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 'B24'

Effective from Academic Year 2024-25

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 |

Contents

Vision statement of Institute

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

Mission statement of Institute

- To endure that 100% students are employable in Industry, Higher studies, Become Entrepreneurs, Civil/Defense Services / Government Jobs and other areas like Sports and Theatre.

- To strengthen Academic Practices in terms of Curriculum, Pedagogy, Assessment and Faculty Competence.

- Promote Research Culture amongst Students and Faculty through Projects and Consultancy.

- To make students Socially Responsible Citizen.

Core Values

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

Vision statement of Department

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

Mission statement of Department

- To deliver knowledge of Instrumentation and Control Engineering by strengthening involvement of Research institutions and industries in academics

- To build conducive environment for advanced learning through participation of faculty and students in collaborative research, consultancy projects, student exchange programs and internships

- To develop competent Engineers with entrepreneurial skills to address socio-economic needs.

Program Educational Objectives (PEO)

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

The Graduates would demonstrate

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

Program Outcomes

Engineering Graduates will be able to:

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

7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. **Individual and teamwork:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes (PSOs)

Graduates shall have the ability to:

1. Evaluate the performance of suitable sensors / Process components/ Electronic / Electrical components for building complete automation systems.

2. Analyze real-world engineering problems in the area of Instrumentation and Control.

3. Design or Develop measurement / electronic / embedded and control systems with computational algorithms to provide practical solutions to multidisciplinary engineering problems.

S.Y. B.Tech - Instrumentation and Control Engineering Structure for Pattern B-24, Module-3 with effect from Semester-1 of Academic Year 2024-25 (SY Common)

Course Type	Course Code	Course Name	Teaching Learning Scheme (Hrs./Week)				Credits	Assessment Scheme (100 mark scale)												Total
								In Semester Assessment							End Semester Assessment					100
			Th	Lab	Tut	Total		Lab 10	CP 20	CT1 35	MSE Review 30	Seminar / GD / HA 20			ESE 30			ESE Review 70	CVV 20	
												Seminar	GD	HA	Written	MCQ	Practical			
S1	MD2201	Data Science	2	2	1	5	4	10	20			20			30				20	100
S2	CS2221	Internet of Things	2	2	1	5	4	10	20				20			30			20	100
S3	CS2218	Object Oriented Programming	2	2	1	5	4	10	20								50		20	100
S4	CS2227	Database Management Systems	2	2	1	5	4	10	20			20			30				20	100
S5	IC2223	Applied Electronics	2	0	0	2	2			35									35	30	100
S6	IC2236	Design Thinking-3	0	0	1	1	1														Graded
S7	IC2240	Engineering Design and Innovation - III	0	8	0	8	4				30								70		100
S8	SH2001	Reasoning and Aptitude Development	1	0	0	1	1														Graded
		Total	**11**	**16**	**5**	**32**	**24**	**40**	**80**	**35**	**30**	**40**	**20**	**0**	**60**	**30**	**50**	**105**	**110**	**600**

SEMESTER I

MD2201:: 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: 4   **Teaching Scheme :**   **Theory : 2** Hours/Week
                                                            Tut : 1 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.

Data science definition, raw data, processed data and their attributes, meta data, data cleaning, data science pipeline.   **(3 Hours)**

Normal distribution, evaluating normal distribution, Binomial distribution, confidence Intervals, central limit Theorem, hypothesis testing   **(6 Hours)**

Vector norms, Unconstrained Optimization   **(4 Hours)**

Simple and multiple   linear regression; Logistic regression, non-linear regression, polynomial regression   **(4 Hours)**

Nearest Neighbor Classification – Knn approach, branch and bound algorithm, projection algorithm; Naïve Bayes Classification; Classification using decision trees, divisive and agglomerative clustering, K-means clustering   **(6 Hours)**

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. **(3 Hours)**

List of Tutorials:

1. Data Visualization
2. Distances and Projections
3. Singular Value Decomposition
4. Principal Component Analysis
5. Optimization
6. Normal & Binomial Distribution
7. Hypothesis Testing
8. ANOVA test
9. Linear Regression
10. Logistic Regression
11. Nearest Neighbor Classification
12. Decision Trees based classification
13. Naive Bayes classification
14. Clustering
15. Evaluation of model performance
16. Bagging & Boosting approaches

List of Practical's: (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

List of Course Seminar Topics:

1. Data wrangling
2. Predictive modeling
3. Data analytics in life science (multiple topics)
4. Ensemble modeling techniques
5. Text pre-processing
6. Feature scaling for machine learning
7. Multivariate normal distribution applications
8. Distance metrics and their applications
9. Visualization techniques such as Chernoff's faces
10. Tree based algorithms
11. Ridge regression
12. LASSO

Assessment Scheme:
1. Written ESE:30
2. Course Project:20
3. Laboratory Work:10
4. Seminar Presentation:20
5. CVV:20

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
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. Cloud Computing – AWS
9. IOT
10. Artificial Intelligence
11. Pattern Recognition
12. Natural Language Processing
13. Computer Vision
14. Machine Vision
15. Fault Diagnosis
16. Optimization
17. Bioinformatics
18. Computational Biology
19. Econometrics
20. Supply Chain
21. Ergonomics
22. Operations Research
23. Nano-informatics

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. Enterprise Architect
12. Machine Learning Engineering
13. Machine Learning Scientist

CS2221:: 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: 4   **Teaching Scheme:**   **Theory: 2** Hours/Week
                                                    Tut: 1 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. Interne 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 Practical's: (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

List of Group Discussion Topics:
1. Role of Internet of Things in development of India.
2. Manufacturing industries should make efforts to limit contribution to IoT.
3. Should countries put a ban on IoT for children?
4. Should IoT pay more attention to security rather than just expanding its horizon to the extremes?
5. IoT is the next big thing in technology.
6. IoT poses a huge risk to privacy, if they your system is hacked.
7. IoT is the next big thing for hackers trying to have access to your intimate data.
8. Pros and cons of over-usage of IoT at homes and offices.
9. IoT at battlefields will make life of soldiers safer and easier.
10. IoT will make way for robots to rule over humans one day.
11. IoT devices are making people lazier and obese.
12. IoT needs to be regulated before it goes out of limits and poses serious threat.

Assessment Scheme:
1. Written ESE:30
2. Course Project:20
3. Laboratory Work:10
4. Group Discussion:20
5. CVV:20

Text Books:
1. Arshdeep Bahga and Vijay Madisetti, Internet of Things: A Hands-on Approach", (Universities Press)
2. PethuruRajandAnupamaC.Raman,"TheInternetofThings:EnablingTechnologies,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 ThingsApplications-From Research and Innovation to Market Deployment", ISBN:987-87-93102-94-1,RiverPublishers
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 (CO Attainmentlevel:2)
2. Recognize IoT Design Methodology Steps(COAttainmentlevel:3)
3. Select sensors for different IoT applications (COAttainmentlevel:3)
4. Analyze fundamentals of networking (COAttainmentlevel:4)
5. Apply basic Protocols in IoT (CO Attainmentlevel:4)
6. Provide IoT solutions practically with the help of case study(COAttainmentlevel:5)

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.

CS2218:: 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: 4   **Teaching Scheme Theory:** 2 Hours/Week
                                                          Tut: 1 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 Practical's:
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 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, update 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
181. Domain Search Engine
182. E-Acquisition
183. E-Advertisement
184. E-Learning
185. Enterprise Scheme Planner
186. Face Identification
187. File and Folder Explorer
188. Font Detector/Finder
189. HTML Color Code Finder
190. HTML Spell Checker
191. Image Compressor Application
192. Image to Text Converter
193. Internet Credit Card System
194. Internet Usage Monitoring System
195. Intrusion Detection in Wireless Sensor Network
196. Keyword Finder and Number Calculator
197. Language Emulator
198. Mac Ethernet Address
199. Malware Scanner
200. MP4 Video Converter
201. Online Auction
202. Online Magazine
203. Password Protector and Reminder
204. PDF Converter
205. Pharmacy Management System
206. Port Scanner
207. Process Analysis in Asynchronous System
208. Remote Desktop Administrator
209. Resource Planner and Organizer
210. Search Engine
211. Security System for DNS using Cryptography

212. SmartFTP Uploads
213. Synchronous Conferencing System
214. Text to HTML Converter
215. Unicode Font
216. Voice Chatting and Video Conferencing
217. Voice Compressor Software
218. Windows Fixer
219. XML Compactor

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", 3rd edition, Pearson Education, Inc.*

Assessment Scheme:
1. Practical ESE:50
2. Course Project:20
3. Laboratory Work:10
4. CVV:20

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
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.

CS2227:: 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: 4   **Teaching Scheme Theory: 2** Hours/Week
                                         Tut: 1 Hours/Week
                                         Lab: **2** Hours/Week

Course Relevance:
The course emphasizes on 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: (Any 1)

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.
13. Online appointment booking

List of Course Seminar Topics:

1. Object and Object-Relational Databases
2. XML data model, XML documents and associated languages
3. Database Security
4. Modern Storage Architectures
5. Google Cloud- SQL Databases
6. Google Cloud- NOSQL Databases
7. Amazon Databases
8. Oracle NoSQL Database
9. Cassandra DB
10. Data Center Engineering
11. Google File System (GFS)

Assessment Scheme:

1. Written ESE:30
2. Course Project:20
3. Laboratory Work:10
4. Seminar Presentation:20
5. CVV:20

Text Books:

1. Abraham Silberschatz, Henry F. Korth, S. Sudarshan; "Database System Concepts"; 6th Edition, McGraw-Hill Education

2. Ramez Elmasri, Shamkant B. Navathe; "Fundamentals of Database Systems"; 7th Edition, Pearson

Reference Books:

1. Thomas M. Connolly, Carolyn E. Begg," Database Systems: A Practical Approach to Design, Implementation, and Management, 6th Edition ;Pearson
2. Raghu Ramakrishnan, Johannes Gehrke; "Database Management Systems", 3rd Edition; McGraw Hill Education
3. Kristina Chodorow, MongoDB The definitive guide, O'Reilly Publications, ISBN: 978-93-5110-269-4, 2nd Edition.
4. Dr. P. S. Deshpande, SQL and PL/SQL for Oracle 10g Black Book, DreamTech.
5. Ivan Bayross, SQL, PL/SQL: The Programming Language of Oracle, BPB Publication. 6. Reese G., Yarger R., King T., Williums 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:

https://nptel.ac.in/courses/106/105/106105175/
https://onlinecourses.nptel.ac.in/noc21_cs04/preview
https://www.datacamp.com/courses/introduction-to-sql
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

IC2223:: APLIED ELECTRONICS

Course Prerequisites: Concepts of modern physics and basic electrical engineering.

Course Relevance: Almost in all modern measurement and control systems, electronic devices and components are employed. Therefore, fundamental knowledge of electronics is necessary for understanding the functioning of electronic devices and circuits to make the engineer capable of designing electronic systems and maintenance, troubleshooting of measurement and control systems in which electronic system is present.

Course Objectives:
1. To familiarize with characteristics and working of discrete electronic devices.
2. To design electronic circuits using discrete electronic components/devices.
3. To impart knowledge of operational amplifier and op-amp. Circuit design.
4. To know basics of voltage regulators and design voltage regulator circuits.
5. To design basic digital circuits and understand their applications.
6. To understand the concepts of ADCs and DACs and their selection.

Credits: 04   **Teaching Scheme:** Theory: 2 Hours/Week

Section 1:
Unit-1: Discrete Electronic Components   (4 Hours)
Introduction to various types of electronics components. SMD electronic components. Different types of diodes. Characteristics, specifications and applications. Diode circuits such as rectifiers, clipping, clamping zener shunt regulator etc.

Unit-2: Transistors and Applications.   (6 Hours)
Introduction to various types of transistors. BJT types, characteristics and need of biasing. BJTC C B , CC, CB configuration. CC and CE BJT amplifiers, BJT Darlington and push pull amplifier. BJT constant current source. BJT switching applications, astable multi-vibrator, zener series regulators. Application of FET and MOSFETs. Zener series regulator.

Unit-3: Operational Amplifier and Circuits   (6 Hours)
Introduction to operational amplifier, block diagram and working. Operational amplifiers datasheet interpretation and   selection. Inverting and non-inverting amplifier configurations.   Adder, differential and summing amplifiers. Schmitt trigger, sample and hold, precision rectifiers, I-V and V-I converter, instrumentation amplifier, active filters, Oscillators: wein bridge and phase shift oscillators etc.

Section 2 :
Unit-4: Voltage regulators and references.   (4 Hours)
Fundamental of voltage regulator circuit. Various voltage regulators and voltage reference ICs. Three pin fixed voltage regulator ICs. Variable regulators ICs. Datasheet interpretation of voltage regulator ICs. Design of fixed and variable voltage regulator circuits for a DC power supply.

Unit-5: Digital Logic circuits.   **(4 Hours)**

Various types of logic ICs families. Various types of digital logic families. Boolean algebra, combinational logic. Karnaugh map and application. multiplexers, de-multiplexers, encoders etc. BCD to seven segment decoder/driver ICs. Interfacing of seven segments LED display. Design of combinational logic circuits for various applications.

Unit-6: ADC and DAC converters   **(4 Hours)**

Digital –to-Analog converters: Types, working and selection. Analog-to-Digital converters: Types, working and Selection, ADC and DAC ICs, Specifications and selection of ADCs and DACs.

Text Books

1. Albert Malvino; Electronic Principles by Albert Malvino; Tata McGraw Hill.
2. Ramakant A. Gayakwad; Op-Amps and Linear Integrated Circuits; 4th Edition, PHI
3. H.S.Kalsi; ElectronicInstrumentation; Tata McGrawHill

Reference Books

1. Leach, Malvino,Saha; Digital Principles and Applications; 8thEdition,McGraw Hill
2. R.P.Jain; Modern Digital Electronics;4th Edition, McGraw Hill

Course Outcomes

The student will be able to –

1. IC2223_CO1: Identify and select discrete electronic components for circuit design.
2. IC2223_CO2: Design electronic circuits using discrete electronic components.
3. IC2223_CO3: Interpret the specification of op-amps and design op-amp circuits.
4. IC2223_CO4: Select suitable voltage regulator ICs and design voltage regulator circuits.
5. IC2223_CO5: Select digital logic ICs and design digital logic circuits.
6. IC2223_CO5: Demonstrate working of various types of ADCs and DACs and select them.

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

CO attainment levels

CO No.	IC2023_CO1	IC2023_CO2	IC2023_CO3	IC2023_CO4	IC2023_CO5	IC2023_6
Attainment Level	2	5	4	3	4	4

IC2236:: DESIGN THINKING -3

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

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

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

Course Outcomes:

The student will be able to

1. IC2236_CO1 : Understand the importance of doing Research
2. IC2236_CO2 : Interpret and distinguish different fundamental terms related to Research
3. IC2236_CO3 : Apply the methodology of doing research and mode of its publication
4. IC2236_CO4 : Write a Research Paper based on project work
5. IC2236_CO5 : Understand Intellectual property rights
6. IC2236_CO6 : Use the concepts of Ethics in Research
7. IC2236_CO7 : Understand the Entrepreneurship and Business Planning

CO-PO Mapping :

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

CO attainment levels

CO No.	IC2236_CO1	IC2236_CO2	IC2236_CO3	IC2236_CO4	IC2236_CO5	IC2236_CO6	IC2236_CO7
Attainment Level	2	2	3	6	2	3	2

IC2240:: ENGINEERING DESIGN AND INNOVATION-3

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

Course Objectives: The student will be able to

1. Understand the importance of choosing socially relevant areas for project work
2. Understand the importance of Project centric learning
3. Plan and execute systematic strategy to complete the Project work
4. Document and present the completed project work in proper scientific format
5. To Evaluate alternative approaches, and justify the use of selected tools and methods
6. To provide every student 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: 4   **Teaching Scheme :   Lab:** 8 Hours/Week

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

Topics and Contents

It is based on Real time project implementation in the chosen specific defined area.
Agriculture Healthcare Automotive Process Control IoT
Basics for Projects
Importance of Project Centric Learning, Concept of Domains, Tools and Technology**,** Socially Relevant Project Areas
Domain Project Areas: Awareness and identification of appropriate areas for project work such as: Agriculture, Defense, Healthcare, Smart city, Smart energy, Security Systems, Automobile, Space, Green Earth, Automobiles, Assistive Aid, Water Management, Swachh Bharat (any other socially relevant research area)
Tools: Self learning Activity Learn and use latest engineering tools as per the project need. A few are listed below
Tools in Computer Engineering:
Programming / Coding Tools :- JavaScript, Python, Java, C#, C++, PHP, **Computer Vision Tools** :- OPENCV,MATLAB), **Single board computers:** Raspberry Pi, **Neural network simulators Tools:- Neural Lab, NEST , Machine Learning Tools:- Torch, TensorFlow, Data Science Tools :-** R language programming**,** SQL,
Tools in Electronics and Electronics & Telecommunication Engineering:
Electronic Design Simulation Integrated Circuit Tools:- VHDL, Xilinx, Modelsim , Cadence learn, **Embedded System Tools**:- AVR Studio, Arduino ,Kiel µvision, **Circuit Simulation**

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

Tools in Instrumentation and Control Engineering:-

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

Tools in Mechanical, Industrial, Production, Engineering:-

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

Tools in Chemical Engineering :-

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

(any other suitable tool as per the project requirement)

Technology: Map the appropriate technology**:**

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

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

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

Medical and Healthcare Technologies:- Biomedical Technology,

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

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

Other imp Technologies:- Automobile ,3 D printing

(any other technology as per the project requirement)

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

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

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

Course Outcomes:

1. Design solutions for given engineering problem **[1]**
2. Demonstrate practical knowledge by constructing models/algorithms for real time applications **[1]**
3. Express effectively in written and oral communication **[2]**
4. Exhibit the skills to work in a team 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	PO12	PSO1	PSO2	PSO3
CO1	2	3	3	3	2	2	2	2	1	1	2	2	1	1	3
CO2	2	2	2	2	3	1	2	1	1	0	2	1	2	2	3
CO3	1	1	1	1	0	2	1	3	1	3	1	1	1	1	1
CO4	1	0	0	2	0	1	1	2	3	2	1	1	0	1	0
CO5	1	0	0	1	0	2	1	1	2	2	3	2	0	2	2
CO6	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0

SH2001 : REASONING AND APTITUDE DEVELOPMENT

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

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 'B24'

Effective from Academic Year 2024-25

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

Contents

Vision statement of Institute

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

Mission statement of Institute

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

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

Vision statement of Department

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

Mission statement of Department

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

Program Educational Objectives (PEO)

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

The Graduates would demonstrate

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

Program Outcomes

Engineering Graduates will be able to:

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. **Conduct investigations of complex problems:** Use research –based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. **Individual and teamwork:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes (PSOs)

Graduates shall have the ability to:

1. Evaluate the performance of suitable sensors / Process components/ Electronic / Electrical components for building complete automation systems.

2. Analyze real-world engineering problems in the area of Instrumentation and Control.

3. Design or Develop measurement / electronic / embedded and control systems with computational algorithms to provide practical solutions to multidisciplinary engineering problems.

S.Y. B.Tech - Instrumentation and Control Engineering Structure for Pattern B-24, Module-4 with effect from Semester-2 of Academic Year 2024-25 (Department Module)

Course Type	Course Code	Course Name	Teaching Learning Scheme (Hrs./Week)				Credits	In Semester Assessment				Seminar / GD / HA 20			End Semester Assessment			ESE Review 70	CVV 20	Total 100
			Th	Lab	Tut	Total		Lab 10	CP 20	CT1 35	MSE Review 30	Seminar	GD	HA	ESE 30 Written	MCQ	Practical			
S1	IC2222	Advanced Data Structures	2	2	1	5	4	10	20								50		20	100
S2	IC2224	Data Communication	2	2	1	5	4	10	20				20			30			20	100
S3	IC2226	Signal and Image Processing	2	2	1	5	4	10	20			20			30				20	100
S4	IC2228	Industrial Automation	2	2	1	5	4	10	20				20		30				20	100
S5	IC2242	Transducers and Signal Conditioning	2	0	0	2	2			35								35		30	100
S6	IC2238	Design Thinking-4	0	0	1	1	1														Graded
S7	IC2241	Engineering Design and Innovation - IV	0	8	0	8	4				30								70		100
S8	SH2002	Reasoning and Aptitude Development	1	0	0	1	1														Graded
		Total	**11**	**16**	**5**	**32**	**24**	**40**	**80**	**35**	**30**	**20**	**40**	**0**	**60**	**30**	**50**	**105**	**110**	**600**

SEMESTER II

IC2222 :: ADVANCED DATA STRUCTURES

Course Prerequisites: Basic understating of C/C++ programming

Course Objectives:

1. To impart the basic concepts of data structures and algorithms.

2. To understand concepts about searching and sorting techniques.

3. To construct and implement various data structures and abstract data types including lists, stacks, queues, trees, and graphs.

4. To make understand about writing algorithms and step by step approach in solving problems with the help of fundamental data structures.

5. To emphasize the importance of data structures in developing and implementing efficient algorithms

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

Course Relevance:

In the current scenario there is huge demand in the software industry for a skilled personnel. Data Structures is a basic fundamental course for any student who wishes to make a career in the field of Software industry. Almost every industry working in the software sector be it in the development, service, banking and finance, Data analysis and allied looks for an engineer who has basic programming and analysis skills. Data structures give the students the insights of the working of program and file handling. The course content is included in such a way that the beginner can easily understand the course. The course has hands-on sessions so as to make the learner understand the concepts clearly. Once a student successfully learns the concepts of DS s/he can certainly implement the same in real world engineering applications such as Billing management systems, Database handling, File handling and operations, NLP implementation, Shortest path finding problem solving are to name a few.

Moreover the Students who are aspiring to pursue a master's degree in the field of Engineering are also expected to have a deep understanding of concepts of Data Structures.

This course will develop a core competency in the field of Software technology.

SECTION-1:

Unit-1 : Introduction to DS Sorting and Searching Techniques   [6 Hrs]
 Types: Primitive, Non primitive, Linear, Nonlinear, Static, Dynamic Single and Multidimensional arrays: Memory representation and indexing, operations on multidimensional arrays. Time & Space Complexity Analysis**.**
Sorting Techniques:
Understanding of Selection, Bubble, Insertion, Merge, Quick, Heap sort techniques.
Understanding Time and Space complexities of the algorithms
Searching: Understanding Linear and Binary Search algorithm and Time and Space
Complexities

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   [5 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   [6 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   [6 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 Tutorials (Any 10):

1. Sorting Techniques: Bucket, Heap , Merge sort, Shell Sort, Radix Sort.
2. Searching Techniques: Ternary Search, Fibonacci Search.
3. Problem solving using stack (Maze problem, Tower of Hanoi).
4. Expression conversion like infix to prefix and postfix and vice versa.
5. Priority Queues and Job Scheduling Algorithm.
6. Generalized Linked Lists.
7. Threaded Binary tree and Stack less Traversals using TBT.
8. B and B+ Tree.
9. Applications of Graph in Network problems.
10. Design of Hashing Functions and Collision Resolution techniques.
11. Cuckoo Hashing.

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 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 data base 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 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

Assessment Scheme:

Course Assessment: Total : 100 mks

1. Lab Assignments : 10 marks (ISA, *100 marks converted to 10)*
2. Course Project : 20 marks (ESA, *100 marks converted to 20)*
3. Programming practical exam : 50 mks (ESA, *100 marks converted to 50)*
4. Viva : 20 mks (ESA, *100 marks converted to 20)*

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
2. 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	PO:12	PSO:1	PSO:2	PSO:3
CO:1	1	1	1	0	0	0	0	0	0	0	0	2	0	2	0
CO:2	0	2	2	2	2	0	0	0	0	0	0	0	2	0	2
CO:3	0	0	1	2	2	0	0	0	0	0	0	0	0	2	0
CO:4	2	0	0	1	2	2	2	0	0	0	0	0	0	0	2
CO:5	0	2	0	0	1	2	2	2	0	0	0	0	0	0	0
CO:6	2	0	2	0	0	1	2	2	2	0	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.

IC2224 :: DATA COMMUNICATION

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

Course Objectives:

1. Study of Basic components of a communication system, Serial Communication Methods, Transmission impairment in data communication, Line Coding, Interface standards**:**RS-232, RS-485, Serial Interconnect Buses I2C, SPI, USB
2. Study of different methods of error detection or control, causes of signal distortion Communication media: guided and unguided
3. Study of different methods of modulation, data compression techniques, Multiplexing,
4. Study of different Industrial Protocol used instrumentation and control system: Modbus, HART Protocol, Open Industrial Fieldbus systems,
5. Study of Local Area Network (LAN), Ethernet, Internet protocol suite, CAN bus.
6. Study of IoT wireless technologies and their use cases: LPWANs, Cellular (3G/4G/5G), Zigbee and Other Mesh Protocols, Bluetooth and BLE, Wi-Fi, RFID.

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. Starting from the basics, this course gives you the tools to design and maintain industrial communications systems on plant floor. You'll learn the underlying principles behind today's industrial communications systems, including Modbus, Data Highway Plus, Ethernet, and TCP/IP. Real-life examples and case histories provide insight into the facts behind control networks and how to apply and maintain them effectively in plant.

SECTION-1 :

Unit 1: Overview of Data Communication (6 Hrs.)
        Basics of data communication, role of standards and protocols, important physical standards: *typical serial data communications link*, purpose of instrumentation and control system, important control devices: *Graphical representation of data communications*
        Baseband and broadband transmission, factors affecting transmission speed: Bandwidth, Signal-to-noise ratio, Data throughput, Error rate

Transmission impairment in data communication: attenuation, distortion, noise.
Shannon capacity (NOISY CHANNEL), Nyquist bit rate (NOISELESS)
Basic components of a communication system
Communication modes: Simplex, Half duplex, Full duplex
Digital Representations of Data, Synchronous and Asynchronous Data communication
Data Rate, Channel Capacity, Error Rate, Noise. Nyquist Sampling Rate, Shannon Channel Capacity, SNR.
Line Coding: Unipolar NRZ, Polar NRZ, NRZ Inverted, Bipolar Encoding, Manchester Encoding, Differential Manchester Encoding.

Serial Data Communication Methods and Interface Standards
Balanced and unbalanced data communication
Function of the important standards organizations, serial data communications interface standards: RS-232, RS-485, Serial interface converters
Serial Interconnect Buses I2C, SPI, USB: basic characteristics, frame format configuration, use cases

Unit 2: Error Detection (5 Hrs.)
Origin of errors: Static events, Thermal noise, Transient events
Factors affecting the propagation of signals: Attenuation Limited bandwidth, Delay distortion, Noise,
Methods of feedback error control: Character redundancy: parity check, Block redundancy: longitudinal parity check, arithmetic checksum, Cyclic redundancy check (CRC), Forward error correction: hamming codes
Communication Media: guided and unguided
General properties and use of Guided media copper-based cables, two-wire open lines, twisted pair cables, coaxial cables, fiber-optic cables, General properties and use of Unguided media

Unit 3: Modems and Multiplexers (4 Hrs.)
Modes of operation of a modem, Describe the different methods of **modulation**: AM, FM, PAM, PWM, PPM, PPM,ASK, FSK, PSK,
Components of a modem: transmitter and receiver
Data compression techniques Run length encoding, Adaptive frequency encoding, enhanced data compression, Huffman encoding
Multiplexing: TDM, FDM, etc.

SECTION-2 :

Unit 4: Industrial Protocols (5 Hrs.)
Modbus structures: Message format, The Modbus messaging protocol, Modbus Serial RTU, Modbus Serial ASCII, Modbus TCP/IP, OSI layers of Modbus
HART Protocol: benefits of the HART protocol, HART Data, communication modes, HART networks, OSI layers of the HART protocol
Open Industrial Fieldbus systems: Benefits**,** comparison traditional system, H1 and HSE links, Integrated Architecture, Fieldbus components, The OSI model and
Fieldbus systems, HSE High Speed Ethernet, Examples of various Fieldbus protocols

Unit 5: Local Area Network (LAN), CAN bus (5 Hrs.)

LAN Topologies: Access Mechanisms and Media, Ethernet: specifications and protocols

Internet protocol suite: Basics of TCP/IP Protocols

Controller Area Network (CAN bus): Applications, Architecture, Message Frame Format, OSI reference model for CAN,

Unit 6: Wireless Communications Technologies and Networking (5 Hrs.)

Radio spectrum international telecommunication union (ITU), Microwave basics, Wireless networking components, Introduction to satellite communication,

Types of IoT wireless technologies and their use cases: Low Power Wide Area Networks (LPWANs), Cellular Network 3G, 4G & 5G, Zigbee and Other Mesh Protocols, Bluetooth and BLE, Wi-Fi, RFID, IRDa.

List of Tutorials: (Any Six)
1. Examples and analysis of Unipolar NRZ, Polar NRZ, NRZ Inverted, Bipolar Encoding,
2. Manchester Encoding, Differential Manchester Encoding
3. Examples and analysis on Modulation and demodulation techniques
4. Examples on network performance parameters : RTT, Delay, Bandwidth, Throughput and efficiency
5. Analyze packet formats of Ethernet, IP, TCP and UDP
6. Data Compression Algorithms
7. Frequency Hopping Spread Spectrum (FHSS) and Direct Sequence   Spread Spectrum (DSSS) used in broadband communication Home automation
8. Any tutorials based on relevant technology with respect to subject data communication.

List of Practical: (Any Six)
1. Programming for different error detection
2. Simulation of I2C and SPI communication Protocol
3. Serial communication simulation using RS-232
4. Serial communication simulation using RS-485
5. Simulation of Modbus
6. Simulation of data communication using Cisco Packet tracer
7. Demonstration of modulation techniques
8. Demonstration Multiplexer techniques
9. Setting up small computer networks
10. UDP Socket Programming using Single Thread.
11. Network simulation using Cloudsim
12. Linux Commands for testing connectivity and transfer rates
13. Any practical based on relevant technology with respect to subject data communication.

List of Projects:

1. Communication Systems Using Python
2. Python networking projects
3. Arduino Long Distance Communication
4. Start Sending Data Over Long Distance using Arduino via Wired and Wireless Connection and extend Arduino Capabilities
5. Arduino SMS Sending Motion Detector using Python
6. CAN bus implementation or simulation
7. Power Line Data Communication
8. LIDAR data acquisition
9. Cryptography / Steganography for secured data communication
10. Green Communications for Future Vehicular Networks
11. UAV-Assisted Data Collection
12. Vehicle speed measurement system
13. Vision based measurement system
14. MODBUS simulation
15. BLE simulation
16. Home automation
17. Develop a tool fox for modulation and demodulation methods
18. Implementation of RIP/OSPF/BGP using Packet Tracer
19. Simulation of routing protocol using Packet Tracer/ NS3/OMNet
20. USB to RS232 serial communication or vice versa
21. Simulation of modulation and demodulation for digital telephone lines
22. Simulation of modulation and demodulation for Ethernet Network
23. Simulation of modulation and demodulation for 3G/ 4G for mobile networks
24. Develop a tool for line encoding methods
25. Design and deploy TCP based Multithreaded HTTP client server
26. Design and deploy UDP based Multithreaded TFTP client server
27. Design and deploy TCP based Multithreaded SMTP and POP3 mail client server
28. Design and deploy TCP based Multithreaded Chat client server
29. Cloud Computing
30. Smart metering
31. Any course project based on relevant technology with respect to subject data communication.

List of Course Group Discussion Topics:

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

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

Assessment Scheme:

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

Text Books:

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

Reference Books:

1. Matthew S. Gast "802.11 Wireless Networks", O'Reilly publications; 2nd Edition.
2. C. Siva Ram Murthy and B. S. Manoj, "Ad Hoc Wireless Networks: Architectures and Protocols" Prentice Hall, 2004.
3. Holger Karl and Andreas Willig, "Protocols and Architectures for Wireless Sensor Networks", Wiley, ISBN:0-470-09510-5

Moocs Links and additional reading material:

1. Data Communication: *https://nptel.ac.in/courses/106105082*
2. Digital Communication System: *https://nptel.ac.in/courses/106/108/106108098/*
3. Data comm. Virtual lab: *http://eagle-beacon.com/virtuallab/index.html*
4. Basics of Cisco Packet Tracer (Part 1): *https://www.netacad.com/courses/packet-tracer*
5. Advanced Network Technologies Virtual Lab: *http://vlabs.iitkgp.ac.in/ant/*

Course Outcomes:

The student will be able to –

1. Differentiate serial interface techniques, standards, interconnect buses
2. Apply different methods of error detection, control transmission media
3. Analyse different methods of modulation used for data communication and network, data compression techniques, Multiplexing,
4. Describe different Industrial Protocol used instrumentation and control system
5. Understand LAN, Ethernet, CAN
6. Select IoT wireless technologies for various applications

CO PO Map:

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

CO attainment levels:

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

Future Courses Mapping:

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

Job Mapping:

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

FF No. : 654

IC2226 :: 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: 4   **Teaching Scheme Theory: 2** Hours/Week
                                                Tut : 1 Hour/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 Tutorials:
1. Sampling theorem – compute and plot the continuous and discrete theorem. Change the sampling frequency and plot the signal on paper.
2. Computation of time shift and time scale operations on discrete signals. Computation of convolution
3. Computation of 1 -D DFT and IDFT - by formula and Computation of 1-D DFT and IDFT – by linear Transformations.
4. Computation of FFT radix 2 – DIT and DIF algorithm. Compare the computational complexity in computing DFT and FFT
5. Designing FIR Filter using windowing technique. Designing low pass IIR Filter using BZT method
6. Computation of Geometric transforms on image – scale, rotate, reflect translate (considering 3*3 matrix)
7. Computation of 2D convolution. Computation of 2 D – DFT and 2D IFFT

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 Course Seminar Topics:
1. Signal Processing Applications in sensing and measurement
2. Signal Processing application in Robotics
3. Signal Processing applications in Automation
4. Signal Processing application in Industry
5. Signal Processing application in Space technology
6. Image Processing application in automation
7. Image processing application in robotics
8. Image processing application in Industry 4.0
9. Image processing application in Consumer Electronics
10. Signal processing application in consumer electronics

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:

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

Assessment Scheme:

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

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.

IC2228:: INDUSTRIAL AUTOMATION

Credits: 4   **Teaching Scheme Theory: 2** Hours/Week
Tut   : 1 Hour/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, over load 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 its applications
Pneumatic components: pneumatic power Supply, types of pneumatic relay, FRL unit, pneumatic actuator (cylinders and air motors), pneumatic valves,
Pneumatic circuits: development of pneumatic circuits using standard symbols, sequence diagram (step-displacement) for implementing pneumatic circuits, different pneumatic circuits like reciprocating, sequencing, block transfer, speed regulation, job sorting, electro-pneumatic circuits, etc
Mechanical components : Springs and Gears

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, Future trends, Internet based SCADA display system, Comparison of different SCADA packages. Trending, Historical data storage and Reporting, Alarm management. Programming techniques For: Creation of pages, Sequencing of pages, Creating graphics and Animation and development of application using SCADA System.
Control panels
Control Panel: Control panel basics, control room layout, Electric Power Systems, Instrument Power Requirements, Power Distribution, Control Room Lighting, Communication Systems
Control Panel Types, Flat face Panels, Breakfront Panels, Consoles, Comparison of Panel Types, Panel Layout, Control Panel Bid Specifications, Panel Inspections.

List of Practicals: *Students should perform at least 10 practicals out of following*:
1. Implementation of logic circuits using switches.
2. Implementation of relay logic electrical wiring for given application.
3. Implementation of latching, sequencing and interlocking electrical wiring for given application using contactor.
4. Implementation and testing of hydraulic circuit.
5. Implementation and testing of pneumatic circuit.
6. Testing of hydraulic logic circuit using H-simulator.

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

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

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

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

Assessment Scheme:

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

Text Books:

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

Reference Books:

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

Course Outcomes:

The student will be able to:
1. 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	PO-12	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	1	1	1	1	2	2	1	1	3	2	3
6	3	2	3	2	1	1	-	1	2	2	1	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

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 Product Manager
– Automation Project Manager
– Industrial Automation Sales Engineer
– Automation Controls Engineer
– Automation Application Engineer
– Field Systems Engineer
– PLC Programmer

IC2242 :: TRANSDUCERS AND SIGNAL CONDITIONING

Course Prerequisites: Basic Physics laws.

Course Objectives:

1. Evaluate characteristics of sensors and transducers
2. Understand working principle of different sensors and Transducer
3. Select suitable sensors and transducers for an application
4. Understand Designing procedure for signal conditioning for level, temperature sensor etc
5. Understand Designing procedure for signal conditioning for pressure, displacement etc
6. Compare different sensors and transducers with their performance

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

SECTION 1:

Basic Measurement System, Process system components, Static and Dynamic characteristic of sensor and system , Standards and calibrations data sheet reading and discussion, Discussion on sensor Flow measurement volumetric flow measurement sensor and discussion on its signal conditioning system , Ultrasonic flow measuring system and discussion on its signal conditioning system Hot wire anemometer and target type of flow measurement system and discussion on its signal conditioning system, PH measurement system Conductivity measurement system Turbidity and Viscosity measurement Humidity measurement

SECTION 2 :

Weight measurement, Instrumentation amplifier design in the context of load cell, Ultrasonic sensor level measurement designing discussion ,Temperature sensor – RTD discussion on its signal conditioning system, Temperature sensor Thermistor and discussion on its signal conditioning system, Temperature sensor Thermocouple discussion on its signal conditioning system, Pressure sensors and discussion on its signal conditioning system ,Piezoresistive differential pressure senor signal conditioning system ,Discussion on capacitive pressure sensor sytem, LVDT and discussion on its signal conditioning system Biomedical sensor: Electrode Theory Biomedical system and sensors related to biological systems, Micropower circuits for signal conditioning

Assessment Scheme:

Course Assessment: Total : 100 mks
1. Class Test 1 : 35 marks
2. Class Test 2 : 35 Marks
3. End Semester CVV Examination: 100 marks (100 marks converted to 30) on total syllabus

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. IC2242_CO1: Evaluate characteristics of sensors and transducers [1]
2. IC2242_CO2: Understand working principle of different sensors and transducers for process and chemical parameter. [3]
3. IC2242_CO3: Select suitable sensors and transducers for an application. [5]
5. IC2242_CO4: Designing procedure for signal conditioning for level, temperature sensor etc. [2]
6. IC2242_CO5: Designing procedure for signal conditioning for pressure, displacement sensor etc. [4]
7. IC2242_CO6: Compare different sensors and transducers with their performance. [5]

CO PO Map:

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

CO attainment levels:

CO No.	IC2230_CO1	IC2230_CO2	IC2230_CO3	IC2230_CO4	IC2230_CO5	IC2230_CO6
Attainment Level	1	2	5	3	4	2

Future Courses Mapping:
Measurement systems, Process Instrumentation, Building and Process Automation, etc

IC2236:: DESIGN THINKING -3

Course Objectives:

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

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

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

Course Outcomes:

The student will be able to

1. IC2236_CO1 : Understand the importance of doing Research
2. IC2236_CO2 : Interpret and distinguish different fundamental terms related to Research
3. IC2236_CO3 : Apply the methodology of doing research and mode of its publication
4. IC2236_CO4 : Write a Research Paper based on project work
5. IC2236_CO5 : Understand Intellectual property rights
6. IC2236_CO6 : Use the concepts of Ethics in Research
7. IC2236_CO7 : Understand the Entrepreneurship and Business Planning

CO-PO Mapping :

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

CO attainment levels:

CO No.	IC2236_CO1	IC2236_CO2	IC2236_CO3	IC2236_CO4	IC2236_CO5	IC2236_CO6	IC2236_CO7
Attainment Level	2	2	3	6	2	3	2

IC2240:: ENGINEERING DESIGN AND INNOVATION-3

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

Course Objectives: The student will be able to

1. Understand the importance of choosing socially relevant areas for project work
2. Understand the importance of Project centric learning
3. Plan and execute systematic strategy to complete the Project work
4. Document and present the completed project work in proper scientific format
5. To Evaluate alternative approaches, and justify the use of selected tools and methods
6. To provide every student 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: 6   **Teaching Scheme Theory:** Hours/Week

                                          Tut: Hours/Week

                                          Lab: 12 Hours/Week

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

Topics and Contents

It is based on Real time project implementation in the chosen specific defined area.
Agriculture Healthcare Automotive Process Control IoT
Basics for Projects
Importance of Project Centric Learning, Concept of Domains, Tools and Technology**,** Socially Relevant Project Areas
Domain Project Areas: Awareness and identification of appropriate areas for project work such as: Agriculture, Defense, Healthcare, Smart city, Smart energy, Security Systems, Automobile, Space, Green Earth, Automobiles, Assistive Aid, Water Management, Swachh Bharat (any other socially relevant research area)
Tools: Self learning Activity Learn and use latest engineering tools as per the project need. A few are listed below
Tools in Computer Engineering:
Programming / Coding Tools :- JavaScript, Python, Java, C#, C++, PHP, **Computer Vision Tools** :- OPENCV,MATLAB), **Single board computers:** Raspberry Pi, **Neural network simulators Tools:- Neural Lab, NEST , Machine Learning Tools:- Torch, TensorFlow, Data Science Tools :-** R language programming**,** SQL,

Tools in Electronics and Electronics & Telecommunication Engineering:
Electronic Design Simulation Integrated Circuit Tools:- VHDL, Xilinx, Modelsim , Cadence learn, **Embedded System Tools**:- AVR Studio, Arduino ,Kiel μvision, **Circuit Simulation Tools:-** Pspice, Simulink, Workbench, Tinkercad, ThingSpeak, Proteus, CircuitPro ,**Processor based integrated circuits** :Microcontroller, electronic prototype platforms: Arduino,**Networking Tools** :- Wired / Wireless and Ad-hoc Networking NS-2 , Packet Tracer, **Signal Processing Tools**:- Code Composer Studio along with Integrated circuits
Tools in Instrumentation and Control Engineering:-
System Automation Tools :- PLC , SCADA , PADS, ORCAD ,Eagle, Kicad,
Tools in Mechanical, Industrial, Production, Engineering:-
Engineering Design Tools:- AutoCAD, CATIA,COMSOL Multiphysics, Solidworks, Inventor, PTC Creo **Fluid Dynamics:-** Fluent, HyperWorks, **Finite Element/ Structural Analysis:-** Ansy's, Ansy's Free Student software **Thermal Simulation:-** FlowTherm, Ansys Icepak
Tools in Chemical Engineering :-
Chemical process simulator:- DWSIM - Open Source Process Simulator, **chemical simulation software:-** Schrödinger,
(any other suitable tool as per the project requirement)
Technology: Map the appropriate technology**:**
Emerging Technologies :- Artifical Intelligence, 5G networks, IoT, Serverless Computing, Blockchain , Virtual reality (VR)/Augmented reality (AR), Drone, Quantum Computing, Robotics
 Interdisciplinary Technologies:- Nanotechnology, Nanomaterials, Nanoelectronics, Quantum Computing , Spintronics
Computer Technologies:- Big Data, Cloud Computing, Human Machine Interface (HMI),Cyber Security
Medical and Healthcare Technologies:- Biomedical Technology,
Energy Technologies :- Solar Energy Based Technologies, Wind energy, Green energy Technologies, Energy Storage
 Electronics, Communication Technologies:- Wireless, GPS, Bluetooth, Mobile/social Internet Automation, Mobile Technologies, Voice Assistants, signal processing, image processing, Machine vision, Sensors, Optoelectronics,
Other imp Technologies:- Automobile ,3 D printing
 (any other technology as per the project requirement)

Project Implementation: Selection of the domain area, Literature review, Identify and finalize the Problem Statement (student in consultation with Guide), Understand and select and use the appropriate tools, Map the technologies learned with the project needs (refer available online offline Resources, books, soft materials, relevant MOOCs, consult with domain expertise) Self Learning:- learn the required tools, skill sets, acquire knowledge to do the project
Designing & Testing: Designing of project prototype based on domain areas by incorporating appropriate tools and technology, validation and Testing of the prototype to give the best possible solution

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

Course Outcomes:
1. 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	PO12	PSO1	PSO2	PSO3
CO1	2	3	3	3	2	2	2	2	1	1	2	2	1	1	3
CO2	2	2	2	2	3	1	2	1	1	0	2	1	2	2	3
CO3	1	1	1	1	0	2	1	3	1	3	1	1	1	1	1
CO4	1	0	0	2	0	1	1	2	3	2	1	1	0	1	0
CO5	1	0	0	1	0	2	1	1	2	2	3	2	0	2	2
CO6	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0

SH2002 : REASONING AND APTITUDE DEVELOPMENT

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

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 'C24'

Effective from Academic Year 2024-25

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

Contents

Vision statement of Institute

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

Mission statement of Institute

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

Core Values

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

Vision statement of Department

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

Mission statement of Department

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

Program Educational Objectives (PEO)

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

The Graduates would demonstrate

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

Program Outcomes

Engineering Graduates will be able to:

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

6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. **Individual and teamwork:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes (PSOs)

Graduates shall have the ability to:

1. Evaluate the performance of suitable sensors / Process components/ Electronic / Electrical components for building complete automation systems.

2. Analyze real-world engineering problems in the area of Instrumentation and Control.

3. Design or Develop measurement / electronic / embedded and control systems with computational algorithms to provide practical solutions to multidisciplinary engineering problems.

T.Y. B.Tech - Instrumentation and Control Engineering Structure for Pattern C-24, Module-5 with effect from Semester-1 of Academic Year 2024-25

Course Type	Course Code	Course Name	Teaching Learning Scheme (Hrs./Week)				Credits	Assessment Scheme (100 mark scale)												Total
								In Semester Assessment				Seminar / GD / HA 20			End Semester Assessment					
			Th	Lab	Tut	Total		Lab 10	CP 20	MSE-MCQ 30	MSE Review 30	Seminar	GD	HA	ESE 30			ESE Review 70	CVV 20	100
															Written	MCQ	Practical			
S1	IC3231	Process Instrumentation	2	2	1	5	4	10	20				20			30			20	100
s2	IC3233	Measurement Systems	2	2	1	5	4	10	20			20			30				20	100
s3	IC3237	Control Theory	2	2	1	5	4	10	20			20			30				20	100
s4	IC3243	Artificial Intelligence and Machine Learning	2	2	1	5	4	10	20					20	30				20	100
s5	IC3255	Design Thinking - 5	0	0	1	1	1													Graded
s6	IC3252	Engineering Design and Innovation - V	0	12	0	12	6				30							70		100
s7	SH3001	Reasoning and Aptitude Development	1	0	0	1	1									100				Graded
		Total	**9**	**20**	**5**	**34**	**24**	**40**	**80**		**30**	**40**	**20**	**20**	**60**	**160**		**70**	**80**	**600**

T.Y. B.Tech - Instrumentation and Control Engineering Structure for Pattern C-24, Module-6 with effect from Semester-2 of Academic Year 2024-25

Course Type	Course Code	Course Name	Th	Lab	Tut	Total	Credits	Lab 10	CP 20	MSE-MCQ 30	MSE Review 30	Seminar	GD	HA	Written	MCQ	Practical	ESE Review 70	CVV 20	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	MD32XX	Coursera Track course	1	0	0	1	4													Graded
s5	IC3257	Design Thinking - 6	0	0	1	1	1													Graded
s6	IC3258	Engineering Design and Innovation - VI	0	12	0	12	6				30							70		100
s7	SH3002	Reasoning and Aptitude Development	1	0	0	1	1													Graded
		Total	**8**	**18**	**4**	**30**	**24**	**30**	**60**		**30**	**20**	**40**	**0**	**30**	**60**		**70**	**60**	**400**
		Audit Course – Emerson Course																		Audit
S8	IC3222	Batch Process Control	2			2	0						30			40			30	100

SEMESTER I

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/cm².
6. Develop square root extractor circuit for voltage range / current range.
7. Develop and Simulate flow totalizer unit.
8. Develop high selector / low selector using opamp circuit.
9. Design of intrinsic safety circuit.
10. Develop alarm annunciator using digital logic circuits / ladder program of PLC
11. Tune PID controller for level control application. Use PC lab setup
12. Tune PID controller for flow control application. Use PC lab setup
13. Tune PID controller for pressure control application. Use PC lab setup
14. Tune PID controller for temperature control application. Use PI lab setup
15. Develop op-amp based ON-OFF controller for temperature control loop.
16. Demonstrate different types of positioners available in PI Lab.
17. Demonstrate different types of control valves available in PI lab.
18. Design of PID controller for a SOPDT system by Ziegler Nichols method.
19. Design of feedback system for industrial dryers.
20. Design of feedback control scheme for distillation column.
21. Configure the D.P. transmitter and calibrate it using hand-held configurator for level.

List of Course Group Discussion Topics:
1. Feedback versus Feed-forward control scheme.
2. Wired versus Wireless transmitters: Pros and Cons.
3. Conventional versus Smart transmitters.

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

Assessment Scheme:

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

Text Books:

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

Reference Books:

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

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

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

CO PO Map:

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

CO attainment levels

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

Future Courses Mapping:

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

Job Mapping:

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

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

IC3233:: MEASUREMENT SYSTEMS

Course Prerequisites: Knowledge of basic physics, mathematics, electrical and electronics
Course Objectives:
1. To understand principle and operations of various sensors and transducers
2. To understand the requirement of signal conditioning for various sensor and transducer
3. To get knowledge of various measurement systems for process parameter measurement
4. To understand type electromagnetic interferences and their reduction techniques
5. To understand various analytical instruments and their measurement techniques
6. To understand the operation and applications of various biomedical instruments

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

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

SECTION-1:

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

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

Unit-3: Flow and level measurement: classification, principle, working, specifications of flow sensors such as Orifice, venture-meter, pitot tube, rotameter, turbine, electromagnetic, ultrasonic flow measurement and requirement of signal conditioning circuits. classification, principle, working, specifications of various level sensors such as float, ultrasonic, capacitive, radar, resistance level sensors and requirement of signal conditioning circuits.

SECTION-2:

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

Unit-5: Analytical Instruments and Measurement: Introduction and classification of analytical instruments, qualitative and quantitative analysis, Electromagnetic spectrum, beer lamberts law, optical filters, monochromators, Filter photometer, colorimeter and spectrophotometers. Environmental sensors: Measurement of PH, conductivity, humidity, Gas analyzers, Gas and liquid chromatography instruments

Unit-6: Biomedical Instrumentation Instruments and Measurement: Introduction to human physiology, Biopotential generation, sensors used for physiological measurement, Cardiovascular system and related instruments   (Blood pressure measurement, ECG recorder, Blood flow measurement, blood volume measurement). Life saving devices like pacemaker, defibrillator, Brain system and EEG recorder, Respiratory system and spirometers.

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

List of Practical: (Any Six)
1. Design of signal conditioning of temperature sensor RTD/ thermistors
2. Design of signal conditioning ckt. for weight measurement using Strain Gauge
3. Designing of ECG and EEG Instrumentation amplifier for a given application
4. Simulation of ECG recorder
5. Simulation of pacemaker and defibrillator
6. Simulation of Spectrophotometer
7. Frequency/time period measurement
8. Design of Filter for a given application
9. Design of signal conditioning of temperature sensor thermocouple

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

11. Body temperature measurement system
12. Design of humidity measurement system
13. Design of milliohm and micro ohm measurement techniques
14. Weather parameter measurement and monitoring system

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

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

Text Books:

1. Rangan, Sharma and Mani; Instrumentation: Devices and Systems. Tata McGraw-Hill.
2. Earnest O. Doebelin; Measurement Systems. Tata McGraw-Hill
3. Balagurusamy; Reliability Engineering; Tata McGraw-Hill
4. R S Khandpur; Handbook of Analytical Instruments; McGraw Hill Education; 2 edition
5. Willard, H. H., Merritt Jr, L. L., Dean, J. A., & Settle Jr, F. A. Instrumental methods of analysis. 7th edition. CBS Publishers & Distributors.

6. R.S. Khandpur; Handbook of Biomedical Instrumentation; Third Edition; 2014, McGraw Hill Education (India) Private Limited.

Reference Books:

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

MOOCs Links and additional reading material:

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

Course Outcomes:

After completing the course the students will be able to:

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

CO-PO map:

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

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

Job Mapping:

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

IC3237:: CONTROL THEORY

Credits: 04   **Teaching Scheme:**
                                                            Theory: 2 Hours/Week
                                                            Lab : 2 Hours/Week
                                                            Tutorial: 1 Hour /Week

Section 1 :

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

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

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

Section 2:

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

Unit 5:
Control system Analysis using State Variable methods
Introduction, State variable representation, conversion of state variable model to transfer function, conversion of transfer function to canonical state variable models, solution of state equations, concept of controllability and observability, Controllability and Observability tests

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

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

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

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

List of Tutorials

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

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

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

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

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

Mooc's Links and additional reading material:
https://nptel.ac.in/courses/108/106/108106098/

CO PO Map:

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

FF No. : 654

IC3243 :: ARTIFICIAL INTELLEGIENCE AND MACHINE LEARNING

Course Prerequisites: Fundamentals of Linear Algebra, Probability and Statistics

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

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

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

Section 1 :
Unit 1
Introduction, Brief history, Agents and rationality, task environments, agent architecture types, Search and Knowledge representation, Search spaces, Hill climbing, simulated annealing, genetic algorithms
Unit 2
 Logic based representations and inference, Prolog, Rule based representations, forward and backward chaining, matching algorithms., Probabilistic reasoning and uncertainty., Bayes nets and reasoning with them, Uncertainty and methods to handle it.
Unit 3
Learning, Forms of learning, Statistical methods: naive-Bayes, nearest neighbor, kernel, Decision trees, inductive learning, Clustering - basic agglomerative, divisive algorithms based on similarity/dissimilarity measures, Applications to NLP, vision, robotics, etc

Section 2:
Unit 4
Linear Regression with One Variable: Concept of Linear regression, application of linear regression, cost function, introduction to the gradient descent method for learning. Logistic Regression: Classification, Hypothesis Representation, Decision Boundary, Cost Function,

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

Unit 5

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

Unit 6

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

List of Practicals: (Any Six)

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

List of Tutorials

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

List of Home Assignments

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

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

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

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

Project areas in Computer Vision and Deep learning
1. Image Classification
2. Visual tracking system
3. Face detection system
4. Hand written Digit Recognition System
5. Image caption generator
6. Traffic sign classification
7. Human Pose Estimation

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

Project areas in audio signal processing
1. Audio Data Analysis Using Deep Learning
2. Audio Fingerprinting
3. Automatic Music Tagging
4. Audio Segmentation

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

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

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

Assessment Scheme:

Course Assessment: Total : 100 mks

1. End Semester Examination: 30 marks (ESA, MCQ 30 marks)

2. Course Project : 20 marks (ISA, 100 marks converted to 20)

3. Home Assignment : 20 mks (ISA, Case study, Design work, Survey, Blog) (100 marks converted to 20)

4. Viva : 20 mks (ESA, 100 marks converted to 20)

5. Lab Assignment: 10 mks (ISA, 100 marks converted to 10)

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

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

Mooc's Links and additional reading material:

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

Course Outcomes:

The student will be able to -

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

CO PO Map:

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

CO attainment levels

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

Future Courses Mapping:

Deep Learning, Big Data Analytics, Data analytics

Job Mapping:

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

IC3255:: DESIGN THINKING -5

Course Objectives:

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

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

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

Course Outcomes:

The student will be able to

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

CO-PO Mapping :

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

CO attainment levels :

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

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

Tools in Chemical Engineering :-

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

(any other suitable tool as per the project requirement)

Technology: Map the appropriate technology**:**

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

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

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

Medical and Healthcare Technologies:- Biomedical Technology,

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

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

Other imp Technologies:- Automobile ,3 D printing

(any other technology as per the project requirement)

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

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

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

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

CO-PO Mapping :

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

CO attainment levels :

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

SH3001 : REASONING AND APTITUDE DEVELOPMENT

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

SEMESTER II

FF No. : 654

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, NORSOK, Hazardous area classification, comparison of methods of protections, NEMA ratings, understanding markings, certification process, etc.

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

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

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

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

IC3234 :: BUILDING AND PROCESS AUTOMATION

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

Course Prerequisites: Process Instrumentation

Course Objectives:

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

SECTION-1:

Unit-1

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

Unit-2

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

Unit-3

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

SECTION-2:

Unit-4

ProfiBus and Foundation Fieldbus: Profibus: variants, it's location, architecture, physical layer and wiring, data link layer, communication, application layer, Profibus PA, DP, FMS in detail, advantages.
Foundation Fieldbus: characteristics, variants, comparison with Profibus, advantages, disadvantages, components, physical layer, data link layer, communication layers, User layer, Link Active Scheduler, application layer, function blocks.

Unit-5

Introduction of building automation: Introduction of Components used in building automation system. Concept and application of Building Management System and Automation. Communication protocols used in Building Automation.
Light Control System: Need of Light control in Building Automation. Occupancy sensors and Daylight harvesting methods. Use of DALI communication protocol
Fire &Alarm System: Different fire sensors, smoke detectors and their types.CO and CO2 sensors. Fire control panels. Design considerations for the FA system. Concept of IP enabled Fire & Alarm system.

Unit-6

HVAC system: HVAC processes, components, Central vs Local systems, Duct Configurations, Air Handling Unit, Fan Coil Unit, components, controls, Constant Air-Variable Air Volume System,   Chiller configurations and controls.
Public access (PA) System: Components like microphones, speakers, amplifiers, mixers, Design aspects of PA system. EPBX system and its components.
Access Control & Security System: types, components, Modern Electronic Security Devices, Surveillance Systems, Electronic Access Control Systems, and Intrusion Detection System.

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

List of Practicals: (Any Six)

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

List of Projects:

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

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

Assessment Scheme:

Course Assessment: Total : 100 mks

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

Text Books:

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

Reference Books:

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

Moocs Links and additional reading material:

1. www.nptelvideos.in

Course Outcomes:

1. IC3234_CO1: Demonstrate the working of DCS system [1]
2. IC3234_CO2: Comprehend the Database and Alarm management system and Network topologies. [3]
3. IC3234_CO3: Contrast the performance of Serial data communications, HART and ASI protocol [2]
4. IC3234_CO4: Analyze the performance of ProfiBus and Foundation Fieldbus [4]
5. IC3234_CO5: Design the lighting control / fire alarm system for building automation problem. [3]
6. IC3234_CO6: Develop instrumentation and control scheme for HVAC system. [5]

CO PO Map:

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

CO attainment levels:

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

Future Courses Mapping:

Advanced Process Control, Multivariable Control System, etc.

Job Mapping:

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

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

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

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

Course Relevance:

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

SECTION-1

Unit 1: Data communication networking and physical layer

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

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

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

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

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

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

Unit-2: Data Link Layer and MAC sub layer

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

Unit-3: Network Layer:

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

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

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

SECTION-II

Unit 4: Transport Layer

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

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

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

Unit 6: Advanced topics computer networking
Advanced topics (any 2 of the following): Wireless networks and mobile computing; network management systems; security threats and solutions; IPv6; ATM; Multimedia applications and its impact on networking, Overlay networks and virtualization, network design and management, network simulation and performance analysis **[5 Hrs]**

List of Tutorials: (Any Three)
1) Examples and analysis of Unipolar NRZ, Polar NRZ, NRZ Inverted, Bipolar Encoding, Manchester Encoding, Differential Manchester Encoding

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

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

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

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

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

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

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

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

   e) Slow Start and Additive Increase

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

11) Examples and analysis on Modulation and demodulation techniques
12) Examples on network performance parameters : RTT, Delay, Bandwidth, Throughput and efficiency
13) Analyze packet formats of Ethernet, IP, TCP and UDP
14) Data Compression Algorithms

List of Practical: (Any Six)

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

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

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

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

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

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

6)   Write a program using TCP Berkeley socket primitives for wired /wireless network for following
   a) Say Hello to Each other (For all students)
   b) File transfer (For all students)
   c) Calculator (Arithmetic) (50% students)
   d) Calculator (Trigonometry) (50% students)
Demonstrate the packets captured traces using Wireshark Packet Analyzer Tool for peer to peer mode.

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

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

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

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

List of Projects:

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

13. Design and deploy TCP based Multithreaded Chat client server for your class.
14. Design and deploy UDP based Multithreaded Chat client server for your class.
15. Design and deploy UDP based Multithreaded Audio Conferencing client server for computer engineering department.
16. Design and deploy UDP based Multithreaded Video Conferencing client server for computer
17. Communication Systems Using Python
18. Python networking projects
19. Start Sending Data Over Long Distance using Arduino via Wired and Wireless Connection and extend Arduino Capabilities
20. CAN bus implementation or simulation
21. Power Line Data Communication
22. Cryptography / Steganography for secured data communication
23. Green Communications for Future Vehicular Networks
24. MODBUS simulation
25. Implementation of RIP/OSPF/BGP using Packet Tracer
26. Simulation of routing protocol using Packet Tracer/ NS3/OMNet
27. Simulation of modulation and demodulation for Ethernet Network
28. Cloud Computing
29. Illustrate the steps for implementation of S/MIME email security through Microsoft® Office Outlook.
30. To study the SSL protocol by capturing the packets using Wireshark tool while visiting any SSL secured website (banking, e-commerce etc.).

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

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

Text Books:

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

Reference Books:

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

Moocs Links and additional reading material:

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

Course Outcomes:

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

CO PO Map

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

CO attainment levels :

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

Future Courses Mapping:
High Speed Networks, Wireless Networks, Mobile Networks, Cyber Security, Network Security And Information System, Cloud Computing And Security

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

FF No. : 654

MD32XX :: COURSERA TRACK CERTIFICATE COURSE

IBM

MD4228 : IBM Full Stack Software Developer Professional Certificate

Professional Certificate - 15 course series

Introduction to Software Engineering

Course 1•14 hours•4.7(1,477 ratings)

Introduction to Cloud Computing

Course 2•12 hours•4.6(6,376 ratings)

Introduction to HTML, CSS, & JavaScript

Course 3•10 hours•4.4(176 ratings)

Getting Started with Git and GitHub

Course 4•10 hours•4.6(1,207 ratings)

Developing Front-End Apps with React

Course 5•14 hours•4.3(490 ratings)

Developing Back-End Apps with Node.js and Express

Course 6•13 hours•4.4(410 ratings)

Python for Data Science, AI & Development

Course 7•25 hours•4.6(37,177 ratings)

Developing AI Applications with Python and Flask

Course 8•11 hours•4.4(738 ratings)

Django Application Development with SQL and Databases

Course 9•14 hours•4.5(243 ratings)

Introduction to Containers w/ Docker, Kubernetes & OpenShift

Course 10•17 hours•4.4(811 ratings)

Application Development using Microservices and Serverless

Course 11•14 hours•4.6(277 ratings)

Full Stack Application Development Capstone Project

Course 12•16 hours•4.5(143 ratings)

Full Stack Software Developer Assessment

Course 13•6 hours•4.7(211 ratings)

Generative AI: Elevate your Software Development Career

Course 14•17 hours•4.7(56 ratings)

Software Developer Career Guide and Interview Preparation

Course 15•11 hours•4.7(139 ratings)

∞ Meta

MD 4229 : Meta Back-End Developer Professional Certificate

 Professional Certificate - 9 course series

Introduction to Back-End Development

Course 1•18 hours•4.7(3,171 ratings)

Programming in Python

Course 2•44 hours•4.6(1,439 ratings)

Version Control

Course 3•13 hours•4.6(3,247 ratings)

Introduction to Databases for Back-End Development

Course 4•27 hours•4.6(570 ratings)

Django Web Framework

Course 5•45 hours•4.7(519 ratings)

APIs

Course 6•20 hours•4.4(280 ratings)

The Full Stack

Course 7•24 hours•4.6(178 ratings)

Back-End Developer Capstone

Course 8•20 hours•4.5(130 ratings)

Coding Interview Preparation

Course 9•11 hours•4.6(527 ratings)

MD4237 : IBM Cybersecurity Analyst

Professional Certificate - 14 course series

Introduction to Cybersecurity Careers

Course 1•7 hours•4.6(185 ratings)

Introduction to Cybersecurity Essentials

Course 2•12 hours•4.8(564 ratings)

Introduction to Cybersecurity Tools & Cyberattacks

Course 3•11 hours•4.6(15,520 ratings)

Operating Systems: Overview, Administration, and Security

Course 4•17 hours•4.6(5,450 ratings)

Network Security & Database Vulnerabilities

Course 5•14 hours•4.7(3,134 ratings)

Database Essentials and Vulnerabilities

Course 6•14 hours

Cybersecurity Architecture

Course 7•12 hours•4.9(28 ratings)

Cybersecurity Compliance Framework, Standards & Regulations

Course 8•11 hours•4.7(3,227 ratings)

Penetration Testing, Incident Response and Forensics

Course 9•17 hours•4.6(2,310 ratings)

Cyber Threat Intelligence

Course 10•27 hours•4.7(1,662 ratings)

Cybersecurity Capstone: Breach Response Case Studies

Course 11•13 hours•4.8(1,438 ratings)

IBM Cybersecurity Analyst Assessment

Course 12•4 hours•4.8(1,173 ratings)

Generative AI: Boost Your Cybersecurity Career

Course 13•9 hours•4.7(25 ratings)

Cybersecurity Job Search, Resume, and Interview Prep

Course 14•10 hours

Google

MD4240 : Google Data Analytics

Professional Certificate - 8 course series

Foundations: Data, Data, Everywhere

Course 1•18 hours•4.8(104,518 ratings)

Ask Questions to Make Data-Driven Decisions

Course 2•21 hours•4.7(31,858 ratings)

Prepare Data for Exploration

Course 3•24 hours•4.8(20,310 ratings)

Process Data from Dirty to Clean

Course 4•26 hours•4.8(16,269 ratings)

Analyze Data to Answer Questions

Course 5•32 hours•4.6(10,992 ratings)

Share Data Through the Art of Visualization

Course 6•25 hours•4.6(8,860 ratings)

Data Analysis with R Programming

Course 7•34 hours•4.8(10,223 ratings)

Google Data Analytics Capstone: Complete a Case Study

Course 8•13 hours•4.8(15,149 ratings)

MD4248 : IBM DevOps and Software Engineering

Professional Certificate - 14 course series

Introduction to DevOps
Course 1•9 hours•4.8(2,946 ratings)

Introduction to Cloud Computing
Course 2•12 hours•4.6(6,376 ratings)

Introduction to Agile Development and Scrum
Course 3•11 hours•4.9(1,923 ratings)

Getting Started with Git and GitHub
Course 4•10 hours•4.6(1,207 ratings)

Hands-on Introduction to Linux Commands and Shell Scripting
Course 5•14 hours•4.6(1,253 ratings)

Python for Data Science, AI & Development
Course 6•25 hours•4.6(37,177 ratings)

Developing AI Applications with Python and Flask
Course 7•11 hours•4.4(738 ratings)

Introduction to Containers w/ Docker, Kubernetes & OpenShift
Course 8•17 hours•4.4(811 ratings)

Application Development using Microservices and Serverless
Course 9•14 hours•4.6(277 ratings)

Introduction to Test and Behavior Driven Development
Course 10•19 hours•4.8(193 ratings)

Continuous Integration and Continuous Delivery (CI/CD)
Course 11•14 hours•4.7(162 ratings)

Application Security for Developers and DevOps Professionals
Course 12•17 hours•4.8(163 ratings)

Monitoring and Observability for Development and DevOps
Course 13•16 hours•4.5(50 ratings)

DevOps Capstone Project
Course 14•18 hours•4.8(92 ratings)

MD4251 : IBM Front-End Developer

Professional Certificate - 11 course series

Getting Started with Front-End and Web Development

Course 1•14 hours•4.6(205 ratings)

Introduction to Software Engineering

Course 2•14 hours•4.7(1,477 ratings)

Designing User Interfaces and Experiences (UI/UX)

Course 3•18 hours•4.5(157 ratings)

Introduction to HTML, CSS, & JavaScript

Course 4•10 hours•4.4(176 ratings)

Developing Websites and Front-Ends with Bootstrap

Course 5•7 hours•4.4(46 ratings)

Getting Started with Git and GitHub

Course 6•10 hours•4.6(1,207 ratings)

Developing Front-End Apps with React

Course 7•14 hours•4.3(490 ratings)

Intermediate Web and Front-End Development

Course 8•12 hours•4.4(25 ratings)

Get Started with Cloud Native, DevOps, Agile, and NoSQL

Course 9•13 hours•4.8(24 ratings)

Front-End Development Capstone Project

Course 10•20 hours•4.1(20 ratings)

Software Developer Career Guide and Interview Preparation

Course 11•11 hours•4.7(139 ratings)

MD4259 : Akamai Network Engineering

Professional Certificate - 5 course series

Operating Systems Fundamentals

Course 1•30 hours•4.8(63 ratings)

Networking Fundamentals

Course 2•26 hours•4.7(53 ratings)

Managing Relational Databases

Course 3•17 hours•4.7(16 ratings)

Python Scripting Fundamentals

Course 4•33 hours

Introduction to IT Security

Course 5•22 hours•4.8(13 ratings)

Google

MD4260 : Google Project Management

Professional Certificate - 6 course series

Foundations of Project Management

Course 1•18 hours•4.9(84,008 ratings)

Project Initiation: Starting a Successful Project

Course 2•23 hours•4.8(20,727 ratings)

Project Planning: Putting It All Together

Course 3•33 hours•4.8(12,547 ratings)

Project Execution: Running the Project

Course 4•30 hours•4.8(8,488 ratings)

Agile Project Management

Course 5•28 hours•4.8(12,486 ratings)

Capstone: Applying Project Management in the Real World

Course 6•47 hours•4.8(8,981 ratings)

MD4267 : AWS Cloud Technology Consultant

Professional Certificate - 9 course series

Introduction to Information Technology and AWS Cloud

Course 1•6 hours•4.8(225 ratings)

AWS Cloud Technical Essentials

Course 2•26 hours•4.8(5,221 ratings)

Providing Technical Support for AWS Workloads

Course 3•7 hours•4.8(46 ratings)

Developing Applications in Python on AWS

Course 4•9 hours•4.6(61 ratings)

Skills for Working as an AWS Cloud Consultant

Course 5•10 hours•4.8(39 ratings)

DevOps on AWS and Project Management

Course 6•8 hours•4.8(64 ratings)

Automation in the AWS Cloud

Course 7•8 hours•4.8(35 ratings)

Data Analytics and Databases on AWS

Course 8•9 hours•4.6(35 ratings)

Capstone: Following the AWS Well Architected Framework

Course 9•11 hours•4.8(16 ratings)

Google

MD4268 : Google UX Design

Professional Certificate - 7 course series

Foundations of User Experience (UX) Design

Course 1•19 hours•4.8(67,364 ratings)

Start the UX Design Process: Empathize, Define, and Ideate

Course 2•21 hours•4.8(15,229 ratings)

Build Wireframes and Low-Fidelity Prototypes

Course 3•17 hours•4.9(8,702 ratings)

Conduct UX Research and Test Early Concepts

Course 4•20 hours•4.8(5,319 ratings)

Create High-Fidelity Designs and Prototypes in Figma

Course 5•29 hours•4.8(4,159 ratings)

Build Dynamic User Interfaces (UI) for Websites

Course 6•22 hours•4.8(3,347 ratings)

Design a User Experience for Social Good & Prepare for Jobs

Course 7•26 hours•4.8(3,722 ratings)

IC3257:: DESIGN THINKING -6

Course Objectives:

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

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

Tut: 1 Hours/Week

Topics and Contents

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

Course Outcomes:

The student will be able to

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

CO-PO Mapping :

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

CO attainment levels :

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

FF No. : 654

IC3258 :: ENGINEERING DESIGN AND INNOVATION-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 µvision, **Circuit Simulation Tools:-** Pspice, Simulink, Workbench, Tinkercad, ThingSpeak, Proteus, CircuitPro ,**Processor based integrated circuits** :Microcontroller, electronic prototype platforms:

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

Tools in Instrumentation and Control Engineering:-

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

Tools in Mechanical, Industrial, Production, Engineering:-

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

Tools in Chemical Engineering :-

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

(any other suitable tool as per the project requirement)

Technology: Map the appropriate technology**:**

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

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

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

Medical and Healthcare Technologies:- Biomedical Technology,

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

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

Other imp Technologies:- Automobile ,3 D printing

(any other technology as per the project requirement)

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

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

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

Course Outcomes :

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

CO-PO Mapping :

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

CO attainment levels :

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

SH3002 : REASONING AND APTITUDE DEVELOPMENT

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

IC3222 :: BATCH PROCESS CONTROL

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

Section 1 : [IC3222_CO1, IC3222_CO2, IC3222_CO3]

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

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

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

Section 2: [IC3222_CO4, IC3222_CO5, IC3222_CO6]

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

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

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

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

Reference Books:

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

Course Outcomes:

The student will be able to –

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

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 'D24'

Effective from Academic Year 2024-25

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

Contents

Vision statement of Institute

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

Mission statement of Institute

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

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

Vision statement of Department

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

Mission statement of Department

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

Program Educational Objectives (PEO)

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

The Graduates would demonstrate

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

Program Outcomes

Engineering Graduates will be able to:

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

7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. **Individual and teamwork:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes (PSOs)

Graduates shall have the ability to:

1. Evaluate the performance of suitable sensors / Process components/ Electronic / Electrical components for building complete automation systems.

2. Analyze real-world engineering problems in the area of Instrumentation and Control.

3. Design or Develop measurement / electronic / embedded and control systems with computational algorithms to provide practical solutions to multidisciplinary engineering problems.

Final Year B.Tech - Instrumentation and Control Engineering Structure for Pattern D-24, Module-7 with effect from Semester-1 of Academic Year 2024-25

Course Type	Course Code	Course Name	Th	Lab	Tut	Total	Credits	Lab 10	CP 20	MSE-MCQ 30	MSE Review 30	Seminar	GD	HA	Written	MCQ	Practical	ESE Review 70	CVV 20	100
S1-OE1	MD4228	IBM Full Stack Software Developer	1	0	0	1	4													Graded
S1-OE1	MD 4229	Meta Back-End Developer																		
S1-OE1	MD4237	IBM Cybersecurity Analyst																		
S1-OE1	MD4240	Google Data Analytics																		
S1-OE1	MD4248	IBM DevOps and Software Engineering																		
S1-OE1	MD4251	IBM Front-End Developer																		
S1-OE1	MD4259	Akamai Network Engineering																		
S1-OE1	MD4260	Google Project Management																		
S1-OE1	MD4267	AWS Cloud Technology Consultant																		
S1-OE1	MD4268	Google UX Design																		
S2-OE2	IC4249	Deep Learning (NPTEL course)	1	0	0	1	2			30				10		30			30	100
S2-OE2	IC4250	Modern Computer Vision (NPTEL course)	1	0	0	1	2			30				10		30			30	100
S3	IC4372	Design Thinking - 7	0	0	1	1	1													Graded
S4	IC4243	Major Project	0	18	0	18	9				30							70		100
		Total	**2**	**18**	**1**	**21**	**16**			**30**	**30**			**10**		**30**		**70**	**30**	**200**

Final Year B.Tech - Instrumentation and Control Engineering Structure for Pattern D-24, Module-8 with effect from Semester-1 of Academic Year 2024-25

Course Type	Course Code	Course Name	Teaching Learning Scheme (Hrs./Week)				Credits	Assessment Scheme (100 mark scale)													Total
								In Semester Assessment							End Semester Assessment					
			Th	Lab	Tut	Total		Lab 10	CP 20	MSE-MCQ 30	MSE Review 30	Seminar / GD / HA 20			ESE 30			ESE Review 70	CVV 20	100
												Seminar	GD	HA	Written	MCQ	Practical			
S1	IC4211	Industry Internship		30		30	15				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													Graded
		Total		**30**	**1**	**31**	**16**				**30**							**70**		**100**

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

2. Students can register for new courses of module-7 as module-8 courses instead of Internship module-8

3. Design Thinking – 7 is applicable in only semester 7 irrespective of module.

SEMESTER I

MD42XX :: COURSERA TRACK CERTIFICATE COURSE

IBM

MD4228 : IBM Full Stack Software Developer Professional Certificate

Professional Certificate - 15 course series

Introduction to Software Engineering

Course 1•14 hours•4.7(1,477 ratings)

Introduction to Cloud Computing

Course 2•12 hours•4.6(6,376 ratings)

Introduction to HTML, CSS, & JavaScript

Course 3•10 hours•4.4(176 ratings)

Getting Started with Git and GitHub

Course 4•10 hours•4.6(1,207 ratings)

Developing Front-End Apps with React

Course 5•14 hours•4.3(490 ratings)

Developing Back-End Apps with Node.js and Express

Course 6•13 hours•4.4(410 ratings)

Python for Data Science, AI & Development

Course 7•25 hours•4.6(37,177 ratings)

Developing AI Applications with Python and Flask

Course 8•11 hours•4.4(738 ratings)

Django Application Development with SQL and Databases

Course 9•14 hours•4.5(243 ratings)

Introduction to Containers w/ Docker, Kubernetes & OpenShift

Course 10•17 hours•4.4(811 ratings)

Application Development using Microservices and Serverless

Course 11•14 hours•4.6(277 ratings)

Full Stack Application Development Capstone Project

Course 12•16 hours•4.5(143 ratings)

Full Stack Software Developer Assessment

Course 13•6 hours•4.7(211 ratings)

Generative AI: Elevate your Software Development Career

Course 14•17 hours•4.7(56 ratings)

Software Developer Career Guide and Interview Preparation

Course 15•11 hours•4.7(139 ratings)

∞ Meta

MD 4229 : Meta Back-End Developer Professional Certificate

 Professional Certificate - 9 course series

Introduction to Back-End Development

Course 1•18 hours•4.7(3,171 ratings)

Programming in Python

Course 2•44 hours•4.6(1,439 ratings)

Version Control

Course 3•13 hours•4.6(3,247 ratings)

Introduction to Databases for Back-End Development

Course 4•27 hours•4.6(570 ratings)

Django Web Framework

Course 5•45 hours•4.7(519 ratings)

APIs

Course 6•20 hours•4.4(280 ratings)

The Full Stack

Course 7•24 hours•4.6(178 ratings)

Back-End Developer Capstone

Course 8•20 hours•4.5(130 ratings)

Coding Interview Preparation

Course 9•11 hours•4.6(527 ratings)

MD4237 : IBM Cybersecurity Analyst

Professional Certificate - 14 course series

Introduction to Cybersecurity Careers

Course 1•7 hours•4.6(185 ratings)

Introduction to Cybersecurity Essentials

Course 2•12 hours•4.8(564 ratings)

Introduction to Cybersecurity Tools & Cyberattacks

Course 3•11 hours•4.6(15,520 ratings)

Operating Systems: Overview, Administration, and Security

Course 4•17 hours•4.6(5,450 ratings)

Network Security & Database Vulnerabilities

Course 5•14 hours•4.7(3,134 ratings)

Database Essentials and Vulnerabilities

Course 6•14 hours

Cybersecurity Architecture

Course 7•12 hours•4.9(28 ratings)

Cybersecurity Compliance Framework, Standards & Regulations

Course 8•11 hours•4.7(3,227 ratings)

Penetration Testing, Incident Response and Forensics

Course 9•17 hours•4.6(2,310 ratings)

Cyber Threat Intelligence

Course 10•27 hours•4.7(1,662 ratings)

Cybersecurity Capstone: Breach Response Case Studies

Course 11•13 hours•4.8(1,438 ratings)

IBM Cybersecurity Analyst Assessment

Course 12•4 hours•4.8(1,173 ratings)

Generative AI: Boost Your Cybersecurity Career

Course 13•9 hours•4.7(25 ratings)

Cybersecurity Job Search, Resume, and Interview Prep

Course 14•10 hours

Google

MD4240 : Google Data Analytics

Professional Certificate - 8 course series

Foundations: Data, Data, Everywhere

Course 1•18 hours•4.8(104,518 ratings)

Ask Questions to Make Data-Driven Decisions

Course 2•21 hours•4.7(31,858 ratings)

Prepare Data for Exploration

Course 3•24 hours•4.8(20,310 ratings)

Process Data from Dirty to Clean

Course 4•26 hours•4.8(16,269 ratings)

Analyze Data to Answer Questions

Course 5•32 hours•4.6(10,992 ratings)

Share Data Through the Art of Visualization

Course 6•25 hours•4.6(8,860 ratings)

Data Analysis with R Programming

Course 7•34 hours•4.8(10,223 ratings)

Google Data Analytics Capstone: Complete a Case Study

Course 8•13 hours•4.8(15,149 ratings)

MD4248 : IBM DevOps and Software Engineering

Professional Certificate - 14 course series

Introduction to DevOps

Course 1•9 hours•4.8(2,946 ratings)

Introduction to Cloud Computing

Course 2•12 hours•4.6(6,376 ratings)

Introduction to Agile Development and Scrum

Course 3•11 hours•4.9(1,923 ratings)

Getting Started with Git and GitHub

Course 4•10 hours•4.6(1,207 ratings)

Hands-on Introduction to Linux Commands and Shell Scripting

Course 5•14 hours•4.6(1,253 ratings)

Python for Data Science, AI & Development

Course 6•25 hours•4.6(37,177 ratings)

Developing AI Applications with Python and Flask

Course 7•11 hours•4.4(738 ratings)

Introduction to Containers w/ Docker, Kubernetes & OpenShift

Course 8•17 hours•4.4(811 ratings)

Application Development using Microservices and Serverless

Course 9•14 hours•4.6(277 ratings)

Introduction to Test and Behavior Driven Development

Course 10•19 hours•4.8(193 ratings)

Continuous Integration and Continuous Delivery (CI/CD)

Course 11•14 hours•4.7(162 ratings)

Application Security for Developers and DevOps Professionals

Course 12•17 hours•4.8(163 ratings)

Monitoring and Observability for Development and DevOps

Course 13•16 hours•4.5(50 ratings)

DevOps Capstone Project

Course 14•18 hours•4.8(92 ratings)

MD4251 : IBM Front-End Developer

Professional Certificate - 11 course series

Getting Started with Front-End and Web Development

Course 1•14 hours•4.6(205 ratings)

Introduction to Software Engineering

Course 2•14 hours•4.7(1,477 ratings)

Designing User Interfaces and Experiences (UI/UX)

Course 3•18 hours•4.5(157 ratings)

Introduction to HTML, CSS, & JavaScript

Course 4•10 hours•4.4(176 ratings)

Developing Websites and Front-Ends with Bootstrap

Course 5•7 hours•4.4(46 ratings)

Getting Started with Git and GitHub

Course 6•10 hours•4.6(1,207 ratings)

Developing Front-End Apps with React

Course 7•14 hours•4.3(490 ratings)

Intermediate Web and Front-End Development

Course 8•12 hours•4.4(25 ratings)

Get Started with Cloud Native, DevOps, Agile, and NoSQL

Course 9•13 hours•4.8(24 ratings)

Front-End Development Capstone Project

Course 10•20 hours•4.1(20 ratings)

Software Developer Career Guide and Interview Preparation

Course 11•11 hours•4.7(139 ratings)

MD4259 : Akamai Network Engineering

Professional Certificate - 5 course series

Operating Systems Fundamentals

Course 1•30 hours•4.8(63 ratings)

Networking Fundamentals

Course 2•26 hours•4.7(53 ratings)

Managing Relational Databases

Course 3•17 hours•4.7(16 ratings)

Python Scripting Fundamentals

Course 4•33 hours

Introduction to IT Security

Course 5•22 hours•4.8(13 ratings)

MD4260 : Google Project Management

Professional Certificate - 6 course series

Foundations of Project Management

Course 1•18 hours•4.9(84,008 ratings)

Project Initiation: Starting a Successful Project

Course 2•23 hours•4.8(20,727 ratings)

Project Planning: Putting It All Together

Course 3•33 hours•4.8(12,547 ratings)

Project Execution: Running the Project

Course 4•30 hours•4.8(8,488 ratings)

Agile Project Management

Course 5•28 hours•4.8(12,486 ratings)

Capstone: Applying Project Management in the Real World

Course 6•47 hours•4.8(8,981 ratings)

aws

MD4267 : AWS Cloud Technology Consultant

Professional Certificate - 9 course series

Introduction to Information Technology and AWS Cloud

Course 1•6 hours•4.8(225 ratings)

AWS Cloud Technical Essentials

Course 2•26 hours•4.8(5,221 ratings)

Providing Technical Support for AWS Workloads

Course 3•7 hours•4.8(46 ratings)

Developing Applications in Python on AWS

Course 4•9 hours•4.6(61 ratings)

Skills for Working as an AWS Cloud Consultant

Course 5•10 hours•4.8(39 ratings)

DevOps on AWS and Project Management

Course 6•8 hours•4.8(64 ratings)

Automation in the AWS Cloud

Course 7•8 hours•4.8(35 ratings)

Data Analytics and Databases on AWS

Course 8•9 hours•4.6(35 ratings)

Capstone: Following the AWS Well Architected Framework

Course 9•11 hours•4.8(16 ratings)

Google

MD4268 : Google UX Design

Professional Certificate - 7 course series

Foundations of User Experience (UX) Design

Course 1•19 hours•4.8(67,364 ratings)

Start the UX Design Process: Empathize, Define, and Ideate

Course 2•21 hours•4.8(15,229 ratings)

Build Wireframes and Low-Fidelity Prototypes

Course 3•17 hours•4.9(8,702 ratings)

Conduct UX Research and Test Early Concepts

Course 4•20 hours•4.8(5,319 ratings)

Create High-Fidelity Designs and Prototypes in Figma

Course 5•29 hours•4.8(4,159 ratings)

Build Dynamic User Interfaces (UI) for Websites

Course 6•22 hours•4.8(3,347 ratings)

Design a User Experience for Social Good & Prepare for Jobs

Course 7•26 hours•4.8(3,722 ratings)

FF No. : 654

IC4249: DEEP LEARNING

Credits: 2   **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 Goodfelllow, 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

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

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

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
CO1	1	1	1	1	1	0	0	0	0	0	0	1	0	1	1
CO2	1	1	1	1	1	0	0	0	0	0	0	1	0	1	1
CO3	2	2	3	3	2	2	1	2	2	3	0	1	1	1	1
CO4	3	3	3	3	3	2	1	2	2	3	1	1	1	1	1
CO5	1	1	1	1	1	0	0	0	0	0	0	0	0	0	1
CO6	2	2	2	2	2	2	1	3	2	3	0	1	0	0	1
CO7	1	1	1	1	1	0	0	0	0	0	0	1	0	0	1

CO attainment levels :

CO No.	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 II

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
b) Develop a technical artifact requiring new technical skills.	PSO-1, PSO-2
c) Improve problem-solving and critical thinking skills.	PSO-3
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
b) Effectively utilize appropriate software tool to complete a task	PSO-1, PSO-2
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

IC4224_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	
IC4224_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	
IC4224_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	
IC4224_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	
IC4224_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	

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

IC4226_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	
IC4226_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	
IC4226_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	
IC4226_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	
IC4226_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	

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

IC4240_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	
IC4240_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	
IC4240_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	
IC4240_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	
IC4240_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	

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
CO1	1	1	1	1	1	0	0	0	0	0	0	1	0	1	1
CO2	1	1	1	1	1	0	0	0	0	0	0	1	0	1	1
CO3	2	2	3	3	2	2	1	2	2	3	0	1	1	1	1
CO4	3	3	3	3	3	2	1	2	2	3	1	1	1	1	1
CO5	1	1	1	1	1	0	0	0	0	0	0	0	0	0	1
CO6	2	2	2	2	2	2	1	3	2	3	0	1	0	0	1
CO7	1	1	1	1	1	0	0	0	0	0	0	1	0	0	1

CO attainment levels :

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

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)