



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 'B25'**

**Effective from Academic Year 2025-26**

**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**



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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. **PO5: 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. **PO6: 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. **PO7: Ethics:** Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws. (WK9)
8. **PO8: Individual and Collaborative Team work:** Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.
9. **PO9: 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. **PO10: 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. **PO11: 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.

**S.Y. B.Tech - Instrumentation and Control Engineering Structure for Pattern B-25, Module-3 with effect from Semester-1 of Academic Year 2025-26**

Course Type	Course Code	Course Name	Teaching Learning Scheme (Hrs./Week)				Credits	Assessment Scheme (100 mark scale)													
			Th	Lab	Tut	Total		LA	CP	T1 MCQ	CT1 Written	MSE Review	In Semester Assessment			End Semester Assessment			Total		
S1	IC2301	Data Science	2	2	0	4	3	10	30							40			20	100	
S2	IC2303	Sensors and Transducers	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 MDM	ICM001	Sensors and Automation	2	0	1	3	3			35						30		35		100	
	ICM002	Microcontroller and Applications																			
EEMC	HS2002	From Campus to Corporate-1	2	0	0	2	2			50							50			100	
S7	IC2236	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	IC2240	Engineering Design and Innovation - I	0	4	0	4	2						30					70		100	
		<b>Total</b>	<b>13</b>	<b>12</b>	<b>2</b>	<b>27</b>	<b>21</b>	<b>40</b>	<b>120</b>	<b>85</b>		<b>30</b>		<b>30</b>	<b>80</b>	<b>90</b>	<b>60</b>	<b>35</b>	<b>270</b>	<b>60</b>	<b>900</b>

**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

**S.Y. B.Tech - Instrumentation and Control Engineering Structure for Pattern B-25, Module-4 with effect from Semester-2 of Academic Year 2025-26**

Course Type	Course Code	Course Name	Teaching Learning Scheme (Hrs./Week)				Credits	Assessment Scheme (100 mark scale)																
			Th	Lab	Tut	Total		Lab	CP	T1 MCQ	CT1 Written	MSE Review	In Semester Assessment			End Semester Assessment			T2 MCQ	ESE Review	CVV	Total		
S1	IC2302	Advanced Data Structures	2	2	0	4	3	10	30										40+20			100		
S2	IC2304	Internet of Things	2	2	0	4	3	10	30										40			20 100		
S3	IC2306	Signal and Image Processing	2	2	0	4	3	10	30										40			20 100		
S4	IC2308	Industrial Automation	2	2	0	4	3	10	30										40			20 100		
S5 MDM	ICMM1402	Microcontroller and Applications	2	0	1	3	3			35								30			35		100	
	ICMM1405	Healthcare Analytics																						
EEMC	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 - II	0	4	0	4	2						30									70		100
		<b>Total</b>	<b>13</b>	<b>12</b>	<b>2</b>	<b>27</b>	<b>21</b>	<b>40</b>	<b>120</b>	<b>85</b>	<b>35</b>	<b>30</b>				<b>30</b>	<b>155</b>	<b>50</b>	<b>60</b>	<b>35</b>	<b>270</b>	<b>60</b>	<b>900</b>	

**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

# **SEMESTER I**

**MD2301:: DATA SCIENCE****Course Prerequisites:**

1. Linear Algebra Basics
2. Central Tendency & Measures of Dispersion – Mean, Mode, Median
3. Probability
4. Some exposure to programming environment – C programming; Python

**Course Objectives:**

1. Understand data processing pipeline
2. Perform dimensionality reduction operations
3. Optimize the performance of functions
4. Apply descriptive statistics tools
5. Deduce meaningful statistical inferences
6. Use unsupervised classification algorithms
7. Use supervised classification algorithms
8. Utilize the data science principles for an entire project life cycle as a case study

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

The course is offered in S.Y. B.Tech. to all branches of Engineering

Data Science is a multidisciplinary field. It uses scientific approaches, procedures, algorithms and frameworks to extract knowledge and insight from a huge amount of data.

Data Science uses concepts and methods which belong to fields like information technology, Mathematics, Statistics, Computer Science etc.

Data Science influences the growth and improvements of the product by providing a lot of intelligence about customers and operations, by using methods such as data mining and data analysis.

The course is relevant to all branches of Engineering and beyond, since data is generated as an obvious outcome of many processes.

Unit-1: Data science definition, raw data, processed data and their attributes, meta data, data cleaning, data science pipeline.	<b>(4 Hours)</b>
Unit-2: Normal distribution, evaluating normal distribution, Binomial distribution, confidence Intervals, central limit Theorem, hypothesis testing	<b>(6 Hours)</b>
Unit-3: Vector norms, Unconstrained Optimization	<b>(4 Hours)</b>
Unit-4: Simple and multiple linear regression; Logistic regression, non-linear regression, polynomial regression	<b>(4 Hours)</b>
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	<b>(6 Hours)</b>
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.	<b>(4 Hours)</b>

**List of Practicals: (Any Six)**

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 Course Projects:**

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

**Text Books:**

1. 'A Beginner's Guide to R' – Zuur, Leno, Meesters; Springer, 2009
2. 'Introduction to Data Science' – Igual, Segui; Springer, 2017
3. 'Mathematics for Machine Learning' – Diesenroth, 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

**Moocs Links and additional reading material:**

1. [www.nptelvideos.in](http://www.nptelvideos.in)
2. <https://www.edx.org/course/machine-learning-fundamentals-2>
3. <https://www.edx.org/course/foundations-of-data-analysis-part-1-statistics-usi>
4. <https://www.coursera.org/learn/statistical-inference/home/welcome>
5. <https://www.coursera.org/learn/data-scientists-tools/home/welcome>

**Course Outcomes:** Upon 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

**Future Courses Mapping:**

1. Deep Learning
2. Reinforcement Learning
3. DBMS
4. Big Data
5. Data Mining
6. Information Retrieval
7. Recommendation Systems
8. IOT
9. Artificial Intelligence
10. Pattern Recognition
11. Computer Vision
12. Machine Vision
13. Fault Diagnosis
14. Optimization
15. Bioinformatics
16. Computational Biology
17. Operations Research

**Job Mapping:**

1. Data Scientist
2. Data Analyst
3. AI Engineer
4. Data Architect.
5. Data Engineer.
6. Statistician.
7. Database Administrator.
8. Business Analyst
9. Business Intelligence Developer
10. Infrastructure Architect
11. Machine Learning Engineering
12. Machine Learning Scientist

**IC2304 :: SENSORS AND TRANSDUCERS****Course Prerequisites:** Basic Physics and chemistry laws.**Course Objectives:**

1. Able to evaluate characteristics of sensors and transducers
2. Analyzing different temperature sensor
3. Select flow sensor for application
4. Compare different pressure sensor
5. Understand different level sensors for different applications
6. Evaluate different speed and noncontact type of sensors

**Credits: 3****Teaching Scheme :** **Theory : 2 Hours/Week**  
**Lab : 2 Hours/Week****SECTION 1:****Unit 1: Basic Measurement system:** **(4 Hrs)**

Basic Measurement System, Process system components, Static and Dynamic characteristic of sensor and system, Standards and calibrations, Transducer definition, classification, and performance characteristics.

Resistive: Potentiometer equivalent circuits, charge and voltage sensitivity. Inductive: LVDT, RVDT, variable, reluctance, self-inductance and mutual inductance. Strain measurement: principle, strain gauge, types, gauge factor, gauge wire properties.

Comparison of pneumatic, hydraulic and electronic Load cell.

**Unit 2: Displacement and Speed Measurement:** **(4 Hrs)**

Digital transducers: encoders – types of translational and rotary encoders. Proximity sensors: inductive, capacitive, optical, ultrasonic, hall-effect and magnetic. Flapper nozzle: sensitivity, characteristics. AC and DC tachometers: Hall Effect, proximity pickup, photoelectric, photo-reflective, Stroboscopes, toothed rotor, eddy current, electromagnetic transducers (moving coil, moving magnet), PH and Conductivity measurement.

**Unit 3: Temperature Measurement:** **(5 Hrs)**

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 (Thermo well), EMF Measurement methods, Thermistor: its types (NTC, PTC), measuring circuits, thermopiles.

**SECTION 2 :****Unit 4: Flow Measurement:** **(5 Hrs)**

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, Variable area type: Rotameter Other flow meters: Turbine, target, electromagnetic, ultrasonic, Hot- wire anemometer.

**Unit 5: Pressure measurement:** (5 Hrs)

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).

**Unit 6: Level Measurement:** (5 Hrs)

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.

**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

**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 - 9th 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.

**Course Outcomes:**

The student will be able to:

1. IC2230\_CO1: Understand the fundamentals of sensors and transducers for mechanical parameters. [1]
2. IC2230\_CO2: Demonstrate the working of sensors and transducers for mechanical parameters.[3]
3. IC2230\_CO3: Analyze the mathematical equation and solve different example of sensors and transducers for mechanical parameters. [5]
5. IC2230\_CO4: Comprehend the fundamentals of sensors and transducers for process parameters.[2]
6. IC2230\_CO5: Demonstrate the working of sensors and transducers for process parameters.[4]
7. IC2230\_CO6: Analyze the mathematical equation and solve different example of sensors and transducers for process parameters. [5]

**CO PO Map:**

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

**CO attainment levels:**

CO No.	1	2	3	4	5	6
Attainment Level	1	2	5	3	4	2

**Future Courses Mapping:**

Measurement systems, Process Instrumentation, Building and Process Automation, etc

**Job Mapping:**

Industrial Automation is a rapidly evolving field and currently there is a tremendous scope and job opportunities available in the market for Automation Engineers

Some of the exciting and challenging jobs performed by Industrial Controls Automation professionals are: Automation Project Manager, – Automation Control Engineer, – Automation Application Engineer

**IC2305:: OBJECT ORIENTED PROGRAMMING**

**Course Prerequisites:** Basic course on programming

**Course Objectives:**

1. Understand Object Oriented programming concepts
2. Demonstrate Object Oriented programming concepts by writing suitable Java programs
3. Model a given computational problem in Object Oriented fashion
4. To develop problem solving ability using Object Oriented programming constructs like multithreading
5. Develop effective solutions using for real world problems using the concepts such as file handling and GUI
6. Implement applications using Java I/O and event-based GUI handling principles

**Credits: 3**

**Teaching Scheme Theory:** 2 Hours/Week

**Lab:** 2 Hours/Week

**Course Relevance:**

This is an important course for engineering students. It develops computational problem solving and logic building capability of students. Acquiring programming skills has a high relevance in all branches of Engineering. Once the student gains expertise in coding, this course proves to be beneficial to them to excel in industry demanding coding in specific software.

**Course Contents :**

**Introduction:**

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. 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).

#### List of Practicals:

1. 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
2. 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: []
3. Write Java program to calculate area of triangle, square & circle using function overloading. Function parameter accept from user (Use function Overloading concepts and Inheritance).
4. Write a program for following exception, develop a suitable scenario in which the following exceptions occur:
  - a. divide by zero
  - b. Array index out of bounds exception
  - c. 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 Course Projects:

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
21. Teachers Feedback Form Java Project
22. Online Job Portal Java Project
23. Online Examination Java Project
24. Alumini Database Java Project
25. Virtual Classroom Java Project
26. Lan Chat and File Sharing Java Project
27. Payroll System Java Project
28. Online Exam Java Project
29. Java Game mini Project
30. Online Shopping Java Project
31. Online Library Management System
32. Feedback Collection System java project
33. Text Editor in Java Project
34. Moving Balls using Java Applet
35. Online Reservation System Project
36. Web skeletonizer service
37. Web Enabled Manufacturing Process Project
38. Album Manager Project
39. Global Communication Network
40. Library System project
41. Link Handler System Project
42. Crypto system Project
43. Scheduling and Dispatching project
44. Intranet Mailing System
45. Online Examination System Project
46. Business to Customer System Project
47. University Admission & Maintenance System
48. Campaign Management System Project
49. Content Management System Project
50. Digital Library System Project
51. Contract Labour Management System Project

52. Pay Roll System Project using Java
53. Revenue Recovery System Project
54. Online medical Booking Store Project
55. Client Management System Project
56. Tele Dormitory System Project
57. Reusable CAPTCHA security engine Project
58. Mobile Service Provider System
59. Forestry Management System
60. Distributed Channel management System
61. Online Tenders Management System
62. Noble Job Portal System
63. Energy Audit Processing System
64. Collector Monthly Review System
65. Grievance Handling System
66. Student Project Allocation and Management Project
67. Web Based Reporting System
68. Vehicle Identification System
69. Diamond Shipping System
70. Visa Processing System
71. Enterprise Fleet Management System
72. Global Communication Media
73. HR Help Desk System
74. SQL Workbench Project
75. Remarketing System project
76. Cargo Express Courier project
77. Automated Sports Club Project
78. Multi Banking System Project
79. Java Application World
80. Cricket Game Java Project
81. Email Program System
82. Employee Information and Payroll System
83. Complete Mailing System
84. Complete Banking System
85. College Library Application System
86. Colleges Enrollment System
87. Car Sales System
88. Bus Booking System
89. Bug Tracking System
90. University Admission Management System Java Project
91. Beat It Game in Java
92. Civilization Game Project
93. Airways Reservation System
94. Airstrike System Game
95. Pong Game Java Project
96. Faculty Book System
97. Bank Application System
98. ATM Database System

99. Advanced Payroll System
100. Virtual Private Network Java Project
101. ISP Automation System
102. Life Insurance Management System
103. Help Desk Management System
104. Datamart Management System
105. Automated Sports Club System
106. University Search Engine Project
107. Online Exam Suite Project
108. Forensic Management System
109. Student Registration System
110. E Mail Scanning Project
111. Criminal Face Detection System
112. Web Server Management System Java Project
113. Stores Management System
114. Bug Tracking System Java Project
115. Career Information Management System Java Project
116. Course Management System Java Project
117. Data Visualization Software Java Project
118. Digital Steganography Java Project
119. E Health Care Management System Java Project
120. Electricity Billing System Java Project
121. Email Client Software Java Project
122. Event Management System Java Project
123. Farmers Buddy Java Project Java Project
124. File Transfer and Chat Java Project
125. Knowledge Evaluator Software Java Project
126. Library Management System Java Project
127. Mail Server Java Project
128. Network Packet Sniffer Java Project
129. Number Guessing Game Java Project
130. Online Attendance Management System Java Project
131. Online Bank Management System Java Project
132. Online Book Store
133. Online Customer Care and Service Center Java Project
134. Online Document Management System Java Project
135. Online Examination Management System Java Project
136. Online Medical Management System Java Project
137. Online Quiz System Java Project
138. Online Survey System Java Project
139. Photo Lab Management System Java Project
140. RSS Feed Reader Java Project
141. Smart City Project Java Project
142. Stock Management System Java Project
143. Student Result Processing System Java Project
144. Supply Chain Management System Java Project
145. Telephone Billing System Java Project

- 146. Travel Management System Java Project
- 147. Currency Converter
- 148. Career Information Management System
- 149. Digital Steganography
- 150. Event Management System
- 151. Farmers Buddy
- 152. File Transfer and Chat
- 153. Knowledge Evaluator Software
- 154. Mail Server
- 155. Number Guessing Game
- 156. Online Attendance Management System
- 157. Online Customer Care and Service Center
- 158. Online Document Management System
- 159. Online Examination Management System
- 160. Online Quiz System
- 161. Photo Lab Management System
- 162. Student Result Processing System
- 163. Travel Management System
- 164. University Admission Management System
- 165. Web Server Management System
- 166. Address Book Management System
- 167. Affiliate Manager
- 168. Ajax Browser
- 169. Application Installer Software
- 170. Application Re-installer Software
- 171. ATM Simulator System
- 172. Automatic File Update
- 173. Bookmark Sync
- 174. Bus Ticket Reservation System
- 175. Calendar Icon Maker Application
- 176. CSS Color and Image Annotator
- 177. Cybercafe Management System
- 178. Data Encryption
- 179. Database Explorer
- 180. Directory and File Explorer

**Text Books:**

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

**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.
2. R. Morelli and R. Walde, "Java, java, Java – Object-Oriented Problem Solving", 3<sup>rd</sup> edition, Pearson Education, Inc.

**Moocs Links and additional reading material:**

1. Programming using Java| Java Tutorial | By Infosys Technology  
[https://infyspringboard.onwingspan.com/en/app/toc/lex\\_auth\\_01304972186110361645\\_shared/overview](https://infyspringboard.onwingspan.com/en/app/toc/lex_auth_01304972186110361645_shared/overview)
2. An Introduction to Programming through C++ – Prof A.G. Ranade- NPTEL- computer science and engineering – NOC <https://nptel.ac.in/courses/106/101/106101208/#>

**Course Outcomes:**

The 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

**Future Courses Mapping:**

Advanced Data Structures, Advanced Java, Spring Frame Work, Grails Frame Work

**Job Mapping:** Java Programmer, Application Developer, Design Engineer, Senior Software Developer.

**IC2307:: DATABASE MANAGEMENT SYSTEMS****Course Prerequisites:**

Data structures, Discrete Mathematics

**Course Objectives:**

1. Learn the fundamentals of different data modeling techniques.
2. Design and development of relational database management systems.
3. Study the theory behind database systems, the issues that affect their functionality and performance
4. Design of query languages and the use of semantics for query optimization.
5. Understand the latest trends of data management systems.

**Credits: 3**

**Teaching Scheme Theory: 2 Hours/Week**

**Lab: 2 Hours/Week**

**Course Relevance:**

The course emphasizes the fundamentals of database modelling and design, the languages and models provided by the database management systems, and database system implementation techniques. The goal is to provide an in-depth and up-to-date presentation of the most important aspects of database systems and applications, and related technologies.

**SECTION-I****Topics and 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-II****Topics and 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 Databases, BASE properties, CAP theorem, Introduction to Big Data

**Data Warehousing:** Architecture and Components of Data Warehouse, OLAP and OLTP

**List of Practical: (Any Six)**

- 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 indicative 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.

**Text Books:**

1. Abraham Silberschatz, Henry F. Korth, S. Sudarshan; "Database System Concepts"; 6<sup>th</sup> Edition, McGraw-Hill Education
2. Ramez Elmasri, Shamkant B. Navathe; "Fundamentals of Database Systems"; 7<sup>th</sup> 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, DreamTech.
5. Ivan Bayross, SQL, PL/SQL: The Programming Language of Oracle, BPB Publication.
6. Reese G., 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.

**Moocs Links and additional reading material:**

1. <https://nptel.ac.in/courses/106/105/106105175/>
2. [https://onlinecourses.nptel.ac.in/noc21\\_cs04/preview](https://onlinecourses.nptel.ac.in/noc21_cs04/preview)
3. <https://www.datacamp.com/courses/introduction-to-sql>
4. Oracle MOOC: PL/SQL Fundamentals - Oracle APEX

**Course Outcomes:**

The 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

**Future Courses Mapping:**

Advanced databases  
 Big Data Management  
 Cloud Databases  
 Database Administrator

**Job Mapping:**

Database Engineer, SQL developer, PL/SQL developer

**HS2002: FROM CAMPUS TO CORPORATE– 1****Credits:2****Teaching Scheme: Theory: 2 Hours/Week**

Introduction to the Corporate World Understanding organizational structure and hierarchy, Work culture differences: campus vs. corporate, Employer expectations from fresh graduates, Time management and ownership in corporate settings

**Professional Communication Skills:** Verbal and non-verbal communication, Email and business writing etiquette, Presentation skills and use of visual aids, Listening skills and telephone etiquette,

**Soft Skills and Interpersonal Effectiveness:** Body language, grooming, and first impressions, Conflict resolution and negotiation skills, Team dynamics and collaboration, Assertiveness vs. aggressiveness

**Resume Building and Job Preparation:** Building an effective resume and cover letter, identifying strengths and achievements, Preparing for technical and HR interviews, Handling rejections and feedback

**Group Discussions and Personal Interviews:** Group discussion formats and evaluation criteria, Strategies for initiating, contributing, and summarizing, Mock interviews with feedback, STAR technique for answering behavioral questions,

**Corporate Etiquette and Workplace Ethics:** Meeting and greeting protocol, Dining and social etiquette, Work ethics, punctuality, confidentiality, Respect for diversity and inclusion in the workplace

**Adaptability and Emotional Intelligence:** Handling pressure, deadlines, and ambiguity, Self-awareness and emotional regulation, Empathy and workplace relationships, Managing feedback and continuous learning,

**Introduction to Project Management Basics:** Understanding tasks, milestones, deadlines, Collaboration using tools like Trello, Slack, Teams, Basics of Agile/Scrum concepts, Reporting and escalation protocol

Faculty are supposed to conduct following in the class

- Resume and LinkedIn profile workshops
- Mock interviews and GD sessions
- Role plays: workplace scenarios, conflict handling
- Business Email Writing exercises
- Presentation and elevator pitch sessions

**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

**IC2236:: DESIGN THINKING-1**

**Course Prerequisites:** Problem Based Learning, Project Centric Learning

**Course Objective:**

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

**Credits: 1**

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

**Section 1: Topics/Contents**

What is research?

Importance of Paper Publication and Patents

Structure of Paper

Journal Publication

Publication in conference

Literature Review

Research Paper Writing

Journal Ratings and Evaluation

How to rate a Journal?

Intellectual property (IP)

Research Ethics

Entrepreneurship

**Section 2: Topics/Contents**

Structure of The paper

Journal List (Top 50 Journals)

Selection of the journal

Use of various online journal selection tools

Plagiarism checking

Improving contents of the paper

Patent drafting

Patent search

Filing of patent

Writing answers to reviewer questions

Modification in manuscript

Checking of publication draft

**Course Outcome:** [Publication of paper or patent]

The student will be able to

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

**CO-PO Map:**

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

**CO attainment levels**

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

## HS2001 : REASONING AND APTITUDE DEVELOPMENT-3

**Credits: 1**

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

### **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, S. Chand Publishing, ISBN: 978-8121903423.

**Course Outcomes –**

Upon completion of the course, the 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

**IC2240:: ENGINEERING DESIGN AND INNOVATION-I****Course Prerequisites:** Electronic design, simulation, MATLAB, Labview, PCB design**Course Objectives:** The student will be able to

1. Understand the importance of choosing socially relevant areas for project work
2. Understand the importance of Project centric learning
3. Plan and execute systematic strategy to complete the Project work
4. Document and present the completed project work in proper scientific format
5. To Evaluate alternative approaches, and justify the use of selected tools and methods
6. To provide every student with the opportunity to get involved either individually or as a group so as to develop team skills and learn professionalism.
7. To develop an ecosystem to promote entrepreneurship and research culture among the students

**Credits: 2****Teaching Scheme :** **Lab:** 4 Hours/Week**Course Relevance:** This course will develop

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

**Topics and Contents****It is based on Real time project implementation in the chosen specific defined area.**

Agriculture Healthcare Automotive Process Control IoT

**Basics for Projects**

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

**Domain Project Areas:** Awareness and identification of appropriate areas for project work such as: Agriculture, Defense, Healthcare, Smart city, Smart energy, Security Systems, Automobile, Space, Green Earth, Automobiles, Assistive Aid, Water Management, Swachh Bharat (any other socially relevant research area)**Tools:** *Self learning Activity* Learn and use latest engineering tools as per the project need. A few are listed below**Tools in Computer Engineering:****Programming / Coding Tools** :- JavaScript, Python, Java, C#, C++, PHP, **Computer Vision Tools** :- OPENCV, MATLAB), **Single board computers**: Raspberry Pi, Neural network simulators **Tools**:- Neural Lab, NEST , Machine Learning **Tools**:- Torch, TensorFlow, **Data Science Tools** :- R language programming, SQL,**Tools in Electronics and Electronics & Telecommunication Engineering:****Electronic Design Simulation Integrated Circuit Tools**:- VHDL, Xilinx, Modelsim , Cadence learn, **Embedded System Tools**:- AVR Studio, Arduino ,Kiel µvision, **Circuit Simulation Tools**:- Pspice, Simulink, Workbench, Tinkercad, ThingSpeak, Proteus, CircuitPro ,**Processor based integrated circuits** :Microcontroller, electronic prototype platforms: Arduino, **Networking**

**Tools :-** Wired / Wireless and Ad-hoc Networking NS-2 , Packet Tracer, **Signal Processing**

**Tools:-** Code Composer Studio along with Integrated circuits

**Tools in Instrumentation and Control Engineering:-**

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

**Tools in Mechanical, Industrial, Production, Engineering:-**

**Engineering Design Tools:-** AutoCAD, CATIA,COMSOL Multiphysics, Solidworks, Inventor,

**PTC Creo Fluid Dynamics:-** Fluent, HyperWorks, **Finite Element/ Structural Analysis:-**

Ansys's, Ansys's Free Student software **Thermal Simulation:-** FlowTherm, Ansys Icepak

**Tools in Chemical Engineering :-**

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

**software:-** Schrödinger,

(any other suitable tool as per the project requirement)

**Technology:** Map the appropriate technology:

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

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

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

**Medical and Healthcare Technologies:-** Biomedical Technology,

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

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

Other imp Technologies:- Automobile ,3 D printing

(any other technology as per the project requirement)

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

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

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

**Course Outcomes:**

1. Design solutions for given engineering problem [1]
2. Demonstrate practical knowledge by constructing models/algorithms for real time applications [1]
3. Express effectively in written and oral communication [2]
4. Exhibit the skills to work in a team or individually [2]
5. Prepare a time chart and financial record for execution of the project [3]
6. Choose and compare alternative approaches to select most feasible one [2]

**CO-PO Mapping:**

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

# **SEVEN<sup>TH</sup> SEMESTER**

## IC2302 :: ADVANCED DATA STRUCTURES

**Course Prerequisites:** Basic understanding of C/C++ programming

**Course Objectives:**

1. To impart the basic concepts of data structures and algorithms
2. To learn and understand linear and non-linear data structures.
3. To implement searching and sorting techniques using linear data structures.
4. To understand how to solve problems using step by step approach with the help of fundamental data structures.
5. To emphasize the importance of data structures in developing and implementing efficient algorithms

**Credits: 3**

**Teaching Scheme Theory: 2 Hours/Week**

**Lab : 2 Hours/Week**

**Course Relevance:**

This is a basic Course for Computer Engineering and allied branches. This course has high relevance in all domains of computer engineering such as in Industries; research etc. as a basic prerequisite course. Data Structures are a crucial part of computer algorithms as they allow programmers to do data management efficiently. A wise selection of data structures can improve the performance of a computer program or algorithm in a more useful way.

**SECTION-1:**

**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

**SECTION-2:****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.

**List of Practicals (Any 10):**

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.
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

#### **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

#### **Moocs Links and additional reading material:**

1. [nptel.ac.in/courses/106/102/106102064](https://nptel.ac.in/courses/106/102/106102064)
2. [nptel.ac.in/courses/106/105/10610508](https://nptel.ac.in/courses/106/105/10610508)

#### **Course Outcomes:**

The student will be able to –

1. To interpret and diagnose the properties of data structures with their memory representations
2. To comprehend various sorting and searching algorithms.
3. To use linear data structures like stacks, queues etc. with their applications
4. To handle operations like searching, insertion, deletion, traversing mechanism etc. On tree.
5. To demonstrate the use of binary tree traversals and to perform various operations on nonlinear data structures.
6. To implement the graph data structures to solve engineering problems.

#### **CO PO Map:**

CO/PO	PO:1	PO:2	PO:3	PO:4	PO:5	PO:6	PO:7	PO:8	PO:9	PO:10	PO:11		PSO:1	PSO:2	PSO:3
CO:1	1	1	1	0	0	0	0	0	0	0	0		0	2	0
CO:2	0	2	2	2	2	0	0	0	0	0	0		2	0	2
CO:3	0	0	1	2	2	0	0	0	0	0	0		0	2	0
CO:4	2	0	0	1	2	2	2	0	0	0	0		0	0	2
CO:5	0	2	0	0	1	2	2	2	0	0	0		0	0	0
CO:6	2	0	2	0	0	1	2	2	2	0	0		0	0	0

**CO attainment levels:**

CO No	IC2202_CO1	IC2202_CO2	IC2202_CO3	IC2202_CO4	IC2202_CO5	IC2202_CO6
Attainment level	1	2	2	3	3	4

**Future Courses Mapping:**

Data Analytics, Data Science, OOPS, Artificial Intelligence, Machine learning, Software Engineering

**Job Mapping:**

DS is a fundamental course for the students who are aspiring to make a career in the field of Software engineering. Once this course is learned students can apply for a job as a Software developer, Software testing, Data Analyst etc. The course is also helpful for students who are planning to have their own start-ups in the area of Software development.

**IC2304:: INTERNET OF THINGS****Course Prerequisites:**

Students should have a basic Understanding of the Internet, Cloud, Networking Concepts and Sensors

**Course Objectives:**

The student will be able to

1. Understand IoT Architecture and framework.
2. Recognize and differentiate between the various use cases of different sensors, actuators, solenoid valve etc
3. Learn about fundamental concepts of networking and protocols.
4. Understand IoT Physical, Datalink and Higher layer Protocols.
5. Apply theoretical knowledge for Cloud computing.
6. Implement an IoT solution practically

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

The Internet of Things is transforming our physical world into a complex and dynamic system of connected devices on an unprecedented scale. Internet of Things is a system of interrelated computing and sensing devices and has the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction.

Advances in technology are making possible a more widespread adoption of IoT, from pill-shaped micro-cameras that can pinpoint thousands of images within the body, to smart sensors that can assess crop conditions on a farm, to the smart home devices that are becoming increasingly popular.

IoT is highly relevant in this growing ecosystem of internet-enabled devices. IoT offers increasing opportunities to collect, exchange, analyse and interpret data in real-time. This robust access to data will result in opportunities to further enhance and improve operations. In a world which is moving towards an increasingly connected future, Internet of Things (IoT) is the next big thing. Right from our homes to our cars to our cities, everything is being connected and the technology of IoT is right in the middle of it.

**Introduction to IoT**

Physical Design of IOT, Logical Design of IOT, IOT Enabling Technologies, IOT Levels & Deployment Templates **(4 Hours)**

**IOT Platform Design Methodology**

IOT Design Methodology Steps, Home Automation Case Study, Smart Cities, Health Care, Agriculture **(4 Hours)**

**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 Hours)**

**Introduction to Wireless Sensor Network**

Sensor Node, Smart Sensor Network, Wireless Sensor Network, RFID - Principles and Components, Node MCU **(4 Hours)**

**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 Hours)**

**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 Hours)**

**List of Practicals: (Minimum Six)**

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 Course 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

**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", ISBN:987-87-93102-94-1, River Publishers
3. Joe Biron and Jonathan Follett, "Foundational Elements of an IoT Solution," by Joe Biron

**MOOCs Links and additional reading material:**

1. <https://proed.stanford.edu/course/view.php?id=191>
2. <https://nptel.ac.in/courses/106/105/106105166/>
3. <https://create.arduino.cc/projecthub/electropeak/getting-started-w-nodemcu-esp8266-on-arduino-ide-28184f>

**Course Outcomes**

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

**Future Courses Mapping:**

1. Ad-Hoc Networks
2. Cyber Security
3. Wireless Networks
4. Industry 4.0
5. Big Data

**Job Mapping:**

The Internet of Things (IoT) is the most emerging field in today's world. It is revolutionizing every industry, from home appliances to agriculture to space exploration. Since the advent of cloud computing, there has been an exponential growth in the number of sensor-enabled devices connected to the internet and expecting further growth accelerating in the coming years. There are diversified career opportunities in this field. The various career positions available as IoT Research Developer, IoT Design Engineer, IoT Product Manager, IoT Software Developer, IoT Solution Architect, IoT Service Manager and many more.

FF No. : 654

**IC2306 :: SIGNAL AND IMAGE PROCESSING****Course Prerequisites:** Mathematics, Mathematical Transforms, Linear Algebra**Course Objectives:**

1. Upon completion of this course, students will be familiar with basic signal and image processing techniques for solving real problems.
2. This course will provide understanding to design, implement, and analysis digital system utilizing the signal and image processing techniques

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

Signal and Image processing course is the basis of machine learning, deep learning, artificial intelligence, robotics, automation, IOT, Industry 4.0

**SECTION-1: Signal Processing****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: Image Processing****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 (4 Hrs)**

Segmentation based on Discontinuities (point, Line, Edge)

Image Edge detection using Robert, Sobel, Previtt masks, Canny's Edge Detector.

### **List of Projects Areas:**

1. Audio signal filtering
2. Biomedical Signal analysis
3. Frequency spectrum analysis
4. Vibration Signal analysis
5. Speech recognition
6. Image filtering
7. Image recognition
8. Image Classification
9. Object detection using image processing
10. Image compression

### **List of Lab assignments:**

**Lab1:** (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.

**Lab4:** (i) Formation of image from a 8\*8 matrix, plotting negative image 8\*8 matrix. (ii) Geometric operations on a image scale, rotate, reflect translate

**Lab 5:** 2D FFT of an image

**Lab 6:** Convolution of kernel and images – Smoothening filter and sharpening filter

### **Link for MOOCs:**

1. Signal Processing - <https://nptel.ac.in/courses/117/102/117102060/>
2. Image Processing - <https://nptel.ac.in/courses/117/105/117105135/>

### **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

**Course Outcomes:** The student will be able to

1. **IC2226\_CO1:** Digitize the continuous time signal, perform various operations on the signal and analyze the properties of the given digital systems.
2. **IC2226\_CO2:** 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. **IC2226\_CO3:** 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. **IC2226\_CO4:** Perform operations on pixel, Perform Geometric transformation on image.
5. **IC2226\_CO5 - :** Analyze images in the frequency domain using various transforms.
6. **IC2226\_CO6 -** Evaluate the techniques for image enhancement and image restoration.  
Interpret image segmentation and representation techniques

#### CO PO Map:

C O	PO -1	PO -2	PO -3	PO -4	PO -5	PO -6	PO -7	PO -8	PO -9	PO -10	PO -11		PSO -1	PSO -2	PSO -3
1	3	3	3	3	3	1	1	1	1	1	1		1	3	3
2	3	3	3	3	3	1	1	1	1	1	1		1	3	3
3	3	3	3	3	3	1	1	1	1	1	1		1	3	3
4	3	3	3	3	3	1	1	1	1	1	1		1	3	3
5	3	3	3	3	3	1	1	1	1	1	1		1	3	3
6	3	3	3	3	3	1	1	1	1	1	1		1	3	3

#### CO attainment levels

CO No.	IC2226_CO1	IC2226_CO2	IC2226_CO3	IC2226_CO4	IC2226_CO5	IC2226_CO6
Attainment Level	3	5	4	4	4	4

#### Future Courses Mapping:

Computer vision, machine learning, deep learning, artificial intelligence, natural language processing

#### Job Mapping:

Signal and Image processing course may lead to jobs in embedded system, digital system manufacturing industries, software industries for application development, finance software.

**IC2308:: INDUSTRIAL AUTOMATION****Credits: 3****Teaching Scheme Theory: 2 Hours/Week****Lab : 2 Hours/Week****Course Prerequisites:** Fundamentals of Sensors and Transducers, digital electronics**Course Objectives:**

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

**SECTION 1:****Unit 1: Industrial Control Devices (5 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 (5 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 (5 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 :****Unit 4: Programmable Logic Controllers (5 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 (5 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: (5 Hrs)**

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

**Control panels**

Control Panel: Control panel basics, control room layout, Electric Power Systems, Instrument Power Requirements, Power Distribution, Control Room Lighting, Communication Systems Control Panel Types, Flat face Panels, Breakfront Panels, Consoles, Comparison of Panel Types, Panel Layout, Control Panel Bid Specifications, Panel Inspections.

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

1. Implementation of logic circuits using switches.
2. Implementation of relay logic electrical wiring for given application.
3. Implementation of latching, sequencing and interlocking electrical wiring for given application using contactor.
4. Implementation and testing of hydraulic circuit.
5. Implementation and testing of pneumatic circuit.
6. Testing of hydraulic logic circuit using H-simulator.
7. Testing of pneumatic logic circuit using P-simulator.
8. Develop and Simulate Ladder program for simple on-off, timer and counter applications.

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

**List of Course Project areas**

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

**Text Books:**

1. F. D. Petruzzella "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 Petruzzella "Programmable logic controller", McGraw-Hill Education.
5. SCADA by Stuart A Boyer : ISA 1999

**Course Outcomes:**

The student will be able to:

1. IC2228\_CO1: Comprehend the working of electrical, hydraulic, pneumatic, mechanical, PLC, drives, HMI and control panel components.
2. IC2228\_CO2: Develop electrical wiring diagrams, hydraulic, pneumatic circuits for given application.
3. IC2228\_CO3: Select and size the electrical, mechanical, hydraulic and pneumatic components to solve a problem.

4. IC2228\_CO4: Identify, formulate and solve a problem using electrical, mechanical, hydraulic and pneumatic system.
5. IC2228\_CO5: Develop PLC, SCADA, HMI programs for given application.
6. IC2228\_CO6: Demonstrate practical knowledge, communication and team skills, by constructing models for real life applications

**CO PO Map:**

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

**CO attainment levels:**

CO No.	IC2228_CO1	IC2228_CO2	IC2228_CO3	IC2228_CO4	IC2228_CO5	IC2228_CO6
Attainment Level	1	2	5	5	3	3

**Future Courses Mapping:**

Process Instrumentation, Building and Process Automation, etc.

**HS2003: FROM CAMPUS TO CORPORATE– 2****Credits: 2****Teaching Scheme: Theory: 2 Hours/Week**

Introduction to the Corporate World Understanding organizational structure and hierarchy, Work culture differences: campus vs. corporate, Employer expectations from fresh graduates, Time management and ownership in corporate settings

**Professional Communication Skills:** Verbal and non-verbal communication, Email and business writing etiquette, Presentation skills and use of visual aids, Listening skills and telephone etiquette,

**Soft Skills and Interpersonal Effectiveness:** Body language, grooming, and first impressions, Conflict resolution and negotiation skills, Team dynamics and collaboration, Assertiveness vs. aggressiveness

**Resume Building and Job Preparation:** Building an effective resume and cover letter, identifying strengths and achievements, Preparing for technical and HR interviews, Handling rejections and feedback

**Group Discussions and Personal Interviews:** Group discussion formats and evaluation criteria, Strategies for initiating, contributing, and summarizing, Mock interviews with feedback, STAR technique for answering behavioral questions,

**Corporate Etiquette and Workplace Ethics:** Meeting and greeting protocol, Dining and social etiquette, Work ethics, punctuality, confidentiality, Respect for diversity and inclusion in the workplace

**Adaptability and Emotional Intelligence:** Handling pressure, deadlines, and ambiguity, Self-awareness and emotional regulation, Empathy and workplace relationships, Managing feedback and continuous learning,

**Introduction to Project Management Basics:** Understanding tasks, milestones, deadlines, Collaboration using tools like Trello, Slack, Teams, Basics of Agile/Scrum concepts, Reporting and escalation protocol

Faculty are supposed to conduct following in the class

- Resume and LinkedIn profile workshops
- Mock interviews and GD sessions
- Role plays: workplace scenarios, conflict handling
- Business Email Writing exercises
- Presentation and elevator pitch sessions

**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

**IC2316:: DESIGN THINKING-2**

**Course Prerequisites:** Problem Based Learning, Project Centric Learning

**Course Objective:**

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

**Credits: 1**

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

**Section 1: Topics/Contents**

What is research?

Importance of Paper Publication and Patents

Structure of Paper

Journal Publication

Publication in conference

Literature Review

Research Paper Writing

Journal Ratings and Evaluation

How to rate a Journal?

Intellectual property (IP)

Research Ethics

Entrepreneurship

**Section 2: Topics/Contents**

Structure of the paper

Journal List (Top 50 Journals)

Selection of the journal

Use of various online journal selection tools

Plagiarism checking

Improving contents of the paper

Patent drafting

Patent search

Filing of patent

Writing answers to reviewer questions

Modification in manuscript

Checking of publication draft

**Course Outcome:** [Publication of paper or patent]

The student will be able to

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

**CO-PO Map:**

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

**CO attainment levels**

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

**HS2002 : REASONING AND APTITUDE DEVELOPMENT-4****Credits: 1****Teaching Scheme Tut: 1 Hours/Week****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, S. Chand Publishing, ISBN: 978-8121903423.

**Course Outcomes –**

Upon completion of the course, the 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

## IC2317:: ENGINEERING DESIGN AND INNOVATION-II

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

**Course Objectives:** The student will be able to

1. Understand the importance of choosing socially relevant areas for project work
2. Understand the importance of Project centric learning
3. Plan and execute systematic strategy to complete the Project work
4. Document and present the completed project work in proper scientific format
5. To Evaluate alternative approaches, and justify the use of selected tools and methods
6. To provide every student with the opportunity to get involved either individually or as a group so as to develop team skills and learn professionalism.
7. To develop an ecosystem to promote entrepreneurship and research culture among the students

**Credits: 2**

**Teaching Scheme :** **Lab:** 4 Hours/Week

**Course Relevance:** This course will develop

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

### Topics and Contents

**It is based on Real time project implementation in the chosen specific defined area.**

Agriculture Healthcare Automotive Process Control IoT

### Basics for Projects

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

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

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

### Tools in Computer Engineering:

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

### Tools in Electronics and Electronics & Telecommunication Engineering:

**Electronic Design Simulation Integrated Circuit Tools**:- VHDL, Xilinx, Modelsim , Cadence learn, **Embedded System Tools**:- AVR Studio, Arduino ,Kiel µvision, **Circuit Simulation Tools**:- Pspice, Simulink, Workbench, Tinkercad, ThingSpeak, Proteus, CircuitPro ,**Processor based integrated circuits** :Microcontroller, electronic prototype platforms: Arduino,Networking

**Tools :-** Wired / Wireless and Ad-hoc Networking NS-2 , Packet Tracer, **Signal Processing**

**Tools:-** Code Composer Studio along with Integrated circuits

**Tools in Instrumentation and Control Engineering:-**

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

**Tools in Mechanical, Industrial, Production, Engineering:-**

**Engineering Design Tools:-** AutoCAD, CATIA,COMSOL Multiphysics, Solidworks, Inventor,

**PTC Creo Fluid Dynamics:-** Fluent, HyperWorks, **Finite Element/ Structural Analysis:-**

Ansys's, Ansys's Free Student software **Thermal Simulation:-** FlowTherm, Ansys Icepak

**Tools in Chemical Engineering :-**

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

**software:-** Schrödinger,

(any other suitable tool as per the project requirement)

**Technology:** Map the appropriate technology:

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

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

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

**Medical and Healthcare Technologies:-** Biomedical Technology,

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

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

Other imp Technologies:- Automobile ,3 D printing

(any other technology as per the project requirement)

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

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

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

**Course Outcomes:**

1. Design solutions for given engineering problem [1]
2. Demonstrate practical knowledge by constructing models/algorithms for real time applications [1]
3. Express effectively in written and oral communication [2]
4. Exhibit the skills to work in a team or individually [2]
5. Prepare a time chart and financial record for execution of the project [3]
6. Choose and compare alternative approaches to select most feasible one [2]

#### CO-PO Mapping:

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



Bansilal Ramnath Agarwal Charitable Trust's  
**Vishwakarma Institute of Technology**

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

**Structure & Syllabus of**

**Third Year B.Tech.  
(Instrumentation and Control Engineering)**

**Pattern 'C25'**

**Effective from Academic Year 2025-26**

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

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

**Signed by**

  
**Chairman – BOS**

  
**Dean Academics**

  
**Chairman – Academic Board**



**Syllabus of TY BTech (Instrumentation and Control) offered by B.O.S. in Instrumentation Engineering  
for Academic Year 2025-26**

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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. **PO5: 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. **PO6: 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. **PO7: Ethics:** Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws. (WK9)
8. **PO8: Individual and Collaborative Team work:** Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.
9. **PO9: 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. **PO10: 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. **PO11: 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)
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## **Program Specific Outcomes (PSOs)**

Graduates shall have the ability to:

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

**T.Y. B.Tech - Instrumentation and Control Engineering Structure for Pattern C-25, Module-5 with effect from Semester-1 of Academic Year 2025-26**

Course Type	Course Code	Course Name	Teaching Learning Scheme (Hrs./Week)				Credits	Assessment Scheme (100 mark scale)											
								In Semester Assessment					End Semester Assessment					Total	
			Th	Lab	Tut	Total		Lab 10	CP 20	MSE-MCQ 30	MSE-Review 30	Seminar / GD / HA 20			ESE 30	ESE Review 70	CVV 20		
S1	IC3231	Process Instrumentation	2	2	1	5	4	10	20				20		30		20	100	
s2	IC3233	Measurement Systems	2	2	1	5	4	10	20			20		30			20	100	
s3	IC3237	Control Theory	2	2	1	5	4	10	20			20		30			20	100	
s4	IC3243	Artificial Intelligence and Machine Learning	2	2	1	5	4	10	20				20		30		20	100	
s5	IC3255	Design Thinking - 5	0	0	1	1	1											100	
s6	IC3252	Engineering Design and Innovation - V	0	12	0	12	6				30					70		100	
s7	SH3001	Reasoning and Aptitude Development-1	1	0	0	1	1							100				100	
		<b>Total</b>	<b>9</b>	<b>20</b>	<b>5</b>	<b>34</b>	<b>24</b>	<b>40</b>	<b>80</b>		<b>30</b>	<b>40</b>	<b>20</b>	<b>20</b>	<b>60</b>	<b>160</b>	<b>70</b>	<b>80</b>	<b>700</b>

**Nomenclature for Teaching Scheme**

Th : Theory

Lab : Laboratory

Tut : Tutorial

**Nomenclature for Assessment Scheme**

Lab : Laboratory Continuous Assessment

HA : Home Assignment

CP : Course Project

CVV : Comprehensive Viva Voce

T1 / T2: Online Test

GD : Group Discussion

CT1/ CT2 : Class Test

HA : Home Assignment

MSE : Mid Semester Examination

Pract : Practical Exam

ESE : End Semester Examination

MCQ : Multiple Choice Questions

Vishwakarma Institute of Technology

Title : Course Structure

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

FF No. 653

**T.Y. B.Tech - Instrumentation and Control Engineering Structure for Pattern C-25, Module-6 with effect from Semester-2 of Academic Year 2025-26**

Course Type	Course Code	Course Name	Teaching Learning Scheme (Hrs./Week)				Credits	Assessment Scheme (100 mark scale)																
			Th	Lab	Tut	Total		Lab 10	CP 20	MSE-MCQ 30	MSE Review 30	In Semester Assessment Seminar / GD / HA 20			End Semester Assessment ESE 30			ESE Review 70	CVV 20	Total 100				
S1	IC3260	Instrumentation Project Engineering	2	2	1	5	4	10	20						20		30		20	100				
S2	IC3234	Building and Process Automation	2	2	1	5	4	10	20						20		30		20	100				
S3	IC3240	Computer Network and Web Technologies	2	2	1	5	4	10	20						20		30		20	100				
s4	IC3259	Cybersecurity	2	2	1	5	4	10	20						20		30		20	100				
s5	IC3257	Design Thinking - 6	0	0	1	1	1													100				
s6	IC3254	Engineering Design and Innovation - VI	0	12	0	12	6								30				70	100				
s7	SH3002	Reasoning and Aptitude Development-2	1	0	0	1	1													100				
		<b>Total</b>	<b>8</b>	<b>18</b>	<b>4</b>	<b>30</b>	<b>24</b>	<b>30</b>	<b>60</b>						<b>30</b>	<b>20</b>	<b>40</b>	<b>0</b>	<b>30</b>	<b>60</b>	<b>70</b>	<b>60</b>	<b>700</b>	
		<b>Audit Course - Emerson Course</b>																						<b>Audit</b>
S8	IC3222	Batch Process Control	2			2	0									30		40			30			100

**Nomenclature for Teaching Scheme**

Th : Theory

Lab : Laboratory

Tut : Tutorial

**Nomenclature for Assessment Scheme**

Lab : Laboratory Continuous Assessment

HA : Home Assignment

CP : Course Project

CVV : Comprehensive Viva Voce

T1 / T2: Online Test

GD : Group Discussion

CT1/ CT2 : Class Test

HA : Home Assignment

MSE : Mid Semester Examination

Pract : Practical Exam

ESE : End Semester Examination

MCQ : Multiple Choice Questions

# **SEMESTER I**

FF No. : 654

**IC3231 :: PROCESS INSTRUMENTATION**

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

**Course Objectives:**

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

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

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

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

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

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

**SECTION-1 :****Process Instrumentation Components****Unit 1 : Fundamentals of process control (5 Hrs)**

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

**Transmitters and Convertors**

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

Types of transmitters: Two and four wire configurations, electronic and pneumatic transmitters, Transmitter circuits, Electronic Differential Pressure Transmitter: working, application of DPT for level and flow measurements, installation and calibration, zero elevation and suppression.

SMART: Comparison with conventional transmitter, block schematic, Specifications of DPT and Smart transmitter, Converters: Current to pressure and pressure to current converters.

**Unit 2 : Control Actions (5 Hrs)**

Discontinuous: Two position, time-proportional control modes

Continuous: Proportional, integral, derivative, proportional-integral, proportional- derivative, proportional-integral-derivative (PID) control modes, Reset windup, rate before reset, bumpless transfer, effect of process characteristics on PID combination, tuning of controller. faceplate of Digital PID controller and its specifications.

**Unit 3 : Control Valves and Actuators (5 Hrs)**

Necessity and comparison with other final control elements.

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

Control valve characteristics: inherent and installed.

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

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

**Control valve accessories**

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

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

**SECTION-2 :****Unit 4 : Auxiliary process components and Modeling (4 Hrs)**

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

Hazardous area classification and Intrinsic safety components.

**Fundamental and empirical models**

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

**Unit 5 : Process Instrumentation Applications****Boiler Instrumentation and control (5 Hrs)**

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

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

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

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

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

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

**List of Tutorials: (Any Six)**

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

**List of Practicals: (Any Six)**

1. Study and calibration of current to pressure converter.
2. Study and calibration of pressure to current converter.
3. Study and implementation of Square root extractor.
4. Demonstration and study of alarm annunciator for different working modes.
5. Implementation and characterization of Flow Totalizer.
6. Study and characterization of conventional and intelligent two-wire RTD temperature transmitter.
7. Study and characterization of Level transmitter.
8. Develop op-amp based ON-OFF controller for temperature control loop.
9. Tuning of PID controller for temperature/pressure/Level control loop.
10. Study of control valve types, parts, accessories, actuators and Plot the installed characteristics of control valves.
11. Study of Limiters and Selectors

**List of Projects:**

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

**List of Course Group Discussion Topics:**

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

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

**Text Books:**

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

**Reference Books:**

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

**Moocs Links and additional reading material:**

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

**Course Outcomes:**

1. IC3231\_CO1: Comprehend the fundamentals of process control loop.
2. IC3231\_CO2: Demonstrate the working of controller and solve a problem using control actions.
3. IC3231\_CO3: Select and Design the control valve and actuators to solve a problem.
4. IC3231\_CO4: Build a mathematical model and auxiliary process loop components.
5. IC3231\_CO5: Develop different control schemes for the Boiler.
6. IC3231\_CO6: Develop instrumentation and control scheme for different process equipments.

**CO PO Map:**

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

**CO attainment levels**

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

**Future Courses Mapping:**

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

**Job Mapping:**

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

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

## IC3233:: MEASUREMENT SYSTEMS

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

**Course Objectives:**

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

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

**Credits: 4**

**Teaching Scheme Theory: 2 Hours/Week**

**Tut : 1 Hour/Week**

**Lab : 2 Hours/Week**

### SECTION-1:

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

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

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

### SECTION-2:

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

**Biomedical Instrumentation:** Introduction to human physiology, Bio-potential generation, sensors used for physiological measurement Cardiovascular system and related instruments

(Blood pressure measurement, ECG recorder, Blood flow measurement, blood volume measurement). Life saving devices like pacemaker, defibrillator, heart lung system. Brain system and EEG recorder. Respiratory system and spirometers, IOT in Biomedical system.

**List of Tutorials (any Six):**

1. Conversion of a galvanometer into a voltmeter and ammeter
2. Digital multimeter circuits
3. Measurement of intrinsic noise in electronic components.
4. Testing using ATE systems
5. Calculation of reliability of a system.
6. Measurement of concentration using a filter photometer.
7. Sensors requirement for physiological measurement
8. Cardiovascular signal processing techniques
9. Spirometer measurement techniques
10. IOT in healthcare system

**List of Practical: (Any Six)**

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

**List of Course projects:**

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

**List of Course Seminar Topics:**

1. Applications of automatic test equipment
2. Redundancy techniques in various equipment
3. Calculation of MTTF and MTBF of a system
4. DSO specifications and selection
5. Virtual instruments
6. PCB making process
7. EMI testing techniques
8. Shielding and grounding techniques
9. Surface mount devices SMD
10. Smart energy meter

11. Lux meter
12. Gauss meter
13. IR spectroscopy and applications
14. AAS, MRI, NMR, ESR
15. Any other topic related to the subject

**Text Books:**

1. Kalsi H S; Electronic Instrumentation; Tata McGraw-Hill.
2. A. J. Bowens; Digital Instrumentation; Tata McGraw-Hill.  
Reliability
3. R S Khandpur; Handbook of Analytical Instruments; McGraw Hill Education; 2 edition
4. Willard, H. H., Merritt Jr, L. L., Dean, J. A., & Settle Jr, F. A. Instrumental methods of analysis. 7th edition. CBS Publishers & Distributors.
5. R.S. Khandpur; Handbook of Biomedical Instrumentation; Third Edition; 2014, McGraw Hill Education (India) Private Limited.

**Reference Books:**

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

**MOOCs Links and additional reading material:**

1. [www.nptelvideos.in](http://www.nptelvideos.in)
2. <https://www.nptelvideos.in/2012/11/industrial-instrumentation.html>

**Course Outcomes:**

After completing the course the students will be able to:

1. CO1: Demonstrate the working and use analog instruments for electrical measurements.
2. CO2: Select and use suitable digital instruments for electronic measurements.
3. CO3: Students will understand apply EMI /EMC concepts while designing measurement systems.
4. CO4: Students will be able to apply reliability engineering knowledge for electronic system design.
5. CO5: Students will be able to demonstrate the working of analytical instruments.
6. CO6: Students will understand the principle and working of biomedical instruments.

**CO-PO map:**

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

**CO attainment levels**

CO No.	IC3233_CO1	IC3233_CO2	IC3233_CO3	IC3233_CO4	IC3233_CO5	IC3233_6
Attainment Level	1	3	4	2	2	3

**Job Mapping:**

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

FF No.: 654

**IC3237:: CONTROL THEORY****Credits: 04****Teaching Scheme:**

Theory: 2 Hours/Week

Lab : 2 Hours/Week

Tutorial: 1 Hour /Week

**Section 1 :**

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

**Unit 2:** Classical control actions as proportional, integral and derivative control, Signal Flow graphs. Time domain analysis of control systems Impulse response of a system, first order systems, second order systems and their response to impulse and step inputs, time domain specifications of first and second order systems, static error coefficients. Response of first order systems to ramp input, dynamic error coefficients.

**Unit 3:** Stability analysis in s-plane Concept and classification of stability, Pole-zero plots, effects of addition of poles and zeros on stability, Hurwitz Criterion, Routh Array. Analysis of relative stability using Routh array. Root Locus: definition and properties, rules for constructing root locus.

**Section 2:**

**Unit 4:** Frequency domain analysis of control systems Frequency response and frequency domain specifications, correlation between frequency and time domain specifications, Bode Plot, construction of actual and asymptotic Bode plots, stability analysis, Determining value of gain for marginal stability gain and phase margins

**Unit 5:****Control system Analysis using State Variable methods**

Introduction, State variable representation, conversion of state variable model to transfer function, conversion of transfer function to canonical state variable models, solution of state equations, concept of controllability and observability, Controllability and Observability tests

**Unit 6:****Controller Design**

Stability improvement by state feedback, pole placement design,

**List of Practicals**

1. For a given Electrical system obtain the transfer function of the system, pole zero plot, impulse response, and step response
2. For given various transfer functions of the system, analysis the stability of the system using pole zero plot and impulse response of the system

3. Transient Response Analysis of second order system - For a RLC circuit analyze the step response for identifying damping (overdamped, underdamped, critically damped, undamped) of the system using MATLAB/SCILAB/PYTHON
4. Write a Program for obtaining root locus of a transfer function and observe the effect of addition of pole/zero.
5. Write a Program for obtaining Bode plot of a transfer function and compute frequency domain specifications of the same.
6. Write a program to obtain state space model and step response of the system

### **List of Tutorials**

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

### **Text Books and Reference Books**

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

### **Course Project**

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

**Course Outcomes** The student will be able to

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

**Mooc's Links and additional reading material:**

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

**CO PO Map:**

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

**IC3243 :: ARTIFICIAL INTELLEGIENCE AND MACHINE LEARNING**

**Course Prerequisites:** Fundamentals of Linear Algebra, Probability and Statistics

**Course Objectives:**

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

**Credits:** 4

**Teaching Scheme :**      **Theory:** 2 Hours/Week

**Tut :** 1 Hour/Week

**Lab :** 2 Hours/Week

**Course Relevance:**

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

**Section 1 :**

**Unit 1**

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

**Unit 2**

Logic based representations and inference, Prolog, Rule based representations, forward and backward chaining, matching algorithms., Probabilistic reasoning and uncertainty., Bayes nets and reasoning with them, Uncertainty and methods to handle it.

**Unit 3**

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

**Section 2:**

**Unit 4**

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

Simplified Cost Function and Gradient Descent, Regularization: The Problem of Over fitting, Cost Function, Regularized Linear Regression

### **Unit 5**

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

### **Unit 6**

Neural Networks representation and learning: Introduction to Neural networks, architecture, applications of Neural networks, Learning, back propagation algorithm, learn parameters for a neural network, implementation.

#### **List of Practicals: (Any Six)**

1. Experimentation to write a code for Forward chaining, backward chaining.
2. Write programme on Search, using heuristics, graph heuristics
3. Experimentation on algorithm for Game search
4. Experimentation on evaluating k-nearest neighbour's
5. Evaluate neural nets for NLP application.
6. Evaluate a linear regression on a random data set with single regression
7. Evaluate a linear regression on a random data set with multiple regression
8. Implement Polynomial regression for given application
9. Implement logistic regression for given application
10. Validation of gradient descent algorithm
11. Evaluate the effect of changing the decision boundary for logistic regression
12. Back propagation algorithm for data classification
13. Develop algorithm for data classification
14. Implement feed-forward network in NN for given application
15. Implement back propagation algorithm in NN for given application
16. Application of neural networks to classification
17. Neural net for nonlinear process control application.
18. Analysis of SVM for OCR
19. Application of SVM for classification

#### **List of Tutorials**

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

**List of Home Assignments****Design:**

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

**Case Study:**

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

**Blog:**

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

**Surveys:**

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

**Project areas in Computer Vision and Deep learning**

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

**Project areas for Biomedical and deep learning**

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

**Project areas in audio signal processing**

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

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

**Project areas in Sentiment analysis**

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

**Project areas in Artificial Intelligence**

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

**Text Books:**

1. Artificial Intelligence, Elaine Rich & Kevin Knight, TMH Publication
2. Introduction to Turbo PROLOG, Carl Townsend, BPB Publication
3. Introduction to AI & Expert Systems, Dan W. Patterson, PHI Publication
4. S. Rogers and M. Girolami, A First Course in Machine Learning, 2nd edition, Chapman & Hall/CRC 2016, ISBN: 9781498738484.
5. K. Murphy, "Machine Learning: A Probabilistic Perspective" MIT Press 2012.

**Reference Books:**

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

**Mooc's Links and additional reading material:**

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

**Course Outcomes:**

The student will be able to -

1. IC\_3243\_CO1: Comprehend concept of Artificial Intelligence and intelligent agents
2. IC\_3243\_CO2: Examine the useful search techniques
3. IC\_3243\_CO3: Analyze learning models for AI
4. IC\_3243\_CO4: Apply machine learning techniques to given applications
5. IC\_3243\_CO5: Formulate neural networks for given application
6. IC\_3243\_CO6: Implement the practical applicability of intelligent systems and machine learning algorithms to real world applications

**CO PO Map:**

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

**CO attainment levels**

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

**Future Courses Mapping:**

Deep Learning, Big Data Analytics, Data analytics

**Job Mapping:**

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

FF No. : 654

**IC3255 :: DESIGN THINKING -5****Course Prerequisites:** Problem Based Learning, Project Centric Learning**Course Objective:**

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

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

What is research?

Importance of Paper Publication and Patents

Structure of Paper

Journal Publication

Publication in conference

Literature Review

Research Paper Writing

Journal Ratings and Evaluation

How to rate a Journal?

Intellectual property (IP)

Research Ethics

Entrepreneurship

**Section 2: Topics/Contents**

Structure of The paper

Journal List (Top 50 Journals)

Selection of the journal

Use of various online journal selection tools

Plagiarism checking

Improving contents of the paper

Patent drafting

Patent search

Filing of patent

Writing answers to reviewer questions

Modification in manuscript

Checking of publication draft

**Course Outcome:** [Publication of paper or patent]

The student will be able to

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

**CO-PO Map:**

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

**CO attainment levels**

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

## IC3252:: ENGINEERING DESIGN AND INNOVATION - V

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

**Course Objectives:** The student will be able to

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

**Credits: 6**

**Teaching Scheme Theory:** Hours/Week

**Tut:** Hours/Week

**Lab:** 12 Hours/Week

**Course Relevance:** This course will develop

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

### Topics and Contents

**It is based on Real time project implementation in the chosen specific defined area.**

Agriculture Healthcare Automotive Process Control IoT

#### Basics for Projects

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

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

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

#### Tools in Computer Engineering:

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

#### Tools in Electronics and Electronics & Telecommunication Engineering:

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

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

**Tools in Instrumentation and Control Engineering:-**

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

**Tools in Mechanical, Industrial, Production, Engineering:-**

**Engineering Design Tools**:- AutoCAD, CATIA,COMSOL Multiphysics, Solidworks,

Inventor, PTC Creo **Fluid Dynamics**:- Fluent, HyperWorks, **Finite Element/ Structural**

**Analysis**:- Ansys's, Ansys's Free Student software **Thermal Simulation**:- FlowTherm, Ansys Icepak

**Tools in Chemical Engineering :-**

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

(any other suitable tool as per the project requirement)

**Technology**: Map the appropriate technology:

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

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

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

**Medical and Healthcare Technologies**:- Biomedical Technology,

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

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

Other imp Technologies:- Automobile ,3 D printing

(any other technology as per the project requirement)

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

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

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

**Course Outcomes :**

1. IC3256\_CO1 Analyse solutions for given engineering problem
2. IC3256\_CO2 Design solutions for given engineering problem
3. IC3256\_CO3 Demonstrate practical knowledge by constructing models/algorithms for real time applications
4. IC3256\_CO4 Express effectively in written and oral communication
5. IC3256\_CO5 Exhibit the skills to work in a team
6. IC3256\_CO6 Prepare a time chart and financial record for execution of the project

**CO-PO Mapping :**

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

**CO attainment levels :**

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

## SH3001 : REASONING AND APTITUDE DEVELOPMENT-1

### **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, S. Chand Publishing, ISBN: 978-8121903423.

**Course Outcomes –**

Upon completion of the course, the 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

# SEVENESTER II

**IC3260 :: INSTRUMENTATION PROJECT ENGINEERING****Credits: 4****Teaching Scheme: Theory: 2 Hours/Week****Section 1 : [IC3220\_CO1, IC3220\_CO2, IC3220\_CO3]****Unit-1 : Concept study & definition of Project Engineering & Management**

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

**Unit-2 : Project engineering documents, drawing and softwares**

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

**Unit-3 : Detailed Project engineering**

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

**Section 2 : [IC3220\_CO2, IC3220\_CO3, IC3220\_CO4, IC3220\_CO5, IC3220\_CO6]****Unit-4 : Procurement activities**

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

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

**Unit-5 : Project Management**

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

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

**Unit-6 : Codes and standards**

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

**List of Home Assignments:**

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

**Text Books:**

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

**Reference Books:**

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

**Course Outcomes:**

The students will have ability to:

1. IC3260\_CO1: Describe the concept of project engineering and management. [1] (PO-1, 11, PSO-1)
2. IC3260\_CO2: Comprehend the Project Engineering and Management documents [2](PO-1, 3,11, PSO-1,3)
3. IC3260\_CO3: Develop Project Engineering and Management documents. [5] (PO-1, 3,11, PSO-1,3)
4. IC3260\_CO4: Discuss the procurement and construction activities of project.[3] (PO-2,11, PSO-2)
5. IC3260\_CO5: Understand the importance of management and financial functions and tools. [4] (PO-2,11,PSO-2)
6. IC3260\_CO6: Explain different codes and standards used for instrumentation and control [4] (PO-1, 3,11, PSO-1,3)

FF No. : 654

**IC3234 :: BUILDING AND PROCESS AUTOMATION****Credits: 4****Teaching Scheme Theory: 2 Hours/Week****Tut : 1 Hour/Week****Lab : 2 Hours/Week****Course Prerequisites:** Process Instrumentation**Course Objectives:**

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

**SECTION-1:****Unit-1**

**DCS Introduction:** History of computer controls with their merits and demerits, Location of DCS in Plant, advantages and limitations, Comparison of DCS with PLC, DCS block diagram/ Architecture, components, Functional requirements at each level.

**DCS Hardware:** DCS System Layout, Loop wiring, Controller Details, Redundancy, I/O Card Details, Junction Boxes and Marshalling Cabinets, Electronic Marshalling, Characterization Modules, System cabinet, Operator Interface, DCS Workstation and their Types, Type of displays, Guided Transmission Media, Device Signal Tags, DCS Selection criteria.

**Unit-2**

**Database and Alarm management:** Database management, Historical data using in log, report and trend display, Types of alarm, Alarm management, DCS Programming.

**Network topology:** Star, Bus, Ring, Tree, Mesh, Hybrid topology, wireless topologies, OSI model, Repeater, Hub, Bridge, Switch, Router, Gateway, Access point, Wireless Access points. Smart switches.

**Unit-3**

**Serial data communications:** Methods of Serial data transmission, Synchronous, Asynchronous serial protocol, Serial data communications interface standards, RS-232, RS-422, RS-485 interface standard, their comparison, MODBUS Serial Communication.

**HART Communication Protocol:** Architecture, FSK, physical, data link, application layer, communication modes, HART Networks, commands, benefits, revisions.

**Introduction to Fieldbus:** types, classes, benefits of Fieldbus.

Actuator Sensor Interface: AS-i advantages, types of integration, components, signal coding, AS-i extensions.

## SECTION-2:

### Unit-4

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

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

### Unit-5

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

**Light Control System:** Need of Light control in Building Automation. Occupancy sensors and Daylight harvesting methods. Use of DALI communication protocol

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

### Unit-6

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

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

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

### List of Tutorials: (Any Six)

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

**List of Practicals: (Any Six)**

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

**List of Projects:**

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

**List of Course Group Discussion Topics:**

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

**Text Books:**

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

**Reference Books:**

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

**Moocs Links and additional reading material:**

1. [www.nptelvideos.in](http://www.nptelvideos.in)

**Course Outcomes:**

1. IC3234\_CO1: Demonstrate the working of DCS system [1]
2. IC3234\_CO2: Comprehend the Database and Alarm management system and Network topologies. [3]
3. IC3234\_CO3: Contrast the performance of Serial data communications, HART and ASI protocol [2]
4. IC3234\_CO4: Analyze the performance of ProfiBus and Foundation Fieldbus [4]
5. IC3234\_CO5: Design the lighting control / fire alarm system for building automation problem. [3]
6. IC3234\_CO6: Develop instrumentation and control scheme for HVAC system. [5]

**CO PO Map:**

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

**CO attainment levels:**

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

**Future Courses Mapping:**

Advanced Process Control, Multivariable Control System, etc.

**Job Mapping:**

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

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

FF No. : 654

**IC3240 :: COMPUTER NETWORKS AND WEB TECHNOLOGIES**

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

**Course Objectives:**

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

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

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

**SECTION-1****Unit 1: Data communication networking and physical layer**

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

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

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

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

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

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

**Unit-2: Data Link Layer and MAC sub layer**

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

**Unit-3: Network Layer:**

Network Layer: Introduction: Functions of Network layer Switching Techniques: Circuit, Message and Packet Switching.

IP Protocol: Classes of IP (Network addressing), IPv4 , IPv6, Network Address Translation, Sub-netting , CIDR. Network layer Protocols: ARP, RARP, ICMP, IGMP.

Network Routing and Algorithms: Static Routing, Dynamic Routing, Distance Vector Routing, Link State Routing, Path Vector. Routing Protocols: RIP, OSPF, BGP, MPLS. Routing in MANET: AODV, DSR, Mobile IP. **[5 Hrs ]**

**SECTION-II****Unit 4: Transport Layer**

Transport Layer Process to Process Delivery, Services, Socket Programming, Elements of Transport Layer Protocols: Addressing, Connection establishment, Connection release, Flow control and buffering, Multiplexing, Congestion Control.

Transport Layer Protocols: TCP and UDP, SCTP, RTP, Congestion control and Quality of Service (QoS), Differentiated services, Real Time Support Protocols: Real Time Transport protocol(RTP), TCP and UDP for Wireless networks. **[5 Hrs ]**

**Unit 5: Application Layer**

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

**Unit 6: Advanced topics computer networking**

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

**List of Tutorials: (Any Three)**

- 1) Examples and analysis of Unipolar NRZ, Polar NRZ, NRZ Inverted, Bipolar Encoding, Manchester Encoding, Differential Manchester Encoding
- 2) Line coding, Channel Encoding and modulations Techniques: used in IEEE 802.3 standard and its extensions, IEEE 802.11 standards and its extensions for 100 Mbps, 1 GbE, 1 Gbps, 2.5 Gbps, 5 Gbps, 10 Gbps, 25Gbps, 40 Gbps, 100 Gbps networks. Chanel

Encodings in 3G, 4G and 5G Mobile Networks

- 3) Examples on Network Performance parameters: RTT, Delay, Bandwidth, Throughput and efficiency
- 4) PHY and MAC Layer IEEE 802.3 Standards For Copper: Overview of 10 Mbps Ethernet, Fast Ethernet, GbE -Gigabit Ethernet, 2.5 Gigabit Ethernet, 5 Gigabit Ethernet, 10 Gigabit Ethernet, 25 Gigabit Ethernet, 40 Gigabit Ethernet, 100 Gigabit Ethernet
- 5) PHY and MAC Layer IEEE 802.3 Standards For Optical Fiber: 100 Mbps Fast Ethernet, GbE -Gigabit Ethernet, 2.5 Gigabit Ethernet, 5 Gigabit Ethernet, 10 Gigabit Ethernet, 25 Gigabit Ethernet, 40 Gigabit Ethernet, 100 Gigabit Ethernet
- 6) PHY and MAC Layer IEEE 802.11 Wireless LAN Standards: IEEE 802.11, Wi-Fi 1/IEEE 802.11a, Wi-Fi 2/IEEE 802.11b, Wi-Fi 3/IEEE 802.11g, Wi-Fi 4/IEEE 802.11n, Wi-Fi 5/IEEE 802.11ac, IEEE 802.11ad (WiGig), IEEE 802.11ah (HaLow), Wi-Fi 6/IEEE 802.11ax, Wi-Fi 6/IEEE 802.11ay, Wi-Fi 6/IEEE 802.11by, Wi-Fi 7/IEEE 802.11be
- 7) Examples of Network Layer Logical Addressing
  - a) Classful IP and CIDR : Subnetting, IP Prefixes
  - b) NAT Mapping: Public to Private IP and Port Mapping
  - c) Packet Delivery in Internetwork : Packets traversing through different subnetworks with different MTU and Speeds
  - d) Packet Dropping Probabilities of Routers
- 8) Examples of Network Layer Routing
  - a) Shortest Path and Spanning Tree
  - b) Dijkstra's Algorithm
  - c) Distance Vector Routing
  - d) Link State Routing
  - e) ECMP
- 9) Examples of Transport Layer
  - a) TCP Connection Establishment: SYN and ACK, Normal Packets
  - b) Flow Control : Calculating Optimal Size of Sliding Window
  - c) Cumulative ACK scheme
  - d) Smoothed RTT
  - e) Slow Start and Additive Increase
- 10) Examples of Application Layer
  - a) DNS: URL Domain Processing
  - b) Performance of HTTP1.0 and HTTP1.1
  - c) CDN
- 11) Examples and analysis on Modulation and demodulation techniques
- 12) Examples on network performance parameters : RTT, Delay, Bandwidth, Throughput and efficiency
- 13) Analyze packet formats of Ethernet, IP, TCP and UDP
- 14) Data Compression Algorithms

**List of Practical: (Any Six)**

- 1) Write a program in C++/JAVA to implement - Unipolar NRZ, Polar NRZ, NRZ Inverted, Bipolar Encoding, Manchester Encoding and Differential Manchester Encoding.
- 2) Setting up small computer networks and Hands on networking commands:  
Set up a small wired and wireless network of 2 to 4 computers using Hub/Switch/Access point. It includes installation of LAN Cards, Preparation of Cables/ Installation and Configuration of Access Point, Assigning unique IP addresses and use of ping utility. Hands on for network commands - ping, pathping, ipconfig/ifconfig, arp, netstat, nbtstat, nslookup, route, traceroute/tracert, nmap.
- 3) Write a program for error detection and correction for 7/8 bits ASCII codes using Hamming Codes or CRC. Demonstrate the packets captured traces using Wireshark Packet Analyzer Tool for peer to peer mode. (50% students will perform Hamming Code and others will perform CRC). Further extend it to real implementation of CRC over Ethernet standard.
- 4) Write a program to simulate Go back N and Selective Repeat Modes of Sliding Window Protocol in peer to peer mode and demonstrate the packets captured traces using Wireshark Packet Analyzer Tool for peer to peer mode. Further extend it to real implementation of Flow Control over TCP protocol.
- 5) Write a program to find the shortest path using Dijkstra Equation for Link State Routing Protocol which is used by Open Shortest Path First Protocol (OSPF) in the Internet for the networkflow provided by instructor.
- 6) Write a program using TCP Berkeley socket primitives for wired /wireless network for following
  - a) Say Hello to Each other ( For all students)
  - b) File transfer ( For all students)
  - c) Calculator (Arithmetic) (50% students)
  - d) Calculator (Trigonometry) (50% students)
 Demonstrate the packets captured traces using Wireshark Packet Analyzer Tool for peer to peer mode.
- 7) Write a program using UDP Berkeley Sockets for wired/wireless network to enable file transfer (Script, Text, Audio and Video one file each) between two machines. Demonstrate the packets captured traces using Wireshark Packet Analyzer Tool for peer to peer mode.
- 8) Understanding protocol stack of Intranet Analyze packet formats of Ethernet, IP, TCP and UDP captured through Wireshark for wired networks.
- 9) Develop a client-server to demonstrate the behavior of HTTP1.0, HTTP1.1, HTTP1.2 and HTTP2.0 protocols.
- 10) Simulation of data communication using Cisco Packet tracer
- 11) Network simulation using Cloudsim
- 12) Linux Commands for testing connectivity and transfer rates
- 13) Demonstrate the different types of topologies and types of transmission media by using a

packet tracer tool

- 14) Setup a WAN which contains wired as well as wireless LAN by using a packet tracer tool. Demonstrate transfer of a packet from LAN 1 (wired LAN) to LAN2 (Wireless LAN)
- 15) Write a program to demonstrate Sub-netting and find subnet masks
- 16) Write a program to implement link state /Distance vector routing protocol to find suitable path for transmission
- 17) Use packet Tracer tool for configuration of 3 router network using one of the following protocol RIP/OSPF/BGP
- 18) Write a program using UDP Sockets to enable file transfer (Script, Text, Audio and Video one file each) between two machines
- 19) Write a program using UDP Sockets to enable file transfer (Script, Text, Audio and Video one file each) between two machines
- 20) Study and Analyze the performance of HTTP, HTTPS and FTP protocol using Packet tracer tool

#### **List of Projects:**

- 1.. Simulation of modulation and demodulation for digital telephone lines
2. Simulation of modulation and demodulation for 100 Mbps Ethernet Network
3. Simulation of modulation and demodulation for Gigabit Ethernet Network
4. Simulation of modulation and demodulation for 10Gigabit Ethernet Networks
5. Simulation of modulation and demodulation for 3G for mobile networks
6. Simulation of modulation and demodulation for 4G mobile networks
7. Develop a tool fox for line encoding methods
8. Develop a tool fox for modulation and demodulation methods
9. Design and deploy TCP based Multithreaded HTTP client server for accessing student activity data in the institute.
10. Design and deploy TCP based Multithreaded FTP client server to share institute level notices.
11. Design and deploy UDP based Multithreaded TFTP client server for your class
12. Design and deploy TCP based Multithreaded SMTP and POP3 mail client server for your campus.
13. Design and deploy TCP based Multithreaded Chat client server for your class.
14. Design and deploy UDP based Multithreaded Chat client server for your class.
15. Design and deploy UDP based Multithreaded Audio Conferencing client server for computer engineering department.
16. Design and deploy UDP based Multithreaded Video Conferencing client server for computer
17. Communication Systems Using Python
18. Python networking projects
19. Start Sending Data Over Long Distance using Arduino via Wired and Wireless Connection and extend Arduino Capabilities
20. CAN bus implementation or simulation
21. Power Line Data Communication
22. Cryptography / Steganography for secured data communication
23. Green Communications for Future Vehicular Networks
24. MODBUS simulation
25. Implementation of RIP/OSPF/BGP using Packet Tracer
26. Simulation of routing protocol using Packet Tracer/ NS3/OMNet

27. Simulation of modulation and demodulation for Ethernet Network
28. Cloud Computing
29. Illustrate the steps for implementation of S/MIME email security through Microsoft® Office Outlook.
30. To study the SSL protocol by capturing the packets using Wireshark tool while visiting any SSL secured website (banking, e-commerce etc.).

**List of Course Group Discussion Topics:**

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

**Text Books:**

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

**Reference Books:**

1. Matthew S. Gast "802.11 Wireless Networks", O'Reilly publications; 2nd Edition.
2. C. Siva Ram Murthy and B. S. Manoj, "Ad Hoc Wireless Networks: Architectures and Protocols" Prentice Hall, 2004
3. Holger Karl and Andreas Willig, "Protocols and Architectures for Wireless Sensor Networks", Wiley, ISBN:0-470-09510-5
4. L. Peterson and B. Davie, "Computer Networks: A Systems Approach", 5th Edition, Morgan-Kaufmann, 2012.
5. Douglas E. Comer & M.S Narayanan, "Computer Network & Internet", Pearson Education
6. John Park, Steve Mackey, Edwin Wright, Practical Data Communications for Instrumentation and Control, Elsevier Publication

**Moocs Links and additional reading material:**

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

**Course Outcomes:**

The students are able to:

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

**CO PO Map**

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

**CO attainment levels :**

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

**Future Courses Mapping:**

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

**Job Mapping:**

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

FF No. : 654

**IC3259 ::CYBER SECURITY****Credits: 4****Teaching Scheme Theory : 2 Hours/Week****Tut : 1 Hour/Week****Lab : 2 Hours/Week****SECTION 1:****Unit I**

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

**Unit II**

Difference between OT and IT security. Understanding of IT and OT network. Purdue model defines OT mark, NIST cyber security recommended, Standards ISA 62443, AIC-OT, 800-py3

Zero trust- Communication from PLC to HMI due diligence.

Active information gathering, passive information gathering, Trace route, Interacting with DNS Servers, SNMP and SMTP attacks. Port Scanning, Target Enumeration and Port Scanning Techniques: Scanning for Open Ports and Services, Types of Port Scanning, Firewall/IDS Evading.

Penetration Testing types and tools

Physical Security Perimeter defenses, Asset management, asset security, Ex DCS-server in DCS system, Asset classification and handling, Next generation Firewalls – Multifactor authentication firewalls , Paulo alto, MODBUS: port opening

**Unit III**

Introduction to Attacks and Hacking: Vulnerabilities, Threats, Threat Modeling, Risk, attack and attack types, Avoiding attacks, Security services. Trustworthiness

Ethical issues and practices, Tradeoffs of balancing key security properties - Confidentiality, Integrity, and Availability. Protocol Vulnerabilities: DoS and DDoS, session hijacking, ARP spoofing, Pharming attack, Dictionary Attacks.

Software vulnerabilities: Phishing, buffer overflow, Cross-site scripting attack, Virus and Worm Features, Trojan horse, Social engineering attacks, ransomware, SYN-Flooding, SQL-injection, DNS poisoning, Sniffing

## SECTION 2 :

### Unit IV

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

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

### Unit V

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

### Unit VI

Authentication and Authorization:

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

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

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

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

### List of Labs: (Any 6)

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

i. Ceaser cipher	ii. Playfair cipher
iii. Hill Cipher	iv. Vigenere cipher

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

**List of Course Seminar Topics:**

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

**Text Books:**

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

**Reference Books:**

1. M. Speciner, R. Perlman, C. Kaufman, “Network Security: Private Communications in a Public World”, Prentice Hall, 2002

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

**Course Outcomes:**

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

FF No. : 654

**IC3257:: DESIGN THINKING -6****Course Prerequisites:** Problem Based Learning, Project Centric Learning**Course Objective:**

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

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

What is research?

Importance of Paper Publication and Patents

Structure of Paper

Journal Publication

Publication in conference

Literature Review

Research Paper Writing

Journal Ratings and Evaluation

How to rate a Journal?

Intellectual property (IP)

Research Ethics

Entrepreneurship

**Section 2: Topics/Contents**

Structure of The paper

Journal List (Top 50 Journals)

Selection of the journal

Use of various online journal selection tools

Plagiarism checking

Improving contents of the paper

Patent drafting

Patent search

Filing of patent

Writing answers to reviewer questions

Modification in manuscript

Checking of publication draft

**Course Outcome:** [Publication of paper or patent]

The student will be able to

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

**CO-PO Map:**

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

**CO attainment levels**

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

FF No. : 654

**IC3254 :: ENGINEERING DESIGN AND INNOVATION-VI****Course Prerequisites:** Electronic design, simulation, MATLAB, Labview, PCB design**Course Objectives:** The student will be able to

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

**Credits: 6****Teaching Scheme Theory:** Hours/Week**Tut:** Hours/Week**Lab:** 12 Hours/Week**Course Relevance:** This course will develop

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

**Topics and Contents****It is based on Real time project implementation in the chosen specific defined area.**

Agriculture Healthcare Automotive Process Control IoT

**Basics for Projects**

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

**Domain Project Areas:** Awareness and identification of appropriate areas for project work such as: Agriculture, Defense, Healthcare, Smart city, Smart energy, Security Systems, Automobile, Space, Green Earth, Automobiles, Assistive Aid, Water Management, Swachh Bharat (any other socially relevant research area)**Tools:** *Self learning Activity* Learn and use latest engineering tools as per the project need. A few are listed below**Tools in Computer Engineering:****Programming / Coding Tools** :- JavaScript, Python, Java, C#, C++, PHP, **Computer Vision Tools** :- OPENCV, MATLAB), **Single board computers**: Raspberry Pi, Neural network simulators Tools:- Neural Lab, NEST , Machine Learning Tools:- Torch, TensorFlow, **Data Science Tools** :- R language programming, SQL,**Tools in Electronics and Electronics & Telecommunication Engineering:****Electronic Design Simulation Integrated Circuit Tools**:- VHDL, Xilinx, Modelsim , Cadence learn, **Embedded System Tools**:- AVR Studio, Arduino ,Kiel  $\mu$ vision, **Circuit Simulation Tools**:- Pspice, Simulink, Workbench, Tinkercad, ThingSpeak, Proteus, CircuitPro ,**Processor based integrated circuits** :Microcontroller, electronic prototype platforms:

**Arduino, Networking Tools** :- Wired / Wireless and Ad-hoc Networking NS-2 , Packet Tracer, **Signal Processing Tools**:- Code Composer Studio along with Integrated circuits

**Tools in Instrumentation and Control Engineering:-**

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

**Tools in Mechanical, Industrial, Production, Engineering:-**

**Engineering Design Tools**:- AutoCAD, CATIA,COMSOL Multiphysics, Solidworks, Inventor, PTC Creo

**Fluid Dynamics**:- Fluent, HyperWorks, **Finite Element/ Structural Analysis**:- Ansys's, Ansys's Free Student software **Thermal Simulation**:- FlowTherm, Ansys Icepak

**Tools in Chemical Engineering :-**

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

(any other suitable tool as per the project requirement)

**Technology**: Map the appropriate technology:

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

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

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

**Medical and Healthcare Technologies**:- Biomedical Technology,

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

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

Other imp Technologies:- Automobile ,3 D printing

(any other technology as per the project requirement)

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

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

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

**Course Outcomes :**

1. IC3258\_CO1 Analyse solutions for given engineering problem
2. IC3258\_CO2 Design solutions for given engineering problem
3. IC3258\_CO3 Demonstrate practical knowledge by constructing models/algorithms for real time applications
4. IC3258\_CO4 Express effectively in written and oral communication
5. IC3258\_CO5 Exhibit the skills to work in a team
6. IC3258\_CO6 Prepare a time chart and financial record for execution of the project

**CO-PO Mapping :**

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

**CO attainment levels :**

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

## SH3002 : REASONING AND APTITUDE DEVELOPMENT-2

### 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, S. Chand Publishing, ISBN: 978-8121903423.

**Course Outcomes –**

Upon completion of the course, the 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

FF No. : 654

**IC3222 :: BATCH PROCESS CONTROL****Credits:** Audit course**Teaching Scheme:** Theory: 2 Hours/Week**Section 1 :** [IC3222\_CO1, IC3222\_CO2, IC3222\_CO3]**Unit-1 : Standards and control system of Batch Process**

Batch control system terminology, characteristics of batch processes, hierarchical batch model, control structure for batch systems

**Unit-2 : Standards for Batch Process:** Role of standards in batch control systems, study of International Standards and Practices such as S 88, S 95, USA FDA regulation, 21CFR 11 etc.

**Unit-3:Control of batch Process:** General control requirements, safety interlocking, regulatory & discrete controls, sequential control of batch processes, control activities and process management, information handling for a batch process.

**Section 2:** [IC3222\_CO4, IC3222\_CO5, IC3222\_CO6]

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

**Unit-5 : Specifications and data management:** Batch control system specifications and implementation, Information/display requirements, cost justification and benefits, data management, Generic implementation of batch processes, case study of batch control system implementation for applications in food and beverages, pharmaceuticals etc.

**List of Home Assignments:**

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

**Text Books:**

1. Thomas .G. Fisher William M. Hawkins, —Batch Control Systems, ISA series, 1<sup>st</sup> ed., 2008
2. Process/ Industrial Instruments and Controls Handbook, Gregory K. Macmillan, McGraw Hill

**Reference Books:**

1. Thomas.G. Fisher, William M. Hawkins, —Batch Control Systems, ISA series, 2<sup>nd</sup> ed., 2012

**Course Outcomes:**

The student will be able to –

1. IC3222\_CO1: Understand the fundamentals of batch process [1] (PO-1, 11,12 PSO-1,2 )
2. IC3222\_CO2: Understand the role of standards for batch process [2] (PO-1,11,12 PSO-1,2)
3. IC3222\_CO3: Comprehend the control and management aspects of batch processes [3] (PO- 1,2,3,4,5 PSO-1,2,3)
4. IC3222\_CO4: Comprehend control strategies to a given batch processes [3] (PO-1,2,3,4,5 PSO-1,2,3)
5. IC3222\_CO5: Specify controls and data management system [4] (PO-1,2,3,4,5 PSO-2,3)
6. IC3222\_CO6: Case study of any batch process [5] (PO-1,2,3,4,5,6,7,11,12 PSO-1,2,3)



Bansilal Ramnath Agarwal Charitable Trust's  
**Vishwakarma Institute of Technology**

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

**Structure & Syllabus of**

**Final Year B.Tech.  
(Instrumentation and Control Engineering)**

**Pattern 'D25'**

**Effective from Academic Year 2025-26**

**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 Final Year BTech (Instrumentation and Control) offered by B.O.S. in Instrumentation  
Engineering for Academic Year 2025-26**

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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. **PO5: 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. **PO6: 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. **PO7: Ethics:** Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws. (WK9)
8. **PO8: Individual and Collaborative Team work:** Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.
9. **PO9: 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. **PO10: 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. **PO11: 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.

**Final Year B.Tech - Instrumentation and Control Engineering Structure for Pattern D-25, Module-7 with effect  
from Semester-1 of Academic Year 2025-26**

Course Type	Course Code	Course Name	Teaching Learning Scheme (Hrs./Week)				Credits	Assessment Scheme (100 mark scale)									
								In Semester Assessment					End Semester Assessment				Total
			Th	Lab	Tut	Total		Lab 10	CP 20	MSE-MCQ 30	MSE Review 30	Seminar / GD / HA 20		ESE 30			
S1-OE1	MD4274	Large Language Models Skill Development	1	0	0	1	1										100
S1-OE1	MD4275	Mastering Microsoft Power BI															
S1-OE1	MD4276	Generative AI Skills for Developers															
S1-OE1	MD4277	Career in Data Analysis															
S1-OE1	MD4278	Concepts of Data Visualization and Storytelling															
S1-OE1	MD4279	AWS Certified Solutions Architect															
S1-OE1	MD4280	IT Security Specialist															
S1-OE1	MD4281	Technical Program Management															
S2-OE1	MD4282	Natural Language Processing Skill Development	1	0	0	1	1										100
S2-OE1	MD4283	Prompt Engineering Skills															
S2-OE1	MD4284	Essentials in Generative AI courses															
S2-OE1	MD4285	Python in Finance															
S2-OE1	MD4286	Understanding Quantum Computing															
S2-OE1	MD4287	Foundational Maths for Machine Learning															

S3-0E2	CS4217	Human Computer Interaction	2	0	0	2	2		30			10		30			30	100
S3-0E2	IC4201	Industrial Electronics																
S3-0E2	ML4001	Generative AI																
S3-0E2	IT4216	Data Management, Protection and Governance																
S3-0E2	ET4230	Natural Language Processing																
S3-0E2	AI4015	Network Security																
S4-0E3	IC4249	Deep Learning (NPTEL course)	2	0	0	2	2		30			10		30			30	100
S4-0E3	IC4250	Modern Computer Vision (NPTEL course)																
S5	IC4243	Major Project	0	20	0	20	9			30						70		100
S6	IC4372	Design Thinking-7	0	0	1	1	1									100		100
		<b>Total</b>	<b>6</b>	<b>20</b>	<b>0</b>	<b>26</b>	<b>16</b>		<b>60</b>	<b>30</b>		<b>20</b>		<b>60</b>		<b>370</b>	<b>60</b>	<b>600</b>

**Final Year B.Tech - Instrumentation and Control Engineering Structure for Pattern D-25, Module-8 with effect from Semester-1 of Academic Year 2025-26**

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		
								Lab 10	CP 20	MSE-MCQ 30	MSE Review 30	Seminar / GD / HA 20		ESE 30		ESE Review 70			
S1	IC4211	Industry Internship		30		30	16					30					70		100
S1	IC4224	Global Internship																	
S1	IC4226	Research Internship																	
S1	IC4240	Project Internship																	
S2	IC4372	Design Thinking-7	0	0	1	1	1									100		100	
		<b>Total</b>		<b>32</b>		<b>32</b>	<b>16</b>					<b>30</b>					<b>70</b>		<b>100</b>

*Note : 1. Students can opt for any module in any semester.*

*Students can register for Coursera courses of module-7 as module-8 courses instead of Internship module-8*

# **SEMESTER I**

## IC4201:: INDUSTRIAL ELECTRONICS

**Course Prerequisites:** Basic knowledge electrical and electronics engineering

### Course Objectives:

1. To understand the operation of various power devices
2. Knowledge of protection techniques for power devices
3. To understand power devices driving techniques and driver circuits
4. Study various power electronics circuits and their analysis
5. To Learn various power electronics circuits for industrial applications
6. To understand power electronics in Electric vehicles and solar photovoltaic systems

**Credits:** 2

**Teaching Scheme: Theory:** 2 Hours/Week

**Course Relevance:** This course gives knowledge of power electronics and its industrial applications. Almost in all industries power electronic systems are used for power supply, control, conversion and other applications. Power electronics is also employed in electric vehicles and renewable energy systems which have a great scope currently and in also future.

### SECTION-1

**Unit-1: Power electronics devices:** Introduction to various power devices such as SCR, TRIAC, DIAC, IGBT, silicon and silicon carbide MOSFETs. Construction, characteristics, specifications and selection of the above devices.

**Unit-2: Power device drivers and heat sink design:** Driving requirement for power devices. Various driver ICs such as isolated, non-isolated, low side, high side etc. Interfacing power devices with digital logic circuits and microcontrollers-based systems. Static and dynamic switching losses in power devices. Power dissipation calculations, cooling requirement, heat sink design and selection.

**Unit-3: Protection techniques for power devices:** Protection devices such as semiconductor fuses, resettable fuses, PTC thermistors, MOV, TVS, snubber and overcurrent protection circuits for protection of power devices. Series and parallel operation of power devices. Over current and overvoltage protection of power devices.

## SECTION-2

**Unit-4: AC power control and controlled rectifiers:** Single phase controlled rectifiers, three phase half wave, full wave rectifiers, AC power control techniques. Calculations of RMS and average values. Power factor improvement. Static switches.

**Unit-5: DC to DC converters:** Non isolated dc-dc various converters such as buck, boost, buck boost etc. Transformer isolated dc-dc converters such as flyback, forward, push-pull, half bridge and full bridge. Bidirectional converters.

**Unit-6: Industrial applications:** SMPS, Inverters and UPS systems. Induction and dielectric heating. Temperature and light intensity control. Speed control of AC and DC motors. Variable frequency drives for AC induction motor. LED drivers. Application of power electronics in solar photovoltaic systems and electric vehicles.

### List of Home Assignments:

#### Design:

1. Snubber circuit design for a given application
2. Estimation of power losses and design of a heat sink
3. Design of a boost converter
4. Design of a buck converter
5. IOT and power electronics
6. Batteries bank for electric vehicles
7. Selection of fuses for over-current protection
8. Power electronic transformers for converters
9. Induction cooker

#### Case Study:

10. Power converters in electric vehicles
11. Power electronic in wind energy system
12. Power electronics in locomotives
13. High power UPS systems
14. Rooftop solar photovoltaic system
15. Power electronics in industrial process control
16. Super capacitor application
17. HVDC transmission
18. Power electronics in robotics

#### Blog:

19. GaN power devices and applications
20. Solar photovoltaic plants
21. SiC MOSFETs applications
22. Fuel cell
23. Electric vehicle battery charging

- 24. Electric vehicles
- 25. Renewable energy systems
- 26. Over-current sensing techniques
- 27. Silicon carbide power devices

**Surveys**

- 28. Ferrite cores types and applications
- 29. Energy storage systems
- 30. Solar microinverters
- 31. Snubber circuits
- 32. Wind generators types and applications
- 33. Renewable energy systems
- 34. Smart grids
- 35. TRIAC application

**Assessment Scheme:**

Course Assessment: Total: 100 marks

- 1. Mid Semester Examination: 30 marks (Total: 30 marks based on Section I)  
*30 marks converted to 30*
- 2. End Semester Examination: 30 marks (Total: 30 marks based on Section II)  
*30 marks converted to 30*
- 3. Home Assignment: 10 marks (Total: 100 marks: Case study, Design work, Survey, Blog)  
*100 marks converted to 10*
- 4. Viva: 30 marks (at the end of semester); *100 marks converted to 30*

**Text Books:**

- 1. Singh, Khanchandani; Power Electronics; Tata McGraw-Hill Education, 2008.
- 2. Robert W. Erickson, Dragan Maksimovic; Fundamentals of Power Electronics, Springer.

**Reference Books:**

- 1. Ned Mohan; Power Electronics: A First Course; Wiley International.
- 2. Kambiz Ebrahimi, Yimin Gao, Stefano Longo; Modern Electric, Hybrid Electric, and Fuel Cell Vehicles, 3<sup>rd</sup> Edition; CRC Press

**MOOCs Links and additional reading material:**

- 1. [www.nptelvideos.in](http://www.nptelvideos.in)
- 2. <http://www.nptelvideos.in/2012/11/power-electronics.html>
- 3. <http://www.nptelvideos.in/2012/11/industrial-drives-power-electronics.html>

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

1. Select a suitable power device for the given applications.
2. Calculate power losses, design heat sinks and select suitable driver ICs.
3. Protect power devices using protection devices and circuits.
4. Will be able demonstrate the operation of power electronic circuits.
5. Analyze the power electronic circuits.
6. Contribute in the design and development of power electronic systems.

#### CO-PO Map

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
1	2	2	3	2	1	1	0	0	0	0	0	1	1	1	2
2	2	2	3	2	1	1	0	0	0	0	0	1	1	1	2
3	3	2	2	2	0	0	0	0	0	0	0	0	1	1	1
4	1	2	2	1	1	0	0	0	1	2	0	1	0	1	1
5	2	3	1	1	2	0	0	0	0	0	0	0	0	1	1
6	3	2	2	2	2	1	1	1	1	1	1	1	1	1	3

#### CO attainment levels

CO No.	IC4201 CO1	IC4201 CO2	IC4201 CO3	IC4201 CO4	IC4201 CO5	IC4201 CO6
Attainment Level	3	4	4	3	5	5

#### Future Courses Mapping: Advanced Power Electronics

#### Job Mapping:

Job opportunities in UPS and Inverter manufacturing industries. Industries manufacturing AC and DC drives or motor controllers. In instrumentation industries where power electronics components are involved. Industries related to electric vehicles, solar photovoltaic systems. Power plants.

FF No. : 654

**CS4217:: HUMAN-COMPUTER INTERACTION****Prerequisites:** Mathematics**Course Objectives:**

1. To differentiate IT applications into categories based on measurable human factors
2. To study user categorization and ethnographic observations in user community
3. To generate the awareness about usability guidelines, principles and standards
4. To design user-friendly user interface with due consideration of interface theory and principles
5. To apply usability evaluation methods to identify the usability issues with IT applications
6. To integrate web, CSCW and mobile app design approaches

**Credits:** 2**Teaching Scheme Theory:** 2 Hours/Week

**Course Relevance:** Human-Computer Interaction (HCI) is a socio-technical course, with a goal of bringing the power of computers and communication systems to users, customers or people. It aims to make all computing and communications systems more accessible, maintainable and useful in working, learning and recreational lives of users or people. It helps every computing, web or mobile application to become really user-centric, increasing its users as well as related sales.

**SECTION-I**

**Unit-I Fundamentals of Human Computer Interaction (HCI):** Definition of HCI, Interdisciplinary Nature, Related Disciplines, Goals of System Engineering, Usability, Types of Usability, User Interface (UI), Measurable Human Factors, Accessibility, Differently-abled Users. **[5 hours]** [CO 1] [PO1][ PO4 ]

**Unit-II Interaction Concepts and Models:** User Persona, User Categorization, Golden Rules of Interface Design, Miller's Principle, Task Analysis - GOMS, Contextual Inquiry, Work Models, Interaction Styles, Ethnography, Empathy Maps. **[5 hours]** [ CO2 ] [ PSO2 ][ PO5 ]

**Unit-III Design Process:** Design Concept, Three Pillars of Design, Process of Design, Participatory Design, Internationalization, Interaction Design Patterns. **[4 hours]** [ CO4 ] [ PO3 ] [ PO8 ]

**SECTION-II**

**Unit-IV Usability Evaluation:** Expert-based Evaluation, User-based Evaluation, Formative Evaluation, Summative Evaluation, Heuristic Evaluation, Cognitive Walkthrough, Semiotic Analysis, Icon Categorization, User Surveys, Interviews, Usability Testing, Data Analysis, Statistical Methods. **[6 hours]** [ CO5 ][ PO4 ] [ PO10 ]

**Unit-V Documentation and Groupware:** Classification of Documents, Reading from Displays, Online Help, Tutorials, Error / Warning Messages, Groupware, Computer Supported Cooperative Work (CSCW), Dimensions of Cooperation, Asynchronous Interactions, Synchronous Interactions, Online Communities, Challenges with Online Communications, Accessibility Guidelines. **[4 hours]** [ CO3 ] [ PO9 ][ PO11 ]

**Unit-VI Website and Mobile App Design:** Content Design, Interaction and Navigation Design, Presentation Design, Differences in design approaches, Design and Evaluation Tools. [4 hours]  
[ CO6 ] [ PO3 ][ PO11 ]

**List of Home Assignments:**

**Design :**

- HA\_D** 01 Design of Effective Search-----
- HA\_D** 02 Pocket Clouds - One App, One World, One Touch-----
- HA\_D** 03 Design of Online Voting System -----
- HA\_D** 04 App Design: Health &Fitness Tracking-----
- HA\_D** 05 Online Art Gallery-----
- HA\_D** 06 Design of Currency Detection App for Visually Impaired Users -
- HA\_D** 07 Design of Dashboard -----
- HA\_D** 08 Design of Android Application for Medicine Reminder-
- HA\_D** 09 Design of City Tourism App -----
- HA\_D** 10 Design of Mood-Based Song Recommendation System -

**Case Study:**

- HA\_CS** 01 Accessibility in Video Games-----
- HA\_CS** 02Amazon UX -----
- HA\_CS** 03Facebook for Business -----
- HA\_CS** 04Blood Donation Apps -----
- HA\_CS** 05WhatsappVs Telegram -----
- HA\_CS** 06Google Maps Features -----
- HA\_CS** 07Cryptocurrencies -----
- HA\_CS** 08Car Rental Applications in INDIA -----
- HA\_CS** 09Tesla Motors -----
- HA\_CS** 10 Human Computer Interaction in Movies -----

**Blog :**

- HA\_Blog** 01 Learning ON / OFF -----
- HA\_Blog** 02Rise of India's Online Fantasy Game Industry -
- HA\_Blog** 03Is Online Doctor Consultation goingto Replace Traditional Doctor Visit?—
- HA\_Blog** 04Social Media and Politics -----
- HA\_Blog** 05Future of HCI -----
- HA\_Blog** 06Challenges in Food Delivery Services -----
- HA\_Blog** 07Human Robot Interaction: SCARA -----
- HA\_Blog** 08Attention Span as an Important Factor in UI / UX ofeCommerce Apps -----
- HA\_Blog** 09Humanizing Fintech -----
- HA\_Blog** 10 User Centered Design Approach for Wearables -

**Survey :**

- HA\_Survey** 01 Survey on OTT Platforms -----
- HA\_Survey** 02Survey on e-Learning Platforms-----
- HA\_Survey** 03 Survey on Stock Trading Platforms-----
- HA\_Survey** 04Survey on ZomatovsSwiggy -----
- HA\_Survey** 05Survey on OlavsUber -----
- HA\_Survey** 06Survey onJob Application Platforms -----

**HA\_Survey 07**Survey on Online Payment Apps-----

**HA\_Survey 08**Survey on Exposure of Hate Speech among Instagram Users-

**HA\_Survey 09**Survey on Travel Booking Apps -----

**HA\_Survey 10**Survey on Music Streaming Apps -----

**Suggest an assessment Scheme:**

MSE - 30, HA – 100, ESE – 30 & CVV - 100

**Text Books: (As per IEEE format)**

1. Ben Shneiderman, “Designing the User Interface”, Third Edition, Pearson Education, ISBN 81-7808-262-4.
2. Alan Dix, Janet Finlay, Gregory Abowd, Russell Beale, “Human-Computer Interaction”, Third Edition, Pearson Education, ISBN 81- 297-0409-9.

**Reference Books: (As per IEEE format)**

1. Donald Norman, “The Design of Everyday Things”, 2002 Edition, Basic Books, ISBN 100-465-06710-7.
2. Wilbert Galitz, “The Essential Guide to User Interface Design”, Second Edition, Wiley-Dreamtech India (P) Ltd., ISBN 81-265-0280-0.
3. John Carroll, “Human-Computer Interaction in the New Millennium”, Pearson Education, ISBN 81-7808-549-6.

**MOOCs Links and additional reading material:**

1. <https://nptel.ac.in/courses/106103115>
2. <https://www.coursera.org/learn/human-computer-interaction>
3. <https://classroom.udacity.com/courses/ud400>

**Course Outcomes:**

**On the completion of course, student will able to**

1. To appreciate the differences among IT applications and their categories based on measurable human factors.
2. To identify user categories and capture related ethnographic observations in user community
3. To follow usability guidelines, principles and standards
4. To design user interfaces as per interface theory and user requirements
5. To apply a suitable usability evaluation method to identify the usability issues with IT applications
6. To enhance UI designs as per desired web, CSCW or mobile app design approach

### CO-PO Map:

CO1		CO2		CO3		CO4		CO5		CO6	
PO1	PO4	PSO2	PO5	PO9	PO11	PO3	PO8	PO4	PO10	PO3	PO11
3		3		2		2		3		1	

## CO attainment levels:

CO1 ----- 3 CO4 ----- 2

CO4 ----- 2

CO<sub>2</sub> ----- 3

CO5 ----- 3

CO<sub>3</sub> ----- 2

CO6 ----- 1

## Future Course Mapping:

**Mention other courses that can be taken after completion of this course**

User Interface Design, Usable Security, Intelligent User Interfaces

## Job Mapping:

## What are the Job opportunities that one can get after learning this course

UI Designer, Product Designer, Software Engineer, Mobile App Developer

## **ET4230 :: NATURAL LANGUAGE PROCESSING**

### **Course Prerequisites:**

1. Probability and statistics.
2. Linear Algebra
3. Python programming language

### **Course Objectives:**

1. Learn fundamentals of Text processing
2. Understand the different Language Models
3. Implement POS tagging
4. Implement Text classification
5. Implement sentiment analysis
6. Implement Machine translation

**Credits: 2**

**Teaching Scheme Theory: 2 Hours/Week**

### **Course Relevance:**

Natural Language Processing is a branch of artificial intelligence that deals with the interaction between computers and humans using the natural language. The common applications of NLP involve, Google translator, Word Processors such as Microsoft, Interactive Voice Response, Personal assistant applications.

### **SECTION-1**

Text Processing: Basics, Empirical Laws, Spelling Correction: Edit Distance, N-Gram Language Models, Basic Smoothing, POS Tagging, Hidden Markov Models for POS Tagging, Viterbi Decoding for HMM and Parameter Learning, Maximum Entropy Models.

### **SECTION-2**

Maximum Entropy Models, Name entity recognition, Syntax, Dependency Grammars and Parsing, Semantic, text classification, sentiment analysis, Machine Translation, Question Answering

**List of Course Seminar Topics:**

1. SemEval-2016 task 4: Sentiment analysis in Twitter
2. Modelling user attitudes using hierarchical sentiment-topic model
3. Multilingual dynamic topic model
4. Document-Level Text -classification Using Single-Layer Multisize Filters Convolutional Neural Network
5. Twitter Storytelling Generator Using Latent Dirichlet Allocation and Hidden Markov Model POS-TAG (Part-of-Speech Tagging)
7. Part-of-speech Tagging and Named Entity Recognition Using Improved Hidden Markov Model and Bloom Filter
8. Part of speech tagging for Twitter conversations using Conditional Random Fields model
9. A system for named entity recognition based on local grammars
10. A Maximum-Entropy Segmentation Model for Statistical Machine Translation
11. Mobile embodied conversational agent for task specific applications

**List of Course Group Discussion Topics:**

1. Smoothing Technique
2. N-gram models
3. POS tagging
4. Ambiguities in NLP
5. Challenges in NLP
6. Challenges in designing Language Translators
7. Challenges in designing text classification
8. Challenges in designing sentiment analysis
9. Challenges in designing Question and Answering system
10. Challenges in designing text summarization

**Suggest an assessment Scheme:**

Course Assessment: Total : 100 mks

1. Mid Semester Examination : 30 marks (Total : 30 marks based on Section I)  
*30 marks converted to 30*
2. End Semester Examination: 30 marks (Total : 30 marks based on Section II)  
*30 marks converted to 30*
3. Home Assignment : 10 mks (Total : 100 marks: Case study, Design work, Survey, Blog)  
*100 marks converted to 10*
4. Viva : 30 mks (at the end of semester); *100 marks converted to 30*

**List of Home Assignments:****Design:**

1. POS tagging using HMM
2. Build Chatbot
3. Summarization of customers reviews
4. Social media Information extraction
5. SMS spam classification

**Case Study:**

1. Hiring and recruitment
2. Advertising
3. Healthcare
4. Market intelligence
5. Sentiment analysis

**Blog**

1. Social media Information extraction
2. Name Prediction in Multiple Languages using Recurrent Neural Networks
3. Text Classification using Sentiment Analysis
4. Image Caption Generator
5. gender identification in marathi names

**Surveys**

1. POS tagging techniques
2. SMS and email spam classification
3. Categorization of sport articles
4. machine translation Techniques
5. Name entity recognition methods

**Text Books:**

1. Jurafsky & Martin "[Speech and Language Processing](#)" Prentice Hall, 2000
2. Akshar Bharati, Rajeev Sangal and Vineet Chaitanya: "Natural Language Processing: A Paninian Perspective", Prentice-Hall of India, New Delhi, 1995

**Reference Books:**

1. Steven Bird, Ewan Klein, and Edward Loper "Natural Language Processing with Python", O'Reilly Media 2009

**Moocs Links and additional reading material:**

1. <https://nptel.ac.in/courses/106/105/106105158/>
2. <https://nptel.ac.in/courses/106/106/106106211/>

**Course Outcomes:**

The student will be able to –

1. Have broad understanding of the field of natural language processing [3]
2. Get acquainted with the algorithmic description of the main language levels: morphology, syntax, semantics, and pragmatics [3]
3. Apply mathematical models and algorithms in applications of NLP [4]
4. Design and implementation issues in various NLP applications such as information retrieval and information extraction [4]
5. Demonstrate crucial ideas in linguistics (e.g., syntax, semantics, pragmatics), artificial intelligence (e.g., knowledge representation), and machine learning (e.g., deep learning) to natural language processing. [4]
6. Identify one of the contemporary (sub) problems of natural language processing and implement, in the form of a complete computer program as a possible solutions to it. [5]

**CO PO Map**

PO	CO 1	CO 2	CO 3	CO 4	CO 5	CO 6	CO 7	CO 8	CO 9	CO 10	CO 11	CO 12	PS O1	PS O2	
1	3	3	3	2	4	1		1	1	1			2	1	1
2	3	3	3	2	4	1		1	1	1			2	3	3
3	4	3	3	3	4	2		1	1	1			2	3	3
4	4	3	3	3	4	2		1	1	1			2	3	3
5	4	3	3	2	4	2		1	1	1			2	3	3
6	4	3	3	3	4	2		1	1	1			2	3	3

**CO attainment levels**

1. CO1 - Level 3
2. C02 - Level 3
3. CO3 - Level 4
4. CO4 - Level 4
5. CO5 - Level 4
6. CO6 - Level 5

**Job Mapping:**

Natural Language engineers, Data Scientist and Algorithm Architect with industries in domains Media & Entertainment, Healthcare and Finance.

**AI4015: NETWORK SECURITY****Credits: 2****Teaching Scheme: 2 Hours/Week****Prerequisites:** Computer Networks.**Unit 1: (5 Hours)****Introduction**

Introduction to Security: Vulnerabilities, Threats, Threat Modeling, Risk, attack and attack types, Avoiding attacks, Security services.

key security properties - Confidentiality, Integrity, Availability.

Protocol Vulnerabilities: DoS and DDoS, session hijacking, ARP spoofing, Pharming attack, Dictionary Attacks.

Software vulnerabilities: Phishing, buffer overflow, Cross-site scripting attack, Virus and Worm Features, Trojan horse, Social engineering attacks, ransomware, SYN-Flooding, SQL- injection, DNS poisoning, Sniffing

**Unit 2: (4 Hours)****Private key cryptography**

Mathematical background for cryptography: modulo arithmetic, GCD (Euclid's algorithm), Role of random numbers in security, Importance of prime number, DES, AES.

Chinese remainder theorem

**Unit 3: (5 Hours)****Public key cryptography**

RSA: RSA algorithm, Key generation in RSA, attacks on RSA.

Diffie-Hellman key exchange: Algorithm, Key exchange protocol, Attack.

Elliptic Curve Cryptography (ECC), Elliptic Curve arithmetic. Diffie-Hellman key exchange

**Unit 4: (5 Hours)****Authentication and access control**

Message authentication and Hash Function. Authentication: One-Way Authentication, Mutual Authentication, SHA-512, The Needham-Schroeder Protocol.

Kerberos, X.509 authentication service, public key infrastructure.

Access Control in Operating Systems: Discretionary Access Control, Mandatory Access Control, Role Based Access Control.

**Unit 5: (5 Hours)****Security application and design**

Network layer security: IPSec for IPv4 and IPv6.

Transport layer security: SSL and TLS.

Application layer security: Security services, S/MIME, PGP, HTTPS, Honey pots.

Security design: End-to-end security, Security composability, Open design, Cost and tradeoffs

**Unit 6:****(4 Hours)****Cyber Security:**

Cyber Attack, Cyber Reconnaissance, Crimes in Cyber Space-Global Trends & classification, e-commerce security, Computer forensics, facebook forensic, mobile forensic, cyber forensic, digital forensic

**Text Books**

1. "Cryptography and Network Security-Principles and Practices" by William Stallings, Pearson Education, 2006, ISBN 81-7758-774-9, 4th Edition.
2. "Network Security and Cryptography", by Bernard Menezes, Cengage Learning, 2010, ISBN 81-315-1349-1, 1st Edition.

**Reference Books**

1. "Computer Security: Art and Science", by Matt Bishop, Pearson Education, 2002, ISBN 0201440997, 1st Edition.
2. "Network security, private communication in a public world", by Charlie Kaufman, Radia Perlman and Mike Spencer, Prentice Hall, 2002, ISBN 9780130460196, 2nd Edition.
3. "Cryptography and Information Security", by V.K. Pachghare, PHI, 2015, ISBN-978-81-203-5082-3, Second Edition.

**Additional Reading**

1. "Security architecture, design deployment and operations", by Christopher M. King, Curtis Patton and RSA press, McGraw-Hill, 2001, ISBN 0072133856, 1<sup>st</sup> Edition.
2. "Inside Network Perimeter Security" by Stephen Northcott, Leny Zeltser, et al, Pearson Education Asia, ISBN 8178087618, 1<sup>st</sup> Edition.

**Course Outcomes**

Upon completion of the course, the students will be able to:

1. Analyze cryptographic techniques using a mathematical approach by examining nature of attack.
2. Establish type of attack on a given system.
3. Identify different types of attacks.
4. Justify various methods of authentication and access control for application of technologies to various sections of industry and society.
5. Design a secure system for protection from the various attacks for 7 layer model by determining the need of security from various departments of an organization.
6. Estimate future needs of security for a system by researching current environment on a continuous basis for the benefit of society.

**CO-PO Mapping**

	PO: 1	PO: 2	PO: 3	PO: 4	PO: 5	PO: 6	PO: 7	PO: 8	PO: 9	PO: 10	PO: 11	PO: 12	PSO :1	PSO :2	PSO :13
C O <sub>1</sub>	3	2			3								3		
C O <sub>2</sub>	2			2										2	
C O <sub>3</sub>	2		3												3
C O <sub>4</sub>	2	2				2	2		2					2	
C O <sub>5</sub>	3											1			
C O <sub>6</sub>	2					2	2	1							

FF No. : 654

## CS4272 :: NEURAL NETWORK

**Course Prerequisites:** Operating Systems, Fundamentals of Computer Networks

**Course Objectives:**

1. To become familiar with Cloud Computing and its ecosystem
2. To learn basics of virtualization and its importance
3. To evaluate in-depth analysis of Cloud Computing capabilities
4. To give a technical overview of Cloud Programming and Services.
5. To understand security issues in cloud computing

**Credits: 2**

**Teaching Scheme Theory: 2 Hours/Week**

**Course Relevance:** Cloud computing to enable transformation, business development and agility in an organization.

### SECTION-I

Introduction to Cloud Computing: Recent trends in Computing, Grid Computing, Cluster Computing, Distributed Computing, Utility Computing, Evolution of cloud computing

Cloud Computing Architecture: Cloud versus traditional architecture, Infrastructure as a Service(IaaS), Platform as a Service(PaaS), Software as a Service(SaaS), , Public cloud, Private cloud, Hybrid cloud, Community cloud, Google Cloud architecture, The GCP Console, Understanding projects, Billing in GCP, Install and configure Cloud SDK, Use Cloud Shell, GCP APIs

Infrastructure as a Service (IaaS): Introduction to IaaS, Introduction to virtualization, Different approaches to virtualization, Hypervisors, Machine Image, Virtual Machine(VM), Compute options in the cloud, Exploring IaaS with Compute Engine, Configuring elastic apps with autoscaling, Storage options in the cloud, Structured and unstructured storage in the cloud, unstructured storage using Cloud Storage, SQL managed services, Exploring Cloud SQL, Cloud Spanner as a managed service, NoSQL managed service options, Cloud Datastore, a NoSQL document store, Cloud Bigtable as a NoSQL option

### SECTION-II

Platform as a Service (PaaS): Introduction to PaaS, Service Oriented Architecture (SOA). Cloud Platform and Management, Exploring PaaS with App Engine, Event driven programs with Cloud Functions, Containerizing and orchestrating apps with Google Kubernetes Engine

Software as a Service (SaaS): Introduction to SaaS, Web services, Web 2.0, Web OS,

Service Management in Cloud Computing: Service Level Agreements(SLAs), Billing and accounting, Billing in GCP

Cloud Security: Introduction to security in the cloud, the shared security model, Encryption options, Authentication and authorization with Cloud IAM, Identify Best Practices for Authorization using Cloud IAM.

Cloud Network : Introduction to networking in the cloud, Defining a Virtual Private Cloud, Public and private IP address basics, Google's network architecture, Routes and firewall rules in the cloud, Multiple VPC networks, Building hybrid clouds using VPNs, interconnecting, and direct peering, Different options for load balancing.

**List of Course Seminar Topics:**

1. Storage Cost Optimization On Cloud
2. Cloud Security And Cryptography
3. Infrastructure As A Code (IAC)
4. Cloud Computing In Healthcare
5. Serverless Architecture
6. Deployment Of Microservices In Kubernetes Engine
7. RPA Using AWS Cloud
8. Cloud Trends In Supporting Ubiquitous Computing
9. Mobile Cloud Computing
10. Modern Data Center Architecture

**List of Course Group Discussion Topics:**

1. Data Storage Security in Cloud
2. Cloud Services for SMB's
3. Monitoring Services Provided by GCP and AWS
4. Docker and Kubernetes
5. SaaS vs FaaS (Function as a service )
6. Hybrid Cloud
7. GCP Vs AWS Web Service Architecture
8. Cloud based security issues and threats
9. Authentication and identity
10. Future of Cloud-Based Smart Devices

**List of Home Assignments:****Design:**

1. Serverless Web App to order taxi rides using AWS lambda.
2. Deploying App on Kubernetes
3. Serverless web Application ( GCP Cloud Functions)

- 4. Demonstration of EBS, Snapshot, Volumes
- 5. Single Node Cluster Implementation (Hadoop)

**Case Study:**

- 1. PayU Migration to AWS
- 2. Cloud object storage
- 3. Deployment and Configuration options in AWS
- 4. Deployment and Configuration options in Microsoft Azure
- 5. Deployment and Configuration options in GCP

**Blog**

- 1. Comparing design of various cloud computing platforms
- 2. AWS EKS and Google Cloud Functions
- 3. App Engine
- 4. Cloud Endpoints
- 5. Cloud Pub/Sub

**Surveys**

- 1. Disaster Recovery in Cloud Computing
- 2. Cloud Economics
- 3. Data archiving solutions
- 4. Salesforce
- 5. Dropbox

**Assessment Scheme :**

Course Assessment: Total : 100 mks

- 1. Mid Semester Examination : 30 marks (Total : 30 marks based on Section I)  
*30 marks converted to 30*
- 2. End Semester Examination: 30 marks (Total : 30 marks based on Section II)  
*30 marks converted to 30*
- 3. Home Assignment : 10 mks (Total : 100 marks: Case study, Design work, Survey, Blog)  
*100 marks converted to 10*
- 4. Viva : 30 mks (at the end of semester); *100 marks converted to 30*

**Text Books:**

- 1. Judith Hurwitz, R.Bloor, M.Kanfman, F.Halper, “Cloud Computing for Dummies”, Wiley,India.
- 2. Ronald Krutz and Russell Dean Vines, “Cloud Security”, Wiley-India
- 3. Gautam Shroff. “Enterprise Cloud Computing”, Cambridge

**Reference Books:**

- 1. Barrie Sosinsky, “Cloud Computing Bible”, Wiley India
- 2. Antohy T Velte, et.al, “Cloud Computing : A Practical Approach”, McGraw Hill.
- 3. Michael Miller, “Cloud Computing”, Que Publishing.
- 4. Tim Malhar, S.Kumaraswamy, S.Latif, “Cloud Security & Privacy”, SPD,O'REILLY
- 5. Scott Granneman, “Google Apps”, Pearson

**Moocs Links and additional reading material:**

<https://nptel.ac.in/courses/106/105/106105167/>  
[https://swayam.gov.in/nd1\\_noc20\\_cs55/preview](https://swayam.gov.in/nd1_noc20_cs55/preview)  
<https://www.coursera.org/specializations/cloud-computing>  
<https://azure.microsoft.com/en-in/overview/what-is-cloud-computing/>  
<https://aws.amazon.com/what-is-cloud-computing/>  
<https://www.ibm.com/in-en/cloud/learn/cloud-computing>

**Course Outcomes:**

- 1) Describe the main concepts, key technologies, strengths, and limitations of cloud computing and the possible applications for state-of-the-art cloud computing
- 2) Explain the architecture and infrastructure of cloud computing, including SaaS, PaaS, IaaS, public cloud, private cloud, hybrid cloud, etc.
- 3) Identify problems, and explain, analyze, and evaluate various cloud computing solutions.
- 4) Choose the appropriate technologies, algorithms, and approaches for the related issues.
- 5) Display new ideas and innovations in cloud computing.
- 6) Collaboratively research and write a paper on the state of the art (and open problems) in cloud computing.

**CO PO Map**

CO1	CO2	CO3	CO4	CO5	CO6
PO2	PO3	PO7	PO10	PO11	PSO4
3	3	2	2	1	3

**CO attainment levels**

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

**Future Courses Mapping:**

After completing this course different certifications courses in cloud be taken such as AWS, Azure, Google cloud certifications. One can go for higher studies in specialization of cloud computing and allied subjects.

**Job Mapping:**

Cloud Architect, Cloud Engineer, Cloud Administrator, Solutions Architect - Cloud Computing - AWS / Kubernetes, Cloud Computing Technical Consultant, Associate Cloud Computing Engineer, Cloud Computing Trainer

FF NO. : 654

**IT4216:: DATA MANAGEMENT, PROTECTION AND GOVERNANCE**

**Course Prerequisites:** Knowledge of Linear Algebra & Different types of Signals, Image Processing

**Course Objectives:**

1. To introduce the major ideas, methods, and techniques of computer vision
2. To acquaint with Image segmentation and shape representation.
3. To learn pattern recognition.
4. To explore object recognition and its application

**Credits: 2****Teaching Scheme Theory: 2 Hours/Week**

**Course Relevance:** Computer vision is an interdisciplinary scientific field that deals with how computers can gain high-level understanding from digital images or videos. From the perspective of engineering, it seeks to understand and automate tasks that the human visual system can do.

**SECTION-1**

Image Formation Models : Fundamentals of Image Processing, Monocular imaging system, Radiosity: The ‘Physics’ of Image Formation, Color Model etc, Camera model and Camera Calibration, Construction of 3D Model from images.

Image Processing and Feature Extraction-Image preprocessing-Image Enhancement techniques, Image representations (continuous and discrete), Histogram Processing, Statistical & Geometric Transformation.

Shape Representation and Segmentation : Edge detection, Image segmentation techniques: Edge Based approaches to segmentation, Gradient using Masks, LOG, DOG, Canny, Edge Linking, Line detectors (Hough Transform), Corners – Harris, Region Growing, Region Splitting.

**SECTION-2**

Motion Estimation: Regularization theory, Optical computation, Stereo Vision, Motion estimation, Structure from motion.

Object Recognition: Object Recognition, Feature Detectors, Classifications-Supervised and Unsupervised Machine Learning for Image Classification, Principal Component Analysis, Singular Value Decomposition Shape priors for recognition.

Applications: Photo album – Face detection – Face recognition, Object tracking, Surveillance etc.

**List of Projects:**

1. Image and Video Enhancement models
2. Human Motion Detection
3. Object Detection Model
4. Face Recognition Model
5. Dynamic Texture Synthesis
6. Image and Video Editing
7. Develop an application for a vision-based security system during day/night time. The system should trigger an audio- visual alarm upon unauthorized entry.
8. Develop motion estimation/ tracking system to recognize object of interest related to one of the following applications. (Automobile tracking/ face tracking/ human tracking)

**List of Course Seminar Topics:**

1. Various Image Segmentation techniques
2. New trends in Face recognitions
3. Applications of Computer Vision for Traffic management
4. Facial Expression recognitions
5. Gesture recognitions using Computer Vision
6. Autonomous Car
7. Usage of Computer Vision in Robotics
8. AR VR using Computer Vision

**List of Course Group Discussion Topics:**

1. Object Recognitions,
2. 3-D models and its applications,
3. Image Understanding-Pattern Recognition Models,
4. Face detection models,
5. Image Understanding-Pattern Recognition Models,
6. Image Segmentation

**List of Home Assignments:****Design:**

1. Design 3-D models
2. Face Detection Models
3. Develop an application for a vision-based security system during day/night time. The system should trigger an audio- visual alarm upon unauthorized entry.
4. Develop motion estimation/ tracking system to recognize object of interest related to one of the following applications. (Automobile tracking/ face tracking/ human tracking).
5. Develop motion estimation/ tracking system to recognize object of interest related to one of the following applications. (Space vehicle tracking/ solar energy tracking/ crowd pattern tracking).

**Case Study:**

1. Computer Vision for Smart City
2. Computer Vision for AR AVR
3. Research Areas in Computer Vision
4. Computer Vision for Swastha Bharat
5. Computer Vision in IoT
6. Computer Vision in Health Analytics
7. Computer Vision in wearable computing

**Blog:**

1. Computer Vision for Data Science
2. Computer Vision for Smart Agriculture
3. Computer Vision in Medical Field
4. Usage of AI for Computer Vision
5. Job Opportunities in Computer Vision
6. Usage of Image Processing in Computer Vision, Machine Learning, Deep Learning, and AI

**Surveys:**

1. Computer Vision for Educations
2. Classifications and Recognitions
3. Drone based Surveillance
4. Video Editing
5. Human Motion/Object tracking and detections
6. Computer Vision using High-Performance Computing-Computational
7. Complexity/Time Complexity and Execution time
8. Recent Trends in Computer Vision

**Assessment Scheme:**

Course Assessment: Total : 100 mks

1. Mid Semester Examination : 30 marks (Total : 30 marks based on Section I)  
*30 marks converted to 30*
2. End Semester Examination: 30 marks (Total : 30 marks based on Section II)  
*30 marks converted to 30*
3. Home Assignment : 10 mks (Total : 100 marks: Case study, Design work, Survey, Blog)  
*100 marks converted to 10*
4. Viva : 30 mks (at the end of semester); *100 marks converted to 30*

**Text Books:**

1. Richard Szeliski, “Computer Vision: Algorithms and Applications (CVAA)”, Springer, 2010.
2. E. R. Davies, “Computer & Machine Vision,” Fourth Edition, Academic Press, 2012.
3. Simon J. D. Prince, “Computer Vision: Models, Learning, and Inference”, Cambridge University Press, 2012.

4. Rafael Gonzalez & Richard Woods, "Digital Image Processing," 3<sup>rd</sup> Edition, Pearson publications, ISBN 0132345633.

#### Reference Books:

1. D. Forsyth and J. Ponce, "Computer Vision - A modern approach," Prentice Hall.
2. E. Trucco and A. Verri, "Introductory Techniques for 3D Computer Vision,"- Publisher: Prentice Hall.
3. D. H. Ballard, C. M. Brown, " Computer Vision", Prentice-Hall, Englewood Cliffs, 1982.

#### Moocs Links and additional reading material: [www.nptelvideos.in](http://www.nptelvideos.in)

#### Course Outcomes:

The student will be able –

1. Extract features from Images and do analysis of Images
2. Generate 3D model from images
3. Understand video processing, motion computation and 3D vision and geometry
4. Apply pre-processing algorithms to acquired images
5. Develop feature descriptor for object detection purpose.
6. Make use of Computer Vision algorithms to solve real-world problems

#### CO PO Map:

CO1	CO2	CO3	CO4	CO5	CO6
PO1	PO5	PO6	PO7	PO9	PSO3
3	2	3	3	2	3

#### CO attainment levels:

CO	CO1	CO2	CO3	CO4	CO5	CO6
Level	2	3	4	2	4	5

#### Future Courses Mapping: AR VR, NLP, AI, ML, DL, Video Analytics using GPU etc

**Job Mapping:** Machine Vision Engineer, Associate Data Scientist Computer Vision, Data Scientist-Computer Vision, tensor RT, Keras, Lead Scientist - Image Analytics & Signal Processing - Deep Learning, Software Development Engineer - Image Processing, Image Processing & Computer Vision Engineer, Architect - Video and Image Processing, Lead - Medical Image Analysis Developer, Research Engineer - Computer Vision, , Image Analysis Scientist - Image Processing/Pattern Recognition.

**FF No. : 654****IC4242: DEEP LEARNING****Credits: 3****Teaching Scheme Theory: 2 Hours/Week****Course Objectives:**

1. On completion of this course, a student will be familiar with traditional Machine Learning approaches, e.g. Bayesian Classification, Multilayer Perceptron etc.
2. Understand modern Deep Learning architectures like Convolutional Neural Networks, Autoencoders etc
3. Acquire the knowledge of applying Deep Learning techniques to solve various real life problems

**Course Relevance:** Machine learning, Computer Vision, Machine Vision, Natural language processing

**SECTION-1:****Unit -01(5 Hrs)**

Introduction to Deep Learning, Bayesian Learning, Decision Surfaces, Linear Classifiers, Linear Machines with Hinge Loss

**Unit:02: (5 Hrs)**

Optimization Techniques, Gradient Descent, Batch Optimization, Introduction to Neural Network, Multilayer Perceptron, Back Propagation Learning

**Unit:03:(5 Hrs)**

Unsupervised Learning with Deep Network, Autoencoders , Convolutional Neural Network, Building blocks of CNN, Transfer Learning

**SECTION-2:****Unit:01: (5Hrs)**

Revisiting Gradient Descent, Momentum Optimizer, RMSProp, Adam, Effective training in Deep Net- early stopping, Dropout, Batch Normalization, Instance Normalization, Group Normalization

**Unit :02:(5 Hrs)**

Recent Trends in Deep Learning Architectures, Residual Network, Skip Connection Network, Fully Connected CNN etc., Classical Supervised Tasks with Deep Learning, Image Denoising, Semantic Segmentation, Object Detection etc.

**Unit :03(5 Hrs)**

LSTM Networks, Generative Modeling with DL, Variational Autoencoder, Generative Adversarial Network Revisiting Gradient Descent, Momentum Optimizer, RMSProp, Adam

**List of Home Assignments:**

Students can choose the following topics for Design, Blog writing, Case study and Survey

1. Applications of NLP
2. Applications of Health Care
3. Applications of Computer vision
4. Applications of Machine Vision

**Assessment Scheme:**

Online ESE: 30 Marks

Online ESE: 30 Marks

Comprehensive Viva Voce: 100 Marks converted to 30 equivalent Marks

Home Assignment Assessment: 100 Marks converted to 10 Marks

### Text and Reference Books:

1. Deep Learning- Ian Goodfellow, Yoshua Benjio, Aaron Courville, The MIT Press 2. Pattern Classification- Richard O. Duda, Peter E. Hart, David G. Stork, John Wiley & Sons Inc.

### Moocs Links and additional reading material:

1. Deep Learning NPTEL Course by Prof. Prabir Kumar Biswas, IIT Kharagpur.  
[https://onlinecourses.nptel.ac.in/noc23\\_ee131/preview](https://onlinecourses.nptel.ac.in/noc23_ee131/preview)

**Course Outcomes:** The student will be able to –

1. Comprehend concepts of Machine learning and classification
2. Apply neural networks and back propagation
3. Understand building blocks of CNN and Autoencoders for different real time applications
4. Identify different types of optimizers and types of Normalization
5. Analyze recent Deep Learning Architectures for various real time applications
6. Explore LSTM networks, Generative Adversarial Network etc.. for various real time applications

### CO PO Map:

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

### CO attainment levels

CO No.	IC4242_CO1	IC4242_CO2	IC4242_CO3	IC4242_CO4	IC4242_CO5	IC4242_CO6
Attainment Level	3	3	4	4	3	3

**Job Mapping:** Machine Learning engineer, Computer vision expert

## IC4250 : MODERN COMPUTER VISION (NPTEL COURSE)

[https://onlinecourses.nptel.ac.in/noc24\\_ee21/preview](https://onlinecourses.nptel.ac.in/noc24_ee21/preview)

**Week 1:** Course introduction, Introduction to deep learning, Introduction to neuron

**Week 2:** Multilayer perceptron (MLP), Gradient descent, Backpropagation in MLP

**Week 3:** Optimization and regularization, Regularization and preprocessing, Convolutional neural network (CNN)

**Week 4:** CNN properties, CNN architectures, Introduction to recurrent neural network (RNN), Encoder-Decoder models in RNN

**Week 5:** Low-level vision, Spatial and frequency domain filtering, Edge detection

**Week 6:** Line detection, Feature detectors, Harris corner detector

**Week 7:** Blob detection, SIFT, Feature descriptors, SURF

**Week 8:** Single-view geometry, 2D Geometric transformations, Camera intrinsics and extrinsics

**Week 9:** Two-view stereo, Algebraic representation of epipolar geometry, Fundamental matrix computation

**Week 10:** Structure from motion, Batch processing in SFM, Dense 3D reconstruction

**Week 11:** Deepnets for stereo and SFM, Mid-level vision, Image segmentation

**Week 12:** Deepnets for segmentation, High-level vision, Deepnets for object detection

## Books and references

R. Szeliski, Computer Vision: Algorithms and Applications, Springer, 2010 (online draft)

## Course Outcomes

- 1) Compute the mathematics behind functioning of artificial neural networks
- 2) Understand concept of Multilayer perceptron, training a neural network. compute gradient descent, compute Back Propagation in MLP
- 3) Understand building blocks of CNN and Autoencoders for different real time applications
- 4) Apply spatial and frequency domain filter for images, Learn Edge detection, line detection
- 5) Apply 2D geometric transforms to images, Understand Algebraic representation of epipolar geometry, Fundamental matrix computation
- 6) Understand Deepnets for Stereo and SFM, Mid-level vision, Image segmentation, High-level vision, and Deepnets for object detection

**FF No. : 654****IC4372:: DESIGN THINKING -7****Course Objectives:**

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

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

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

**Course Outcomes:**

The student will be able to

1. IC4372\_CO1 Understand the importance of doing Research
2. IC4372\_CO2 Interpret and distinguish different fundamental terms related to Research
3. IC4372\_CO3 Apply the methodology of doing research and mode of its publication
4. IC4372\_CO4 Write a Research Paper based on project work
5. IC4372\_CO5 Understand Intellectual property rights
6. IC4372\_CO6 Use the concepts of Ethics in Research
7. IC4372\_CO7 Understand the Entrepreneurship and Business Planning

**CO-PO Mapping :**

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

**CO attainment levels :**

CO No.	IC4372_CO1	IC4372_CO2	IC4372_CO3	IC4372_CO4	IC4372_CO5	IC4372_CO6	IC4372_CO7
Attainment Level	2	2	3	6	2	3	2

**IC4243 :: MAJOR PROJECT****Credits: 9****Teaching Scheme:** Lab: 18 Hours/Week

- Major project should be real time and research based problems based on the courses studied.
- Project to be completed with detailed design, implementation, test case preparations, testing and demonstration
- It is having Group formation, discussion with faculty advisor, formation of the project statement, resource requirement, identification and implementation and Time scheduling of the project.
- continuous assessment for the activities mentioned has been carried out throughout the semester
- The student should prepare a consolidated report in LaTeX /word and submit it before term end.
- Project consists of presentation and oral examination based upon the project work demonstration of the fabricated/designed equipment or software developed for simulation. The said examination will be conducted by a panel of examiners, consisting of preferably guide working as internal examiners and another external examiner preferably from an industry or university.

**List of Project areas:**

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

**Course Outcomes:**

Students will be able to

1. IC4243\_CO1: Design solutions for given engineering problem [4] (PO-1,2,3,4,5,6,7 PSO- 1,2,3)
2. IC4243\_CO2: Demonstrate practical knowledge by constructing models/algorithms for real time applications [4] (PO-1,2,3,4,5,6,7 PSO- 1,2,3)
3. IC4243\_CO3: Express effectively in written and oral communication. [3] (PO- 8,10,12 PSO- 1)
4. IC4243\_CO4: Exhibit the skills to work in a team [2] (PO- 8,9,12 PSO-2)
5. IC4243\_CO5: Prepare a time chart and financial record for execution of the project[1] (PO-8,11,12 PSO-3)

# **SEMESTER III**

## IC4211:: INDUSTRY INTERNSHIP

**Credits:** 15

**Teaching Scheme:** Working in Industry 30 Hours / Week

- Gain practical experience within the industry environment.
- Acquire knowledge of the industry in which the internship is done.
- Apply knowledge and skills learned in the classroom in a work setting.
- Develop a greater understanding about career options while more clearly defining personal career goals.
- Experience the activities and functions of business professionals.
- Develop and refine oral and written communication skills.
- Identify areas for future knowledge and skill development.

**Course Outcomes:**

**IC4211\_CO1 : Technical and Analytical Competencies :** Ability to

a)	Seek knowledge, select appropriate technologies, and apply it to different areas	[5] PO-1, PO-3, PO-4, PO-6 PSO-1, PSO-2 PSO-3
b)	Develop a technical artifact requiring new technical skills.	
c)	Improve problem-solving and critical thinking skills.	
d)	Acquire and evaluate information	
e)	Analyze or visualize data to create information	

**IC4211\_CO2: Skill Development / Modern Tool Usage :** Ability to

a)	learn modern engineering tools	[4] PO-5 PSO-1, PSO-2
b)	Effectively utilize appropriate software tool to complete a task	
c)	Effectively utilize modern engineering tools necessary for engineering practices	

**IC4211\_CO3: Communication & Presentation Skills:** Ability to

a)	Communicate ideas orally and in written form	[3] PO-9, PO-10
b)	Report effectively the status of task completion	
c)	Effectively Participate as a team member	
d)	Listen effectively	
e)	Present effectively	

**IC4211\_CO4: Professionalism:** Ability to

a)	Demonstrate understanding of professional customs and practices.	[2] PO-8, PO-12
b)	Organize and maintain information	
c)	Identify, understand and work with professional standards	
d)	Behave professionally and ethically	

**IC4211\_CO5: Technical Writing:** Ability to

a)	Write requirements documentation	[2] PO-10, PO-12
b)	Write Maintenance and troubleshoot report	
c)	Prepare documentation of task completed	

**IC4224:: GLOBAL INTERNSHIP****Credits:** 15**Teaching Scheme:** Working in Industry 30 Hours / Week

- Gain practical experience within the industry/ Institute environment.
- Acquire knowledge of the industry/ Institute in which the internship is done.
- Apply knowledge and skills learned in the classroom in a work setting.
- Develop a greater understanding about career options while more clearly defining personal career goals.
- Experience the activities and functions of business professionals.
- Develop and refine oral and written communication skills.
- Identify areas for future knowledge and skill development.
- If applicable the students should complete the following & document as applicable: Literature Review, Problem scope, Problem Definition, Requirement Analysis, Methodology to solve problem, Implementation, Preliminary results, Implementation, Observations, Results, Conclusion.

**Course Outcomes**

<b>IC4224 CO1 : Technical and Analytical Competencies : Ability to</b>		
a)	Seek knowledge, select appropriate technologies, and apply it to different areas	[5] PO-1, PO-3, PO-4, PO-6 PSO-1, PSO-2 PSO-3
b)	Develop a technical artifact requiring new technical skills.	
c)	Improve problem-solving and critical thinking skills.	
d)	Acquire and evaluate information	
e)	Analyze or visualize data to create information	
<b>IC4224 CO2: Skill Development / Modern Tool Usage : Ability to</b>		
a)	learn modern engineering tools	[4] PO-5 PSO-1, PSO-2
b)	Effectively utilize appropriate software tool to complete a task	
c)	Effectively utilize modern engineering tools necessary for engineering practices	
<b>IC4224 CO3: Communication &amp; Presentation Skills: Ability to</b>		
a)	Communicate ideas orally and in written form	[3] PO-9, PO-10
b)	Report effectively the status of task completion	
c)	Effectively Participate as a team member	
d)	Listen effectively	
e)	Present effectively	
<b>IC4224 CO4: Professionalism: Ability to</b>		
a)	Demonstrate understanding of professional customs and practices.	[2] PO-8, PO-12
b)	Organize and maintain information	
c)	Identify, understand and work with professional standards	
d)	Behave professionally and ethically	
<b>IC4224 CO5: Technical Writing: Ability to</b>		
a)	Write requirements documentation	[2] PO-10, PO-12
b)	Write Maintenance and troubleshoot report	
c)	Prepare documentation of task completed	

FF No. : 654

**IC4226:: RESEARCH INTERNSHIP****Credits: 15****Teaching Scheme:** Working in Industry 30 Hours / Week**Section 1**

- Should complete the following
- Literature Review
- Problem scope
- Problem Definition
- Requirement Analysis
- Methodology to solve problem

**Section 2**

- Implementation
- Preliminary results
- Implementation
- Observations
- Results
- Conclusion

**Course Outcomes**

<b>IC4226_CO1 : Technical and Analytical Competencies : Ability to</b>		
a)	Seek knowledge, select appropriate technologies, and apply it to different areas	[5] PO-1, PO-3, PO-4, PO-6 PSO-1, PSO-2 PSO-3
b)	Develop a technical artifact requiring new technical skills.	
c)	Improve problem-solving and critical thinking skills.	
d)	Acquire and evaluate information	
e)	Analyze or visualize data to create information	
<b>IC4226_CO2: Skill Development / Modern Tool Usage : Ability to</b>		
a)	learn modern engineering tools	[4] PO-5 PSO-1, PSO-2
b)	Effectively utilize appropriate software tool to complete a task	
c)	Effectively utilize modern engineering tools necessary for engineering practices	
<b>IC4226_CO3: Communication &amp; Presentation Skills: Ability to</b>		
a)	Communicate ideas orally and in written form	[3] PO-9, PO-10
b)	Report effectively the status of task completion	
c)	Effectively Participate as a team member	
d)	Listen effectively	
e)	Present effectively	
<b>IC4226_CO4: Professionalism: Ability to</b>		
a)	Demonstrate understanding of professional customs and practices.	[2] PO-8, PO-12
b)	Organize and maintain information	
c)	Identify, understand and work with professional standards	
d)	Behave professionally and ethically	
<b>IC4226_CO5: Technical Writing: Ability to</b>		
a)	Write requirements documentation	[2] PO-10, PO-12
b)	Write Maintenance and troubleshoot report	
c)	Prepare documentation of task completed	

**IC4240:: PROJECT INTERNSHIP****Credits: 15****Teaching Scheme:** Working in Industry 30 Hours / Week**Section 1**

- Should complete the following
- Literature Review
- Problem scope
- Problem Definition
- Requirement Analysis
- Methodology to solve problem

**Section 2**

- Implementation
- Preliminary results
- Implementation
- Observations
- Results
- Conclusion

**Course Outcomes**

<b>IC4240_CO1 : Technical and Analytical Competencies : Ability to</b>		
a)	Seek knowledge, select appropriate technologies, and apply it to different areas	[5] PO-1, PO-3, PO-4, PO-6 PSO-1, PSO-2 PSO-3
b)	Develop a technical artifact requiring new technical skills.	
c)	Improve problem-solving and critical thinking skills.	
d)	Acquire and evaluate information	
e)	Analyze or visualize data to create information	
<b>IC4240_CO2: Skill Development / Modern Tool Usage : Ability to</b>		
a)	learn modern engineering tools	[4] PO-5 PSO-1, PSO-2
b)	Effectively utilize appropriate software tool to complete a task	
c)	Effectively utilize modern engineering tools necessary for engineering practices	
<b>IC4240_CO3: Communication &amp; Presentation Skills: Ability to</b>		
a)	Communicate ideas orally and in written form	[3] PO-9, PO-10
b)	Report effectively the status of task completion	
c)	Effectively Participate as a team member	
d)	Listen effectively	
e)	Present effectively	
<b>IC4240_CO4: Professionalism: Ability to</b>		
a)	Demonstrate understanding of professional customs and practices.	[2] PO-8, PO-12
b)	Organize and maintain information	
c)	Identify, understand and work with professional standards	
d)	Behave professionally and ethically	
<b>IC4240_CO5: Technical Writing: Ability to</b>		
a)	Write requirements documentation	[2] PO-10, PO-12
b)	Write Maintenance and troubleshoot report	
c)	Prepare documentation of task completed	

## IC4244:: MAJOR PROJECT

**Credits:** 9

**Teaching Scheme:** Lab: 18 Hours/Week

- Major project should be real time and research based problems based on the courses studied.
- Project to be completed with detailed design, implementation, test case preparations, testing and demonstration
- It is having Group formation, discussion with faculty advisor, formation of the project statement, resource requirement, identification and implementation and Time scheduling of the project.
- continuous assessment for the activities mentioned has been carried out throughout the semester
- The student should prepare a consolidated report in LaTeX /word and submit it before term end.
- Project consists of presentation and oral examination based upon the project work demonstration of the fabricated/designed equipment or software developed for simulation. The said examination will be conducted by a panel of examiners, consisting of preferably guide working as internal examiners and another external examiner preferably from an industry or university.

### **List of Project areas:**

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

### **Course Outcomes:**

Students will be able to

1. IC4244\_CO1: Design solutions for given engineering problem [4] (PO-1,2,3,4,5,6,7 PSO- 1,2,3)
2. IC4244\_CO2: Demonstrate practical knowledge by constructing models/algorithms for real time applications [4] (PO-1,2,3,4,5,6,7 PSO- 1,2,3)
3. IC4244\_CO3: Express effectively in written and oral communication. [3] (PO- 8,10,12 PSO- 1)
4. IC4244\_CO4: Exhibit the skills to work in a team [2] (PO- 8,9,12 PSO-2)
5. IC4244\_CO5: Prepare a time chart and financial record for execution of the project[1] ( PO-8,11,12 PSO-3)