbler. Electrical : Float, displacer (torque tube unit), ultrasonic, radioactive, radar (contact, non-contact – TDR / PDS), thermal. Solid level detectors electronic Load cell Float type: float and wire, float and board, capacitive, resistance.

PH and Conductivity ,Viscosity and Turbidity Moisture and Humidity measurement. **(6 Hours)**

Text Books:

- | | |
|----|---|
| 1. | Nakra-Chaudhary, "Instrumentation Measurement and Analysis", Tata McGraw Hill Publications -21 st Reprint. |
| 2. | A. K. Sawhney, "Electrical and Electronic Measurements and Instrumentation", Dhanpat Rai and Sons Publications, 2002. |
| 3. | 'R. K. Jain, "Mechanical and Industrial Measurement", Khanna Publications - 9 th print. |

Reference Books:

- | | |
|----|---|
| 1. | B. G. Liptak, "Process Measurement and Analysis", Butterworth Heinemann, Third Edition. |
| 2. | E. O. Doebelin, "Measurement System Application and Design", McGraw-Hill International Publications - Fourth Edition. |

List of Practicals:

1. To evaluate performance characteristics of LVDT.
2. To evaluate static characteristics of different proximity sensors.
3. Compare performance of optical pulsating speed sensor and tachometer.
4. To evaluate performance characteristics of Load cell.
5. To evaluate performance characteristics Thermocouple/RTD.
6. To evaluate performance characteristics vibration sensor.
7. To evaluate performance of C-type bourdon gauge.
8. Compare performance of electromagnetic flow meter, Vortex flowmeter and Rotameter.
9. To evaluate performance characteristics capacitive level sensor.
10. To evaluate performance characteristics level switch, air-purge and ultrasonic sensor.
11. To evaluate performance characteristics of pH and conductivity sensor
12. To evaluate performance characteristics of Torque-meter
13. Calibration of pressure gauge using Dead weight tester and vacuum gauge tester
14. To evaluate performance of Linear and Rotary encoder
15. To evaluate performance of air-flow and sound-level meter

List of Project areas:

1. Digital Displacement Measurement Using LVDT.
2. Automatic Object Detection Using Inductive and Capacitive Proximity Sensors.
3. Rotary Encoder-Based Shaft Position Measurement System.
4. Digital Tachometer Using Hall-Effect Sensor.
5. Load Cell-Based Digital Weighing Machine.
6. Force Measurement System Using Strain Gauge.
7. Thermocouple-Based Digital Temperature Monitoring System.
8. RTD-Based Industrial Temperature Measurement System.
9. Smart Temperature Monitoring and Alarm System Using Thermistor.
10. Water Flow Measurement Using Turbine Flow Sensor.
11. Ultrasonic Flow Measurement System.
12. IoT-Based Water Flow Monitoring and Data Logging System.
13. Digital Pressure Monitoring System Using Pressure Sensor.
14. Pneumatic Pressure Measurement and Display System.
15. Hydraulic Pressure Monitoring with Alarm.
16. Automatic Water Tank Level Indicator and Controller.
17. Ultrasonic Liquid Level Measurement System.
18. Smart Water Level Monitoring Using IoT.

CO-PO / PSO Articulation Matrix

Correlation: 1 = Low (Slight), 2 = Medium (Moderate), 3 = High (Substantial), '-' = no correlation.

CO	Program Outcome (PO)											PSO		
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	2	1	-	-	-	-	-	-	-	1	1	1
CO2	2	2	3	2	-	-	-	-	-	-	-	2	2	2
CO3	3	3	3	-	-	-	-	-	-	-	-	3	2	3
CO4	2	2	3	2	-	-	-	-	-	-	-	2	2	2
CO5	3	2	3	2	-	-	-	-	-	-	-	3	2	3
CO6	3	2	3	2	1	1	-	1	2	2	1	3	2	3
Avg	2.16	2.16	2.83	1.50	0.16	0.17	0.00	0.16	0.33	0.33	0.16	2.33	1.83	2.33

CO-WK Mapping (Knowledge & Attitude Profiles)

'✓' indicates the knowledge profile drawn upon by the CO.

CO	WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9
CO1		✓	✓	✓				✓	
CO2		✓	✓	✓	✓	✓			
CO3		✓	✓	✓		✓		✓	
CO4		✓	✓	✓	✓	✓			
CO5		✓	✓	✓	✓	✓		✓	
CO6		✓	✓	✓	✓	✓	✓	✓	

CO- WP Mapping (Complex Engineering Problems)

CO	WP1	WP2	WP3	WP4	WP5	WP6	WP7
CO1	✓	✓					
CO2	✓	✓	✓				
CO3	✓	✓	✓				
CO4	✓	✓	✓	✓			
CO5	✓	✓	✓	✓	✓		
CO6	✓	✓	✓	✓	✓	✓	✓

CO-EA Mapping (Complex Engineering Activities)

'✓' indicates the activity attribute addressed by the CO

CO	EA1	EA2	EA3	EA4	EA5
CO1	✓				
CO2	✓	✓	✓		
CO3	✓	✓	✓		
CO4	✓	✓	✓	✓	
CO5	✓	✓	✓	✓	
CO6	✓	✓	✓	✓	✓

CO-SDG Mapping (Sustainable Development Goals)

CO	SDG(s) Addressed	Justification / Linkage
CO1	4, 9	Develops knowledge of transducers, sensors, and measurement principles, promoting quality education (SDG 4) and supporting industrial innovation (SDG 9).
CO2	9	Applies speed, force, weight, and strain measurement techniques for industrial automation and smart manufacturing (SDG 9).
CO3	3, 9	Temperature measurement techniques improve process safety, healthcare instrumentation, and industrial monitoring, contributing to good health (SDG 3) and industry innovation (SDG 9).
CO4	6, 9	Flow measurement supports efficient water resource management (SDG 6) and enhances industrial process efficiency through advanced instrumentation (SDG 9).
CO5	9,12	Pressure measurement improves safe industrial operations, energy efficiency, and responsible production processes (SDG 9, SDG 12).
CO6	6,9, 11	Level, pH, conductivity, humidity, and moisture measurement support water management, smart infrastructure, environmental monitoring, and sustainable cities (SDGs 6, 9, and 11).

MD2301:: DATA SCIENCE

Teaching Scheme	Examination Scheme
Credits : 3	CP: 30 Marks
Lectures : 2 Hrs/week	Lab: 10 Marks
Practical : 2 Hrs/week	CVV: 20 Marks
Tutorial : - Hrs/week	ESE (W): 40 Marks

Prerequisites:	
●	Linear Algebra Basics
●	Central Tendency & Measures of Dispersion – Mean, Mode, Median
●	Probability
●	Some exposure to programming environment – C programming; Python
Course Objectives:	
●	Understand data processing pipeline
●	Perform dimensionality reduction operations
●	Optimize the performance of functions
●	Apply descriptive statistics tools
●	Deduce meaningful statistical inferences
●	Use unsupervised classification algorithms
●	Use supervised classification algorithms
●	Utilize the data science principles for an entire project life cycle as a case study
Course Outcomes:	
	After completion of the course, student will be able to
1.	Apply data processing and data visualization techniques
2.	Perform descriptive and inferential statistical analysis
3.	Utilize appropriate distance metrics and optimization techniques
4.	Implement supervised algorithms for classification and prediction
5.	Implement unsupervised classification algorithms
6.	Evaluate the performance metrics of supervised and unsupervised algorithms

Section1:	Topics/Contents
Unit-1:	Data science definition, raw data, processed data and their attributes, meta data, data cleaning, data science pipeline. (4 Hours)
Unit-2:	Normal distribution, evaluating normal distribution, Binomial distribution, confidence Intervals, central limit Theorem, hypothesis testing (6 Hours)
Unit-3:	Vector norms, Unconstrained Optimization (4 Hours)
Section2:	Topics/Contents
Unit-4:	Simple and multiple linear regression; Logistic regression, non-linear regression, polynomial regression (4 Hours)
Unit-5:	Nearest Neighbor Classification – Knn approach, branch and bound algorithm, projection algorithm; Naïve Bayes Classification; Classification using decision trees, divisive and agglomerative clustering, K-means clustering (6 Hours)

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Unit-6: Evaluation of model performance – Confusion matrices, sensitivity, specificity, precision, recall, F-measure, Classifier performance measurement metrics – Training & Testing strategies – Resubstitution, Hold-out, Cross validation, Bootstrap. **(4 Hours)**

Text Books:

- | | |
|----|---|
| 1. | ‘A Beginner’s Guide to R’ – Zuur, Leno, Meesters; Springer, 2009 |
| 2. | ‘Introduction to Data Science’ – Iguar, Segui; Springer, 2017 |
| 3. | ‘Mathematics for Machine Learning’ – Driesenroth, Faisal, Ong; Cambridge University Press, 2017 |
| 4. | ‘Machine Learning with R’ – Lantz, Packt Publishing, 2018 |

Reference Books:

- | | |
|----|---|
| 1. | ‘Elements of Statistical Learning’ - Hastie, Tibshirani, Friedman; Springer; 2011 |
| 2. | ‘Data Science from Scratch’ - Grus; Google Books; 2015 |
| 3. | ‘The art of Data Science’ - Matsui, Peng; 2016 |
| 4. | ‘Machine Learning for absolute beginners’ - Theobald; Google Books; 2017 |

List of Practicals:

1. Data visualization
2. Unconstrained Optimization
3. Hypothesis Testing
4. Linear regression
5. Logistic Regression
6. Nearest Neighbor classification
7. Naive Bayes classification
8. Clustering
9. Classifier performance using Confusion matrix and other attributes
10. Cross Validation methods

List of Project areas:

1. Movie recommendation system
2. Customer Segmentation using Machine Learning
3. Sentiment analysis
4. Uber Data analysis
5. Loan prediction
6. HVAC needs forecasting
7. Customer relationship management
8. Clinical decision support systems
9. Development of machine learning solutions using available data sets (multiple projects)
10. Fraud detection

CO-PO / PSO Articulation Matrix

Correlation: 1 = Low (Slight), 2 = Medium (Moderate), 3 = High (Substantial), '-' = no correlation.

CO	Program Outcome (PO)											PSO		
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	2	1	-	-	-	-	-	-	-	1	1	1
CO2	2	2	3	2	-	-	-	-	-	-	-	2	2	2
CO3	3	3	3	-	-	-	-	-	-	-	-	3	2	3
CO4	2	2	3	2	-	-	-	-	-	-	-	2	2	2
CO5	3	2	3	2	-	-	-	-	-	-	-	3	2	3
CO6	3	2	3	2	1	1	-	1	2	2	1	3	2	3
Avg	2.67	2.17	2.83	1.50	0.17	0.17	0.00	0.17	0.33	0.33	0.17	2.33	1.83	2.33

CO-WK Mapping (Knowledge & Attitude Profiles)

'✓' indicates the knowledge profile drawn upon by the CO.

CO	WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9
CO1			✓	✓				✓	
CO2		✓		✓	✓	✓			
CO3		✓		✓		✓		✓	
CO4		✓		✓		✓			
CO5				✓		✓		✓	
CO6				✓	✓	✓		✓	

CO- WP Mapping (Complex Engineering Problems)

CO	WP1	WP2	WP3	WP4	WP5	WP6	WP7
CO1	✓						
CO2	✓		✓				
CO3	✓		✓				
CO4	✓	✓	✓				
CO5	✓	✓	✓				
CO6	✓		✓				✓

CO-EA Mapping (Complex Engineering Activities)

'✓' indicates the activity attribute addressed by the CO

CO	EA1	EA2	EA3	EA4	EA5
CO1	✓				
CO2	✓		✓		
CO3	✓		✓		
CO4	✓		✓		
CO5	✓		✓		
CO6	✓		✓	✓	✓

CO-SDG Mapping (Sustainable Development Goals)

CO	SDG(s) Addressed	Justification / Linkage
CO1	4, 9	Builds the analytical foundation (SDG 4) that drives data-led innovation (SDG 9)
CO2	9	Supervised models power industrial and predictive applications (SDG 9).
CO3	3, 9	Statistical learning supports health diagnostics (SDG 3) and broader innovation (SDG9).
CO4	8, 9	Classifiers enable fraud detection and economic applications (SDG 8, 9).
CO5	9	Decision-tree and ensemble models support data-driven industry solutions (SDG 9).
CO6	9, 11	Clustering / RL enable smart-city and resource applications (SDG 9, 11).

IC2305:: OBJECT ORIENTED PROGRAMMING

Teaching Scheme	Examination Scheme
Credits : 3	CP: 30 Marks
Lectures : 2 Hrs/week	LAB : 10 Marks
Practical : 2 Hrs/week	ESE (W): 40 Marks
	CVV : 20 Marks

Prerequisites:	
•	Fundamentals of Programming using C or Python
Course Objectives:	
•	Understand the fundamental concepts of object-oriented programming
•	Demonstrate Object Oriented programming concepts by writing suitable Java programs
•	Model a given computational problem in Object Oriented fashion
•	To develop problem solving ability using Object Oriented programming constructs like multithreading
•	Develop effective solutions for real world problems using the concepts such as file handling and GUI
•	Implement applications using Java I/O and event-based GUI handling principles
Course Outcomes:	
	After completion of the course, student will be able to
1.	Understand object-oriented programming features
2.	Develop real world applications using class, inheritance and polymorphism
3.	Adapt Best Practices of Class Design by using Standard Templates Library
4.	Solve computing problems by applying the knowledge of Exception handling and Multithreading
5.	Design solutions by choosing suitable data structures such as Array, Vector, Map, etc.
6.	Implement applications using Java I/O and event-based GUI handling principles

Section1:	Topics/Contents
	What is Object Oriented Programming (OOP)? The need of OOP, Characteristics of OOP. Java overview: Classes and Objects, Java object storage, Access Modifiers, this reference, main method, Static vs Instance block, Static methods vs Instance methods in Java. Constructors: Constructors in Java, Default constructor, Parameterized constructor. Input and Output: Byte Stream vs Character Stream, use of Scanner Class. Arrays in Java: Arrays in Java, initialization, Default Array values, multi-dimensional array, java.util .Arrays class, string class, string buffer, string builder. Methods in Java: Methods, Parameters passing, Returning Multiple values. Inheritance: Inheritance in Java, Types, Constructor in Inheritance, Using final with Inheritance, Accessing superclass member, Parent and Child classes having same data member, Base vs derived class reference.
Section2:	Topics/Contents
	Polymorphism: Method Overloading, Overloading main(), Static vs Dynamic Binding, Method Hiding. Private and final methods, Passing and Returning Objects in Java

Exception Handling: Exceptions, types, types of handling exception, Checked vs Unchecked Exceptions, Throw and Throws, User-defined Exception.

Interfaces and Abstract Classes: Interface and its usage, Abstract Class and its usage, Difference between Abstract Class and Interface, Nested Interface, Nested Class, Inner class, Anonymous

Collection in Java: Collections Class, Using Iterators, Iterator vs Foreach, Array List, Vector, Map, Set.

Multithreading: Thread life Cycle, Thread Priority, Thread Methods.

File Handling: File Processing, Primitive Data Processing, Object Data Processing, Connecting Java with database (JDBC/ODBC).

Java GUI: Swing, Components. Layout Manager: Flow, Border, Grid and Card. Label, Button, Choice, List, Event Handling (mouse, key).

Text Books:

1	Herbert Schildt, "JAVA- The Complete Reference", , 11th Edition, McGraw Hill Education
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Reference Books:

1	Bruce Eckel, "Thinking In Java – The Definitive Introduction to Object-Oriented Programming in the Language of the World-Wide Web", Fourth Edition, Pearson Education, Inc.
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2	R. Morelli and R. Walde, "Java, java, Java – Object-Oriented Problem Solving", 3 rd edition, Pearson Education, Inc.
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List of Practicals:

- Implement Student class using following Concepts
 - All types of Constructors
 - Static variables and instance variables
 - Static blocks and instance blocks
 - Static methods and instance methods
- There is a class Adder which has two data members of type 1D int array and int variable. It has two functions: getdata and numsum. Function getdata accepts non-empty array of distinct integers from user in 1D int array data member and a targetsum in another data member. The function numsum adds any two elements from an input array which is equal to targetsum and return an array of resulting two elements, in any order. If no two numbers sum up to the target sum, the function should return to an empty array. Note that the target sum is to be obtained by summing two different integers in the array; you can't add a single integer to itself in order to obtain the target sum. You can assume that there will be at most one pair of numbers summing up to the target sum. Use constructor. Use extra variables if needed

Input:

Array=[3,5,-4,8,11,1,-1,7] targetsum=15

Output: [8,7]

Input:

Array=[3,5,-4,8,11,1,-1,6] targetsum=15

Output: []
- Write Java program to calculate area of triangle, square & circle using function overloading. Function parameter accept from user (Use function Overloading concepts and Inheritance).
- Write a program for following exception, develop a suitable scenario in which the following exceptions occur:
 - divide by zero

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- a. Array index out of bounds exception
- b. Null pointer Exception
5. Write a java program to solve producer-consumer problem where there are two producer threads and one consumer thread.
6. Implement various operations using JDBC Connectivity.
7. Display bank account information (Use interface and inheritance using java)
8. Develop a GUI in java which reads, updates the file.

List of Project areas:

1. Airline reservation system
2. Course management system
3. Data visualization software
4. Electricity billing system
5. e-Healthcare management system
6. Email client software
7. Library management system
8. Network packet sniffer
9. Online bank management system
10. Online medical management system
11. Online quiz management system
12. Online Survey System
13. RSS feed reader
14. Smart city project
15. Stock management system
16. Supply chain management system
17. Virtual private network
18. Pocket Tanks Game Java Project
19. Internet Banking
20. Hospital Management Java Project

CO – PO / PSO Articulation Matrix

Correlation: 1 = Low (Slight), 2 = Medium (Moderate), 3 = High (Substantial), '-' = no correlation.

CO	Program Outcome (PO)											PSO		
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	2	1	-	-	-	-	-	-	-	1	1	1
CO2	2	2	3	2	-	-	-	-	-	-	-	2	2	2
CO3	3	3	3	-	-	-	-	-	-	-	-	3	2	3
CO4	2	2	3	2	-	-	-	-	-	-	-	2	2	2
CO5	3	2	3	2	-	-	-	-	-	-	-	3	2	3
CO6	3	2	3	2	1	1	-	1	2	2	1	3	2	3
Avg	2.66	2.1	2.83	1.5	0.14	0.14	-	0.14	0.33	0.33	0.14	2.33	1.7	2.6

CO – WK Mapping (Knowledge & Attitude Profiles)

'✓' indicates the knowledge profile drawn upon by the CO.

CO	WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9
CO1			✓	✓				✓	
CO2		✓		✓	✓	✓			
CO3		✓		✓		✓		✓	
CO4		✓		✓		✓			
CO5				✓		✓		✓	
CO6				✓	✓	✓		✓	

CO – WP Mapping (Complex Engineering Problems)

CO	WP1	WP2	WP3	WP4	WP5	WP6	WP7
CO1	✓						
CO2	✓		✓				
CO3	✓		✓				
CO4	✓	✓	✓				
CO5	✓	✓	✓				
CO6	✓		✓				✓

CO – EA Mapping (Complex Engineering Activities)

'✓' indicates the activity attribute addressed by the CO

CO	EA1	EA2	EA3	EA4	EA5
CO1	✓				
CO2	✓		✓		
CO3	✓		✓		
CO4	✓		✓		
CO5	✓		✓		
CO6	✓		✓	✓	✓

CO – SDG Mapping (Sustainable Development Goals)

CO	SDG(s) Addressed	Justification / Linkage
CO1	4, 9	Builds the analytical foundation (SDG 4) that drives data-led innovation (SDG 9).
CO2	9	Supervised models power industrial and predictive applications (SDG 9).
CO3	3, 9	Statistical learning supports health diagnostics (SDG 3) and broader innovation (SDG 9).
CO4	8, 9	Classifiers enable fraud detection and economic applications (SDG 8, 9).
CO5	9	Decision-tree and ensemble models support data-driven industry solutions (SDG 9).
CO6	9, 11	Clustering / RL enable smart-city and resource applications (SDG 9, 11).

IC2307:: DATABASE MANAGEMENT SYSTEMS

Teaching Scheme	Examination Scheme
Credits : 3	CP: 30 Marks
Lectures : 2 Hrs/week	LAB: 10 Marks
Practical : 2 Hrs/week	MSE (W/O): 40 Marks
	CVV: 20 Marks

Prerequisites:	
	Data structures, Discrete Mathematics
Course Objectives:	
	Learn the fundamentals of different data modeling techniques.
	Design and development of relational database management systems.
	Study the theory behind database systems, the issues that affect their functionality and performance
	Design of query languages and the use of semantics for query optimization.
	Understand the latest trends of data management systems.
Course Outcomes:	
	After completion of the course, student will be able to
1.	Design data models as per data requirements of an organization
2.	Synthesize a relational data model up to a suitable normal form
3.	Develop a database system using relational queries and PL/SQL objects
4.	Apply indexing techniques and query optimization strategies
5.	Understand importance of concurrency control and recovery techniques
6.	Adapt to emerging trends considering societal requirements

Section-1:	Topics/Contents
Introduction: Need of Database Management Systems, Evolution, Database System Concepts and Architecture, Database Design Process. Data Modeling: Entity Relationship (ER) Model, keys, Extended ER Model, Relational Model, Codd's Rules Database Design: Need of Normalization, Functional Dependencies, Inference Rules, Functional Dependency Closure, Minimal Cover, Decomposition Properties, Normal Forms: 1NF, 2NF, 3NF and BCNF, Multi-valued Dependency, 4NF Query Languages: Relational Algebra, SQL: DDL, DML, Select Queries, Set, String, Date and Numerical Functions, Aggregate Functions, Group by and Having Clause, Join Queries, Nested queries, DCL, TCL, PL/SQL: Procedure, Function, Trigger, Mapping of Relational Algebra to SQL	
Section-2:	Topics/Contents
Storage and Querying: Storage and File structures, Indexed Files, Single Level and Multi Level Indexes; Query Processing, Query Optimization Transaction Management: Basic concept of a Transaction, ACID Properties, State diagram, Concept of Schedule, Serializability – Conflict and View, Concurrency Control Protocols, Recovery techniques Parallel and Distributed Databases: Architecture, I/O Parallelism, Interquery, Intraquery, Intraoperation and Interoperation Parallelism, Types of Distributed Database Systems, Distributed Data Storage, Distributed Query Processing NOSQL Databases and Big Data Storage Systems: Introduction to NOSQL Databases, Types of NOSQL	

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Databases, BASE properties, CAP theorem, Introduction to Big Data.	
Data Warehousing: Architecture and Components of Data Warehouse, OLAP and OLTP	
Text Books:	
1	Abraham Silberschatz, Henry F. Korth, S. Sudarshan; “Database System Concepts”; 6 th Edition McGraw-Hill Education
2	Ramez Elmasri, Shamkant B. Navathe; “Fundamentals of Database Systems”; 7th Edition, Pearson
Reference Books:	
1	Thomas M. Connolly, Carolyn E. Begg,” Database Systems: A Practical Approach to Design, Implementation, and Management, 6th Edition ;Pearson
2	Raghu Ramakrishnan, Johannes Gehrke; “Database Management Systems”, 3rd Edition; McGraw Hill Education
3	Kristina Chodorow, MongoDB The definitive guide, O’Reilly Publications, ISBN: 978-93-5110-269-4, 2nd Edition.
4	Dr. P. S. Deshpande, SQL and PL/SQL for Oracle 10g Black Book, Dream Tech.
5	Ivan Bayross, SQL, PL/SQL: The Programming Language of Oracle, BPB Publication. 6. Reese G.,
6	Yarger R., King T., Williams H, Managing and Using MySQL, Shroff Publishers and Distributors Pvt. Ltd., ISBN: 81 - 7366 - 465 – X, 2nd Edition.
7	Dalton Patrik, SQL Server – Black Book, DreamTech Press.
8	Eric Redmond, Jim Wilson, Seven databases in seven weeks, SPD, ISBN: 978-93-5023-918-6.
9	Jay Kreibich, Using SQLite, SPD, ISBN: 978-93-5110-934-1, 1st edition.

List of Practicals:

- 1) Choose a database application; you propose to work on throughout the course. Perform requirement analysis in detail for the same. Draw an entity-relationship diagram for the proposed database.
- 2) Create a database with appropriate constraints using DDL and populate/modify it with the help of DML.
- 3) Design and Execute “SELECT” queries using conditional, logical, like/not like, in/not in, between...and, is null/is not null operators in where clause, order by, group by, aggregate functions, having clause, and set operators. Use SQL single row functions for date, time, string etc.
- 4) Write equijoin, non equijoin, self join and outer join queries. Write queries containing single row / multiple row / correlated sub queries using operators like =, in, any, all, exists etc. Write DML queries containing sub queries. Study a set of query processing strategies.
- 5) Write PL/SQL blocks to implement all types of cursor.
- 6) Write useful stored procedures and functions in PL/SQL to perform complex computation.
- 7) Write and execute all types of database triggers in PL/SQL.
- 8) Execute DDL statements which demonstrate the use of views. Try to update the base table using its corresponding view. Also consider restrictions on updatable views and perform view creation from multiple tables.
- 9) Create a database with suitable example using MongoDB and implement Inserting and saving document, Removing document, Updating document
- 10) Execute at least 10 queries on any suitable MongoDB database that demonstrates following querying techniques: find and findOne, Query criteria, Type-specific queries
- 11) Implement Map Reduce operation with suitable example using MongoDB.

List of Project areas:

Following is the indicative list of projects but is not limited to. Student and teacher can also jointly decide project area other than specified in the list.

1. University/Educational institute database
2. Railway reservation/Show booking system
3. Finance management system
4. Travel/Tours management system
5. Blood bank management system
7. Sales management
8. Online retailer/payment systems
9. Hospital management system
10. Human resource management
11. Manufacturing/production management
12. Matrimonial databases for finding matches.

CO – PO / PSO Articulation Matrix

Correlation: 1 = Low (Slight), 2 = Medium (Moderate), 3 = High (Substantial), '-' = no correlation.

CO	Program Outcome (PO)											PSO		
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	3	3	0	2	0	0	0	1	0	1	2	0	0
CO2	2	2	3	0	3	0	0	0	1	0	1	2	3	2
CO3	2	3	3	1	2	0	0	0	1	0	1	2	3	2
CO4	2	3	3	2	1	0	0	0	1	0	2	2	1	2
CO5	2	2	3	1	2	0	0	0	1	0	2	2	3	2
CO6	2	2	3	2	3	0	0	0	2	1	2	3	3	3
Avg	2.0	2.5	3.0	1.0	2.2	0	0	0	1.2	0.2	1.5	2.2	2.2	1.8

CO – WK Mapping (Knowledge & Attitude Profiles)

'✓' indicates the knowledge profile drawn upon by the CO.

CO	WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9
CO1		✓	✓	✓	✓				
CO2		✓	✓	✓	✓	✓			
CO3		✓	✓	✓	✓	✓	✓		
CO4		✓	✓	✓	✓	✓	✓		
CO5			✓	✓	✓	✓	✓	✓	
CO6		✓	✓	✓	✓	✓	✓	✓	

CO – WP Mapping (Complex Engineering Problems)

CO	WP1	WP2	WP3	WP4	WP5	WP6	WP7
CO1	✓	✓					
CO2	✓	✓	✓				
CO3	✓	✓	✓	✓			
CO4	✓	✓	✓	✓	✓		
CO5	✓	✓	✓	✓	✓	✓	
CO6	✓	✓	✓	✓	✓	✓	✓

CO – EA Mapping (Complex Engineering Activities)

'✓' indicates the activity attribute addressed by the CO

CO	EA1	EA2	EA3	EA4	EA5
CO1	✓	✓			
CO2	✓	✓	✓		
CO3	✓	✓	✓	✓	
CO4	✓	✓	✓	✓	
CO5	✓	✓	✓	✓	✓
CO6	✓	✓	✓	✓	✓

CO – SDG Mapping (Sustainable Development Goals)

CO	SDG(s) Addressed	Justification / Linkage
CO1	4, 9	Develops knowledge of database concepts, data modeling, and normalization, strengthening quality education (SDG 4) and supporting digital infrastructure and innovation (SDG 9).
CO2	4, 9	SQL and PL/SQL programming develop practical database skills (SDG 4) and support efficient software and industrial database applications (SDG 9).
CO3	9	Query optimization, indexing, and storage techniques improve the efficiency and reliability of database systems, promoting innovation and resilient digital infrastructure (SDG 9).
CO4	9, 16	Transaction management and distributed databases ensure secure, reliable, and consistent information systems, supporting innovation (SDG 9) and effective institutions through trustworthy data management (SDG 16).
CO5	9, 11	NoSQL databases, Big Data, and Data Warehousing support intelligent industrial systems and smart city applications through scalable data management (SDG 9, SDG 11).
CO6	4, 9	Database application development integrates theoretical knowledge with practical implementation, enhancing technical education (SDG 4) and enabling innovative software solutions (SDG 9).

MM1405: HEALTHCARE ANALYTICS

Teaching Scheme	Examination Scheme
Credits : 3	CP: 30 Marks
Lectures : 2 Hrs/week	LAB: 10 Marks
Practical : 2 Hrs/week	MSE (W/O): 40 Marks
	CVV: 20 Marks

Course Objectives:	
•	To understand the fundamentals of human physiology, biopotential generation, electrode systems, and bio-signal characteristics.
•	To understand and analyze bio-signal conditioning techniques, including bio-amplifiers, filters, isolation amplifiers, and power-line interference reduction.
•	To study and understand biomedical instruments used for cardiovascular measurements, including ECG, Holter monitoring, phonocardiography, and vector cardiography.
•	To understand the principles and instrumentation used for measurement of blood pressure, blood flow, cardiac output, and other cardiovascular parameters.
•	To understand and apply biomedical sensors and instruments used in life-saving, neurological, muscular, and respiratory applications, including pacemakers, defibrillators, EEG, EMG, spirometers, and pulse oximeters.
Course Outcomes:	After completion of the course, student will be able to
1.	Explain the fundamentals of biopotential generation, electrode systems, and bio-signal characteristics.
2.	Explain and analyze bio-signal conditioning techniques using bio-amplifiers, filters, isolation amplifiers, and interference reduction techniques.
3.	Demonstrate the working principles of biomedical sensors and instruments used for cardiovascular measurements, including ECG and related systems.
4.	Explain the principles and instrumentation used for measurement of cardiac output, blood pressure, and blood flow.
5.	Explain the working principles and applications of life-saving biomedical devices such as pacemakers, defibrillators, and heart-lung machines.
6.	Apply the principles of biomedical sensors and instruments for measurement and monitoring of nervous, muscular, and respiratory system parameters.
Section 1:	Topics/Contents
Unit 1: Human Physiology and Electrode System (7 Hrs): Origin of bio potential and its propagation; electrode-electrolyte interface; electrode-skin interface; half-cell potential; impedance; polarization effects; polarized and nonpolarizable electrodes; surface, needle and micro electrodes and equivalent circuits; recording problems; two-electrode measurement; bio-signal frequency and amplitude ranges. Unit 2: Bio Signal Conditioning Techniques (7 Hrs): Need for bio-amplifier; single-ended and differential bio-amplifiers; right-leg-driven ECG amplifier; low-pass, high-pass and band-pass filtering; isolation amplifiers; transformer and optical isolation; isolated DC amplifier; AC carrier amplifier; chopper amplifier; power-line interference. Unit 3: Cardiovascular System and Related Instrument (7 Hrs): Cardiovascular theory; ECG electrodes; Einthoven's triangle; standard 12-lead system; ECG recorder; Holter monitor and recording; phonocardiography; vector cardiograph.	

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Section 2:	Topics/Contents
	Unit 4: Cardiovascular Allied Measurements (6 Hrs): Measurement of cardiac output; blood pressure measurement; blood flow measurements. Unit 5: Life Saving Devices (6 Hrs): Pacemaker; defibrillator; heart-lung machine; patient safety. Unit 6: Neuro, Muscle and Respiratory Instrument (7 Hrs): Brain system; EEG electrode system and signal acquisition using electroencephalography (EEG); EMG system; respiration system and respiration-rate measurement techniques; spirometers; pulse oximeter.
Text Books:	
1.	Carr & Brown; Biomedical Instrumentation & Measurement; Pearson Publications.
2.	Leslie Cromwell, Fred J. Weibell, Erich A. Pfeiffer; Biomedical Instrumentation and Measurement; Prentice-Hall India.
3.	R. S. Khandpur; Handbook of Biomedical Instrumentation; Tata McGraw Hill.
Reference Books:	
1.	John G. Webster; Medical Instrumentation: Application and Design; Wiley Publications.
2.	Sanjay Guha; Medical Electronics and Instrumentation; University Publications.
3.	S. C. Richard Cobbald; Transducers for Biomedical Measurements; Krieger.

List of Tutorials:

1. Design of ECG amplifier
2. Design of 50Hz filter
3. Design of high pass, low pass and bandpass filter
4. Simulation of ECG waveform
5. Simulation of half-cell potential
6. Simulation of respiration rate measurement
7. Study of PH measurement
9. Study of Blood Pressure measurement
10. Study of Pacemaker
11. Study of Defibrillator

CO – PO / PSO Articulation Matrix

Correlation: 1 = Low (Slight), 2 = Medium (Moderate), 3 = High (Substantial), '-' = no correlation.

CO	Program Outcome (PO)										PSO		
CO													
CO1													
CO2													
CO3													
CO4													
CO5													
CO6													
Avg													

CO – WK Mapping (Knowledge & Attitude Profiles)

'✓' indicates the knowledge profile drawn upon by the CO.

CO	WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9
CO1									
CO2									
CO3									
CO4									
CO5									
CO6									

CO – WP Mapping (Complex Engineering Problems)

CO1							
CO2							
CO3							
CO4							
CO5							
CO6							

CO – EA Mapping (Complex Engineering Activities)

'✓' indicates the activity attribute addressed by the CO

CO	EA1	EA2	EA3	EA4	EA5
CO1					
CO2					
CO3					
CO4					
CO5					
CO6					

CO – SDG Mapping (Sustainable Development Goals)

CO	SDG(s) Addressed	Justification / Linkage
CO1		
CO2		
CO3		
CO4		
CO5		
CO6		

MM1408: MICROCONTROLLER AND APPLICATIONS

Teaching Scheme	Examination Scheme
Credits : 3	CP: 20 Marks
Lectures : 2 Hrs/week	GD/PPT/HA: 20 Marks
Practical : Hrs/week	MSE (W/O): 40 Marks
Tutorial : 1 Hrs/week	CVV: 20 Marks

Prerequisites:	
•	Basic digital electronics, C programming, Fundamentals of microcontroller architecture and peripherals
Course Objectives:	
•	To build a foundation in microcontroller architecture, memory and peripherals, and to apply a structured framework for selecting a microcontroller against measurement and control requirements.
•	To develop register-level programming skills for ports, timers, interrupts, PWM and input capture, and to reason about timing-critical paths.
•	To analyse serial and peripheral communication (UART, SPI, I2C, RS-485 / Modbus) and to design interrupt-driven, reliable data-flow schemes
•	To analyse the complete measurement signal chain — from transducer through acquisition to processing and actuation — in healthcare and building-automation instruments
•	To develop skills in firmware structure, debugging, low-power operation and reliable, fail-safe design
•	To analyse how commercial instruments, including resource-critical machine-vision nodes, are architected around a microcontroller, and to reason about the transition from prototype to product
Course Outcomes:	
	After completion of the course, student will be able to
1.	Justify the selection of a microcontroller for a given measurement or control application using a structured framework
2.	Map the functions of an instrument onto specific microcontroller peripherals (I/O, timers, PWM, interrupts, input capture) and reason about timing-critical paths at register level
3.	Configure and analyse the microcontroller's serial interfaces (UART, SPI, I2C, RS-485 / Modbus) to design interrupt-driven, reliable data-flow schemes
4.	Analyse the microcontroller's analog acquisition in a healthcare or building-automation instrument.
5.	Apply firmware-engineering, low-power and fail-safe design principles to microcontroller-based instrument firmware .
6.	Dissect a commercial instrument to expose its microcontroller architecture and evaluate its transition from prototype to product

Section1:	Topics/Contents
Unit 1: Microcontroller Fundamentals and Selection Embedded systems versus general-purpose computing; the 8-, 16- and 32-bit landscape and a survey of representative families (AVR, PIC, ARM Cortex-M) at awareness level. The course microcontroller as a platform: CPU core, buses, clock system and memory architecture (Flash, SRAM, EEPROM) with the rationale for each. The high-level programming abstraction and what lies beneath it — a framing gap analysis. Choosing the right microcontroller: a selection framework proceeding from peripheral and I/O requirements, through performance and memory sizing with margin, power budget, package, tooling and debugger support, cost at volume, and ecosystem and long-term availability.	

Unit 2: Ports, Timers and Interrupts

General-purpose I/O at register level and the cost of abstraction (direct port manipulation versus library calls). The interrupt system: vectors, external and pin-change interrupts, interrupt service routines, latency, and the atomicity hazard on shared multi-byte variables. Timer/counter architecture, modes and prescalers. Pulse-width modulation as a means of actuation, with frequency and resolution as measures of actuation quality. Input capture for the measurement of time, frequency, period and pulse width.

Unit 3 — Serial Communication and Peripheral Integration

UART: frame format, baud rate, register-level configuration and interrupt-driven buffered input/output; data framing and checksums. SPI: protocol, modes, and interfacing an external converter or sensor integrated circuit. I2C: protocol, addressing, and interfacing sensor and real-time-clock devices, including register and FIFO read sequences. RS-485 as the industrial serial standard: half-duplex differential signalling, multi-drop bus topology, driver direction control (the timed GPIO toggle around transmission), and Modbus RTU framing as a representative protocol. Reading a peripheral datasheet as an engineering skill. The boundary at which this course ends and the Internet of Things course begins.

Unit 4 — Application Analysis I: Healthcare and Building Automation

Application-dissection method: functional decomposition, peripheral mapping, resource and power budgeting, reliability requirements, and selection verdict. Integration spectrum: a microcontroller performing the full signal chain versus one reading a smart-sensor system-on-chip. Healthcare devices: acquisition of weak physiological and optical signals; dedicated analog front-end versus on-chip converter; dissection of pulse-oximeter and ECG devices. Building automation: the microcontroller in an HVAC control unit; sensor interfacing; blower and actuator drive; and the capability requirements that drive its selection. Course-boundary signposts to the Internet of Things and Automotive Embedded Systems courses.

Section2:	Topics/Contents
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Unit 4 — Application Analysis I: Healthcare and Building Automation

Application-dissection method: functional decomposition, peripheral mapping, resource and power budgeting, reliability requirements, and selection verdict. Integration spectrum: a microcontroller performing the full signal chain versus one reading a smart-sensor system-on-chip. Healthcare devices: acquisition of weak physiological and optical signals; dedicated analog front-end versus on-chip converter; dissection of pulse-oximeter and ECG devices. Building automation: the microcontroller in an HVAC control unit; sensor interfacing; blower and actuator drive; and the capability requirements that drive its selection. Course-boundary signposts to the Internet of Things and Automotive Embedded Systems courses.

Unit 5 — Firmware Engineering and Reliable Operation

Program structure: the super-loop, interrupt-driven design, finite state machines and non-blocking timing. Debugging: printf-style versus hardware debugging, JTAG/SWD concepts and breakpoints. Low-power operation: sleep modes, wake sources and power budgeting for battery-operated instruments. Reliability: watchdog timers, brown-out detection, defined fail-safe output states and defensive firmware, with awareness of where these practices are formalised in industrial and automotive safety standards.

Unit 6 — Application Analysis II: Microcontrollers in Machine Vision

Vision as a resource-critical application: frame-memory budget against on-chip memory; the inadequacy of an 8-bit device and the need for a 32-bit architecture, larger memory and hardware data movement. Vision-specific peripherals: the parallel camera interface, direct memory access for frame capture, and frame-buffer placement. Machine-vision node dissection: microcontroller class; a deterministic classical pipeline (thresholding, region and blob detection, counting); and industrial use-cases framed as measurements, with a per-stage load and frame-rate budget. On-device inference: deployment of a small quantised model at overview level. Selection ladder: vision microcontroller versus single-board computer versus fixed-function smart camera.

Text Books:	
1	M. A. Mazidi, S. Naimi, and S. Naimi; The AVR Microcontroller and Embedded Systems Using Assembly and C; 2nd ed., Pearson.
2	J. W. Valvano; Embedded Systems: Introduction to Arm Cortex-M Microcontrollers; 5th ed., Self-published (Cengage/CreateSpace).
3	M. A. Mazidi, R. D. McKinlay, and D. Causey; PIC Microcontroller and Embedded Systems: Using Assembly and C for PIC18; 1st ed., Pearson
Reference Books:	
1	E. White; Making Embedded Systems: Design Patterns for Great Software; 1st ed., O'Reilly Media.
2	J. Yiu; The Definitive Guide to Arm Cortex-M3 and Cortex-M4 Processors; 3rd ed., Newnes (Elsevier).
3	S. F. Barrett and D. J. Pack; Atmel AVR Microcontroller Primer: Programming and Interfacing; 2nd ed., Morgan & Claypool.
4	T. Wilmshurst; Designing Embedded Systems with PIC Microcontrollers: Principles and Applications; 2nd ed., Newnes (Elsevier).

List of Practicals

1. Set up the AVR toolchain and a virtual simulation environment; write, assemble and simulate a simple **Assembly Language Program (ALP)** — add/subtract two 8-bit numbers and observe the working registers and SREG flags. *(Unit 1)*
2. **ALP** for data transfer and arithmetic/logic operations using the 32 general-purpose registers; examine the Flash/SRAM/register map in the simulator. *(Unit 1)*
3. **Bare-metal GPIO:** drive LEDs and read switches by direct register manipulation (DDRx, PORTx, PINx); measure and compare the timing of a direct port write versus digitalWrite() (abstraction-gap experiment). *(Unit 2)*
4. **Timer/counter programming (bare metal):** configure Timer0/Timer1 with prescalers to generate accurate delays; verify the period in simulation. *(Unit 2)*
5. **PWM generation:** configure a timer in PWM mode to control LED brightness / a DC-motor as actuation; vary duty cycle and measure frequency and resolution. *(Unit 2)*
6. **Input capture:** measure the frequency, period and pulse-width of an external signal using the input-capture unit and validate against the simulated source. *(Unit 2)*
7. **Interrupt programming:** external and pin-change interrupts with ISRs; demonstrate interrupt latency and the atomicity hazard on a shared multi-byte variable, then apply the fix. *(Unit 2)*
8. **On-chip ADC / analog acquisition (bare metal):** configure the ADC (ADMUX, ADCSRA) to read an analog sensor (temperature/LDR); study resolution, reference and sampling. *(Unit 4)*
9. **UART serial communication:** register-level, interrupt-driven buffered transmit/receive with data framing and checksum; observe on a virtual serial terminal. *(Unit 3)*
10. **SPI communication:** interface an external SPI device (DAC/ADC or sensor IC) in simulation; perform register read/write. *(Unit 3)*
11. **I2C (TWI) communication:** interface an I2C sensor and/or real-time clock; perform register and FIFO read sequences. *(Unit 3)*
12. **RS-485 / Modbus RTU:** implement half-duplex RS-485 with driver direction control (DE/RE toggle) and a basic Modbus RTU frame over a simulated multi-drop link. *(Unit 3)*
13. **Reliable and low-power firmware:** implement a watchdog timer, brown-out handling and sleep modes with wake sources; estimate current in each mode and define fail-safe output states. *(Unit 5)*
14. **Application mini-project (virtual simulation):** build and dissect one instrument — e.g., a pulse-oximeter/heart-rate acquisition front-end or an HVAC blower-PWM control unit — integrating GPIO, ADC, PWM, timer and serial reporting, and present the microcontroller-based design. *(Units 4 & 6)*

List of Tutorials

Conducted weekly (one hour per batch of 20 students); each develops a specific analytical or design skill applied to an adopted instrument.

1. Datasheet interpretation and functional decomposition of an instrument.
2. Peripheral mapping and resource budgeting (memory, CPU, power).
3. Comparative analysis of design architectures (integrated system-on-chip versus discrete front-end with microcontroller).
4. Analog signal-chain and front-end analysis.
5. Sampling strategy, timing, and measurement-uncertainty budgeting.
6. Identification and prioritization of design limitations.
7. Technical literature and prior-work survey methods.
8. Formulating a design solution at method and architecture level.
9. Reliability, fault-handling and fail-safe analysis.
10. Prototype-to-product considerations (EMC, isolation, certification, lifecycle).
11. Microcontroller selection methodology and design-decision justification.
12. Engineering data presentation and technical figures.
13. Technical report structuring and writing.
14. Design review, presentation and defense.

List of Project areas:

Students undertake basic familiarization projects on a range of industry-standard microcontroller development boards drawn from different families — such as AVR, PIC, ARM Cortex-M (ST, NXP, TI) and Renesas — rather than working only on the Arduino board. On each board, students carry out a common set of fundamental tasks, including digital I/O, analog acquisition (ADC), PWM generation, serial communication (UART/SPI/I2C) and simple sensor interfacing, using the board's own development environment and toolchain. The intention is to give students bare-metal, register-level exposure to multiple industrial microcontroller ecosystems at an introductory level, so they become comfortable moving between vendors and understand how the same basic application maps onto different hardware platforms.

CO – PO / PSO Articulation Matrix

Correlation: 1 = Low (Slight), 2 = Medium (Moderate), 3 = High (Substantial), '-' = no correlation.

CO	Program Outcome (PO)											PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO 1	PSO 2	PSO 3
CO1	3	3	2	1	2	-	-	-	-	1	1	2	2	2
CO2	3	3	2	2	2	-	-	-	-	-	-	2	2	3
CO3	2	3	3	2	2	-	-	-	1	-	-	2	2	3
CO4	3	3	2	3	2	-	-	-	-	-	-	3	3	2
CO5	2	2	3	2	2	1	1	-	-	-	1	1	2	3
CO6	2	3	2	3	1	2	1	2	2	2	2	2	3	2
Avg	2.50	2.83	2.33	2.17	1.83	0.50	0.33	0.33	0.50	0.50	0.67	2.00	2.33	2.50

CO – WK Mapping (Knowledge & Attitude Profiles)

'✓' indicates the knowledge profile drawn upon by the CO.

CO	WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9
CO1		✓	✓	✓	✓	✓		✓	
CO2		✓	✓	✓		✓			
CO3		✓	✓	✓		✓			
CO4	✓	✓	✓	✓		✓		✓	
CO5				✓	✓	✓	✓	✓	✓
CO6				✓	✓	✓	✓	✓	✓

CO – WP Mapping (Complex Engineering Problems)

'✓' indicates the complex-engineering-problem attribute addressed by the CO.

CO	WP1	WP2	WP3	WP4	WP5	WP6	WP7
CO1	✓	✓	✓				✓
CO2	✓		✓				✓
CO3	✓		✓		✓		✓
CO4	✓		✓	✓			
CO5	✓	✓	✓		✓		
CO6	✓	✓	✓		✓	✓	✓

CO – EA Mapping (Complex Engineering Activities)

'✓' indicates the activity attribute addressed by the CO.

CO	EA1	EA2	EA3	EA4	EA5
CO1	✓		✓		
CO2	✓	✓			
CO3	✓	✓			
CO4	✓	✓	✓		
CO5	✓		✓	✓	
CO6	✓	✓	✓	✓	

CO – SDG Mapping (Sustainable Development Goals)

CO	SDG(s) Addressed	Justification / Linkage
CO1	4, 9	Structured microcontroller-selection methodology builds engineering analytical capacity (SDG 4) that drives industrial innovation and infrastructure (SDG 9).
CO2	9	Register-level mapping of functions onto microcontroller peripherals underpins reliable industrial instrumentation (SDG 9).
CO3	9	Robust serial and industrial communication (UART/SPI/I2C, RS-485/Modbus) supports resilient industry and infrastructure (SDG 9).
CO4	3, 9	Microcontroller-based analog acquisition in healthcare and building-automation instruments supports good health (SDG 3) and instrumentation innovation (SDG 9).
CO5	7, 9	Low-power, fail-safe firmware enables energy-efficient (SDG 7) and reliable industrial devices (SDG 9).
CO6	9, 11	Dissection of commercial instruments across healthcare, building-automation and vision applications supports industry (SDG 9) and smart, sustainable cities (SDG 11).

HS2002: FROM CAMPUS TO CORPORATE– 1

Teaching Scheme	Examination Scheme
Credits : 2	MSE (W/O): 50 Marks
Lectures : 2 Hrs/week	ESE (W/O): 50 Marks

Course Objectives:	
- Understand the organizational structure, business domains, financial concepts, and functioning of companies in the corporate environment. - Develop knowledge of product management, user experience, quality assurance, customer success, security, and emerging technologies used in modern industries. - Apply analytical thinking, problem-solving, and decision-making techniques to address industry-oriented challenges through case studies and practical scenarios. - Enhance professional competencies including communication, presentation, teamwork, leadership, and interpersonal skills required in multidisciplinary work environments. - Develop project management, planning, prioritization, and execution skills for effective management of professional tasks and projects. - Cultivate professional ethics, adaptability, critical thinking, and lifelong learning to achieve continuous personal and professional growth.	
Course Outcomes:	
	After completion of the course, student will be able to
1.	Explain the organizational structure, business processes, financial concepts, and product development lifecycle in the corporate ecosystem.
2.	Analyse workplace problems and recommend suitable solutions using concepts of product management, quality, customer success, security, and emerging technologies.
3.	Apply critical thinking, problem-solving techniques, AI awareness, and project management principles to solve industry-oriented case studies.
4.	Demonstrate effective communication, teamwork, leadership, and presentation skills while working in professional and multidisciplinary environments.
5.	Apply project planning, prioritization, and management techniques for successful execution of professional assignments and collaborative projects.
6.	Demonstrate professional ethics, social responsibility, adaptability, and lifelong learning necessary for continuous professional development in a dynamic corporate environment.

SECTION-1	Topics/Contents
Vertical 1: COMPANIES & INDUSTRY	
Topic 1: Understanding Companies	
- Understand how to analyse a company-based domains, customers, offering and strategy - Understand how to use this knowledge to contribute earlier and faster.	
Topic 2: Understanding Company Financials (and AOP Budgeting)	
- Understand components of company P&L and Balance Sheet - Be able to assess financial health of a company - How do companies build AOP. Top down and bottom up - Understand the funding avenues	

Vertical 2: Application Of Knowledge

Topic 1: Product Management

- Understand product roadmap creation
- Understand product growth strategies
- Understand product discovery techniques
- Understand backlog prioritization techniques
- Be able to write requirements in detail

Topic 2: Understanding UX And UI

- Understand what usability, user interaction design and consumer journeys mean
- Compare and contrast UX with user interface. Use several industry examples
- technique of building a good UX

Topic 3: Releasing A Product To The Market

- Understand what it takes to release a product to the market by product and engineering teams
- Understand what it takes for a product to be successful with the customer from external go-to market perspective.

Topic 4: Quality – Understanding Beyond The Theory

- Understand how to look at product quality
- Understand how to approach building a good quality product
- Understanding Testing and Test Automation
- Build a Test Plan
- Career options in Quality

Topic 5: Customer Success Management

- Concept of Customer Success
- What is CSAT , NPS , RATING, REVIEWS and how should one track Customer Value
- Understand what issues mean in the industry
- Understand how to identify and prioritize issues and ways to resolve them.

Topic 6: Security And Privacy

- Understand Security concepts (Threat, Vulnerability, Risk)
- Understand about Threat Modelling
- Understand about Security Engineering Approach
- Be able to prepare security test plan

Topic 7: Artificial Intelligence (AI) – The Evolution

- Introduction to AI. AI is pervasive today. Origins of AI and ML Potential and possibilities
- Machine Learning. How is it different from traditional programs? Extensive practical applications over the last decade or so
- Deep Learning. Computer Vision and Natural Language Processing

Vertical 3: Professional Skills

Topic 1: Curiosity And Inquisitiveness

- What is Curiosity and Understand the importance of asking questions
- Review Industry Examples
- Understand techniques of asking thought provoking questions
- Tips and tricks to ask effective questions

Topic 2: Articulation And Communication

- Understand different types of communications
- Understand barriers to communications
- Understand why articulation is important

- How do you make Impactful Introductions

Topic 3: Problem Breakdown and Resolution Using Mind Maps

- What are mind maps
- Tips on creating Mind Maps
- Real-life case of Problem Breakdown
- Prioritizing a long list. Concept and Technique
- Live workshop on understanding constraints and prioritizing and long to-do list

Topic 4: Effective Project And Program Management

- Understand the key concepts within project management
- Understand key aspects of planning
- Understand the link between planning and execution
- Case study based Proj and Prog Management hands on workshop

Topic 5: Developing Critical Thinking Using Mental Models

- Why Critical Thinking
- What are the barriers to Critical Thinking
- Technique and Steps in Critical Thinking
- Why Mental Models
- Using Mental Models for sharper decisions

Reference Books:

1	Dale Carnegie, How to Win Friends and Influence People
2	Stephen R. Covey, 7 Habits of Highly Effective People
3	Shital Kakkar Mehra, Business Etiquette: A Guide for the Indian Professional
4	Peggy Klaus, The Hard Truth About Soft Skills

CO – PO / PSO Articulation Matrix

Correlation: 1 = Low (Slight), 2 = Medium (Moderate), 3 = High (Substantial), '-' = no correlation.

CO	Program Outcomes (PO)											PSO		
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO 1	PSO 2	PSO 3
CO1	2	2	–	–	1	–	–	–	1	–	1	1	–	–
CO2	2	3	2	1	2	2	1	1	–	–	1	2	3	2
CO3	1	3	2	2	2	1	–	2	1	2	2	2	2	3
CO4	–	1	–	–	–	–	2	3	3	2	1	–	1	1
CO5	–	1	2	1	1	1	3	2	2	3	2	1	2	2
CO6	–	–	–	–	1	2	3	2	2	1	3	2	2	3
Average	1.0	1.7	1.0	0.7	1.2	1.0	1.5	1.7	1.5	1.3	1.7	1.3	1.7	1.8

CO – WK Mapping (Knowledge & Attitude Profiles)

'✓' indicates the knowledge profile drawn upon by the CO.

CO	WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9
CO1	✓	✓	-	-	-	-	-	-	-
CO2	-	✓	-	✓	-	✓	-	-	-
CO3	-	✓	-	✓	-	-	-	✓	-
CO4	-	-	-	-	-	-	-	-	✓
CO5	-	-	-	-	-	-	-	✓	✓
CO6	-	-	-	-	-	-	✓	✓	✓

CO – WP Mapping (Complex Engineering Problems)

CO	WP1	WP2	WP3	WP4	WP5	WP6	WP7
CO1	-	✓	-	-	-	-	✓
CO2	-	✓	-	✓	-	✓	-
CO3	-	-	✓	✓	-	-	-
CO4	-	-	-	-	-	-	-
CO5	-	✓	-	-	-	-	✓
CO6	-	✓	-	-	-	-	-

CO – EA Mapping (Complex Engineering Activities)

CO	EA1	EA2	EA3	EA4	EA5
CO1	✓	-	-	-	-
CO2	-	-	-	-	-
CO3	-	✓	✓	-	-
CO4	✓	✓	-	-	✓
CO5	✓	✓	-	-	-
CO6	-	-	-	✓	✓

CO – SDG Mapping (Sustainable Development Goals)

CO	SDG(s) Addressed	Justification / Linkage
CO1	4, 8, 9	Builds foundational understanding of organizational, financial, and product-lifecycle knowledge that prepares students for productive employment and industry participation.
CO2	8, 9	Analyzing workplace problems via product management, quality, security, and emerging technology supports innovation-driven, industry-relevant solutions.
CO3	4, 9	Develops critical thinking, problem-solving, and AI awareness through case studies — building future-ready skills and innovation capability.
CO4	4, 5, 17	Builds communication, teamwork, and leadership for inclusive, multidisciplinary collaboration and stronger partnerships across diverse teams.
CO5	8, 17	Develops project planning and management skills for successful execution of collaborative professional work.
CO6	4, 8, 16	Cultivates professional ethics, social responsibility, and lifelong learning — reinforcing responsible conduct and good practice in the workplace.

IC2236:: DESIGN THINKING-1

Teaching Scheme	Examination Scheme
Credits : 1	CP: Marks
Lectures : Hrs/week	GD/PPT/HA: Marks
Practical : Hrs/week	MSE (W/O): Marks
Tutorial : 1 Hrs/week	ESE (W/O):100 Marks

Prerequisites:	
●	Problem Based Learning, Project Centric Learning Course Relevance.
Course Objectives:	
●	To provide ecosystem for students and faculty for paper publication and patent filing
Course Outcomes:	[Publication of paper or patent]
	After completion of the course, 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, Understand Entrepreneurship and Business Planning

Section1:	Topics/Contents
	What is research? Importance of Paper Publication and Patents 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
Section2:	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

CO – PO / PSO Articulation Matrix

Correlation: 1 = Low (Slight), 2 = Medium (Moderate), 3 = High (Substantial), '-' = no correlation.

CO	Program Outcome (PO)											PSO		
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO 1	PSO 2	PSO 3
CO1	1	1	1	1	1							1	2	2
CO2	1	1	1	1	1							1	2	2
CO3	2	2	3	3	2	2	1	2	2	3		1	3	3
CO4	3	3	3	3	3	2	1	2	2	3	1	1	3	3
CO5	1	1	1	1	1							1	2	2
CO6	2	2	2	2	2	2	1	3	2	3		1	3	3
Avg	1.7	1.7	1.8	1.8	1.7	2.0	1.0	2.3	2.0	3.0	1.0	1.0	2.5	2.5

CO – WK Mapping (Knowledge & Attitude Profiles) Sample Table

✓' indicates the knowledge profile drawn upon by the CO.

CO	WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9
CO1	✓	✓		✓					✓
CO2		✓	✓	✓	✓				
CO3		✓	✓	✓	✓	✓			
CO4			✓	✓	✓	✓	✓		
CO5				✓	✓	✓	✓	✓	
CO6	✓			✓		✓		✓	✓

CO – WP Mapping (Complex Engineering Problems)

CO	WP1	WP2	WP3	WP4	WP5	WP6	WP7
CO1	✓	✓	✓		✓		✓
CO2	✓	✓	✓	✓	✓		
CO3	✓	✓	✓	✓	✓	✓	
CO4	✓	✓	✓	✓	✓	✓	✓
CO5	✓	✓	✓	✓	✓	✓	✓
CO6			✓		✓	✓	✓

CO – EA Mapping (Complex Engineering Activities)

'✓' indicates the activity attribute addressed by the CO

CO	EA1	EA2	EA3	EA4	EA5
CO1	✓	✓			
CO2	✓	✓	✓		
CO3	✓	✓	✓	✓	
CO4		✓	✓	✓	✓
CO5			✓	✓	✓
CO6				✓	✓

CO – SDG Mapping (Sustainable Development Goals) Sample Table

CO	SDG(s) Addressed	Justification / Linkage
CO1	4, 9	Understanding the importance of research promotes quality education, scientific inquiry, innovation, and technological advancement for solving real-world problems.
CO2	4, 9	Knowledge of research terminology and concepts strengthens analytical thinking, research competency, and innovation capabilities.
CO3	9, 17	Applying research methodology and publishing research fosters innovation, knowledge dissemination, and collaboration among researchers and institutions.
CO4	4, 9, 17	Writing research papers develops scientific communication, promotes lifelong learning, and contributes to global knowledge sharing through collaborative research.
CO5	9,12	Understanding Intellectual Property Rights encourages innovation, protection of inventions, responsible use of knowledge, and sustainable technological development.
CO6	4, 16	Applying research ethics promotes academic integrity, responsible conduct of research, transparency, fairness, and ethical decision-making.

HS2001 : REASONING AND APTITUDE DEVELOPMENT-3

Teaching Scheme	Examination Scheme
Credits : 1	ESE (W/O): 100 Marks
Lectures : 1 Hrs/week	

Prerequisites:	
•	Familiarity with basic English language, elementary mathematics, and logical reasoning concepts studied at the 10+2 level.
Course Objectives:	
•	To develop proficiency in English language skills, including reading, writing, vocabulary, grammar, and comprehension, for effective professional communication.
•	To enhance logical reasoning and critical thinking abilities for analyzing, interpreting, and solving real-world problems.
•	To strengthen quantitative aptitude and mathematical problem-solving skills required for academic, competitive, and engineering applications.
•	To develop analytical and decision-making skills by applying verbal, logical, and numerical reasoning techniques.
•	To prepare students for higher studies, competitive examinations, and industry recruitment by improving overall aptitude and communication competencies.
Course Outcomes:	
	After completion of the course, student will be able to
1.	Improve the reading, writing and verbal skills, and enhance comprehension and articulation abilities
2.	Develop logical reasoning abilities, enabling them to make sound decisions in problem-solving scenarios
3.	Develop mathematical aptitude as well as data interpretation abilities and use them in test cases and real-world problems
4.	Learn to apply approaches for optimum time-management, prioritization maximizing the accuracy
5.	Learn data interpretation, apply mathematical skills to draw accurate conclusions
6.	Apply their knowledge of English, reasoning and quantitative skills for planning, critical thinking and real-world problems

Topics/Contents
Unit 1: English Language Familiarity with English Language, Ability to understand written text, spoken word and effective communication through written documents; Coverage of vocabulary to cope up with general and specific terminology, syntax and sentence structure, prevention of incorrect use leading to distortion in communication; synonyms, antonyms and contextual vocabulary, Grammar – Error identification, sentence improvement and construction, Reading Comprehension.
Unit 2: Logical Ability Objective interpretation of things, ability to perceive and interpret trends to make generalizations; ability to analyze assumptions behind an argument or statement; Deductive reasoning: Assessment of ability to

synthesize information and derive conclusions - Coding deduction logic, Data Sufficiency, Directional Sense, Logical word sequence, Objective reasoning, Selection and decision tables, puzzles; Inductive reasoning: Assessment of ability to learn by example, imitation or by trial – Analogy pattern recognition, Classification pattern recognition, Coding pattern recognition, Number series pattern recognition; Abductive reasoning: Critical thinking ability of seeing through logical weak links or loopholes in an argument or a group of statements; Critical reasoning: assessment of ability to think through and analyze logical arguments, assessment of ability to use logical constructs to offer reasoning in unfamiliar situations; Information Gathering and synthesis: Ability of locating information, information ordering, rule based selection and data interpretation, order and classify data, interpret graphs, charts, tables and make rule based deductions. Application of these approaches for using visual, numerical and textual data from single or multiple sources.

Unit 3: Quantitative Ability

Basic numbers – decimals and fractions, factorization, divisibility: HCF, LCM, Odd, even, prime and rational numbers. Application of algebra to real world, direct and inverse proportion, common applications – Speed-time -distance, Profit-loss, percentage, age relations, mixtures, other miscellaneous quantitative combination, exponentials and logarithms, permutations and combinations, probability. Spatial reasoning: Inductive – Missing portions, Sequence and series; Deductive analysis.

Reference Books:

1	"English Grammar in Use" by Raymond Murphy, Cambridge University Press.
2	"Word Power Made Easy" by Norman Lewis, Goyal Publishers & Distributors.
3	"Objective General English" by S.P. Bakshi, Arihant Publications.
4	"English for Competitive Examinations" by K. Sinha, S. Chand Publishing.
5	"Essential English Grammar" by Philip Gucker, Wiley.
6	"English Idioms and Phrasal Verbs" by M.A. Yadav, Vikas Publishing House.
7	"The Oxford English Grammar" by Sidney Greenbaum, Oxford University Press.
8	"A Modern Approach to Verbal & Non-Verbal Reasoning" by R.S. Aggarwal, S. Chand Publishing, ISBN: 978-8121903409.
9	"Logical Reasoning and Data Interpretation for the CAT" by Nishit K. Sinha, Pearson India, ISBN: 978-8131709117.
10	"Logical Reasoning and Data Interpretation for the CAT" by Arun Sharma, McGraw Hill Education, ISBN: 978-0070709642.
11	"A New Approach to Reasoning Verbal and Non-Verbal" by B.S. Sijwali & Indu Sijwali, Arihant Publications, ISBN: 978-9311124692.
12	"Quantitative Aptitude for Competitive Examinations" by R.S. Aggarwal, S. Chand Publishing, ISBN: 978-8121900637.
13	"How to Prepare for Quantitative Aptitude for the CAT" by Arun Sharma, McGraw Hill Education, ISBN: 978-0070709642.
14	"The Pearson Guide to Quantitative Aptitude for Competitive Examination" by Pearson, Pearson India, ISBN: 978-8131709117.
15	"Quantitative Aptitude for Competitive Examinations" by Abhijit Guha, Tata McGraw Hill Education, ISBN: 978-0070666653.
16	"Data Interpretation & Data Sufficiency" by R.S. Aggarwal, S. Chand Publishing ISBN: 978-8121903515.
17	"Quantitative Aptitude for Competitive Examinations" by S. Chand, ISBN: 978-8121903423.

CO – PO / PSO Articulation Matrix

Correlation: 1 = Low (Slight), 2 = Medium (Moderate), 3 = High (Substantial), '-' = no correlation.

CO	Program Outcome (PO)											PSO		
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	1	1	–	–	–	–	–	–	2	3	–	–	–	–
CO2	2	3	2	2	–	–	–	–	–	–	–	–	2	1
CO3	3	2	2	1	–	–	–	–	–	–	–	1	2	2
CO4	2	3	2	2	–	–	–	–	1	1	–	–	2	1
CO5	2	3	2	2	–	–	–	–	1	1	–	–	3	2
CO6	2	3	2	2	1	–	–	–	2	2	1	1	2	3
Avg	2.0	2.5	1.7	1.5	0.2	–	–	–	1.0	1.2	0.2	0.3	1.5	1.5

CO – WK Mapping (Knowledge & Attitude Profiles)

'✓' indicates the knowledge profile drawn upon by the CO.

CO	WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9
CO1			✓	✓				✓	
CO2		✓		✓	✓	✓			
CO3	✓	✓		✓		✓		✓	
CO4		✓		✓		✓	✓		
CO5				✓		✓	✓	✓	
CO6				✓	✓	✓		✓	✓

CO – WP Mapping (Complex Engineering Problems)

CO	WP1	WP2	WP3	WP4	WP5	WP6	WP7
CO1	✓						
CO2	✓		✓				
CO3	✓		✓				
CO4	✓	✓	✓				
CO5	✓	✓	✓				
CO6	✓		✓				✓

CO – EA Mapping (Complex Engineering Activities)

'✓' indicates the activity attribute addressed by the CO

CO	EA1	EA2	EA3	EA4	EA5
CO1	✓				
CO2	✓		✓		
CO3	✓		✓		
CO4	✓		✓		
CO5	✓		✓		
CO6	✓		✓	✓	✓

CO – SDG Mapping (Sustainable Development Goals)

CO	SDG(s) Addressed	Justification / Linkage
CO1	4	Develops English communication, reading comprehension, and writing skills, enhancing employability and lifelong learning.
CO2	4,8	Strengthens logical reasoning and analytical thinking, preparing students for skilled employment and professional decision-making.
CO3	4, 8	Enhances quantitative and mathematical aptitude required for higher education, competitive examinations, and industry readiness.
CO4	4, 9	Promotes critical thinking, problem analysis, and data interpretation, supporting innovation and technology-driven solutions.
CO5	4,16	Develops critical reasoning, ethical decision-making, and objective judgment, contributing to transparent and accountable professional practices
CO6	4,8,9	Integrates communication, reasoning, and quantitative skills to solve multidisciplinary problems, fostering innovation, employability, and sustainable industrial development.

IC2240:: ENGINEERING DESIGN AND INNOVATION-1

Teaching Scheme	Examination Scheme
Credits : 2	CP: Marks
Lectures : Hrs/week	GD/PPT/HA: Marks
Practical : 2 Hrs/week	MSE (W/O):30 Marks
Tutorial : Hrs/week	ESE (W/O):70 Marks

Prerequisites:	
Problem Based Learning Course Relevance: Project Centric Learning (PCL) is a powerful tool for students to work in areas of their choice and strengths. Along with course based projects, curriculum can be enriched with semester long Engineering Design and Development courses, in which students can solve socially relevant problems using various technologies from relevant disciplines. The various socially relevant domains can be like Health care, Agriculture, Defense, Education, Smart City, Smart Energy and Swaccha Bharat Abhiyan. To gain the necessary skills to tackle such projects, students can select relevant online courses and acquire skills from numerous sources under guidance of faculty and enrich their knowledge in the project domain, thereby achieving project centric learning. Modern world sustained and advanced through the successful completion of projects. In short, if students are prepared for success in life, we need to prepare them for a project-based world. It is a style of active learning and inquiry-based learning. Project centric learning will also redefine the role of teacher as mentor in the learning process. The PCL model focuses the student on a big open-ended question, challenge, or problem to research and respond to and/or solve. It brings students not only to know, understand and remember rather it takes them to analyze, design and apply categories of Bloom's Taxonomy.	
Course Objectives:	
- To develop critical thinking and problem-solving ability by exploring and proposing solutions to realistic/social problems. - To Evaluate alternative approaches, and justify the use of selected tools and methods. - To emphasize learning activities those are long-term, inter-disciplinary and student-centric. - To engage students in rich and authentic learning experiences. - To provide every student the opportunity to get involved either individually or as a group so as to develop team skills and learn professionalism. - To develop an ecosystem to promote entrepreneurship and research culture among the students	
Course Outcomes:	
After completion of the course, student will be able to	
1. Design solutions for given engineering problem	
2. Demonstrate practical knowledge by constructing models/algorithms for real time applications	
3. Express effectively in written and oral communication	
4. Exhibit the skills to work in a team or individually	
5. Prepare a time chart and financial record for execution of the project	
6. Choose and compare alternative approaches to select most feasible one	

Section1:	Topics/Contents
	Preamble - The content and process mentioned below is the guideline document for the faculties and students to start with. It is not to limit the flexibility of faculty and students; rather they are free to explore their creativity beyond the guideline mentioned herewith. For all courses of ED, laboratory course contents of “Engineering Design” are designed as a ladder to extend connectivity of software technologies to solve real word problem using interdisciplinary approach. The ladder in the form of gradual steps can be seen as below: Industry Communication Standards, Single Board Computers and IoT, Computational Biology (Biomedical and Bioinformatics), Robotics and Drone, Industry 4.0 (Artificial Intelligence, Human Computer Interfacing, 5G and IoT, Cloud Computing, Big Data and Cyber Security etc). Group Structure: There should be a team/group of 4-5 students. A supervisor/mentor teacher assigned to individual groups. It is useful to group students of different abilities and nationalities together. Selection of Project/Problem: ● Students must focus on initiating the task/idea. The idea of inception and consideration shall be from following areas as a real world problem: -Health Care, Agriculture, Defense, Education, Smart City, Smart Energy, Swaccha Bharat Abhiyan, Environment, Women Safety. ● This is the sample list to start with. Faculty and students are free to include other ar eas which meet society’s requirements at large. ● The model begins with the identifying of a problem, often growing out of a question or “wondering”. This formulated problem then stands as the starting point for learning. Students design and analyze the problem/project within an articulated disciplinary subject frame/domain. ● A problem can be theoretical, practical, social, technical, symbolic, cultural, and/or scientific and grows out of students’ wondering within different disciplines and professional environments. A chosen problem has to be exemplary. The problem may involve an interdisciplinary approach in both the analysis and solving phases. ● By exemplarity, a problem needs to refer to a particular practical, scientific, social and/or technical domain. The problem should stand as one specific example or manifestation of more general learning outcomes related to knowledge and/or modes of inquiry. Teacher’s Role in PCL: ● Teacher is not the source of solutions rather he will act as the facilitator and mentor. ● To utilize the principles of problem solving, critical thinking and metacognitive skills of the students. ● To make the group aware about time management. ● Commitment to devote the time to solving student’s technical problems and interested in helping students to empower them better. Student's Role in PCL: ● Students must have ability to initiate the task/idea, they should not be mere imitators. ● They must learn to think. ● Students working in PCL must be responsible for their own learning. ● Students must quickly learn how to manage their own learning, instead of passively receiving instruction. ● Students in PCL are actively constructing their knowledge and understanding of the

situation in groups.

- Students in PCL are expected to work in groups.
- They have to develop interpersonal and group process skills, such as effective listening or coping creatively with conflicts.

Developing Inquiry Skills:

- Students in PCL are expected to develop critical thinking abilities by constantly relating: What they read to do? What do they want to do with that information?
- They need to analyze information presented within the context of finding answers.
- Modeling is required so that the students can observe and build a conceptual model of the required processes.
- Use the following mechanism to maintain the track of moving towards the solution.
 - How effective is?
 - How strong is the evidence for? How clear is?

What are the justifications for thinking? Why is the method chosen?

- What is the evidence given to justify the solution?

Literature Survey – To avoid reinvention of wheel:

- It is an integral part of self- directed learning
- Identify the information needed to solve a given problem or issue
- Be able to locate the needed information
- Use the information to solve the given problem effectively.
- Skills required by students in information literacy include:
 - How to prepare for the search? How to carry out research
- Sorting and assessing of information in general

Use of Research Methodology: - investigation, collaboration, comprehension, application, analysis, synthesize and evaluation

Focus on the following skills while working in a team to reach to solution:

- Collaborative learning
- Interpersonal Skills
- Resources Evaluation
- Metacognitive Skills
- Reflection Skills

Section2:	Topics/Contents
	EDI Sample Case Studies: - With the adaptation of industry communication standards, Raspberry Pi and Sensors, the following projects can be taken up: 1) Design a deployable product for soil moisture detection 2) Design a deployable product for temperature detection 3) Design a deployable product for pressure detection 4) Design a deployable product smoke detection 5) Design a deployable product for motion detection 6) Design a deployable product for collision detection 7) Design a deployable product for sound detection ...not limited to.....Faculty and students are free to include other areas which meet society's requirements at large.

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Text Books:	
1	A new model of problem based learning. By Terry Barrett. All Ireland Society for higher education (AISHE). ISBN:978-0-9935254-6-9; 2017
2	Problem Based Learning. By Mahnazmoallem, woei hung and Nada Dabbagh, Wiley Publishers. 2019.
3	Stem Project based learning and integrated science, Technology, Engineering and mathematics approach. By Robert Robart Capraro, Mary Margaret Capraro
4	A new model of problem based learning. By Terry Barrett. All Ireland Society for higher education (AISHE). ISBN:978-0-9935254-6-9; 2017

Reference Books:	
1	De Graaff E, Kolmos A., red.: Management of change: Implementation of problembased and project-based learning in engineering. Rotterdam: Sense Publishers. 2007.
2	Project management core textbook, second edition, Indian Edition , by Gopalan.
3	The Art of Agile Development. By James Shore & Shane Warden

CO – PO / PSO Articulation Matrix

Correlation: 1 = Low (Slight), 2 = Medium (Moderate), 3 = High (Substantial), '-' = no correlation.

CO	Program Outcome (PO)											PSO		
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO 1	PSO 2	PSO 3
CO1	2	2	2	2					3		2	3	3	2
CO2	2	2	3	2	2		2		3		2	3	3	2
CO3	2	2	3	2	3		2		3		2	3	3	2
CO4	2	2	3	2	3	3		2	3		2	3	3	2
CO5	2	2	3	2	3	2			3		2	3	3	2
CO6	2	2	3	3	2				3		3	3	3	2
Avg	2.0	2.0	2.83	2.83	2.6	2.5	2.0	2.0	3.0	1.0	2.16	3.0	3.0	2.0

CO – WK Mapping (Knowledge & Attitude Profiles) Sample Table

'✓' indicates the knowledge profile drawn upon by the CO

CO	WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9
CO1		✓	✓	✓	✓			✓	
CO2		✓	✓	✓	✓	✓		✓	
CO3		✓	✓	✓	✓	✓		✓	
CO4		✓	✓	✓	✓	✓	✓	✓	✓
CO5		✓	✓	✓	✓	✓	✓	✓	
CO6		✓	✓	✓	✓	✓		✓	

CO – WP Mapping (Complex Engineering Problems)

CO	WP1	WP2	WP3	WP4	WP5	WP6	WP7
CO1	✓			✓		✓	✓
CO2	✓	✓				✓	
CO3	✓		✓		✓		
CO4	✓				✓	✓	
CO5	✓	✓	✓				
CO6	✓					✓	✓

CO – EA Mapping (Complex Engineering Activities)

'✓' indicates the activity attribute addressed by the CO

CO	EA1	EA2	EA3	EA4	EA5
CO1	✓	✓			
CO2	✓	✓	✓	✓	
CO3	✓	✓	✓	✓	✓
CO4	✓	✓	✓	✓	✓
CO5	✓	✓	✓	✓	✓
CO6	✓	✓	✓		✓

CO – SDG Mapping (Sustainable Development Goals)

CO	SDG(s) Addressed	Justification / Linkage
CO1	4,9	Identifies real-life societal problem and develops engineering knowledge for innovative solutions
CO2	4,9,12	Evaluates and compares alternative solutions to select sustainable and resource efficient approaches
CO3	4,9,11	Analyze engineering problems and synthesizes technological solutions for societal needs
CO4	4,9,11,13	Designs reliable, scalable and sustainable engineering solutions addressing environmental and societal challenges
CO5	4,9,16	Evaluates engineering solutions based on defined technical, ethical and quality criteria to ensure reliability and accountability
CO6	4,17	Promotes lifelong learning, professional development, collaboration and commitment to solving societal problems

SEMESTER II

IC2308:: INDUSTRIAL AUTOMATION

Teaching Scheme	Examination Scheme
Credits : 3	LAB: 40 Marks
Lectures : 3 Hrs/week	ESE (W/O): 40 Marks
Practical : 2 Hrs/week	CVV: 20 Marks

Prerequisites:	
	Fundamentals of Sensors and Transducers, digital electronics
Course Objectives:	
	To understand the working of electrical, hydraulic, pneumatic, mechanical, PLC, drives, HMI and control panel components.
	Develop electrical wiring diagrams, hydraulic, pneumatic circuits, PLC, SCADA, HMI programs for given application.
Course Outcomes:	
	After completion of the course, student will be able to
1.	Comprehend the working of electrical, hydraulic, pneumatic, mechanical, PLC, drives, HMI and control panel components.
2.	Develop electrical wiring diagrams, hydraulic, pneumatic circuits for given application.
3.	Select and size the electrical, mechanical, hydraulic and pneumatic components to solve a problem.
4.	Identify, formulate and solve a problem using electrical, mechanical, hydraulic and pneumatic system.
5.	Develop PLC, SCADA, and HMI programs for given application.
6.	Demonstrate practical knowledge, communication and team skills, by constructing models for real life applications

Section-1:	Topics/Contents
Unit 1: Industrial Control Devices	(7 Hrs)
	Switches: construction, working, application of toggle, slide, DIP, rotary, thumbwheel, selector, push button, micro, limit, emergency, process switches, symbols, specifications.
	Relays: construction, working, terminologies and applications of Electro-mechanical relay, hermetically sealed relay, reed relay, solid-state relays and timing relay, specifications.
	Contactors: construction, working, specifications and applications of contactors.
	Motor control circuits: Development of electrical wiring diagram for starting, stopping, reversing, sequencing and interlocking for motors. Protection of motors: short circuit, overload protection, low / under voltage, phase reversal, over temperature protection.
Unit 2: Hydraulic Components	(7 Hrs)
	Hydraulics: principle, block diagram, advantages, disadvantages, applications, hydraulic fluid desirable properties, Types of hydraulic oil and its selection.
	Hydraulic components: hydraulic power pack, hydraulic pumps, actuators, filters, piping, heat exchangers valves and motors.
	Hydraulic circuits: development of hydraulic circuits using standard symbols, hydraulic circuits like meter in, meter out, reciprocating, speed control, sequencing of cylinders,

direction control, deceleration, regenerative circuit, etc. troubleshooting in hydraulic circuits. Introduction to circuit design.

Unit 3: Pneumatic Components

(7 Hrs)

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

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

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

Mechanical components : Springs and Gears

Section-2:	Topics/Contents
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Unit 4: Programmable Logic Controllers

(7 Hrs)

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

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

Unit 5: Motor, Drives and HMI

(7 Hrs)

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

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

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

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

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

PLC Interface to Hydraulic/Pneumatic circuits.

Unit 6: SCADA and Control panels:

(7Hrs)

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

Control panels

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

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

Text Books:	
1	F. D. Petruzella “Industrial Electronics”, Glancor Publications.
2	Industrial Hydraulics and Pneumatics, Andrew Parr
3	Majumdar, “Pneumatic Systems: Principles and Maintenance”, TMH Publications.
4	John Webb, “Programmable Logic Controllers”, Prentice Hall of India.
5	B. L. Theraja, “Electrical Technology”, S. Chand and Company.
6	Richard Cox, “Programmable Controllers”, International Thomson Computer Press.
Reference Books:	
1	C.T. Kilian, “Modern Control Technology: Components & Systems”, Thomson Learning Publications.
2	“Industrial Hydraulic Technology Parker Motion & Control, Training Department.
3	Festo Controls, “Fundamentals of Pneumatic Control Engineering”, Bangalore.
4	Frank D Petruzella “Programmable logic controller “, McGraw-Hill Education.
5	SCADA by Stuart A Boyer : ISA 1999

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

1. Implementation of logic circuits using switches.
2. Implementation of relay logic electrical wiring for given application.
3. Implementation of latching, sequencing and interlocking electrical wiring for given application using contactor.
4. Implementation and testing of hydraulic circuit.
5. Implementation and testing of pneumatic circuit.
6. Testing of hydraulic logic circuit using H-simulator.
7. Testing of pneumatic logic circuit using P-simulator.
8. Develop and Simulate Ladder program for simple on-off, timer and counter applications.
9. Develop and Simulate Instruction list, Structure Text programming for given process.
10. Develop and Simulate SFC and FBD for given process.
11. Develop and Simulate applications in PLC using advanced instructions.
12. Interfacing PLC to hydraulic/Pneumatic circuits.
13. Interfacing PLC to HMI, VFD/Inverter, Motion Control/Servo systems to PLC
14. Creating and Configuring a Project and tags in SCADA
15. Develop and simulate the level control loop using SCADA
16. Study of Synchro Transmitter Receiver.
17. Implementation of various operational modes of stepper motor.
18. Study the characteristics of Servo motor.
19. Implementation of motor protection circuits.
20. Demonstration of MCC / control panel components.

CO – PO / PSO Articulation Matrix

Correlation: 1 = Low (Slight), 2 = Medium (Moderate), 3 = High (Substantial), '-' = no correlation.

CO	Program Outcome (PO)											PSO		
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO 1	PSO 2	PSO 3
CO1	3	2	2	1	1	1	1	1	1	1	1	1	1	1
CO2	2	2	3	2	1	1	1	1	1	1	1	2	2	2
CO3	3	3	3	1	1	1	1	1	1	1	1	3	2	3
CO4	2	2	3	2	1	1	1	1	1	1	1	2	2	2
CO5	3	2	3	2	1	1	1	1	2	2	1	3	2	3
CO6	3	2	3	2	1	1	1	1	2	2	1	3	2	3
Avg	2.67	2.17	2.83	1.67	1.00	1.00	1.00	1.00	1.33	1.33	1.00	2.33	1.83	2.33

CO – WK Mapping (Knowledge & Attitude Profiles)

'✓' indicates the knowledge profile drawn upon by the CO.

CO	WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9
CO1			✓	✓		✓			
CO2			✓	✓	✓	✓			
CO3		✓	✓	✓	✓	✓			
CO4		✓	✓	✓	✓	✓			
CO5		✓	✓	✓	✓	✓			
CO6			✓	✓	✓	✓	✓		✓

CO – WP Mapping (Complex Engineering Problems)

CO	WP1	WP2	WP3	WP4	WP5	WP6	WP7
CO1	✓						✓
CO2	✓	✓	✓		✓		✓
CO3	✓	✓	✓	✓	✓		✓
CO4	✓	✓	✓	✓	✓	✓	✓
CO5	✓	✓	✓	✓	✓		✓
CO6	✓	✓	✓	✓	✓	✓	✓

CO – EA Mapping (Complex Engineering Activities)

'✓' indicates the activity attribute addressed by the CO

CO	EA1	EA2	EA3	EA4	EA5
CO1	✓	✓			
CO2	✓	✓	✓		✓
CO3	✓	✓	✓	✓	✓
CO4	✓	✓	✓	✓	✓
CO5	✓	✓	✓	✓	✓
CO6	✓	✓	✓	✓	✓

CO – SDG Mapping (Sustainable Development Goals)

CO	SDG(s) Addressed	Justification / Linkage
CO1	(7, 8, 9)	Industrial automation technologies improve industrial productivity, reliability and energy-efficient operation.
CO2	(7, 8, 9, 12)	Efficient electrical, hydraulic and pneumatic circuit design supports resource-efficient and sustainable industrial systems.
CO3	(7, 8, 9, 12, 13)	Appropriate component selection/sizing can reduce energy consumption, material use and lifecycle impact.
CO4	(7, 8, 9, 12, 13)	Integrated problem solving enables efficient, sustainable and resilient industrial automation solutions.
CO5	(7, 8, 9, 12, 13)	PLC/SCADA/HMI systems enable monitoring, process optimization, automation and improved resource utilization.
CO6	(7, 8, 9, 12, 13)	Real-life automation models develop practical skills for smart, efficient and sustainable industrial systems.

IC2306 :: SIGNAL AND IMAGE PROCESSING

Teaching Scheme	Examination Scheme
Credits : 3	LAB: 10 Marks
Lectures : 2 Hrs/week	ESE (W/O): 40 Marks
Practical : 2 Hrs/week	CVV: 20 Marks
	CP : 30 Marks

Prerequisites:	
	Mathematics, Mathematical Transforms, Linear Algebra
Course Objectives:	
	Upon completion of this course, students will be familiar with basic signal and image processing techniques for solving real problems.
	This course will provide understanding to design, implement, and analysis digital system utilizing the signal and image processing techniques.
Course Outcomes:	
	After completion of the course, student will be able to
1.	Digitize the continuous time signal, perform various operations on the signal and analyze the properties of the given digital systems.
2.	Recognize signal spectrum using DFT, compute and plot the spectrum using FFT, analyze the signal in the frequency domain. Reconstruct time domain signal using IDFT. Compute and plot time domain signal using IFFT Algorithm.
3.	Design FIR/IIR filters on paper to meet specific magnitude and phase requirements. Use MATLAB / Python / Scilab / Octave to design the filters and analyze its response. Analyze the effect of quantization on the response of the digital filters.
4.	Perform operations on pixel, perform geometric transformation on image.
5.	Analyze images in the frequency domain using various transforms.
6.	Evaluate the techniques for image enhancement and image restoration. Interpret image segmentation and representation techniques.

Section-1:	Topics/Contents
	Unit 1: Signals and Systems (5 Hrs) Signals – Continuous time and discrete time, time shift and time scale operations on signals, sampling, discrete time systems – memory-less systems, linear time invariant systems, causality, stability properties of linear time-invariant systems. Convolution of discrete time sequences, properties of convolution. Unit 2: Discrete Fourier Transform and Fast Fourier Transform (5 Hrs) DFT and IDFT: Fourier transform, Discrete Fourier Transform (DFT): DFT and IDFT, Properties of DFT, Circular convolution, linear convolution using DFT and IDFT. FFT and IFFT. Fast Fourier Transform (FFT and IFFT) – Radix 2 – DIT algorithm. Unit 3: Filter Design (5 Hrs) FIR Filter Design. FIR filter design using windowing techniques. Low pass, High pass, Band Pass, Band stop filter design by windowing method. Analog filter design and IIR filter design. Analog filter design: Butterworth filters, Low pass Butterworth filter design. Digital IIR filter design: Bilinear transformation.

Section-2:	Topics/Contents
Unit 4: Digital Image Fundamentals (5 Hrs) Introduction to Digital Image, Digital Image Processing System, Sampling and Quantization, Pixel Operations, Distance measurement. Geometric Transformation on image. Image Transformation – 2-D DFT, 2-D IFFT.	
Unit 5: Image Enhancement and Restoration (4 Hrs) Histogram Processing, Histogram equalization. Spatial Filtering, Smoothing and Sharpening Filters, Median Filter.	
Unit 6: Image Segmentation (4Hrs) Segmentation based on Discontinuities (point, Line, Edge). Image Edge detection using Robert, Sobel, Prewitt masks, Canny's Edge Detector.	
Text Books:	
1	J. G. Proakis & D. G. Manolakis, "Digital Signal Processing – Principles, Algorithms and Applications", Prentice Hall of India.
2	E. C. Ifeachor & B. W. Jarvis, "Digital Signal Processing – A Practical Approach", Pearson Education.
3	Gonzalez Rafael C and Woods Richard E, Digital Image Processing, 3rd Edition, Prentice Hall, 2008.
4	Jain Anil K, Fundamentals of Digital Image Processing, Prentice Hall, 1989.

List of Practicals:

Lab 1: (i) Plot of continuous time and discrete time sinusoidal signal – understanding the concept of Sampling Theorem. (ii) Time Shift and Time scale operations on Discrete signal. (iii) Linear Convolution.
Lab 2: To perform Fast Fourier transforms using radix 2 DIT algorithms. Also IFFT.
Lab 3: (i) FIR filter design by using windowing technique. (ii) IIR Filter Design by using Bilinear Transformations method.
Lab 4: (i) Formation of image from a 8×8 matrix, plotting negative image 8×8 matrix. (ii) Geometric operations on an image: scale, rotate, reflect, translate.
Lab 5: 2D FFT of an image.
Lab 6: Convolution of kernel and images – Smoothing filter and sharpening filter.

CO – PO / PSO Articulation Matrix

Correlation: 1 = Low (Slight), 2 = Medium (Moderate), 3 = High (Substantial), '-' = no correlation.

CO	Program Outcome (PO)											PSO		
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	2	1	1	1	1	1	1	1	1	1	1	3
CO2	2	2	3	2	1	1	1	1	1	1	1	2	2	2
CO3	3	3	3	1	1	1	1	1	1	1	1	3	2	3
CO4	2	2	3	2	1	1	1	1	1	1	1	2	2	2
CO5	3	2	3	2	1	1	1	1	2	2	1	3	2	3
CO6	3	2	3	2	1	1	1	1	2	2	1	3	2	3
Avg	2.67	2.17	2.83	1.67	1.0	1.0	1.0	1.0	1.33	1.33	1.0	2.33	1.83	2.67

CO – WK Mapping (Knowledge & Attitude Profiles)

'✓' indicates the knowledge profile drawn upon by the CO.

CO	WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9
CO1	✓	✓	✓						✓
CO2	✓	✓	✓	✓					✓
CO3	✓	✓	✓	✓	✓				✓
CO4		✓	✓	✓	✓				
CO5	✓	✓	✓	✓	✓				✓
CO6		✓	✓	✓	✓	✓			

CO – WP Mapping (Complex Engineering Problems)

CO	WP1	WP2	WP3	WP4	WP5	WP6	WP7
CO1	✓	✓	✓				✓
CO2	✓	✓	✓	✓			✓
CO3	✓	✓	✓	✓	✓		✓
CO4	✓	✓	✓	✓			✓
CO5	✓	✓	✓	✓			✓
CO6	✓	✓	✓	✓	✓	✓	✓

CO – EA Mapping (Complex Engineering Activities)

'✓' indicates the activity attribute addressed by the CO

CO	EA1	EA2	EA3	EA4	EA5
CO1	✓	✓			
CO2	✓	✓	✓		
CO3	✓	✓	✓	✓	✓
CO4	✓	✓	✓		✓
CO5	✓	✓	✓	✓	✓
CO6	✓	✓	✓	✓	✓

CO – SDG Mapping (Sustainable Development Goals)

CO	SDG(s) Addressed	Justification / Linkage
CO1	(3, 9)	Fundamental signal-processing skills support technological learning and development of digital engineering systems.
CO2	(3, 12, 13)	Efficient spectral analysis and FFT-based computation support digital signal analysis and computationally efficient engineering solutions.
CO3	(4, 8, 9, 12, 13)	Efficient digital filter design supports practical signal-processing systems while computationally efficient implementation can reduce processing and resource requirements.
CO4	(4, 9)	Image representation and geometric transformation techniques support computer vision, digital imaging and technological innovation.
CO5	(3, 4, 9)	Frequency-domain image processing has applications in biomedical imaging and intelligent digital systems.
CO6	(3, 4, 8, 9, 12, 13)	Image enhancement, restoration and segmentation support biomedical imaging, computer vision, automation and efficient digital information processing.

IC2302 :: DATA STRUCTURES

Teaching Scheme	Examination Scheme
Credits : 3	LAB: 10 Marks
Lectures : 2 Hrs/week	ESE (W/O): 40 Marks
Practical : 2 Hrs/week	CVV: 20 Marks
	CP : 30 Marks

Prerequisites:	
•	Basic programming Skills (C / C++)
Course Objectives:	
•	To introduce the basic concepts of data structures and algorithms.
•	To learn and understand linear and non-linear data structure constructs.
•	To implement searching and sorting techniques using linear data structures.
•	To understand how to solve problems using a step by step approach with the help of fundamental data structures.
•	To associate data structures in developing and implementing efficient algorithms.
Course Outcomes:	
	After completion of the course, student will be able to-
1.	Make use of single and multi-dimensional array for searching and sorting based applications. Analyze the algorithms to compute the time and space complexity.
2.	Construct computer science applications with the help of dynamic storage representation.
3.	Build computer science applications using stacks and queues.
4.	Demonstrate the use of tree data structure to represent and manipulate hierarchically organized data in various applications.
5.	Utilize graph data structure to design social media, network based and circuit applications.
6.	Design and develop the single and multithreads applications by applying hash table and hash map techniques.

Section1	Topics/Contents
Unit-1 : Introduction to DS Sorting and Searching Techniques	[8 Hrs]
Types of DS, Asymptotic Notations, Time and Space Complexity Introduction, Memory Representation and application of Single and Multidimensional arrays, Sparse Matrix. Searching and sorting techniques: Linear Search, Binary search with Analysis. Sorting Techniques: Bubble Sort, Insertion Sort, Merge Sort, Quick Sort with Analysis and passes.	
Unit-2: Stack and Queue DS	[4 Hrs]
Stack: representation using array, Applications of stack: Recursion, Validity of parentheses, Expression conversions and evaluations etc.	
Queue: representation using array, Types of queue, Applications of Queue: Job Scheduling, Josephus problem etc	
Unit-3: Linked Lists and Its Applications	[3 Hrs]
Singly Linked Lists, Doubly linked Lists, Circular linked lists, Applications of Linked lists, Stack & Queue using linked list, Polynomial Manipulation using linked list	
Section2:	Topics/Contents
Unit-4: Trees and Its Applications	[8 Hrs]
Basic terminology, representation using array and linked list, Tree Traversals: Recursive And Non recursive, counting no of Nodes etc., Construction of binary tree from traversals, Binary Search trees(BST): Insertion, deletion of a node from BST. Threaded Binary tree (TBT): Creation and traversals on TBT, Expression Trees, Gaming Trees	
Advanced Trees: Introduction, AVL tree, R-B tree, B tree and B+ tree.	
Unit-5: Graphs	[4 Hrs]
Terminology and representation using Adjacency Matrix and Adjacency Lists, Graph Traversals and Application: BFS and DFS, Connected graph, Detecting Cycle in graph. Minimum Spanning tree: Prims and Kruskal's Algorithm, Shortest Path Algorithms, Union Find.	
Unit-6: Hashing	[3 Hrs]
Hashing techniques, Hash table, Hash functions. Collision handling and Collision resolution techniques. Warshall's Algorithm for Finding Transitive Closure.	

Text Books:	
1	Fundamentals of Data Structures in C", E. Horwitz , S. Sahani, Anderson-Freed, Second Edition, Universities Press.
2	Data structures using C and C++", Y. Langsam, M.J. Augenstein, A.M.Tenenbaum, Pearson Education, Second Edition
Reference Books:	
1	An Introduction to data Structures with applications", J. Tremblay, P. Soresan, TMH Publication, 2nd Edition

List of Practicals:

1. Assignment based on Sorting and Searching.
2. Assignment based on Stack Application (Expression conversion etc.)
3. Assignment based on Queue Application (Job scheduling, resources allocation etc.)
4. Assignment based on linked list.
5. Assignment based on BST operations (Create, Insert, Delete and Traversals)
6. Assignment based on various operations on Binary Tree
7. Assignment based on AVL and R-B tree.

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8. Assignment based on DFS and BFS
9. Assignment based on MST using Prim's and Kruskals Algorithm.
10. Assignment based on Finding the shortest path in given Graph.
11. Assignment based on Hashing

List of Projects:

1. Implementation of DFS Search algorithms for given application/s
2. Lamentation of BFS Search algorithms for given application/s
3. Implementation of Dijkshetra's shortest path finding algorithm for given application
4. Implementation of A* shortest path algorithm for given application
5. Development of a database for the students of a class using concepts of Structures
6. Development of Ticket booking system using concepts of Queue and Stack
7. Implementation of Topological sort for given application
8. Billing management system
9. Student database creation using Linked list
10. Expression tree
11. Sudoku solver
12. Dictionary using Tree
13. Maze runner problem solver
14. Calendar application using structures
15. Solving the Tower of Hanoi puzzle
16. Calendar Application using File handling.
17. Word Completion Using Tire.
18. Bloom Filters.
19. Scheduling Applications and Simulation.
20. Different Gaming Application

CO – PO / PSO Articulation Matrix

Correlation: 1 = Low (Slight), 2 = Medium (Moderate), 3 = High (Substantial), '-' = no correlation.

CO	Program Outcome (PO)											PSO		
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO 1	PSO 2	PSO 3
CO1	2	2	3	-		1	1	-	-	-	2	3	1	3
CO2	2	3	2	-		1	1	-	-	-	2	3	1	3
CO3	3	3	3	-		2	2	-	-	-	2	3	2	3
CO4	3	3	3	3		2	2	-	-	-	2	3	2	3
CO5	3	3	2	-				-	-	-	2	3	1	3
CO6	2	3	3	-				-	-	-	2	3	1	3
Avg	2.5	3.0	2.66	3.0		2.0	2.0	-	-	-	2.0	3.0	2.0	3.0

CO – WK Mapping (Knowledge & Attitude Profiles)

CO	WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9
CO1	✓	✓	✓		✓	✓	✓	✓	✓
CO2		✓	✓		✓	✓	✓	✓	✓
CO3		✓	✓		✓	✓	✓	✓	✓
CO4		✓	✓		✓	✓	✓	✓	✓
CO5		✓	✓		✓	✓	✓	✓	✓
CO6		✓	✓		✓	✓	✓	✓	✓

CO – WP Mapping (Complex Engineering Problems)

CO	WP1	WP2	WP3	WP4	WP5	WP6	WP7
CO1	✓	✓	✓		✓		✓
CO2	✓	✓	✓		✓		✓
CO3	✓	✓	✓		✓		✓
CO4	✓	✓	✓		✓		✓
CO5	✓	✓	✓		✓		✓
CO6	✓	✓	✓	✓	✓	✓	✓

CO – EA Mapping (Complex Engineering Activities)

✓' indicates the activity attribute addressed by the CO

CO	EA1	EA2	EA3	EA4	EA5
CO1	✓	✓	✓		✓
CO2	✓	✓	✓		✓
CO3	✓	✓	✓		✓
CO4	✓	✓	✓		✓
CO5	✓	✓	✓		✓
CO6	✓	✓	✓		✓

CO – SDG Mapping (Sustainable Development Goals)

CO	SDG(s) Addressed	Justification / Linkage
CO1	4, 9	Builds the analytical foundation (SDG 4) that drives data-led innovation (SDG 9).
CO2	9	Supervised models power industrial and predictive applications (SDG 9).
CO3	3, 9	Statistical learning supports health diagnostics (SDG 3) and broader innovation (SDG 9).
CO4	8, 9	Classifiers enable fraud detection and economic applications (SDG 8, 9).
CO5	9	Decision-tree and ensemble models support data-driven industry solutions (SDG9)
CO6	9, 11	Clustering / RL enable smart-city and resource applications (SDG 9, 11).

IC2304:: INTERNET OF THINGS

Teaching Scheme	Examination Scheme
Credits : 3	LAB: 10 Marks
Lectures : 2 Hrs/week	MSE (W/O): 40 Marks
Practical : 2 Hrs/week	CVV: 20 Marks
	CP : 30 Marks

Prerequisites:	
●	Internet, Cloud, Networking Concepts and Sensors.
Course Objectives:	
●	Understand IoT Architecture and framework.
●	Recognize and differentiate between the various use cases of different sensors, actuators, solenoid valve etc.
●	Learn about fundamental concepts of networking and protocols.
●	Understand IoT Physical, Datalink and Higher layer Protocols.
●	Apply theoretical knowledge for Cloud computing.
Course Outcomes:	
	After completion of the course, student will be able to-
1.	Demonstrate fundamental concepts of Internet of Things
2.	Recognize IoT Design Methodology Steps
3.	Select sensors for different IoT applications
4.	Analyze fundamentals of networking
5.	Apply basic Protocols in IoT
6.	Provide IoT solutions practically with the help of case study

Section1	Topics/Contents
Unit-1 : Introduction to DS Sorting and Searching Techniques	
Introduction to IoT	
Physical Design of IOT, Logical Design of IOT, IOT Enabling Technologies, IOT Levels & Deployment Templates (4 Hrs)	
Unit-2 : IOT Platform Design Methodology	
IoT Design Methodology Steps, Home Automation Case Study, Smart Cities, Health Care, Agriculture (4 Hrs)	
Unit-3 : IoT Devices	
IoT System Design Cycle, Sensors - Terminologies, Calibration, Types, Specification, Use, Actuators - Types and Use, Prototype Development Platform - Arduino / Raspberry pi / Node MCU, Interface with Embedded System. (6 Hrs)	
Section2:	Topics/Contents
Unit-4 : Introduction to Wireless Sensor Network	
Sensor Node, Smart Sensor Network, Wireless Sensor Network, RFID - Principles and Components, Node MCU (4 Hrs)	
Unit-5 : Connectivity Technologies	
Network Configuration in IoT, IoT Stack and Web Stack, IEEE 802.15.4 Standard, Zigbee, Bluetooth, MQTT, Cloud Architecture and Types, Cloud Service Providers (8 Hrs)	
Unit-6 : Case Studies (Any Two from following List to be covered)	
Smart lighting, Home Intrusion Detection, Smart Parking, Weather Monitoring System, Weather Report Bot, Air Pollution Monitoring, Forest fire Detection, Smart Irrigation, IoT Printer, IoT in Manufacturing Industry, IoT in Process Industry, IoT in Quality, Control Applications in Industry, IoT in Material Handling System in Industry, IoT in Automobile Industry, Navigation System, Connected Vehicles, Industry 4.0 (4 Hrs)	

Text Books:

1	Arshdeep Bahga and Vijay Madisetti, "Internet of Things: A Hands-on Approach", Universities Press.
2	Pethuru Raj and Anupama C. Raman, "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", CRC Press.

Reference Books:

1	Adrian McEwen, Hakim Cassimally, "Designing the Internet of Things", Wiley.
2	Ovidiu Vermesan & Peter Friess, "Internet of Things Applications-From Research and Innovation to Market Deployment", River Publishers.
3	Joe Biron and Jonathan Follett, "Foundational Elements of an IoT Solution".

List of Practicals:

1. Setting up Arduino / Raspberry Pi/ Node MCU ESP8266 : Basic handling, programming
2. LED Interfacing
3. Sensor interface to Node MCU/Arduino / Raspberry Pi Temperature measurement using LM35
4. Actuator interface to Node MCU /Arduino / Raspberry Pi Traffic Signal Control
5. Node MCU /Arduino / Raspberry Pi wireless communication Raspberry Pi as a web server
6. Node MCU/Arduino / Raspberry Pi Cloud interfacing and programming like Thingspeak Email alert using SMTP protocol
7. Sensor data acquisition on Mobile (Mobile APP) / Developing Application (WEB APP) with Django Text transfer using MQTT protocol

8. Home Automation using Cisco Packet Tracer

List of Projects:

1. Smart Agriculture System
2. Weather Reporting System
3. Home Automation System
4. Face Recognition Bot
5. Smart Garage Door
6. Smart Alarm Clock
7. Air Pollution Monitoring System
8. Smart Parking System
9. Smart Traffic Management System
10. Smart Cradle System
11. Smart Gas Leakage Detector Bot
12. Streetlight Monitoring System
13. Smart Anti-Theft System
14. Liquid Level Monitoring System
15. Night Patrol Robot
16. Health Monitoring System
17. Smart Irrigation System
18. Flood Detection System
19. Mining Worker Safety Helmet
20. Smart Energy Grid

CO – PO / PSO Articulation Matrix

Correlation: 1 = Low (Slight), 2 = Medium (Moderate), 3 = High (Substantial), '-' = no correlation.

CO	Program Outcome (PO)											PSO		
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO 1	PSO 2	PSO 3
CO1	2	2	3	-		1	1	-	-	-	2	3	1	3
CO2	2	3	2	-		1	1	-	-	-	2	3	1	3
CO3	3	3	3	-		2	2	-	-	-	2	3	2	3
CO4	3	3	3	3		2	2	-	-	-	2	3	2	3
CO5	3	3	2	-				-	-	-	2	3	1	3
CO6	2	3	3	-				-	-	-	2	3	1	3
Avg	2.5	3.0	2.66	3.0		2.0	2.0	-	-	-	2.0	3.0	2.0	3.0

CO – WK Mapping (Knowledge & Attitude Profiles)

CO	WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9
CO1	✓	✓	✓	✓					
CO2	✓	✓	✓	✓	✓				
CO3	✓	✓	✓	✓	✓				
CO4	✓	✓	✓	✓	✓				
CO5	✓	✓	✓	✓	✓				
CO6	✓	✓	✓	✓	✓	✓			

CO – WP Mapping (Complex Engineering Problems)

CO	WP1	WP2	WP3	WP4	WP5	WP6	WP7
CO1	✓	✓	✓				✓
CO2	✓	✓	✓	✓			✓
CO3	✓	✓	✓	✓	✓		✓
CO4	✓	✓	✓	✓	✓		✓
CO5	✓	✓	✓	✓	✓		✓
CO6	✓	✓	✓	✓	✓	✓	✓

CO – EA Mapping (Complex Engineering Activities)

'✓' indicates the activity attribute addressed by the CO

CO	EA1	EA2	EA3	EA4	EA5
CO1	✓	✓			
CO2	✓	✓	✓		
CO3	✓	✓	✓	✓	✓
CO4	✓	✓	✓	✓	
CO5	✓	✓	✓	✓	✓
CO6	✓	✓	✓	✓	✓

CO – SDG Mapping (Sustainable Development Goals)

CO	SDG(s) Addressed	Justification / Linkage
CO1	(4, 9)	IoT fundamentals and enabling technologies develop technological knowledge and support innovation in connected digital infrastructure.
CO2	(9, 11)	IoT design methodology and smart-city case studies support development of connected and resilient systems.
CO3	(2, 3, 12)	Sensor selection supports smart agriculture, health monitoring and efficient monitoring of resources and processes.
CO4	(9, 11)	Networking fundamentals enable reliable connected systems and communication infrastructure for smart environments.
CO5	(9, 12)	IoT protocols and cloud connectivity enable efficient data exchange, monitoring, automation and resource-aware operation.
CO6	(3, 7, 9, 11, 12, 13)	Practical IoT solutions such as health monitoring, smart energy, smart agriculture, pollution monitoring, smart parking and flood detection can contribute to sustainable and resilient systems.

MM1405: HEALTHCARE ANALYTICS

Teaching Scheme	Examination Scheme
Credits : 3	CP: 30 Marks
Lectures : 2 Hrs/week	LAB: 10 Marks
Practical : 2 Hrs/week	MSE (W/O): 40 Marks
	CVV: 20 Marks

Course Objectives:	
•	To understand the fundamentals of human physiology, biopotential generation, electrode systems, and bio-signal characteristics.
•	To understand and analyze bio-signal conditioning techniques, including bio-amplifiers, filters, isolation amplifiers, and power-line interference reduction.
•	To study and understand biomedical instruments used for cardiovascular measurements, including ECG, Holter monitoring, phonocardiography, and vector cardiography.
•	To understand the principles and instrumentation used for measurement of blood pressure, blood flow, cardiac output, and other cardiovascular parameters.
•	To understand and apply biomedical sensors and instruments used in life-saving, neurological, muscular, and respiratory applications, including pacemakers, defibrillators, EEG, EMG, spirometers, and pulse oximeters.
Course Outcomes: After completion of the course, student will be able to	
1.	Explain the fundamentals of biopotential generation, electrode systems, and bio-signal characteristics.
2.	Explain and analyze bio-signal conditioning techniques using bio-amplifiers, filters, isolation amplifiers, and interference reduction techniques.
3.	Demonstrate the working principles of biomedical sensors and instruments used for cardiovascular measurements, including ECG and related systems.
4.	Explain the principles and instrumentation used for measurement of cardiac output, blood pressure, and blood flow.
5.	Explain the working principles and applications of life-saving biomedical devices such as pacemakers, defibrillators, and heart-lung machines.
6.	Apply the principles of biomedical sensors and instruments for measurement and monitoring of nervous, muscular, and respiratory system parameters.
Section 1:	Topics/Contents
Unit 1: Human Physiology and Electrode System (7 Hrs): Origin of bio potential and its propagation; electrode-electrolyte interface; electrode-skin interface; half-cell potential; impedance; polarization effects; polarized and nonpolarizable electrodes; surface, needle and micro electrodes and equivalent circuits; recording problems; two-electrode measurement; bio-signal frequency and amplitude ranges. Unit 2: Bio Signal Conditioning Techniques (7 Hrs): Need for bio-amplifier; single-ended and differential bio-amplifiers; right-leg-driven ECG amplifier; low-pass, high-pass and band-pass filtering; isolation amplifiers; transformer and optical isolation; isolated DC amplifier; AC carrier amplifier; chopper amplifier; power-line interference. Unit 3: Cardiovascular System and Related Instrument (7 Hrs): Cardiovascular theory; ECG electrodes; Einthoven's triangle; standard 12-lead system; ECG recorder; Holter monitor and recording; phonocardiography; vector cardiograph.	

Section 2:	Topics/Contents
	Unit 4: Cardiovascular Allied Measurements (6 Hrs): Measurement of cardiac output; blood pressure measurement; blood flow measurements. Unit 5: Life Saving Devices (6 Hrs): Pacemaker; defibrillator; heart-lung machine; patient safety. Unit 6: Neuro, Muscle and Respiratory Instrument (7 Hrs): Brain system; EEG electrode system and signal acquisition using electroencephalography (EEG); EMG system; respiration system and respiration-rate measurement techniques; spirometers; pulse oximeter.
Text Books:	
1.	Carr & Brown; Biomedical Instrumentation & Measurement; Pearson Publications.
2.	Leslie Cromwell, Fred J. Weibell, Erich A. Pfeiffer; Biomedical Instrumentation and Measurement; Prentice-Hall India.
3.	R. S. Khandpur; Handbook of Biomedical Instrumentation; Tata McGraw Hill.
Reference Books:	
4.	John G. Webster; Medical Instrumentation: Application and Design; Wiley Publications.
5.	Sanjay Guha; Medical Electronics and Instrumentation; University Publications.
6.	S. C. Richard Cobbald; Transducers for Biomedical Measurements; Krieger.

List of Tutorials:

1. Design of ECG amplifier
2. Design of 50Hz filter
3. Design of high pass, low pass and bandpass filter
4. Simulation of ECG waveform
5. Simulation of half-cell potential
6. Simulation of respiration rate measurement
7. Study of PH measurement
2. Study of Blood Pressure measurement
3. Study of Pacemaker
4. Study of Defibrillator

CO – PO / PSO Articulation Matrix

Correlation: 1 = Low (Slight), 2 = Medium (Moderate), 3 = High (Substantial), '-' = no correlation.

CO	Program Outcome (PO)										PSO		
CO													
CO1													
CO2													
CO3													
CO4													
CO5													
CO6													
Avg													

CO – WK Mapping (Knowledge & Attitude Profiles)

'✓' indicates the knowledge profile drawn upon by the CO.

CO	WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9
CO1									
CO2									
CO3									
CO4									
CO5									
CO6									

CO – WP Mapping (Complex Engineering Problems)

CO1							
CO2							
CO3							
CO4							
CO5							
CO6							

CO – EA Mapping (Complex Engineering Activities)

'✓' indicates the activity attribute addressed by the CO

CO	EA1	EA2	EA3	EA4	EA5
CO1					
CO2					
CO3					
CO4					
CO5					
CO6					

CO – SDG Mapping (Sustainable Development Goals)

CO	SDG(s) Addressed	Justification / Linkage
CO1		
CO2		
CO3		
CO4		
CO5		
CO6		

MM1408: MICROCONTROLLER AND APPLICATIONS

Teaching Scheme	Examination Scheme
Credits : 3	CP: 20 Marks
Lectures : 2 Hrs/week	GD/PPT/HA: 20 Marks
Practical : Hrs/week	MSE (W/O): 40 Marks
Tutorial : 1 Hrs/week	CVV: 20 Marks

Prerequisites:	
•	Basic digital electronics, C programming, Fundamentals of microcontroller architecture and peripherals
Course Objectives:	
•	To build a foundation in microcontroller architecture, memory and peripherals, and to apply a structured framework for selecting a microcontroller against measurement and control requirements.
•	To develop register-level programming skills for ports, timers, interrupts, PWM and input capture, and to reason about timing-critical paths.
•	To analyse serial and peripheral communication (UART, SPI, I2C, RS-485 / Modbus) and to design interrupt-driven, reliable data-flow schemes
•	To analyse the complete measurement signal chain — from transducer through acquisition to processing and actuation — in healthcare and building-automation instruments
•	To develop skills in firmware structure, debugging, low-power operation and reliable, fail-safe design
•	To analyse how commercial instruments, including resource-critical machine-vision nodes, are architected around a microcontroller, and to reason about the transition from prototype to product
Course Outcomes:	
	After completion of the course, student will be able to
1.	Justify the selection of a microcontroller for a given measurement or control application using a structured framework
2.	Map the functions of an instrument onto specific microcontroller peripherals (I/O, timers, PWM, interrupts, input capture) and reason about timing-critical paths at register level
3.	Configure and analyse the microcontroller's serial interfaces (UART, SPI, I2C, RS-485 / Modbus) to design interrupt-driven, reliable data-flow schemes
4.	Analyse the microcontroller's analog acquisition in a healthcare or building-automation instrument.
5.	Apply firmware-engineering, low-power and fail-safe design principles to microcontroller-based instrument firmware .
6.	Dissect a commercial instrument to expose its microcontroller architecture and evaluate its transition from prototype to product

Section1:	Topics/Contents
Unit 1: Microcontroller Fundamentals and Selection Embedded systems versus general-purpose computing; the 8-, 16- and 32-bit landscape and a survey of representative families (AVR, PIC, ARM Cortex-M) at awareness level. The course microcontroller as a platform: CPU core, buses, clock system and memory architecture (Flash, SRAM, EEPROM) with the rationale for each. The high-level programming abstraction and what lies beneath it — a framing gap analysis. Choosing the right microcontroller: a selection framework proceeding from peripheral and I/O requirements, through performance and memory sizing with margin, power budget, package, tooling and debugger support, cost at volume, and ecosystem and long-term availability.	

Unit 2: Ports, Timers and Interrupts

General-purpose I/O at register level and the cost of abstraction (direct port manipulation versus library calls). The interrupt system: vectors, external and pin-change interrupts, interrupt service routines, latency, and the atomicity hazard on shared multi-byte variables. Timer/counter architecture, modes and prescalers. Pulse-width modulation as a means of actuation, with frequency and resolution as measures of actuation quality. Input capture for the measurement of time, frequency, period and pulse width.

Unit 3 — Serial Communication and Peripheral Integration

UART: frame format, baud rate, register-level configuration and interrupt-driven buffered input/output; data framing and checksums. SPI: protocol, modes, and interfacing an external converter or sensor integrated circuit. I2C: protocol, addressing, and interfacing sensor and real-time-clock devices, including register and FIFO read sequences. RS-485 as the industrial serial standard: half-duplex differential signalling, multi-drop bus topology, driver direction control (the timed GPIO toggle around transmission), and Modbus RTU framing as a representative protocol. Reading a peripheral datasheet as an engineering skill. The boundary at which this course ends and the Internet of Things course begins.

Unit 4 — Application Analysis I: Healthcare and Building Automation

Application-dissection method: functional decomposition, peripheral mapping, resource and power budgeting, reliability requirements, and selection verdict. Integration spectrum: a microcontroller performing the full signal chain versus one reading a smart-sensor system-on-chip. Healthcare devices: acquisition of weak physiological and optical signals; dedicated analog front-end versus on-chip converter; dissection of pulse-oximeter and ECG devices. Building automation: the microcontroller in an HVAC control unit; sensor interfacing; blower and actuator drive; and the capability requirements that drive its selection. Course-boundary signposts to the Internet of Things and Automotive Embedded Systems courses.

Section2:	Topics/Contents
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Unit 4 — Application Analysis I: Healthcare and Building Automation

Application-dissection method: functional decomposition, peripheral mapping, resource and power budgeting, reliability requirements, and selection verdict. Integration spectrum: a microcontroller performing the full signal chain versus one reading a smart-sensor system-on-chip. Healthcare devices: acquisition of weak physiological and optical signals; dedicated analog front-end versus on-chip converter; dissection of pulse-oximeter and ECG devices. Building automation: the microcontroller in an HVAC control unit; sensor interfacing; blower and actuator drive; and the capability requirements that drive its selection. Course-boundary signposts to the Internet of Things and Automotive Embedded Systems courses.

Unit 5 — Firmware Engineering and Reliable Operation

Program structure: the super-loop, interrupt-driven design, finite state machines and non-blocking timing. Debugging: printf-style versus hardware debugging, JTAG/SWD concepts and breakpoints. Low-power operation: sleep modes, wake sources and power budgeting for battery-operated instruments. Reliability: watchdog timers, brown-out detection, defined fail-safe output states and defensive firmware, with awareness of where these practices are formalised in industrial and automotive safety standards.

Unit 6 — Application Analysis II: Microcontrollers in Machine Vision

Vision as a resource-critical application: frame-memory budget against on-chip memory; the inadequacy of an 8-bit device and the need for a 32-bit architecture, larger memory and hardware data movement. Vision-specific peripherals: the parallel camera interface, direct memory access for frame capture, and frame-buffer placement. Machine-vision node dissection: microcontroller class; a deterministic classical pipeline (thresholding, region and blob detection, counting); and industrial use-cases framed as measurements, with a per-stage load and frame-rate budget. On-device inference: deployment of a small quantised model at overview level. Selection ladder: vision microcontroller versus single-board computer versus fixed-function smart camera.

Text Books:	
1	M. A. Mazidi, S. Naimi, and S. Naimi; The AVR Microcontroller and Embedded Systems Using Assembly and C; 2nd ed., Pearson.
2	J. W. Valvano; Embedded Systems: Introduction to Arm Cortex-M Microcontrollers; 5th ed., Self-published (Cengage/CreateSpace).
3	M. A. Mazidi, R. D. McKinlay, and D. Causey; PIC Microcontroller and Embedded Systems: Using Assembly and C for PIC18; 1st ed., Pearson
Reference Books:	
1	E. White; Making Embedded Systems: Design Patterns for Great Software; 1st ed., O'Reilly Media.
2	J. Yiu; The Definitive Guide to Arm Cortex-M3 and Cortex-M4 Processors; 3rd ed., Newnes (Elsevier).
3	S. F. Barrett and D. J. Pack; Atmel AVR Microcontroller Primer: Programming and Interfacing; 2nd ed., Morgan & Claypool.
4	T. Wilmshurst; Designing Embedded Systems with PIC Microcontrollers: Principles and Applications; 2nd ed., Newnes (Elsevier).

List of Practicals

1. Set up the AVR toolchain and a virtual simulation environment; write, assemble and simulate a simple **Assembly Language Program (ALP)** — add/subtract two 8-bit numbers and observe the working registers and SREG flags. *(Unit 1)*
2. **ALP** for data transfer and arithmetic/logic operations using the 32 general-purpose registers; examine the Flash/SRAM/register map in the simulator. *(Unit 1)*
3. **Bare-metal GPIO:** drive LEDs and read switches by direct register manipulation (DDRx, PORTx, PINx); measure and compare the timing of a direct port write versus digitalWrite() (abstraction-gap experiment). *(Unit 2)*
4. **Timer/counter programming (bare metal):** configure Timer0/Timer1 with prescalers to generate accurate delays; verify the period in simulation. *(Unit 2)*
5. **PWM generation:** configure a timer in PWM mode to control LED brightness / a DC-motor as actuation; vary duty cycle and measure frequency and resolution. *(Unit 2)*
6. **Input capture:** measure the frequency, period and pulse-width of an external signal using the input-capture unit and validate against the simulated source. *(Unit 2)*
7. **Interrupt programming:** external and pin-change interrupts with ISRs; demonstrate interrupt latency and the atomicity hazard on a shared multi-byte variable, then apply the fix. *(Unit 2)*
8. **On-chip ADC / analog acquisition (bare metal):** configure the ADC (ADMUX, ADCSRA) to read an analog sensor (temperature/LDR); study resolution, reference and sampling. *(Unit 4)*
9. **UART serial communication:** register-level, interrupt-driven buffered transmit/receive with data framing and checksum; observe on a virtual serial terminal. *(Unit 3)*
10. **SPI communication:** interface an external SPI device (DAC/ADC or sensor IC) in simulation; perform register read/write. *(Unit 3)*
11. **I2C (TWI) communication:** interface an I2C sensor and/or real-time clock; perform register and FIFO read sequences. *(Unit 3)*
12. **RS-485 / Modbus RTU:** implement half-duplex RS-485 with driver direction control (DE/RE toggle) and a basic Modbus RTU frame over a simulated multi-drop link. *(Unit 3)*
13. **Reliable and low-power firmware:** implement a watchdog timer, brown-out handling and sleep modes with wake sources; estimate current in each mode and define fail-safe output states. *(Unit 5)*
14. **Application mini-project (virtual simulation):** build and dissect one instrument — e.g., a pulse-oximeter/heart-rate acquisition front-end or an HVAC blower-PWM control unit — integrating GPIO, ADC, PWM, timer and serial reporting, and present the microcontroller-based design. *(Units 4 & 6)*

List of Tutorials

Conducted weekly (one hour per batch of 20 students); each develops a specific analytical or design skill applied to an adopted instrument.

1. Datasheet interpretation and functional decomposition of an instrument.
2. Peripheral mapping and resource budgeting (memory, CPU, power).
3. Comparative analysis of design architectures (integrated system-on-chip versus discrete front-end with microcontroller).
4. Analog signal-chain and front-end analysis.
5. Sampling strategy, timing, and measurement-uncertainty budgeting.
6. Identification and prioritization of design limitations.
7. Technical literature and prior-work survey methods.
5. Formulating a design solution at method and architecture level.
6. Reliability, fault-handling and fail-safe analysis.
7. Prototype-to-product considerations (EMC, isolation, certification, lifecycle).
8. Microcontroller selection methodology and design-decision justification.
9. Engineering data presentation and technical figures.
10. Technical report structuring and writing.
11. Design review, presentation and defense.

List of Project areas:

Students undertake basic familiarization projects on a range of industry-standard microcontroller development boards drawn from different families — such as AVR, PIC, ARM Cortex-M (ST, NXP, TI) and Renesas — rather than working only on the Arduino board. On each board, students carry out a common set of fundamental tasks, including digital I/O, analog acquisition (ADC), PWM generation, serial communication (UART/SPI/I2C) and simple sensor interfacing, using the board's own development environment and toolchain. The intention is to give students bare-metal, register-level exposure to multiple industrial microcontroller ecosystems at an introductory level, so they become comfortable moving between vendors and understand how the same basic application maps onto different hardware platforms.

CO – PO / PSO Articulation Matrix

Correlation: 1 = Low (Slight), 2 = Medium (Moderate), 3 = High (Substantial), '-' = no correlation.

CO	Program Outcome (PO)											PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO 1	PSO 2	PSO 3
CO1	3	3	2	1	2	-	-	-	-	1	1	2	2	2
CO2	3	3	2	2	2	-	-	-	-	-	-	2	2	3
CO3	2	3	3	2	2	-	-	-	1	-	-	2	2	3
CO4	3	3	2	3	2	-	-	-	-	-	-	3	3	2
CO5	2	2	3	2	2	1	1	-	-	-	1	1	2	3
CO6	2	3	2	3	1	2	1	2	2	2	2	2	3	2
Avg	2.50	2.83	2.33	2.17	1.83	0.50	0.33	0.33	0.50	0.50	0.67	2.00	2.33	2.50

CO – WK Mapping (Knowledge & Attitude Profiles)

'✓' indicates the knowledge profile drawn upon by the CO.

CO	WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9
CO1		✓	✓	✓	✓	✓		✓	
CO2		✓	✓	✓		✓			
CO3		✓	✓	✓		✓			
CO4	✓	✓	✓	✓		✓		✓	
CO5				✓	✓	✓	✓	✓	✓
CO6				✓	✓	✓	✓	✓	✓

CO – WP Mapping (Complex Engineering Problems)

'✓' indicates the complex-engineering-problem attribute addressed by the CO.

CO	WP1	WP2	WP3	WP4	WP5	WP6	WP7
CO1	✓	✓	✓				✓
CO2	✓		✓				✓
CO3	✓		✓		✓		✓
CO4	✓		✓	✓			
CO5	✓	✓	✓		✓		
CO6	✓	✓	✓		✓	✓	✓

CO – EA Mapping (Complex Engineering Activities)

'✓' indicates the activity attribute addressed by the CO.

CO	EA1	EA2	EA3	EA4	EA5
CO1	✓		✓		
CO2	✓	✓			
CO3	✓	✓			
CO4	✓	✓	✓		
CO5	✓		✓	✓	
CO6	✓	✓	✓	✓	

CO – SDG Mapping (Sustainable Development Goals)

CO	SDG(s) Addressed	Justification / Linkage
CO1	4, 9	Structured microcontroller-selection methodology builds engineering analytical capacity (SDG 4) that drives industrial innovation and infrastructure (SDG 9).
CO2	9	Register-level mapping of functions onto microcontroller peripherals underpins reliable industrial instrumentation (SDG 9).
CO3	9	Robust serial and industrial communication (UART/SPI/I2C, RS-485/Modbus) supports resilient industry and infrastructure (SDG 9).
CO4	3, 9	Microcontroller-based analog acquisition in healthcare and building-automation instruments supports good health (SDG 3) and instrumentation innovation (SDG 9).
CO5	7, 9	Low-power, fail-safe firmware enables energy-efficient (SDG 7) and reliable industrial devices (SDG 9).
CO6	9, 11	Dissection of commercial instruments across healthcare, building-automation and vision applications supports industry (SDG 9) and smart, sustainable cities (SDG 11).

HS2003: FROM CAMPUS TO CORPORATE– 2

Teaching Scheme	Examination Scheme
Credits : 2	MSE (W/O): 50 Marks
Lectures : 2 Hrs/week	ESE (W/O): 50 Marks

Course Objectives:	
- Understand the organizational structure, business domains, financial concepts, and functioning of companies in the corporate environment. - Develop knowledge of product management, user experience, quality assurance, customer success, security, and emerging technologies used in modern industries. - Apply analytical thinking, problem-solving, and decision-making techniques to address industry-oriented challenges through case studies and practical scenarios. - Enhance professional competencies including communication, presentation, teamwork, leadership, and interpersonal skills required in multidisciplinary work environments. - Develop project management, planning, prioritization, and execution skills for effective management of professional tasks and projects. - Cultivate professional ethics, adaptability, critical thinking, and lifelong learning to achieve continuous personal and professional growth.	
Course Outcomes:	
	After completion of the course, student will be able to
1.	Explain the organizational structure, business processes, financial concepts, and product development lifecycle in the corporate ecosystem.
2.	Analyse workplace problems and recommend suitable solutions using concepts of product management, quality, customer success, security, and emerging technologies.
3.	Apply critical thinking, problem-solving techniques, AI awareness, and project management principles to solve industry-oriented case studies.
4.	Demonstrate effective communication, teamwork, leadership, and presentation skills while working in professional and multidisciplinary environments.
5.	Apply project planning, prioritization, and management techniques for successful execution of professional assignments and collaborative projects.
6.	Demonstrate professional ethics, social responsibility, adaptability, and lifelong learning necessary for continuous professional development in a dynamic corporate environment.

SECTION-1	Topics/Contents
	Vertical 1: COMPANIES & INDUSTRY Topic 1: Understanding Companies - Understand how to analyse a company-based domains, customers, offering and strategy - Understand how to use this knowledge to contribute earlier and faster. Topic 2: Understanding Company Financials (and AOP Budgeting) - Understand components of company P&L and Balance Sheet - Be able to assess financial health of a company - How do companies build AOP. Top down and bottom up - Understand the funding avenues

Vertical 2: Application Of Knowledge

Topic 1: Product Management

- Understand product roadmap creation
- Understand product growth strategies
- Understand product discovery techniques
- Understand backlog prioritization techniques
- Be able to write requirements in detail

Topic 2: Understanding UX And UI

- Understand what usability, user interaction design and consumer journeys mean
- Compare and contrast UX with user interface. Use several industry examples
- technique of building a good UX

Topic 3: Releasing A Product To The Market

- Understand what it takes to release a product to the market by product and engineering teams
- Understand what it takes for a product to be successful with the customer from external go-to market perspective.

Topic 4: Quality – Understanding Beyond The Theory

- Understand how to look at product quality
- Understand how to approach building a good quality product
- Understanding Testing and Test Automation
- Build a Test Plan
- Career options in Quality

Topic 5: Customer Success Management

- Concept of Customer Success
- What is CSAT , NPS , RATING, REVIEWS and how should one track Customer Value
- Understand what issues mean in the industry
- Understand how to identify and prioritize issues and ways to resolve them.

Topic 6: Security And Privacy

- Understand Security concepts (Threat, Vulnerability, Risk)
- Understand about Threat Modelling
- Understand about Security Engineering Approach
- Be able to prepare security test plan

Topic 7: Artificial Intelligence (AI) – The Evolution

- Introduction to AI. AI is pervasive today. Origins of AI and ML Potential and possibilities
- Machine Learning. How is it different from traditional programs? Extensive practical applications over the last decade or so
- Deep Learning. Computer Vision and Natural Language Processing

Vertical 3: Professional Skills

Topic 1: Curiosity And Inquisitiveness

- What is Curiosity and Understand the importance of asking questions
- Review Industry Examples
- Understand techniques of asking thought provoking questions
- Tips and tricks to ask effective questions

Topic 2: Articulation And Communication

- Understand different types of communications
- Understand barriers to communications
- Understand why articulation is important

- How do you make Impactful Introductions

Topic 3: Problem Breakdown and Resolution Using Mind Maps

- What are mind maps
- Tips on creating Mind Maps
- Real-life case of Problem Breakdown
- Prioritizing a long list. Concept and Technique
- Live workshop on understanding constraints and prioritizing and long to-do list

Topic 4: Effective Project And Program Management

- Understand the key concepts within project management
- Understand key aspects of planning
- Understand the link between planning and execution
- Case study based Proj and Prog Management hands on workshop

Topic 5: Developing Critical Thinking Using Mental Models

- Why Critical Thinking
- What are the barriers to Critical Thinking
- Technique and Steps in Critical Thinking
- Why Mental Models
- Using Mental Models for sharper decisions

Reference Books:

1	Dale Carnegie, How to Win Friends and Influence People
2	Stephen R. Covey, 7 Habits of Highly Effective People
3	Shital Kakkar Mehra, Business Etiquette: A Guide for the Indian Professional
4	Peggy Klaus, The Hard Truth About Soft Skills

CO – PO / PSO Articulation Matrix

Correlation: 1 = Low (Slight), 2 = Medium (Moderate), 3 = High (Substantial), '-' = no correlation.

CO	Program Outcomes (PO)											PSO		
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO 1	PSO 2	PSO 3
CO1	2	2	–	–	1	–	–	–	1	–	1	1	–	–
CO2	2	3	2	1	2	2	1	1	–	–	1	2	3	2
CO3	1	3	2	2	2	1	–	2	1	2	2	2	2	3
CO4	–	1	–	–	–	–	2	3	3	2	1	–	1	1
CO5	–	1	2	1	1	1	3	2	2	3	2	1	2	2
CO6.	–	–	–	–	1	2	3	2	2	1	3	2	2	3
Average	1.0	1.7	1.0	0.7	1.2	1.0	1.5	1.7	1.5	1.3	1.7	1.3	1.7	1.8

CO – WK Mapping (Knowledge & Attitude Profiles)

'✓' indicates the knowledge profile drawn upon by the CO.

CO	WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9
CO1	✓	✓	-	-	-	-	-	-	-
CO2	-	✓	-	✓	-	✓	-	-	-
CO3	-	✓	-	✓	-	-	-	✓	-
CO4	-	-	-	-	-	-	-	-	✓
CO5	-	-	-	-	-	-	-	✓	✓
CO6	-	-	-	-	-	-	✓	✓	✓

CO – WP Mapping (Complex Engineering Problems)

CO	WP1	WP2	WP3	WP4	WP5	WP6	WP7
CO1	-	✓	-	-	-	-	✓
CO2	-	✓	-	✓	-	✓	-
CO3	-	-	✓	✓	-	-	-
CO4	-	-	-	-	-	-	-
CO5	-	✓	-	-	-	-	✓
CO6	-	✓	-	-	-	-	-

CO – EA Mapping (Complex Engineering Activities)

CO	EA1	EA2	EA3	EA4	EA5
CO1	✓	-	-	-	-
CO2	-	-	-	-	-
CO3	-	✓	✓	-	-
CO4	✓	✓	-	-	✓
CO5	✓	✓	-	-	-
CO6	-	-	-	✓	✓

CO – SDG Mapping (Sustainable Development Goals)

CO	SDG(s) Addressed	Justification / Linkage
CO1	4, 8, 9	Builds foundational understanding of organizational, financial, and product-lifecycle knowledge that prepares students for productive employment and industry participation.
CO2	8, 9	Analyzing workplace problems via product management, quality, security, and emerging technology supports innovation-driven, industry-relevant solutions.
CO3	4, 9	Develops critical thinking, problem-solving, and AI awareness through case studies — building future-ready skills and innovation capability.
CO4	4, 5, 17	Builds communication, teamwork, and leadership for inclusive, multidisciplinary collaboration and stronger partnerships across diverse teams.
CO5	8, 17	Develops project planning and management skills for successful execution of collaborative professional work.
CO6	4, 8, 16	Cultivates professional ethics, social responsibility, and lifelong learning — reinforcing responsible conduct and good practice in the workplace.

IC2316:: DESIGN THINKING-2

Teaching Scheme	Examination Scheme
Credits : 1	CP: Marks
Lectures : Hrs/week	GD/PPT/HA: Marks
Practical : Hrs/week	MSE (W/O): Marks
Tutorial : 1 Hrs/week	ESE (W/O):100 Marks

Prerequisites:	
●	Problem Based Learning, Project Centric Learning Course Relevance.
Course Objectives:	
●	To provide ecosystem for students and faculty for paper publication and patent filing
Course Outcomes:	[Publication of paper or patent]
	After completion of the course, 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, Understand Entrepreneurship and Business Planning

Section1:	Topics/Contents
	What is research? Importance of Paper Publication and Patents 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
Section2:	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

CO – PO / PSO Articulation Matrix

Correlation: 1 = Low (Slight), 2 = Medium (Moderate), 3 = High (Substantial), '-' = no correlation.

CO	Program Outcome (PO)											PSO		
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO 1	PSO 2	PSO 3
CO1	1	1	1	1	1							1	2	2
CO2	1	1	1	1	1							1	2	2
CO3	2	2	3	3	2	2	1	2	2	3		1	3	3
CO4	3	3	3	3	3	2	1	2	2	3	1	1	3	3
CO5	1	1	1	1	1							1	2	2
CO6	2	2	2	2	2	2	1	3	2	3		1	3	3
Avg	1.7	1.7	1.8	1.8	1.7	2.0	1.0	2.3	2.0	3.0	1.0	1.0	2.5	2.5

CO – WK Mapping (Knowledge & Attitude Profiles) Sample Table

✓' indicates the knowledge profile drawn upon by the CO.

CO	WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9
CO1	✓	✓		✓					✓
CO2		✓	✓	✓	✓				
CO3		✓	✓	✓	✓	✓			
CO4			✓	✓	✓	✓	✓		
CO5				✓	✓	✓	✓	✓	
CO6	✓			✓		✓		✓	✓

CO – WP Mapping (Complex Engineering Problems)

CO	WP1	WP2	WP3	WP4	WP5	WP6	WP7
CO1	✓	✓	✓		✓		✓
CO2	✓	✓	✓	✓	✓		
CO3	✓	✓	✓	✓	✓	✓	
CO4	✓	✓	✓	✓	✓	✓	✓
CO5	✓	✓	✓	✓	✓	✓	✓
CO6			✓		✓	✓	✓

CO – EA Mapping (Complex Engineering Activities)

'✓' indicates the activity attribute addressed by the CO

CO	EA1	EA2	EA3	EA4	EA5
CO1	✓	✓			
CO2	✓	✓	✓		
CO3	✓	✓	✓	✓	
CO4		✓	✓	✓	✓
CO5			✓	✓	✓
CO6				✓	✓

CO – SDG Mapping (Sustainable Development Goals) Sample Table

CO	SDG(s) Addressed	Justification / Linkage
CO1	4, 9	Understanding the importance of research promotes quality education, scientific inquiry, innovation, and technological advancement for solving real-world problems.
CO2	4, 9	Knowledge of research terminology and concepts strengthens analytical thinking, research competency, and innovation capabilities.
CO3	9, 17	Applying research methodology and publishing research fosters innovation, knowledge dissemination, and collaboration among researchers and institutions.
CO4	4, 9, 17	Writing research papers develops scientific communication, promotes lifelong learning, and contributes to global knowledge sharing through collaborative research.
CO5	9,12	Understanding Intellectual Property Rights encourages innovation, protection of inventions, responsible use of knowledge, and sustainable technological development.
CO6	4, 16	Applying research ethics promotes academic integrity, responsible conduct of research, transparency, fairness, and ethical decision-making.

HS2002 : REASONING AND APTITUDE DEVELOPMENT-4

Teaching Scheme	Examination Scheme
Credits : 1	ESE (W/O): 100 Marks
Lectures : 1 Hrs/week	

Prerequisites:	
•	Familiarity with basic English language, elementary mathematics, and logical reasoning concepts studied at the 10+2 level.
Course Objectives:	
•	To develop proficiency in English language skills, including reading, writing, vocabulary, grammar, and comprehension, for effective professional communication.
•	To enhance logical reasoning and critical thinking abilities for analyzing, interpreting, and solving real-world problems.
•	To strengthen quantitative aptitude and mathematical problem-solving skills required for academic, competitive, and engineering applications.
•	To develop analytical and decision-making skills by applying verbal, logical, and numerical reasoning techniques.
•	To prepare students for higher studies, competitive examinations, and industry recruitment by improving overall aptitude and communication competencies.
Course Outcomes:	
	After completion of the course, student will be able to
1.	Improve the reading, writing and verbal skills, and enhance comprehension and articulation abilities
2.	Develop logical reasoning abilities, enabling them to make sound decisions in problem-solving scenarios
3.	Develop mathematical aptitude as well as data interpretation abilities and use them in test cases and real-world problems
4.	Learn to apply approaches for optimum time-management, prioritization maximizing the accuracy
5.	Learn data interpretation, apply mathematical skills to draw accurate conclusions
6.	Apply their knowledge of English, reasoning and quantitative skills for planning, critical thinking and real-world problems

	Topics/Contents
Unit 1: English Language	
Familiarity with English Language, Ability to understand written text, spoken word and effective communication through written documents; Coverage of vocabulary to cope up with general and specific terminology, syntax and sentence structure, prevention of incorrect use leading to distortion in communication; synonyms, antonyms and contextual vocabulary, Grammar – Error identification, sentence improvement and construction, Reading Comprehension.	
Unit 2: Logical Ability	
Objective interpretation of things, ability to perceive and interpret trends to make generalizations; ability to analyze assumptions behind an argument or statement; Deductive reasoning: Assessment of ability to	

synthesize information and derive conclusions - Coding deduction logic, Data Sufficiency, Directional Sense, Logical word sequence, Objective reasoning, Selection and decision tables, puzzles; Inductive reasoning: Assessment of ability to learn by example, imitation or by trial – Analogy pattern recognition, Classification pattern recognition, Coding pattern recognition, Number series pattern recognition; Abductive reasoning: Critical thinking ability of seeing through logical weak links or loopholes in an argument or a group of statements; Critical reasoning: assessment of ability to think through and analyze logical arguments, assessment of ability to use logical constructs to offer reasoning in unfamiliar situations; Information Gathering and synthesis: Ability of locating information, information ordering, rule based selection and data interpretation, order and classify data, interpret graphs, charts, tables and make rule based deductions. Application of these approaches for using visual, numerical and textual data from single or multiple sources.

Unit 3: Quantitative Ability

Basic numbers – decimals and fractions, factorization, divisibility: HCF, LCM, Odd, even, prime and rational numbers. Application of algebra to real world, direct and inverse proportion, common applications – Speed-time -distance, Profit-loss, percentage, age relations, mixtures, other miscellaneous quantitative combination, exponentials and logarithms, permutations and combinations, probability. Spatial reasoning: Inductive – Missing portions, Sequence and series; Deductive analysis.

Reference Books:

1	"English Grammar in Use" by Raymond Murphy, Cambridge University Press.
2	"Word Power Made Easy" by Norman Lewis, Goyal Publishers & Distributors.
3	"Objective General English" by S.P. Bakshi, Arihant Publications.
4	"English for Competitive Examinations" by K. Sinha, S. Chand Publishing.
5	"Essential English Grammar" by Philip Gucker, Wiley.
6	"English Idioms and Phrasal Verbs" by M.A. Yadav, Vikas Publishing House.
7	"The Oxford English Grammar" by Sidney Greenbaum, Oxford University Press.
8	"A Modern Approach to Verbal & Non-Verbal Reasoning" by R.S. Aggarwal, S. Chand Publishing, ISBN: 978-8121903409.
9	"Logical Reasoning and Data Interpretation for the CAT" by Nishit K. Sinha, Pearson India, ISBN: 978-8131709117.
10	"Logical Reasoning and Data Interpretation for the CAT" by Arun Sharma, McGraw Hill Education, ISBN: 978-0070709642.
11	"A New Approach to Reasoning Verbal and Non-Verbal" by B.S. Sijwali & Indu Sijwali, Arihant Publications, ISBN: 978-9311124692.
12	"Quantitative Aptitude for Competitive Examinations" by R.S. Aggarwal, S. Chand Publishing, ISBN: 978-8121900637.
13	"How to Prepare for Quantitative Aptitude for the CAT" by Arun Sharma, McGraw Hill Education, ISBN: 978-0070709642.
14	"The Pearson Guide to Quantitative Aptitude for Competitive Examination" by Pearson, Pearson India, ISBN: 978-8131709117.
15	"Quantitative Aptitude for Competitive Examinations" by Abhijit Guha, Tata McGraw Hill Education, ISBN: 978-0070666653.
16	"Data Interpretation & Data Sufficiency" by R.S. Aggarwal, S. Chand Publishing ISBN: 978-8121903515.
17	"Quantitative Aptitude for Competitive Examinations" by S. Chand, ISBN: 978-8121903423.

CO – PO / PSO Articulation Matrix

Correlation: 1 = Low (Slight), 2 = Medium (Moderate), 3 = High (Substantial), '-' = no correlation.

CO	Program Outcome (PO)											PSO		
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	1	1	–	–	–	–	–	–	2	3	–	–	–	–
CO2	2	3	2	2	–	–	–	–	–	–	–	–	2	1
CO3	3	2	2	1	–	–	–	–	–	–	–	1	2	2
CO4	2	3	2	2	–	–	–	–	1	1	–	–	2	1
CO5	2	3	2	2	–	–	–	–	1	1	–	–	3	2
CO6	2	3	2	2	1	–	–	–	2	2	1	1	2	3
Avg	2.0	2.5	1.7	1.5	0.2	–	–	–	1.0	1.2	0.2	0.3	1.5	1.5

CO – WK Mapping (Knowledge & Attitude Profiles)

'✓' indicates the knowledge profile drawn upon by the CO.

CO	WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9
CO1			✓	✓				✓	
CO2		✓		✓	✓	✓			
CO3	✓	✓		✓		✓		✓	
CO4		✓		✓		✓	✓		
CO5				✓		✓	✓	✓	
CO6				✓	✓	✓		✓	✓

CO – WP Mapping (Complex Engineering Problems)

CO	WP1	WP2	WP3	WP4	WP5	WP6	WP7
CO1	✓						
CO2	✓		✓				
CO3	✓		✓				
CO4	✓	✓	✓				
CO5	✓	✓	✓				
CO6	✓		✓				✓

CO – EA Mapping (Complex Engineering Activities)

'✓' indicates the activity attribute addressed by the CO

CO	EA1	EA2	EA3	EA4	EA5
CO1	✓				
CO2	✓		✓		
CO3	✓		✓		
CO4	✓		✓		
CO5	✓		✓		
CO6	✓		✓	✓	✓

CO – SDG Mapping (Sustainable Development Goals)

CO	SDG(s) Addressed	Justification / Linkage
CO1	4	Develops English communication, reading comprehension, and writing skills, enhancing employability and lifelong learning.
CO2	4,8	Strengthens logical reasoning and analytical thinking, preparing students for skilled employment and professional decision-making.
CO3	4, 8	Enhances quantitative and mathematical aptitude required for higher education, competitive examinations, and industry readiness.
CO4	4, 9	Promotes critical thinking, problem analysis, and data interpretation, supporting innovation and technology-driven solutions.
CO5	4,16	Develops critical reasoning, ethical decision-making, and objective judgment, contributing to transparent and accountable professional practices
CO6	4,8,9	Integrates communication, reasoning, and quantitative skills to solve multidisciplinary problems, fostering innovation, employability, and sustainable industrial development.

IC2317:: ENGINEERING DESIGN AND INNOVATION-2

Teaching Scheme	Examination Scheme
Credits : 2	CP: Marks
Lectures : Hrs/week	GD/PPT/HA: Marks
Practical : 2 Hrs/week	MSE (W/O):30 Marks
Tutorial : Hrs/week	ESE (W/O):70 Marks

Prerequisites:	
Problem Based Learning Course Relevance: Project Centric Learning (PCL) is a powerful tool for students to work in areas of their choice and strengths. Along with course based projects, curriculum can be enriched with semester long Engineering Design and Development courses, in which students can solve socially relevant problems using various technologies from relevant disciplines. The various socially relevant domains can be like Health care, Agriculture, Defense, Education, Smart City, Smart Energy and Swaccha Bharat Abhiyan. To gain the necessary skills to tackle such projects, students can select relevant online courses and acquire skills from numerous sources under guidance of faculty and enrich their knowledge in the project domain, thereby achieving project centric learning. Modern world sustained and advanced through the successful completion of projects. In short, if students are prepared for success in life, we need to prepare them for a project-based world. It is a style of active learning and inquiry-based learning. Project centric learning will also redefine the role of teacher as mentor in the learning process. The PCL model focuses the student on a big open-ended question, challenge, or problem to research and respond to and/or solve. It brings students not only to know, understand and remember rather it takes them to analyze, design and apply categories of Bloom's Taxonomy.	
Course Objectives:	
- To develop critical thinking and problem-solving ability by exploring and proposing solutions to realistic/social problems. - To Evaluate alternative approaches, and justify the use of selected tools and methods. - To emphasize learning activities those are long-term, inter-disciplinary and student-centric. - To engage students in rich and authentic learning experiences. - To provide every student the opportunity to get involved either individually or as a group so as to develop team skills and learn professionalism. - To develop an ecosystem to promote entrepreneurship and research culture among the students	
Course Outcomes:	
After completion of the course, student will be able to	
1. Design solutions for given engineering problem	
2. Demonstrate practical knowledge by constructing models/algorithms for real time applications	
3. Express effectively in written and oral communication	
4. Exhibit the skills to work in a team or individually	
5. Prepare a time chart and financial record for execution of the project	
6. Choose and compare alternative approaches to select most feasible one	

Section1:	Topics/Contents
	Preamble - The content and process mentioned below is the guideline document for the faculties and students to start with. It is not to limit the flexibility of faculty and students; rather they are free to explore their creativity beyond the guideline mentioned herewith. For all courses of ED, laboratory course contents of “Engineering Design” are designed as a ladder to extend connectivity of software technologies to solve real word problem using interdisciplinary approach. The ladder in the form of gradual steps can be seen as below: Industry Communication Standards, Single Board Computers and IoT, Computational Biology (Biomedical and Bioinformatics), Robotics and Drone, Industry 4.0 (Artificial Intelligence, Human Computer Interfacing, 5G and IoT, Cloud Computing, Big Data and Cyber Security etc). Group Structure: There should be a team/group of 4-5 students. A supervisor/mentor teacher assigned to individual groups. It is useful to group students of different abilities and nationalities together. Selection of Project/Problem: ● Students must focus on initiating the task/idea. The idea of inception and consideration shall be from following areas as a real world problem: -Health Care, Agriculture, Defense, Education, Smart City, Smart Energy, Swaccha Bharat Abhiyan, Environment, Women Safety. ● This is the sample list to start with. Faculty and students are free to include other areas which meet society’s requirements at large. ● The model begins with the identifying of a problem, often growing out of a question or “wondering”. This formulated problem then stands as the starting point for learning. Students design and analyze the problem/project within an articulated disciplinary subject frame/domain. ● A problem can be theoretical, practical, social, technical, symbolic, cultural, and/or scientific and grows out of students’ wondering within different disciplines and professional environments. A chosen problem has to be exemplary. The problem may involve an interdisciplinary approach in both the analysis and solving phases. ● By exemplarity, a problem needs to refer to a particular practical, scientific, social and/or technical domain. The problem should stand as one specific example or manifestation of more general learning outcomes related to knowledge and/or modes of inquiry. Teacher’s Role in PCL: ● Teacher is not the source of solutions rather he will act as the facilitator and mentor. ● To utilize the principles of problem solving, critical thinking and metacognitive skills of the students. ● To make the group aware about time management. ● Commitment to devote the time to solving student’s technical problems and interested in helping students to empower them better. Student's Role in PCL: ● Students must have ability to initiate the task/idea, they should not be mere imitators. ● They must learn to think. ● Students working in PCL must be responsible for their own learning. ● Students must quickly learn how to manage their own learning, instead of passively receiving instruction. ● Students in PCL are actively constructing their knowledge and understanding of the situation in groups.

- Students in PCL are expected to work in groups.
- They have to develop interpersonal and group process skills, such as effective listening or coping creatively with conflicts.

Developing Inquiry Skills:

- Students in PCL are expected to develop critical thinking abilities by constantly relating: What they read to do? What do they want to do with that information?
- They need to analyze information presented within the context of finding answers.
- Modeling is required so that the students can observe and build a conceptual model of the required processes.
- Use the following mechanism to maintain the track of moving towards the solution.
 - How effective is?
 - How strong is the evidence for? How clear is?

What are the justifications for thinking? Why is the method chosen?

- What is the evidence given to justify the solution?

Literature Survey – To avoid reinvention of wheel:

- It is an integral part of self- directed learning
- Identify the information needed to solve a given problem or issue
- Be able to locate the needed information
- Use the information to solve the given problem effectively.
- Skills required by students in information literacy include:
 - How to prepare for the search? How to carry out research
 - Sorting and assessing of information in general

Use of Research Methodology: - investigation, collaboration, comprehension, application, analysis, synthesize and evaluation

Focus on the following skills while working in a team to reach to solution:

- Collaborative learning
- Interpersonal Skills
- Resources Evaluation
- Metacognitive Skills
- Reflection Skills

Section2:	Topics/Contents
	EDI Sample Case Studies: - With the adaptation of industry communication standards, Raspberry Pi and Sensors, the following projects can be taken up: 1) Design a deployable product for soil moisture detection 2) Design a deployable product for temperature detection 8) Design a deployable product for pressure detection 9) Design a deployable product smoke detection 10) Design a deployable product for motion detection 11) Design a deployable product for collision detection 12) Design a deployable product for sound detection ...not limited to.....Faculty and students are free to include other areas which meet society's requirements at large.

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Text Books:	
1	A new model of problem based learning. By Terry Barrett. All Ireland Society for higher education (AISHE). ISBN:978-0-9935254-6-9; 2017
2	Problem Based Learning. By Mahnazmoallem, woei hung and Nada Dabbagh, Wiley Publishers. 2019.
3	Stem Project based learning and integrated science, Technology, Engineering and mathematics approach. By Robert Robart Capraro, Mary Margaret Capraro
4	A new model of problem based learning. By Terry Barrett. All Ireland Society for higher education (AISHE). ISBN:978-0-9935254-6-9; 2017

Reference Books:	
1	De Graaff E, Kolmos A., red.: Management of change: Implementation of problembased and project-based learning in engineering. Rotterdam: Sense Publishers. 2007.
2	Project management core textbook, second edition, Indian Edition , by Gopalan.
3	The Art of Agile Development. By James Shore & Shane Warden

CO – PO / PSO Articulation Matrix

Correlation: 1 = Low (Slight), 2 = Medium (Moderate), 3 = High (Substantial), '-' = no correlation.

CO	Program Outcome (PO)											PSO		
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO 1	PSO 2	PSO 3
CO1	2	2	2	2					3		2	3	3	2
CO2	2	2	3	2	2		2		3		2	3	3	2
CO3	2	2	3	2	3		2		3		2	3	3	2
CO4	2	2	3	2	3	3		2	3		2	3	3	2
CO5	2	2	3	2	3	2			3		2	3	3	2
CO6	2	2	3	3	2				3		3	3	3	2
Avg	2.0	2.0	2.83	2.83	2.6	2.5	2.0	2.0	3.0	1.0	2.16	3.0	3.0	2.0

CO – WK Mapping (Knowledge & Attitude Profiles) Sample Table

'✓' indicates the knowledge profile drawn upon by the CO

CO	WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9
CO1		✓	✓	✓	✓			✓	
CO2		✓	✓	✓	✓	✓		✓	
CO3		✓	✓	✓	✓	✓		✓	
CO4		✓	✓	✓	✓	✓	✓	✓	✓
CO5		✓	✓	✓	✓	✓	✓	✓	
CO6		✓	✓	✓	✓	✓		✓	

CO – WP Mapping (Complex Engineering Problems)

CO	WP1	WP2	WP3	WP4	WP5	WP6	WP7
CO1	✓			✓		✓	✓
CO2	✓	✓				✓	
CO3	✓		✓		✓		
CO4	✓				✓	✓	
CO5	✓	✓	✓				
CO6	✓					✓	✓

CO – EA Mapping (Complex Engineering Activities)

'✓' indicates the activity attribute addressed by the CO

CO	EA1	EA2	EA3	EA4	EA5
CO1	✓	✓			
CO2	✓	✓	✓	✓	
CO3	✓	✓	✓	✓	✓
CO4	✓	✓	✓	✓	✓
CO5	✓	✓	✓	✓	✓
CO6	✓	✓	✓		✓

CO – SDG Mapping (Sustainable Development Goals)

CO	SDG(s) Addressed	Justification / Linkage
CO1	4,9	Identifies real-life societal problem and develops engineering knowledge for innovative solutions
CO2	4,9,12	Evaluates and compares alternative solutions to select sustainable and resource efficient approaches
CO3	4,9,11	Analyze engineering problems and synthesizes technological solutions for societal needs
CO4	4,9,11,13	Designs reliable, scalable and sustainable engineering solutions addressing environmental and societal challenges
CO5	4,9,16	Evaluates engineering solutions based on defined technical, ethical and quality criteria to ensure reliability and accountability
CO6	4,17	Promotes lifelong learning, professional development, collaboration and commitment to solving societal problems