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 'B22'

Effective from Academic Year 2022-23

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.

4

Structure and syllabus of B.Tech . Instrumentation Engineering. A.Y. 2022-23

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-22, Module-3
with effect from Semester-1 of Academic Year 2022-23

Course Type	Course Code	Course Name	Teaching Learning Scheme (Hrs./Week)				Credits	Assessment Scheme (100 mark scale)										
			Th	Lab	Tut	Total		In Semester Assessment							End Semester Assessment		Total
								HA	Lab	CP	Seminar	GD	MSE	ESE	PRG	Viva	100
S1	MD2201	Data Science	2	2	1	5	4	20		20	20			20		20	100
S2	CS2221	Internet of Things	2	2	1	5	4	20		20		20		20		20	100
S3	CS2218	Object Oriented Programming	2	2	1	5	4		10	10				20	40	20	100
S4	CS2227	Database Management Systems	2	2	1	5	4	20		20	20			20		20	100
S5	IC2236	Design Thinking-3	0	0	1	1	1										Graded
S6	IC2237	Engineering Design and Innovation - 1	0	12	0	12	6						30	70			100
		Total	**8**	**20**	**5**	**33**	**23**										

SEMESTER I

7

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

List of Home Assignments:

Case Study: A very large number of resources are available for data generated out of case study. Unique Home assignments will be set up for all groups

Surveys: Principles of surveying will be implemented by groups to demonstrate use of data science principles in home assignments

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

FF No. : 654

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

14

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 Course Seminar Topics:

1. IoT Architecture
2. Sensor Characteristics
3. IoT for supply chain management and inventory systems
4. IoT Ethics
5. Security in IoT
6. Cloud Computing Platform
7. IoT Best Practices
8. 5GinIoT
9. Middleware Technology
10. M2M energy efficiency routing protocol
11. IoT based Biometric Implementation
12. Complete IoT solution using AWS
13. A smart patient health monitoring system
14. IoT for intelligent traffic monitoring
15. Home automation of lights and fan using IoT

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.

List of Home Assignments:

Design:
1. Smart City
2. Smart Transportation
3. Smart Healthcare
4. Smart Industry using IoT
5. Design of IoT framework

Case Study:
1. Open Source in IoT
2. IoT solutions for automobile
3. Cloud Computing
4. AWS
5. Microsoft Azure

Blog:
1. Network Selection for IoT
2. Need of secure protocols
3. Future of IoT
4. IIoT
5. IoT and Industry4.0

Surveys:
1. Autonomous Vehicles
2. ListofIndiancompanieswhichofferIoTsolutionsforagricultureandfarming.Describethepro blem they are addressing and their solution.
3. Make a list of Indian companies which offer IoT solutions for healthcare. Describe the problem they are addressing and their solution.
4. Makeanexhaustivelistofeverythinginside,justoutside(immediatesurroundings)andon the auto body which must be "observed" for safe and comfortable driving using autonomous vehicles.
5. Compare different Cloud Service providers in the market.

16

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.

FF No.: 654

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.

18

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 Course Seminar Topics:

1. Introduction of Arrays and 1D Array programming examples
2. Multidimensional arrays
3. Variants of main() and command line arguments
4. Input and Output stream classes
5. String concepts and various methods of comparing strings
6. Methods in Java
7. Java String Methods
8. Passing array to a function and Jagged array examples
9. Reading input using Scanner and Buffer Reader Class
10. String, String buffer and String builder
11. Types of Inheritance in Java
12. Implementation of Types using Constructor in Inheritance
13. Using final with Inheritance
14. Base vs derived class reference in Inheritance
15. Using final with Inheritance, Accessing superclass member
16. Parent and Child classes having same data member
17. Overriding, Hiding Fields & Methods
18. Static vs Dynamic Binding & Hiding Methods
19. Private and final methods
20. Passing and Returning Objects in Java
21. Java Memory Management
22. File handling in Java vs C++

23. Data types used in Java vs C++
24. Java Object Serialization and Deserialization
25. Operator precedence
26. Use of Object Class Methods
27. Garbage collection in JAVA
28. Use of Static Blocks in various applications
29. Keywords used in JAVA
30. Types of Variables In JAVA

List of Group Discussion Topics:
1. Introduction of Arrays and 1D Array programming examples
2. Multidimensional arrays
3. Variants of main () and command line arguments
4. Input and Output stream classes
5. String concepts and various methods of comparing strings
6. Methods in Java
7. Java String Methods
8. Passing array to a function and Jagged array examples
9. Reading input using Scanner and Buffer Reader Class
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11. Types of Inheritance in Java
12. Implementation of Types using Constructor in Inheritance
13. Using final with Inheritance
14. Base vs derived class reference in Inheritance
15. Using final with Inheritance, Accessing superclass member
16. Parent and Child classes having same data member
17. Overriding, Hiding Fields & Methods
18. Static vs Dynamic Binding & Hiding Methods
19. Private and final methods
20. Passing and Returning Objects in Java
21. Java Memory Management
22. File handling in Java vs C++
23. Data types used in Java vs C++
24. Java Object Serialization and Deserialization
25. Operator precedence
26. Use of Object Class Methods
27. Garbage collection in JAVA
28. Use of Static Blocks in various applications
29. Keywords used in JAVA
30. Types of Variables In JAVA
31. Data types used in java and Wrapper classes in java
32. Checked and unchecked exception, user defined and standard exception
33. Abstraction in Java and different ways to achieve Abstraction
34. Packages in Java – Types, Advantages & Techniques to Access Packages
35. Inner classes, nested interfaces in Java

36. Difference between Interfaces and abstract classes in Java
37. Exception Handling in Java Vs CPP
38. Difference between 1) throw and throws. 2) Final, finally and finalize in Java
39. Discuss Exception propagation and Discuss Exception handling with method overriding in Java
40. Discuss Packages, Access specifiers and Encapsulation in java.
41. Difference between abstraction and encapsulation in Java.
42. Daemon Threads Vs user threads
43. Preemptive scheduling Vs slicing
44. Is it possible to call the run()method directly to start a new thread? pls comment
45. Arraylist Vs Vector
46. Arrays Vs Collections
47. is Iterator a class or an Interface? what is its use?
48. List Vs Set
49. BufferedWriter and BufferedReader classes in java
50. BufferedReader Vs Scanner class in java
51. Buffered Reader Vs FileReader in java
52. Instanceofjava
53. Difference between CPP and JAVA
54. Difference between JDBC and ODBC connectivity
55. file processing in java
56. Difference between primitive data processing and object data processing
57. Creating GUI using swing
58. comparison between Swing, SWT, AWT, SwingX, JGoodies, JavaFX, Apache Pivot
59. Introduction To JFC And GUI Programming In Java
60. Introduction to wrapper classes
61. Why java uses Unicode System?
62. Checked and unchecked exception, user defined and standard exception
63. Abstraction in Java and different ways to achieve Abstraction
64. Packages in Java – Types, Advantages & Techniques to Access Packages
65. Inner classes, nested interfaces in Java
66. Difference between Interfaces and abstract classes in Java
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89. Introduction To JFC And GUI Programming In Java
90. Introduction to wrapper classes
91. Why java uses Unicode System?

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

Structure and syllabus of B.Tech . Instrumentation Engineering. A.Y. 2022-23

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

List of Home Assignments:
  Blog:
   1. Single and Multidimensional arrays in Java
   2. Comparison Inheritance & Polymorphism
   3. Need of abstract classes and interfaces in Java
   4. Multithreading concept in Java
   5. Signed & Unsigned arithmetic operations usin JAVA
   6. Role of start() and run() methods in multithreading
  Survey:
   1. Strategies for Migration from C++ to Java
   2. Product development using Inheritance and Polymorphism in Industry
   3. on Java/OOP features popular amongst developers
   4. Which other (non-JVM) languages does your application use?
   5. How Java Impacted the Internet

27

    6. How can aArrayList be synchronised without using vector?

Design:
1. Implementation of Singleton design pattern in Java
2. Notes Repository System for Academic
3. Design for employee management system
4. Design for student management system
5. Inventory Management System
6. Write a program to delete duplicate numbers from the file

Case Study:
1. Java development milestones from 1.0 to 16.0
2. Implementation of Different Methods in Polymorphism
3. Real world systems which use java for its implementation
4. Drawing a flag using java
5. Use of different methods of Class object
6. Drawing a flag using java

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.

Moocs Links and additional reading material:

Programming using Java| Java Tutorial | By Infosys Technology
https://infyspringboard.onwingspan.com/en/app/toc/lex_auth_01304972186110361645_shared/overview

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

FF No.: 654

CS2227:: DATABASE MANAGEMENT SYSTEMS

Course Prerequisites:
Basics of computer system and any programming language.

Course Objectives:
1. To study the fundamental concepts of structural Computer system and Computer Arithmetic
2. To understand the basic concepts and functions of Microprocessor
3. To gain knowledge of Computer Memory System
4. To get familiar with GPU and CPU architecture
5. To identify solutions for real world design issues using processors.

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

Course Relevance:

Modern computer technology requires an understanding of both hardware and software, since the interaction between the two offers a framework for mastering the fundamentals of computing.

The purpose of this course is to cultivate an understanding of modern computing technology through an in-depth study of the interface between hardware and software.

In this course, you will study the history of modern computing technology before learning about modern computer architecture and a number of its essential features, including instruction sets, processor arithmetic and control, the Von Neumann architecture, pipelining, memory management, storage, and other input/output topics.

The course will conclude with a look at the recent switch from sequential processing to parallel processing by looking at the parallel computing models and their programming implications.

Course Contents :

Basic concepts of Digital Electronics, Organization and Architecture, Structure & Function, Brief History of computers, Von Neumann Architecture, Integer Representation: Fixed point & Signed numbers. Integer Arithmetic: 2's Complement arithmetic, multiplication, Booth's Algorithm, Division Restoring Algorithm, Non Restoring algorithm, Floating point representation: IEEE Standards for Floating point representations.

8086 Microprocessor Architecture, Register Organization, Instruction types, Types of operands, Instruction formats, addressing modes and address translation. Near & FAR procedure, Instruction cycles. RISC Processors: RISC- Features, CISC Features, Comparison of RISC & CISC Superscalar Processors. Case study of Processor.

30

Fundamental Concepts: Single Bus CPU organization, Register transfers, Performing an arithmetic/ logic operations, fetching a word from memory, storing a word in memory, Execution of a complete instruction. Micro-operations, Hardwired Control, Example-Multiplier CU. Micro-programmed Control: Microinstructions, Microinstruction-sequencing: Sequencing techniques, Micro-program sequencing

Need, Hierarchical memory system, Characteristics, Size, Access time, Read Cycle time and address space. Main Memory Organization: ROM, RAM, EPROM, E 2 PROM, DRAM, Design examples on DRAM, SDRAM, DDR3, Cache memory Organization: Address mapping. Basic concepts: role of cache memory, Virtual Memory concept. Pipeline and its performance, Data hazards: operand forwarding, handling data hazards in software, side effects. Instruction hazards: unconditional branches, conditional branches and branch prediction.

Parallelism in Uniprocessor system, Evolution of parallel processors, Architectural Classification, Flynn's, Fengs, Handler's Classification, Multiprocessors architecture basics, Parallel Programming Models : Shared memory, Message passing, Performance considerations : Amdahl's law, performance indications.

Parallel computing architectures (multi-core CPUs, GPUs, traditional multi-processor system, Xeon-Phi, Jetson Kit, Kilocore processor), multiprocessor and multicomputer systems, interconnection networks, Modern GPU architecture (in brief), Performance comparison: Speedup, Gain time and scalability.

List of Practical's: (Any Six)

1. Study of 8086 Architecture and Execution of sample programs.
2. Write 8086 ALP to access marks of 5 subjects stored in array and find overall percentage and display grade according to it.
3. Write 8086 ALP to perform block transfer operation. (Don't use string operations) Data bytes in a block stored in one array transfer to another array. Use debugger to show execution of program.
4. Write 8086 ALP to find and count zeros, positive number and negative number from the array of signed number stored in memory and display magnitude of negative numbers.
5. Write 8086 ALP to convert 4-digit HEX number into equivalent 5-digit BCD number.
6. Write 8086 ALP to convert 5-digit BCD number into equivalent 4-digit HEX number.
7. Write 8086 ALP for following operations on the string entered by the user.
a. String length
b. Reverse of the String
c. Palindrome
8. Write 8086 ALP for following operations on the string entered by the user (Use Extern Far Procedure).

a. Concatenation of two strings

b. Find number of words, lines.

c. Find number of occurrences of substring in the given string.

9. Write 8086 ALP to initialize in graphics mode and display following object on screen.

10. Write 8086 ALP to encrypt and decrypt the given message.

11. Write 8086 ALP to perform following operations on file

a. Open File

b. Write data in the file.

c. Delete data in the file.

d. Close the file.

List of Course Projects:

1. Combinational and Sequential circuits
2. Memory Management
3. Graphics Mode
4. IOT based projects.
5. IoT based atmospheric CO2 administration.
6. IoT based flood risk predictor.
7. Simulate modern traffic control system.
8. Online Parallel Examination.

List of Course Seminar Topics:

1. Computer Architecture VS Computer Organization
2. Evolution of Computing Devices
3. Instructions types , formats and execution
4. Interrupts in Microprocessor
5. Trends in computer architecture
6. RISC Vs CISC architecture : A Case Study
7. ARM processor architecture
8. Latest Technology in Embedded systems
9. Multiplier Control Unit
10. Booth's Encoding Pattern for Fast Scalar Point Multiplication in ECC for Wireless Sensor Networks
11. Internet of Things (IoT) in 5G Wireless Communications
12. State of the art parallel processor design.
13. Memory management in mobile OS.
14. Evolution of processors.
15. Ultra SPARC Processor Architecture.

Structure and syllabus of B.Tech . Instrumentation Engineering. A.Y. 2022-23

List of Home Assignments:

Design:

1. Write the sequence of control steps required for the single bus organization for each of the following instructions:

   1. ADD the (immediate) number NUM to register R1
   2. ADD the contents of memory location NUM to register R1

   Assume that each instruction consists of two words. The first word specifies the operation and addressing mode, and second word contains the number NUM

2. Configure a 32 Mb DRAM chip. Consider cells to be organized in 8K X 4 array. Find out the number of address lines.

3. A set associative cache consists of 64 lines, or slots, divided into four-line sets. Main memory contains 4K blocks of 128 words each. Analyze the format of main memory addresses with proper explanation.

4. A one pipeline system takes 50 ns to process a task. The same task can be processed in 6 segment pipeline with a clock cycle of 10 ns. Determine the speedup ratio of pipeline for 100 tasks. What is maximum speedup ratio?

Case Study:

1. Micro-programmed Control Unit and Hardwired Control Unit.
2. Pipeline Hazards
3. Flynn's architectural classification scheme.
4. Modern Processor units

Survey:

1. New memory technologies and their potential impact on **architecture**
2. Virtual Memory
3. Simulation of a superscalar processor and analyzing impact of design tradeoffs
4. Cache Consistency Models in Modern Microprocessors

Blog:

1. Super Computer
2. Intel Journey
3. New Arm Interconnect technologies
4. Distributed Systems and Parallel Computing

Text Books:

1. William Stallings, "Computer Organization and Architecture: Designing for Performance", 7th Edition, Pearson Prentice Hall Publication, ISBN 81-7758-9 93-8.

2. C. Hamacher, V. Zvonko, S. Zaky, "Computer Organization", 5th Edition, Tata McGraw Hill Publication, ISBN 007-120411-3.

3. Kai Hwang, "Advanced Computer Architecture", Tata McGraw-Hill ISBN 0-07-113342-9

4. Douglas Hall, "Microprocessors and Interfacing", 2nd Edition, Tata McGraw Hill Publications, ISBN 0-07-025742-6.

5. Peter Abel, "Assembly Language Programming," 5th Edition, Pearson Education Publications, ISBN 10:013030655.

Reference Books:

1. Hwang and Briggs,"Computer Architecture and Parallel Processing", Tata McGraw HillPublication ISBN 13: 9780070315563.

2. A. Tanenbaum, "Structured Computer Organization", Prentice Hall Publication, ISBN 81 –203 – 1553 – 7, 4th Edition.

MOOCs Links and additional reading material:

1. www.nptelvideos.in
2. https://www.udemy.com/
3. https://learn.saylor.org/
4. https://www.coursera.org/
5. https://swayam.gov.in/

Course Outcomes: Upon completion of the course, post graduates will be able to –

1. Demonstrate computer architecture concepts related to design of modern processors, memories and I/Os. (2)
2. Illustrate the micro operations sequencing. (3)
3. Evaluate various alternatives in processor organization. (3)
4. Understand concepts related to memory & IO organization (2)
5. Adapt the knowledge based on Pipeline and its performance (3)
6. Design real world applications using processors. (4)

Future Courses Mapping:

Advance Computer Architecture, Advance Operating Systems

Job Mapping*:*

Application Developers, System programmer

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

IC2237:: ENGINEERING DESIGN AND INNOVATION-1

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

Course Objectives: The student will be able to

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

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 'B22'

Effective from Academic Year 2022-23

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

Structure and syllabus of B.Tech . Instrumentation Engineering. A.Y. 2022-23

2

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.

3

Structure and syllabus of B.Tech . Instrumentation Engineering. A.Y. 2022-23

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-22, Module-4
with effect from Semester-2 of Academic Year 2022-23

Course Type	Course Code	Course Name	Teaching Learning Scheme (Hrs./Week)				Credits	Assessment Scheme (100 mark scale)									Total
			Th	Lab	Tut	Total		In Semester Assessment						End Semester Assessment			
								HA	Lab	CP	Seminar	GD	MSE	ESE	PRG	Viva	100
S1	IC2222	Advanced Data Structures	2	2	1	5	4		10	10				20	40	20	100
S2	IC2224	Data Communication	2	2	1	5	4	20		20		20		20		20	100
S3	IC2226	Signal and Image Processing	2	2	1	5	4	20		20	20			20		20	100
S4	IC2228	Industrial Automation	2	2	1	5	4	20		20		20		20		20	100
S5	IC2236	Design Thinking-3	0	0	1	1	1										Graded
S6	IC2237	Engineering Design and Innovation - 1	0	12	0	12	6						30	70			100
		Total	**8**	**20**	**5**	**33**	**23**										

SEMESTER II

Structure and syllabus of B.Tech . Instrumentation Engineering. A.Y. 2022-23

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.

8

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. End Semester Examination: 20 marks
2. Lab Assignments : 10 marks (*100 marks converted to 10)*
3. Course Project : 10 marks (*100 marks converted to 10)*
4. Programming practical exam : 40 mks (*100 marks converted to 40*)
5. Viva : 20 mks (at the end of semester); *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

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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-II :

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

14

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

List of Home Assignments:
Design:
1. Design a communication framework for irrigation system
2. Design a communication framework for automated car
3. Design a communication framework for smart city applications
4. RIP Routing Protocol for Intranet in VIT campus
5. OSPF Routing Protocol for Internet on India
6. BGP Routing Protocol for Asia continent
7. Hyperspectral Camera
8. Cloud Computing

Case Study:
1. WiTricity technology for industrial applications
2. Multiple access schemes implemented in 4G mobile networks
3. Ultra-Reliable and Low Latency Communications (URLLCs)
4. Transmission technologies for 4G mobile networks
5. Transmission technologies for 5G mobile networks
6. Hyperspectral Camera
7. Cloud Computing

Blog
1. Journey of line encoding methods
2. Journey of modulation techniques
3. Internet Logical Addressing
4. 4 Internet Routing Protocols
5. Ultra-Reliable and Low Latency Communications (URLLCs)
6. Cloud Computing

Surveys
1. Analogy to digital transformations on communication systems
2. Routing protocols for MANET
3. IEEE 802.1 Physical layer standard for Internet
4. IEEE 802.15.4 standard for IoT applications
5. IEEE 802.11 Wireless Standards for Wi-FI
6. Hybrid Networks
7. Cloud Computing

Assessment Scheme:

Course Assessment: Total : 100 mks
1. End Semester Examination: 20 marks (ESA, 60 marks converted to 20)
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. 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

19

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

20

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

List of Home Assignments:

Design:
1. Design of FIR filter for given application
2. Design of IIR filter for given application
3. Design of image filtering algorithm
4. Design of speech algorithm
5. Design of image recognition algorithm

Case Study:
1. Signal Processing case study for audio signal processing
2. Signal Processing case study for biomedical signal processing
3. Signal processing case study in machine learning
4. Image processing case study in deep learning
5. Image processing case study in robotics

Blog
1. Application of signal processing in machine learning
2. Application of signal processing in medical equipment
3. Application of signal processing in robotics
4. Application of image processing in robotics
5. Application of signal and image processing in industrial automation

Surveys
1. Survey of algorithm for speech recognition
2. Survey of algorithms for filtering
3. Survey of algorithm for image recognition
4. Survey of algorithms for object detection
5. Survey of algorithms for image classification

Link for MOOCS:
1. Signal Processing - https://nptel.ac.in/courses/117/102/117102060/
2. Image Processing - https://nptel.ac.in/courses/117/105/117105135/

Books

1. J. G. Proakis & D. G. Manolakis, "Digital Signal Processing –Principles, Algorithms and Applications", Prentice Hall of India.
2. E. C. Ifeachor & B. W. Jarvis ,"Digital Signal Processing- A Practical Approach", Pearson Education.
3. Gonzalez Rafael C and Woods Richard E, Digital Image Processing, 3rd Edition, Prentice Hall, 2008.
4. Jain Anil K, Fundamentals of Digital Image Processing, Prentice Hall, 1989

Course Outcomes: The student will be able to

1. **IC2226_CO1**: Digitize the continuous time signal, perform various operations on the signal and analyze the properties of the given digital systems.
2. **IC2226_CO2**: Recognize signal spectrum using DFT, compute and plot the spectrum using FFT, Analyze the signal in the frequency domain. Reconstruct time domain signal using IDFT Compute and plot time domain signal using IFFT Algorithm.
3. **IC2226_CO3**: Design FIR/ IIR filters on paper to meet specific magnitude and phase requirements. Use MATLAB / Python / Scilab/ Octave to design the filters and analyze its response. Analyze the effect of quantization on the response of the digital filters.
4. **IC2226_CO4**: Perform operations on pixel, Perform Geometric transformation on image.
5. **IC2226_CO5** - : Analyze images in the frequency domain using various transforms.
6. **IC2226_CO6** - Evaluate the techniques for image enhancement and image restoration. Interpret image segmentation and representation techniques

CO PO Map:

C O	PO -1	PO -2	PO -3	PO -4	PO -5	PO -6	PO -7	PO -8	PO -9	PO -10	PO -11	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: 20 marks (ESA, 60 marks converted to 20)
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. 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

List of Home Assignments:
Design:
1. Design of Hydraulic actuator.
2. Design of Pneumatic actuator.
3. Design of contactor based application
4. Design of PLC based system.
5. Design of Control Panel.
6. Design of SCADA system

Case Study:
1. Case study - startup sequence of boiler
2. Development of Boiler interlocks
3. Heat Exchanger control using PLC
4. PLC for batch control application.
5. SCADA system for any process control application.

Blog
1. Advancements in PLC
2. Advancements in Electro-hydraulics
3. Advancements in Electro-pneumatics
4. PLC communications.
5. Latest trends in SCADA / HMI / Drives

Surveys
1. PLC Hardware
2. Recent Trends in PLC
3. Network devices and topology
4. AC-DC Drives
5. Control panel hardware

Assessment Scheme:
Course Assessment: Total : 100 mks
1. End Semester Examination: 20 marks (ESA, *60 marks converted to 20)*
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. 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

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

IC2237:: ENGINEERING DESIGN AND INNOVATION-1

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

Course Objectives: The student will be able to

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

33

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

34

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

VI

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 'C22'

Effective from Academic Year 2022-23

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

Structure and syllabus of B.Tech . Instrumentation Engineering. A.Y. 2022-23

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.

3

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-22, Module-5 with effect from Semester-1 of Academic Year 2022-23

Course Type	Course Code	Course Name	Teaching Learning Scheme (Hrs./Week)				Credits	Assessment Scheme (100 mark scale)								Total
			Th	Lab	Tut	Total		In Semester Assessment						End Semester Assessment		
								HA	Lab	CP	Seminar	GD	MSE	ESE	Viva	100
s1	IC3231	Process Instrumentation	2	2	1	5	4	20		20		20		20	20	100
s2	IC3233	Measurement Systems	2	2	1	5	4	20		20		20		20	20	100
s3	IC3237	Control Theory	2	2	1	5	4	20		20	20			20	20	100
s4	IC3243	Artificial Intelligence and Machine Learning	2	2	1	5	4	20		20	20			20	20	100
s5	IC3251	Design Thinking - I	0	0	1	1	1									Graded
s6	IC3249	Engineering Design and Innovation - V	0	12	0	12	6						30	70		100
		Total	**8**	**20**	**5**	**33**	**23**									

T.Y. B.Tech - Instrumentation and Control Engineering Structure for Pattern C-22, Module-5 with effect from Semester-2 of Academic Year 2022-23

Course Type	Course Code	Course Name	Teaching Learning Scheme (Hrs./Week)				Credits	Assessment Scheme (100 mark scale)									
			Th	Lab	Tut	Total		In Semester Assessment						End Semester Assessment			Total
								HA	Lab	CP	Seminar	GD	MSE	ESE	PRG	Viva	100
S1	IC3232	Web Technologies	2	2	1	5	4		10	10				20	40	20	100
S2	IC3234	Building and Process Automation	2	2	1	5	4	20		20		20		20		20	100
S3	IC3236	Computer Network	2	2	1	5	4	20		20		20		20		20	100
s4	IC3238	Database Management System	2	2	1	5	4	20		20	20			20		20	100
s5	IC3252	Design Thinking - II	0	0	1	1	1										Graded
s6	IC3250	Engineering Design and Innovation - VI	0	12	0	12	6						30	70			100
		Total	**8**	**20**	**5**	**33**	**23**										
Proposed Audit Course																	
S7	IC3220	Instrumentation Project Engineering	3				0	30						40		30	100
S7	IC3222	Batch Process Control	3				0	30						40		30	100

7

SEMESTER I

FF No. : 654

IC3231 :: PROCESS INSTRUMENTATION

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

Course Objectives:

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

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

Course Relevance:

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

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

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

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

SECTION-1 : [IC3231_CO1, IC3231_CO2, IC3231_CO3]

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 : [IC3231_CO4, IC3231_CO5, IC3231_CO6]

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.

List of Home Assignments:
Design:
1. Design of RTD/Thermocouple Signal conditioning circuit various temperature ranges.
2. Design discontinuous control modes for any one application.
3. Design and Simulation of PID controller for any one application.
4. Design of Control valve for given process using Standard ISA S75.01.
5. Design of Reverse acting Spring and Diaphragm type actuator for given application.
6. Design of hydraulic actuators.
7. Design of pneumatic actuators.
8. Design of intrinsic safety circuit.
9. Develop model for any process available in the laboratory.
10. Design and development of Boiler interlock using PLC.

Case Study:
1. Development of P&ID for Ammonia/Petroleum refinery/Wastewater Treatment process plant.
2. Interfacing of smart D.P. transmitter for level loop and its calibration using hand-held configurator.
3. Tuning of PID controller for level/flow control loop.
4. Tuning of PID controller for pressure/temperature control loop.
5. PID interfacing and Demonstration of Heat exchanger setup available in DCS Lab.
6. Design of Direct acting Spring and Diaphragm type actuator for given application.
7. Implementation of ON/Off controller for Temperature control system
8. Different types of control valve
9. Distillation column control schemes.
10. Development of Instrumentation and control schemes for air dryer available in PC Lab.

13

Blog:
1. Communication aspects in Smart and wireless transmitters.
2. Hazardous area classification
3. Intrinsic safety.
4. SIL and SIS.
5. Advanced process controllers.
6. Boiler interlocks
7. P & I D
8. Spray dryer instrumentation
9. Control valve characteristics
10. Smart Transmitter

Surveys:
1. Calibration of transmitters.
2. Intelligent features in transmitters.
3. Control valve for adverse process conditions.
4. Process calibrators.
5. Intrinsic safety
6. PID Controller specifications
7. Un-burnt losses in boiler
8. Mathematical modeling methods for different process
9. Boiler Load management.
10. Dryers used in food industry.

Assessment Scheme:
Course Assessment: Total : 100 mks
1. End Semester Examination: 20 marks (ESA, *60 marks converted to 20)*
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. 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.

14

Structure and syllabus of B.Tech . Instrumentation Engineering. A.Y. 2022-23

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. IC3201_CO1: Comprehend the fundamentals of process control loop.
2. IC3201_CO2: Demonstrate the working of controller and solve a problem using control actions.
3. IC3201_CO3: Select and Design the control valve and actuators to solve a problem.
4. IC3201_CO4: Build a mathematical model and auxiliary process loop components.
5. IC3201_CO5: Develop different control schemes for the Boiler.
6. IC3201_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.

17

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 Group Discussion 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

List of Home Assignments:
Design:
1. Design of a DMM circuit.
2. IOT in measurement systems.
3. Various static and dynamic characteristics of measuring instruments.
4. Atomic absorption spectroscopy and applications
5. Design of a measurement system for a given parameter
6. Imaging technique line sonograpy
7. Ventilator
8. Bone density measurement
9. Pulmonary function test
10. X-ray diffractometer

.**Case Study:**
1. Testing of SMPS for electromagnetic interference
2. IOT for biomedical applications
3. Applications of a spectrophotometer in a pathology lab.
4. Vehicle pollution measurement technique
5. Instruments in flight
6. Design of a waveform generator
7. Design of weight measurement system
8. Design of a measurement system for a given parameter
9. Body temperature measurement system
10. Design of humidity measurement system

Blog:
1. Analog to digital converter techniques
2. Digital to analog converter techniques
3. True RMS multimeters
4. Flame photometer and applications
5. Spirometer
6. Earthquake measurement

Surveys:
1. IOT based measuring instruments
2. Various applications of a spectrophotometer
3. Types of oscilloscopes
4. ATE application in electronic industries
5. Virtual instruments

Assessment Scheme:
Course Assessment: Total : 100 marks.
1. Home Assignment : 20 marks (Total : *100 marks converted to 20)*
2. Course Project : 20 marks (*100 marks converted to 20)*
4. Group Discussion: 20 marks (Before the End of semester); *100 marks converted to 20*
5. Viva: 20 marks (at the end of semester); (*100 marks converted to 20)*
6. End Semester Examination: 20 marks (*100 marks converted to 20)*

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.

21

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 II: 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 III: 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 IV: 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 V:
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 VI:
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: 20 marks (ESA, 60 marks converted to 20)
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. 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] (PO1,2,3,4,5, PSO 2)
2. Determine time domain specification and error coefficients for the given system. [3] (PO1,2,3,4,5, PSO 2)
3. Analyze the stability of the given system and obtain the root locus for the same. [5] (PO1,2,3,4,5, PSO 2)
4. Analyze the given system in frequency domain, derive and compute frequency domain specifications. Analysis of system using the bode plot, [5](PO1,2,3,4,5, PSO 2)
5. Analysis of system using the state space domain.[5](PO1,2,3,4,5, PSO 2)
6. Design a control system using state feedback [5] (PO1,2,3,4,5, PSO 2)

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	PSO2	PSO3
CO1	3	3	3	3	3	1	1	1	1	3	1	1	1	3	1
CO2	3	3	3	3	3	1	1	1	1	3	1	1	1	3	1
CO3	3	3	3	3	3	1	1	1	1	3	1	1	1	3	1
CO4	3	3	3	3	3	1	1	1	1	3	1	1	1	3	1
CO5	3	3	3	3	3	1	1	1	1	3	1	1	1	3	1
CO6	3	3	3	3	3	1	1	1	1	3	1	1	1	3	1

IC3243 :: ARTIFICIAL INTELLEGIENCE AND MACHINE LEARNING

Course Prerequisites: Fundamentals of Linear Algebra, Probability and Statistics

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

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

Course Relevance:

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

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

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

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

Unit 5

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

Unit 6

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

List of Practicals: (Any Six)

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

List of Tutorials

1.   Illustrations of agent types and their descriptions
2.   Case study of task environments and their characteristics
3.   Heuristic function design for Tic-Tac-Toe
4.   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 Course Seminar Topics
1. Deep Learning
2. Non-monotonic Logic and real applications
3. Neural network training for real applications
4. Predicate Logic for reasoning
5. Expert system design and development
6. PROLOG and LISP comparison
7. Heuristic Search Techniques
8. Game playing-A specific game and its method
9. ML Algorithms for predications

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: 20 marks (ESA, 60 marks converted to 20)

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. Course Seminar: 20 mks (ISA, 100 marks converted to 20)

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

30

Structure and syllabus of B.Tech . Instrumentation Engineering. A.Y. 2022-23

IC3251:: DESIGN THINKING -1

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.	IC3251_CO1	IC3251_CO2	IC3251_CO3	IC3251_CO4	IC3251_CO5	IC3251_CO6	IC3251_CO7
Attainment Level	2	2	3	6	2	3	2

FF No. : 654

IC3249:: 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

33

,**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. IC3249_CO1 Analyse solutions for given engineering problem **(1)**
2. IC3249_CO2 Design solutions for given engineering problem
3. IC3249_CO3 Demonstrate practical knowledge by constructing models/algorithms for real time applications (**1**)
4. IC3249_CO4 Express effectively in written and oral communication (**2**)
5. IC3249_CO5 Exhibit the skills to work in a team **(2)**
6. IC3249_CO6 Prepare a time chart and financial record for execution of the project **(3)**

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.	IC3249_CO1	IC3249_CO2	IC3249_CO3	IC3249_CO4	IC3249_CO5	IC3249_CO6
Attainment Level	2	3	2	2	3	5

SEMESTER II

IC3232:   WEB TECHNOLOGY

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

Course Objectives:
1. On completion of this course, a student will be familiar with all latest frame works.
2. Apply different modern technologies used for real-time client server application.
3. Develop different attractive and interactive web pages.
4. Familiar with different types of databases and Server-side code

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

SECTION-1:
Unit -1   **(5 Hrs)**
Introduction to HTML 5: New elements, New input types, new attributes, Local Storage, Session Storage, Server sent events, CSS3, Bootstrap
Unit-2:   **(5 Hrs)**
JQuery: Introduction to JQuery, loading JQuery, selecting elements, changing styles, creating elements, appending elements, removing elements, handling events, Jquery. AJAX Server side technology and TOMCAT, introduction to servlet, need and advantages, servlet lifecycle, creating and testing of sample servlet, session management.
Unit-3:   **(5 Hrs)**
JSP: introduction, advantages of JSP over Servlet, elements of JSP page: directives, comments, scripting elements, actions and templates, JDBC, MongoDB: Introduction, Environment, Create Database, Drop Database, Create Collection, Drop Collection, Read Operations, Write Operations, Data Modelling, Administration.

SECTION-2:
Unit-4:   **(5 Hrs)**
Introduction to Nodejs, What is Nodejs, NodeJS: Getting started, Node Core, Node Modules, File System, Debugger, Automation and Deployment.
Unit-5:   **(5 Hrs)**
Topics and Contents Web Technology Frameworks: Express Framework: Introduction to Express Framework, Getting Started with Express, First Express App, Express Routing, Implementing MVC in Express, Middleware, Using Template Engines, Error Handling , API Handling , Debugging, Developing Template Engines, Using Process Managers, Security & Deployment
Unit-6   **(5 Hrs)**
Angular JS: Overview, MVC architecture, Directives, Expression, Controllers, Filters, Tables, Modules, Forms, Includes, Views, Scopes, Services, Dependency injection, Custom directives, Internationalization

37

List of Tutorials:

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

List of Practicals:

1. Design a web page to demonstrate the use of different HTML5 tags.
2. Design a web page to demonstrate the use of CSS3 tags.
3. Design CRUD (Create, Read, Update, and Delete) application using HTML and Jquery.
4. Design application using JQuery to process a simple quiz, checking if the user entered the correct answer and messaging the result.
5. Design a web page using AJAX methods.
6. Write a program to demonstrate the use of servlet request and response as well as doGet() And doPost() methods.
7. Design Registration form with following fields: First Name, Last Name, Username, Password, Address, Contact Number with JSP and using MVC architecture.
8. Design a simple application using Express framework.
9. Design a Login form using AngularJS
10. Build a web app where users can type in a city name and get real-time weather data instantly displayed on their screen using NodeJS and Express.

List of Projects:

Design and deploy web based application using HTML5, CSS, Bootstrap, JQuery, MobgoDB, AngularJS, Nodejs and Express framework.

1. Student Registration System
2. Library Management System
3. Tours and Travel System
4. Online Examination System
5. Online Hotel Management System

6. E-book shop
7. Online Reservation System
8. Online recruitment System
9. Movies management
10. E healthcare system

Assessment Scheme:

Courses with Programming activity

1. Laboratory Assessment: 100 Marks converted to 10 equivalent Marks
2. Course Project: 100 Marks converted to 10 equivalent Marks
3. Written Examination ESE: 60 Marks converted to 20 equivalent Marks
4. Comprehensive Viva Voce : 100 Marks converted to 20 equivalent Marks
5. Programming Practical End Semester Assessment :100 Marks converted to 40 Marks

Text Books:

1. Thomas Black Book; " JDBC 4.2, Servlet 3.1 & JSP 2.3"; Dreamtech Press, 2016.
2. Adam Bretz & Colin J Ihrig; "Full Stack Javascript Development with MEAN";SPD, 1st Edition, Indian Reprint September 2015.
3. Brad Dayley,"Node.js, MongoDB, and AngularJS Web Development"; Addison-Wesley Professional 2014.
4. Azat Mardanov, Anatoliy Chakkaev;"Express.js Guide: The Comprehensive Book on Express.js: The Comprehensive Book on Express.js"; CreateSpace Independent Publishing Platform 2013

Reference Books:

1. Giulio Zambon; " Beginning JSP, JSF and Tomcat"; 2nd Edition, Apress Publication.
2. Sandeep Panda; "Angular JS: Novice To Ninja"; SPD, 1st Edition, Indian Reprint 2015.
3. Black book; "Web Technologies:HTML,JS,PHP,Java,JSP,ASP.NET,XML and AJAX" ; Dreamtech Press, 2016.
4. Robin Nixon; "Learning PHP, MySQL, JavaScript, CSS and HTML 5";4th Edition, O'Reilly publication.

Moocs Links and additional reading material:

1. JavaScript Tutorial for beginners by Navin Reddy- https://www.youtube.com/watch?V=uDwSnnhl1Ng&list=PLY-UbAd0uV4PnOuWei-D7uZYOxp_Ny7wo
2. Angular JS by Naresh Ithttps://www.youtube.com/watch?v=csG0pwe3O_M&list=PLVlQHNRLflP80qHYWmEFXwBn_3CobbX1q
3. Node JS Tutorials for Beginners by Naresh IT- https://www.youtube.com/watch?v=Yg6AdA5Axb0&list=PLVlQHNRLflP_Pd4-LtOg7OM_rUhJ5pC-I
4. Express JS Tutorial- Ganguly Tech-
https://www.youtube.com/watch?v=Q6swmpfzcgY&list=
PLNHw_0qv1zy_YmVPmRggL94HmI-3dlGm

Course Outcomes: The student will be able to –

1. Design reliable, efficient, scalable front end view of web pages with HTML5, CSS3 and Bootstrap
2. Apply Jquery concepts for responsive web frontend development.
3. Refine dynamic web pages with JSP, Servlet.
4. Implement frontend and backend scenarios to read, write and update data stored in MongoDB.
5. Build responsive web application using Express framework.
6. Develop front end application using Angular JS.

CO PO Map:

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

CO attainment levels

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

Job Mapping: Web designer, Server side developer

40

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 (60 marks converted to 20)
2. Course Project : 20 marks (100 marks converted to 20)
3. Home Assignment : 20 mks (Total : 100 marks: Case study, Design work, Survey, Blog) 100 marks converted to 20
4. Viva : 20 mks (at the end of semester); 100 marks converted to 20
5. Group Discussion: 20 mks (Before the End of semester); 100 marks converted to 20

List of Home Assignments:

Design:
1. Design of Access control system for different applications
2. Design of Fire control system for different applications
3. Design of FA for different applications
4. Design of CCTV system for Surveillance application
5. Design of Access control system for different applications

Case Study:
1. Access Control & Security System
2. Fire & Alarm System
3. Communication Systems in Building automation
4. DCS Applications
5. Trends in DCS communication protocols

Blog
1. Network Devices
2. Serial data communications
3. MODBUS
4. HART Communication Protocol
5. Fieldbus

Surveys
1. Profibus
2. Components of Building Automation
3. DCS Advanced Function Blocks
4. Light Control System
5. HVAC system

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

45

Structure and syllabus of B.Tech . Instrumentation Engineering. A.Y. 2022-23

Course Outcomes:

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

CO PO Map:

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

CO attainment levels:

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

Future Courses Mapping:

Advanced Process Control, Multivariable Control System, etc.

Job Mapping:

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

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

FF No. : 654

IC3236 :: COMPUTER NETWORKS

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

Course Objectives:

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

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

Course Relevance:

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

SECTION-1

47

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

52

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

List of Home Assignments:
Design:
1. Design a communication framework for irrigation system
2. Design a communication framework for automated car
3. Design a communication framework for smart city applications
4. RIP Routing Protocol for Intranet in VIT campus
5. OSPF Routing Protocol for Internet on India
6. BGP Routing Protocol for Asia continent
7. Hyperspectral Camera
8. Cloud Computing
Case Study:
1. WiTricity technology for industrial applications
2. Multiple access schemes implemented in 4G mobile networks
3. Ultra-Reliable and Low Latency Communications (URLLCs)
4. Transmission technologies for 4G mobile networks
5. Transmission technologies for 5G mobile networks
6. Hyperspectral Camera

7. Cloud Computing

8. 5G Cellular Network

Blog

1.Journey of line encoding methods

2. Journey of modulation techniques

3. Internet Logical Addressing

4 Internet Routing Protocols

5. Ultra-Reliable and Low Latency Communications (URLLCs)

6. Cloud Computing

Surveys

1.Analogy to digital transformations on communication systems

2. Routing protocols for MANET

3. IEEE 802.1 Physical layer standard for Internet

4. IEEE 802.15.4 standard for IoT applications

5. IEEE 802.11 Wireless Standards for Wi-FI

6. Hybrid Networks

7. Cloud Computing

Assessment Scheme:

Course Assessment: Total : 100 mks

1.   End Semester Examination: 20 marks (ESA, 60 marks converted to 20)

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.   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

IC3238 :: DATABASE MANAGEMENT SYSTEMS

Prerequisites: Data structures

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

Course Relevance:

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

SECTION-1 :

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;   **5 Hrs**
Database Design: Need of Normalization, Functional Dependencies, Inference Rules, Functional Dependency Closure, Minimal Cover, Decomposition Properti es, Normal Forms: 1NF, 2NF, 3NF and BCNF, Multi-valued Dependency, 4NF   **4 Hrs**
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   **5 Hrs**

SECTION-2 :

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   **5 Hrs**
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   **5 Hrs**
NOSQL Databases and Big Data Storage Systems: Introduction to NOSQL Databases, Types of NOSQL Databases, BASE properties, CAP theorem, MapReduce.

Data Warehousing: Architecture and Components of Data Warehouse, OLAP   **4 Hrs**

List of Practicals

1) Choose a database application; you propose to work on throughout the course. Perform requirement analysis in detail for the same. Draw an entity-relationship diagram for the proposed database.

2) Create a database with appropriate constraints using DDL and populate/modify it with the help of DML.

3) Design and Execute "SELECT" queries using conditional, logical, like/not like, in/not in, between...and, is null/is not null operators in where clause, order by, group by, aggregate functions, having clause, and set operators. Use SQL single row functions for date, time, string etc.

4) Write equijoin, non equijoin, self join and outer join queries. Write queries containing single row / multiple row / correlated sub queries using operators like =, in, any, all, exists etc.
Write DML queries containing sub queries. Study a set of query processing strategies.

5) Write PL/SQL blocks to implement all types of cursor.

6) Write useful stored procedures and functions in PL/SQL to perform complex computation.

7) Write and execute all types of database triggers in PL/SQL.

8) Execute DDL statements which demonstrate the use of views. Try to update the base table using its corresponding view. Also consider restrictions on updatable views and perform view creation from multiple tables.

9) Create a database with suitable example using MongoDB and implement Inserting and saving document, Removing document, Updating document

10) Execute at least 10 queries on any suitable MongoDB database that demonstrates following querying techniques:find and findOne, Query criteria, Type-specific queries

11) Implement Map Reduce operation with suitable example using MongoDB.

List of 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)

List of Home Assignments:
Design:
1. Suppose you want to build a video site similar to YouTube. Identify disadvantages of keeping data in a file-processing system. Discuss the relevance of each of these points to the storage of actual video data, and to metadata about the video, such as title, the user who uploaded it, tags, and which users viewed it.
2. Illustrate data model that might be used to store information in a social-networking system such as Facebook
3.Describe the circumstances in which you would choose to use embedded SQL rather than SQL alone or only a general-purpose programming language.
4. Give the DTD and XML Schema for Library Management System. Give a small example of data corresponding to this DTD and XML.Write ten queries in Xpath and XQuery
5.If you were designing a Web-based system to make airline reservations and sell airline tickets, which DBMS architecture would you choose? Why? Why would the other architectures not be a good choice?Design a schema and show a sample database for that application. What types of additional information and constraints would you like to represent in the schema? Think of several users of your database, and design a view for each.

Case Study:
1. PostgreSQL
2. Oracle
3. IBM DB2 Universal Database
4. Microsoft SQL Server
5. SQLite database

Blog
1.OLAP tools from Microsoft Corp. and SAP
2.Views in database
3. Dynamic SQL and Embedded SQL
4. Active databases and Triggers
5. SQL injection attack

59

Surveys

1. Keyword queries used in Web search are quite different from database queries. List key differences between the two, in terms of the way the queries are specified, and in terms of what is the result of a query.

2. List responsibilities of a database-management system. For each responsibility, explain the problems that would arise if the responsibility were not discharged

3. List reasons why database systems support data manipulation using a declarative query language such as SQL, instead of just providing a a library of C or C++ functions to carry out data manipulation

4. Consider a bank that has a collection of sites, each running a database system. Suppose the only way the databases interact is by electronic transfer of money between themselves, using persistent messaging.Would such a system qualify as a distributed database? Why?

5. Data warehousing products coupled with database systems

Assessment Scheme:

Course Assessment: Total : 100 mks

1.   End Semester Examination: 20 marks (ESA, 60 marks converted to 20)

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.   Course Seminar: 20 mks (ISA, 100 marks converted to 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. Eric Redmond, Jim Wilson, Seven databases in seven weeks, SPD, ISBN: 978-93-5023-918-6.

8. Jay Kreibich, Using SQLite, SPD, ISBN: 978-93-5110-934-1, 1st edition.

Moocs Links and additional reading material:
1. https://nptel.ac.in/courses/106/105/106105175/
2. https://onlinecourses.nptel.ac.in/noc21_cs04/preview
3. https://www.datacamp.com/courses/introduction-to-sql
4. Oracle MOOC: PL/SQL Fundamentals - Oracle APEX

Course Outcomes:
The student will be able to –
1. Design data models as per data requirements of an organization
2. Synthesize a relational data model up to a suitable normal form
3. Develop a database system using relational queries and PL/SQL objects
4. Apply indexing techniques and query optimization strategies
5. Design Databases with concurrency control.
6. Develop applications with recovery algorithms.

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	2	2	1	2	2	0	0	0	2	0	2	2	0	2	0
CO:2	2	2	2	2	2	0	0	0	2	0	1	2	2	0	2
CO:3	2	1	1	2	2	0	0	0	2	0	1	2	0	2	0
CO:4	2	2	2	1	2	2	2	0	2	0	1	2	0	0	2
CO:5	2	2	2	1	1	2	1	1	2	0	1	2	0	0	0
CO:6	2	1	2	1	1	1	2	2	2	0	2	2	0	0	0

CO attainment levels:

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

Future Courses Mapping:
Web technology, Software Development Project, Advanced databases, Big Data Management, Cloud Databases

Job Mapping:

DMS is a fundamental course in the IT / Software engineering domain. Upon learning this course the student will fit in the role of 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 and integration.

FF No. : 654

IC3252:: DESIGN THINKING -2

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.	IC3252_CO1	IC3252_CO2	IC3252_CO3	IC3252_CO4	IC3252_CO5	IC3252_CO6	IC3252_CO7
Attainment Level	2	2	3	6	2	3	2

IC3250 :: 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:

64

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. IC3250_CO1 Analyse solutions for given engineering problem
2. IC3250_CO2 Design solutions for given engineering problem
3. IC3250_CO3 Demonstrate practical knowledge by constructing models/algorithms for real time applications
4. IC3250_CO4 Express effectively in written and oral communication
5. IC3250_CO5 Exhibit the skills to work in a team
6. IC3250_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.	IC3250_CO1	IC3250_CO2	IC3250_CO3	IC3250_CO4	IC3250_CO5	IC3250_CO6
Attainment Level	2	3	2	2	3	5

IC3220 :: INSTRUMENTATION PROJECT ENGINEERING

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

Section 1 : [IC3220_CO1, IC3220_CO2, IC3220_CO3]

Unit-1 : Concept study & definition of Project Engineering & Management
Type of Standards and its studies as applicable to instrumentation and control engineering, Basics of Project Management, Degree of Automation, Organization Structure, Interdepartmental, Inter-organizational and Multi agency interaction involved in Project and their co ordination Project statement. Methods of tagging and nomenclature scheme based on ANSI / ISA std. (S-5.1), P & ID symbols for process loops like temperature, flow, level, pressure, etc.

Unit-2 : Project engineering documents, drawing and softwares
Statement of Project (SOP), Process Flow Diagram, Material Balance Diagram, Pressure and Temperature Diagram, P & I diagram, Process Data sheet, Instrument Index, Specification sheet (S-20 Format) for Local and Primary Instruments, Transmitting and Secondary instruments and Final control devices for process and analytical parameters., Plant layouts and General arrangement drawing (Plans and Elevation), Isometric of instrument piping, Cable schedules Loop wiring diagrams, Field installation sketches, BOM and MBOM. Project engineering softwares.

Unit-3 : Detailed Project engineering
Plant layouts and general arrangement drawing (Plans and Elevation), isometric of instrument piping. Cable engineering (class of conductors, Types, Specification and Application), Selection of cables with respect to specific application, Cable identification schemes, Cable trays. Loop wiring diagrams, Installation sketches of field instrument, Development of BOM and MBOM.

Section 2 : [IC3220_CO2, IC3220_CO3, IC3220_CO4, IC3220_CO5, IC3220_CO6]

Unit-4 : Procurement activities
Vendor registration, Tendering and bidding process, Bid evaluation, Pre-Qualification Evaluation of Vendor, Purchase orders, Kick-off meeting, Vendor documents, drawing and reports as necessary at above activities.
Construction activities: Site conditions and planning, Front availability, Installation and commissioning activities and documents require at this stage, Installation sketches, Contracting, Cold Commissioning and Hot commissioning, Performance trials, As-built Drawings and Documentations and final hand over. Factory Acceptance Test (FAT), Customer Acceptance Test (CAT) and Site Acceptance Test (SAT).

Unit-5 : Project Management
Project Management, Planning and Scheduling Life cycle phases, Statement of work (SOW), Project Specification, milestone scheduling, Work breakdown structure.
Cost and estimation: Types of estimates, pricing process, salary overheads, labor hours, materials and support costs. Program evaluation and review techniques (PERT) and Critical path method (CPM), S-curve concept and crash time concepts, software's used in project management; software features, classification, evaluation and implementation.

Unit-6 : Codes and standards
Meaning of codes and standards, Codes and standards for Instrumentation and Control, ANSI / ISA, API, NAMUR, IEC, IEEE, ISO, NPFA, EEMUA, CENELEC, NORSOK, Hazardous area classification, comparison of methods of protections, NEMA ratings, understanding markings, certification process, etc.

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

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

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

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

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 'D22'

Effective from Academic Year 2022-23

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

Structure and syllabus of B.Tech . Instrumentation Engineering. A.Y. 2022-23

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.

3

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.

4

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.

5

Final Year B.Tech - Instrumentation and Control Engineering Structure for Pattern D-22, Module-7
with effect from Semester-1 of Academic Year 2022-23

Course Type	Course Code	Course Name	Teaching Learning Scheme (Hrs./Week)				Credits	Assessment Scheme (100 mark scale)								
								In Semester Assessment (50)					End Semester Assessment (50)			Total
			Th	Lab	Tut	Total		HA	Lab	Seminar	GD/PPT	MSE	ESE	Viva	100
S1-OE1	MD4201	Engineering and Managerial Economics	2	0	0	2	2	10				30	30	30	100
S1-OE1	MD4202	Project Management													
S1-OE1	IT4219	From Campus to Corporate													
S1-OE1	MD4203	Business Proposal Writing													
S2-OE2	IC4201	Industrial Electronics	2	0	0	2	2	10				30	30	30	100
S2-OE2	CS4217	Human Computer Interaction													
S2-OE2	ET4230	Natural Language Processing													
S2-OE2	IT4217	Network Security													
S3-OE3	IC4271	Machine Intelligence	2	0	0	2	2	10				30	30	30	100
S3-OE3	CS4201	Cloud Computing													
S3-OE3	CS4271	Magic XPA/XPI													
S3-OE3	CS4272	Neural Networks													
S3-OE3	ET4232	Deep Learning													
S3-OE3	IT4216	Data Management, Protection and Governance													
S4	IC4243	Major Project	0	18	0	18	9		30				70		100
		Total	**6**	**20**	**0**	**26**	**15**								

Final Year B.Tech - Instrumentation and Control Engineering Structure for Pattern D-22, Module-8 with effect from Semester-2 of Academic Year 2022-23

Course Type	Course Code	Course Name	Teaching Learning Scheme (Hrs./Week)				Credits	Assessment Scheme (100 mark scale)							
			Th	Lab	Tut	Total		In Semester Assessment (50)					End Semester Assessment (50)		Total
								HA	Lab	Seminar	GD/PPT	MSE	ESE	Viva	100
S1	IC4211	Industry Internship	0	30	0	30	15					30	70		100
S1	IC4224	Global Internship													
S1	IC4226	Research Internship													
S1	IC4240	Project Internship													
		Total	**0**	**30**	**0**	**30**	**15**								

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

7

SEMESTER I

IC4201:: INDUSTRIAL ELECTRONICS

Course Prerequisites: Basic knowledge electrical and electronics engineering

Course Objectives:

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

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

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

SECTION-1

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

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

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

SECTION-2

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

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

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

List of Home Assignments:

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

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

Blog:
19. GaN power devices and applications
20. Solar photovoltaic plants
21. SiC MOSFETs applications

22. Fuel cell
23. Electric vehicle battery charging
24. Electric vehicles
25. Renewable energy systems
26. Over-current sensing techniques
27. Silicon carbide power devices

Surveys

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

Assessment Scheme:

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

Text Books:

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

Reference Books:

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

MOOCs Links and additional reading material:
1. www.nptelvideos.in
2. http://www.nptelvideos.in/2012/11/power-electronics.html
3. http://www.nptelvideos.in/2012/11/industrial-drives-power-electronics.html

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

CO-PO Map

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

CO attainment levels

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

Future Courses Mapping: *Advanced Power Electronics*

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

CS4217:: HUMAN-COMPUTER INTERACTION

Prerequisites: Mathematics

Course Objectives:

1. To categorize IT applications based on measurable human factors,

2. To study the user community through user survey and/or field visit,

3. To design user-friendly user interfaces with due consideration of interface theory and principles,

4. To apply usability evaluation methods to identify the usability issues with IT applications,

5. To understand the kind of documentation required for IT applications,

6. To integrate web and mobile app design approaches as per user requirements

Credits: 02   **Teaching Scheme Theory: 02 Hours/Week**

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

SECTION-1

Fundamentals of Human Computer Interaction (HCI): Definition of HCI Interdisciplinary Nature, Related Disciplines, Usability, Types of Usability, Use Interface (UI), Measurable Human Factors, Accessibility, Differently-abled Users Accessibility Guidelines.

Interaction Concepts and Models: User Persona, User Categorization, Golden Rules of Interface Design, Miller's Principle, Task Analysis - GOMS, Contextual Inquiry, Work Models, Interaction Styles, Empathy Maps.

Design Process: Design Concept, Three Pillars of Design, Process of Design, Ethnographic Observations, Participatory Design, Internationalization, Interaction Design Patterns.

SECTION-II

Usability Evaluation: Expert-based Evaluation, User-based Evaluation, Formative Evaluation, Summative Evaluation, Heuristic Evaluation, Cognitive Walkthrough, Semiotic Analysis, Icon Categorization, User Surveys, Interviews, Usability Testing.

Documentation and Groupware: Classification of Documents, Reading from Displays, Online Help, Tutorials, Error / Warning Messages, Groupware, Computer Supported Cooperative Work (CSCW), Dimensions of Cooperation, Asynchronous Interactions, Synchronous Interactions, Challenges with Online Communications.

Website and Mobile App Design: Content Design, Interaction and Navigation Design, Presentation Design, Differences in design approaches, Design and Evaluation Tools.

List of Home Assignments:

Designs:
1. Social Network for Spiritual Users
2. App for Alzheimer's disease
3. Health Tracking App
4. Ration Card Management App
5. Innovative e-Commerce Platform

Case Studies:
1. Chatbot in healthcare domain
2. Best food ordering app in India
3. Online teaching-learning process
4. Use of Twitter with Indian Users
5. User experience with car booking in India

Blogs:
1. Noise of Notifications
2. Challenges in Food Delivery Service
3. Need for Accessibility Guidelines
4. Usability of Autonomous Vehicles
5. Failure of Usability Testing

Surveys:
1. User experience with video-conferencing apps
2. User errors on Social Networking Sites (SNS)
3. Challenges for hearing impaired users with IT applications
4. Most popular Indian mobile apps (Made in/by India)
5. Impact of ban on Chinese apps in India

Assessment Scheme:

Home Assignments, MSE, ESE

Text Books:

1. *Ben Shneiderman, "Designing the User Interface", Third Edition, Pearson Education, ISBN 81-7808-262-4.*

2. Alan Dix, Janet Finlay, Gregory D. Abowd, Russell Beale, "Human-Computer Interaction", Third Edition, Pearson Education, ISBN 81- 297-0409-9.

Reference Books:

1. *Donald Norman, "The Design of Everyday Things", 2002 Edition, Basic Books, ISBN 100-465-06710-7.*

2. Wilbert Galitz, "The Essential Guide to User Interface Design", Second Edition, Wiley-Dreamtech India (P) Ltd., ISBN 81-265-0280-0.

3. John Carroll, "Human-Computer Interaction in the New Millennium", Pearson Education, ISBN 81-7808-549-6.

MOOCs Links and additional Reading Material:

https://nptel.ac.in/courses/106/103/106103115/

https://www.coursera.org/learn/human-computer-interaction

https://classroom.udacity.com/courses/ud400

Course Outcomes:

1. Students will be able to appreciate the differences among IT applications and their categories based on measurable human factors.
2. Students will be able to study the user community through user survey and/or field visit.
3. Students will be able to design user-friendly user interfaces as per user requirements and UI design principles.
4. Students will be able to apply a suitable usability evaluation method to identify the usability issues.
5. Students will be able to understand the kind of documentation required for IT applications.
6. Students will be able to enhance UI designs as per desired web or mobile app design approach.

CO PO Map:

CO1	CO2	CO3	CO4	CO5	CO6
PO3	PO4	PO8	PO10	PO11	PSO4
3	3	2	2	1	3

CO Attainment Levels:

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

Future Courses Mapping: User Interface Design , Usable Security, Intelligent User Interfaces

Job Mapping:

UI Designer, Product Designer, Software Engineer, Mobile App Developer and other jobs

ET4230 :: NATURAL LANGUAGE PROCESSING

Course Prerequisites:

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

Course Objectives:

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

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

Course Relevance:

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

SECTION-1

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

SECTION-2

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

List of Course Seminar Topics:

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

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

Suggest an assessment Scheme:

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

List of Home Assignments:
Design:

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

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

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

Surveys

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

Text Books:

1. Jurafsky & Martin "Speech and Language Processing" Prentice Hall, 2000

2. Akshar Bharati, Rajeev Sangal and Vineet Chaitanya: "Natural Language Processing: A Paninian Perspective", Prentice-Hall of India, New Delhi, 1995

Reference Books:

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

Moocs Links and additional reading material:
1. https://nptel.ac.in/courses/106/105/106105158/
2. https://nptel.ac.in/courses/106/106/106106211/

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

CO PO Map

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

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

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

IT4218: NETWORK SECURITY

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

Prerequisites: Computer Networks.

Unit 1:   **(5 Hours)**
Introduction
Introduction to Security: Vulnerabilities, Threats, Threat Modeling, Risk, attack and attack types, Avoiding attacks, Security services.
key security properties - Confidentiality, Integrity, Availability.
Protocol Vulnerabilities: DoS and DDoS, session hijacking, ARP spoofing, Pharming attack, Dictionary Attacks.
Software vulnerabilities: Phishing, buffer overflow, Cross-site scripting attack, Virus and Worm Features, Trojan horse, Social engineering attacks, ransomware, SYN-Flooding, SQL- injection, DNS poisoning, Sniffing

Unit 2:   **(4 Hours)**
Private key cryptography
 Mathematical background for cryptography: modulo arithmetic, GCD (Euclids algorithm),
 Role of random numbers in security, Importance of prime number, DES, AES.
Chinese remainder theorem

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

RSA: RSA algorithm, Key generation in RSA, attacks on RSA.
Diffie-Hellman key exchange: Algorithm, Key exchange protocol, Attack.
Elliptic Curve Cryptography (ECC), Elliptic Curve arithmetic. Diffie-Hellman key exchange

Unit 4:   (**5 Hours)**

Authentication and access control

Message authentication and Hash Function. Authentication: One-Way Authentication, Mutual Authentication, SHA-512, The Needham-Schroeder Protocol.
Kerberos, X.509 authentication service, public key infrastructure.
Access Control in Operating Systems: Discretionary Access Control, Mandatory Access Control, Role Based Access Control.

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

Network layer security: IPSec for IPV4 and IPV6.
Transport layer security: SSL and TLS.
Application layer security: Security services, S/MIME, PGP, Https, Honey pots.
Security design: End-to-end security, Security composability, Open design, Cost and tradeoffs

Unit 6:   (4 Hours)
Cyber Security:
Cyber Attack, Cyber Reconnaissance, Crimes in Cyber Space-Global Trends & classification, e-commerce security, Computer forensics, facebook forensic, mobile forensic, cyber forensic, digital forensic

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

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

Additional Reading

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

Course Outcomes

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

CO-PO Mapping

	PO: 1	PO: 2	PO: 3	PO: 4	PO: 5	PO: 6	PO: 7	PO: 8	PO: 9	PO:1 0	PO:1 1	PO:1 2	PSO: 1	PSO: 2	PSO: 13
CO 1	3	2			3								3		
CO 2	2			2										2	
CO 3	2		3												3
CO 4	2	2				2	2		2					2	
CO 5	3											1			
CO 6	2					2	2	1							

IC4271 :: MACHINE INTELLIGENCE

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

Section I

Definition of intelligent systems. Goals and applications of machine intelligence. Aspects of developing an intelligent system: training data, concept representation, function approximation. Different types of learning for intelligent systems

Language learning: Introduction to Natural Language processing, Fundamental techniques of natural language processing. Applications of NLP in machine intelligence

Supervised learning: Linear and multiple regression, logistic regression, regularization, introduction to neural networks, support vector machines, k nearest neighbor classifier, decision trees, random forest classifier.

Section II

Unsupervised learning: Introduction, clustering. Dimensionality reduction, anomaly detection, applications of machine learning algorithms to large scale data, metrics for classification

Neural networks, neural network representation, Activation Functions, gradient descent and back propagation, convolution neural network, introduction to deep learning

Machine Intelligence applications to real time systems like text to speech, amazon alexa, chatbots for different API, google translation, autonomous vehicles etc

Home assignments
Design
1. Design of Image and data classification applications using different classifiers
2. Design of deep learning algorithms for pattern recognition, computer vision
3. Design of algorithms for text analysis
4. Design of Disease prediction algorithms
5. Design of chat bot for given application
6. Back propagation algorithm for data classification
7. Develop algorithm for data classification
8. Implement feedforward network in NN for given application
9. Implement back propagation algorithm in NN for given application
10. Any other design applications after discussion with course faculty

Case Study
1. Case study on how Google assistant works
2. Case study on algorithms used in Google translation
3. Case study on how text to speech works
4. Application of neural networks to classification application

5. Analysis of SVM for OCR
6. Application of SVM for classification
7. Any other case study applications after discussion with course faculty

Survey

1. Survey on learning algorithms for pattern recognition applications
2. Survey on learning algorithms for computer vision applications
3. Survey on classification algorithms for biomedical applications
4. Survey of different algorithms for disease prediction
5. Videos Surveillance application
6. Social Media Services
7. Online Customer Support
8. Any other case study applications after discussion with course faculty

Blog

1. Applications of machine learning for hand written digit classification in Hindi and Marathi scripts
2. Use of different tools for deep learning applications
3. Use of different classification metrics for classification
4. Use of machine intelligence in autonomous vehicles
5. Machine intelligence for game playing applications
6. Email Spam and Malware Filtering
7. Recommendation system
8. Any other application after discussion with course faculty

Course Outcomes and mapping with PO and PSO

The students will be able to

1. Understand the concept of machine intelligence. [4](PO-1,2,6,12,PSO-1)
2. Comprehend use of language learning to real world cases [3] (PO-1,2,3,4,6,12,PSO-1,2)
3. Apply learning algorithms to real world applications [4] (PO-1,2,3,5,12,PSO-1)
4. Illustrate the use of neural networks for different machine intelligence applications [4] (PO-1,2,3,12,PSO-3)
5. Identify the applications of machine intelligence in real world [3] (PO-1,2,3,4,12,PSO-1,2)

Text Books and Reference Books

1. S. Rogers and M. Girolami, A First Course in Machine Learning, 2nd edition, Chapman & Hall/CRC 2016, ISBN: 9781498738484.
2. K. Murphy, "Machine Learning: A Probabilistic Perspective" MIT Press 2012.
3. D. Barber, Bayesian Reasoning and Machine Learning Cambridge University Press 2012.
4. C. Bishop, Pattern Recognition and Machine Learning, Springer 2011.
5. R. Duda, P. Hart, D. Stork, Pattern Recognition (2nd Edition) Wiley 2000.
6. Goodfellow, Bengio and Courville, "Deep learning". Available for free on the web. In print from MIT press on Amazon.

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CS4201 :: CLOUD COMPUTING

Course Prerequisites: Operating Systems, Fundamentals of Computer Networks

Course Objectives:

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

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

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

SECTION-I

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

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

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

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SECTION-II

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

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

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

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

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

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

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

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

4. Demonstration of EBS, Snapshot, Volumes

5. Single Node Cluster Implementation (Hadoop)

Case Study:

1. PayU Migration to AWS

2. Cloud object storage

3. Deployment and Configuration options in AWS

4. Deployment and Configuration options in Microsoft Azure

5. Deployment and Configuration options in GCP

Blog

1. Comparing design of various cloud computing platforms

2. AWS EKS and Google Cloud Functions

3. App Engine

4. Cloud Endpoints

5. Cloud Pub/Sub

Surveys

1. Disaster Recovery in Cloud Computing

2. Cloud Economics

3. Data archiving solutions

4. Salesforce

5. Dropbox

Assessment Scheme :

Course Assessment: Total : 100 mks

1. Mid Semester Examination   : 30 marks (Total : 30 marks based on Section I)
                          30 marks converted to 30

2. End Semester Examination: 30 marks (Total : 30 marks based on Section II)
                          30 marks converted to 30

3. Home Assignment : 10 mks (Total : 100 marks: Case study, Design work, Survey, Blog)
                          100 marks converted to 10

4. Viva : 30 mks (at the end of semester); *100 marks converted to 30*

Text Books:

1. Judith Hurwitz, R.Bloor, M.Kanfman, F.Halper, "Cloud Computing for Dummies", Wiley,India.

2. Ronald Krutz and Russell Dean Vines, "Cloud Security", Wiley-India

3. Gautam Shroff. "Enterprise Cloud Computing", Cambridge

Reference Books:

1. Barrie Sosinsky, "Cloud Computing Bible", Wiley India

2. Antohy T Velte, et.al, "Cloud Computing : A Practical Approach", McGraw Hill.

3. Michael Miller, "Cloud Computing", Que Publishing.

4. Tim Malhar, S.Kumaraswammy, S.Latif, "Cloud Security & Privacy", SPD,O'REILLY

5. Scott Granneman, "Google Apps", Pearson

Moocs Links and additional reading material:

https://nptel.ac.in/courses/106/105/106105167/

https://swayam.gov.in/nd1_noc20_cs55/preview

https://www.coursera.org/specializations/cloud-computing

https://azure.microsoft.com/en-in/overview/what-is-cloud-computing/

https://aws.amazon.com/what-is-cloud-computing/

https://www.ibm.com/in-en/cloud/learn/cloud-computing

Course Outcomes:

1) Describe the main concepts, key technologies, strengths, and limitations of cloud computing and the possible applications for state-of-the-art cloud computing

2) Explain the architecture and infrastructure of cloud computing, including SaaS, PaaS, IaaS, public cloud, private cloud, hybrid cloud, etc.

3) Identify problems, and explain, analyze, and evaluate various cloud computing solutions.

4) Choose the appropriate technologies, algorithms, and approaches for the related issues.

5) Display new ideas and innovations in cloud computing.

6) Collaboratively research and write a paper on the state of the art (and open problems) in cloud computing.

CO PO Map

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

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

Future Courses Mapping:

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

Job Mapping:

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

CS4271 :: MAGIC XPA/XPI

Course Prerequisites: Operating Systems, Fundamentals of Computer Networks

Course Objectives:

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

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

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

SECTION-I

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

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

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

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SECTION-II

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

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Design:
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Case Study:

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Blog

1. Comparing design of various cloud computing platforms

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Surveys

1. Disaster Recovery in Cloud Computing

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CS4272 :: NEURAL NETWORK

Course Prerequisites: Operating Systems, Fundamentals of Computer Networks

Course Objectives:

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1. Disaster Recovery in Cloud Computing

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Assessment Scheme :

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https://www.coursera.org/specializations/cloud-computing

https://azure.microsoft.com/en-in/overview/what-is-cloud-computing/

https://aws.amazon.com/what-is-cloud-computing/

https://www.ibm.com/in-en/cloud/learn/cloud-computing

Course Outcomes:

1) Describe the main concepts, key technologies, strengths, and limitations of cloud computing and the possible applications for state-of-the-art cloud computing

2) Explain the architecture and infrastructure of cloud computing, including SaaS, PaaS, IaaS, public cloud, private cloud, hybrid cloud, etc.

3) Identify problems, and explain, analyze, and evaluate various cloud computing solutions.

4) Choose the appropriate technologies, algorithms, and approaches for the related issues.

5) Display new ideas and innovations in cloud computing.

6) Collaboratively research and write a paper on the state of the art (and open problems) in cloud computing.

CO PO Map

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

CO attainment levels

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

Future Courses Mapping:

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

Job Mapping:

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

ET4232 :: DEEP LEARNING

Course Prerequisites:

Linear algebra, probability theory and statistics, Digital signal processing , Computer vision

Course Objectives:

1. To present the mathematical, statistical and computational concepts for stable representations of high-dimensional data, such as images, text
2. To introduce NN and techniques to improve network performance
3. To introduce Convolutional networks
4. To introduce Sequential models of NN
5. To build deep nets with applications to solve real world problem

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

Course Relevance:

Deep learning is revolutionizing the technology and business world today. It is a subfield of machine learning concerned with algorithms to train computers to perform tasks by exposing neural networks to large amounts of data, its analysis and prediction. It's an incredibly powerful field with capacity to execute feature engineering on its own, uses multiple neural network layers to extract patterns from the data. Top applications of Deep learning involves, self driving cars, natural language processing, robotics, finance and healthcare.

SECTION-I

Foundations of neural networks and deep learning, Logistic regression as a neural network, different activation function, logistic regression cost function, logistic regression gradient descent, vectorizing logistic regression, forward and backward propagation, Techniques to improve neural networks: regularization and optimizations, hyperparameter tuning, batch normalization, data augmentation, deep learning frameworks, Implementation of neural network for a case study

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SECTION-II

Convolutional Neural Networks, padding, strided convolution, pooling layers, convolutional implementation of sliding windows, Applications: object classification, object detection, face verification. ResNet, inception networks, bounding boxes, anchor boxes. Sequence modelling: recurrent nets, architecture, vanishing and exploding gradient problem, Applications & use cases.

List of Course Seminar Topics:

1. Deep learning for Stock Market Clustering

2. Application of Deep Networks in health care

3. Credit card fraud detection

4. Classification of skin cancer with deep neural networks

5. ALEXNET

6. VCGNET

7. Accelerating Deep Network Training by Reducing Internal Covariate Shift

8. Deep learning applications for predicting pharmacological properties of drugs

9. GAN (Generalised Adversial network)

10. Auto encoders

11. LSTM

List of Course Group Discussion Topics:

1. Recurrent or Recursive Networks for sequential Modelling?

2. Initializing network weights vs performance

3. Difficulty of training deep feedforward neural networks

4. Hyperparameter tuning: Is there a rule of thumb?

5. Problem of overfitting: How to handle?

5 Which cost function: Least squared error or binary cross entropy?

6. How to tackle with loss of corner information in CNN

7. Need of hundred classifiers to solve real world classification problem

8. Which optimization: Batch gradient descent of stochastic gradient descent

9. Activation functions: Comparison of trends

10. Remedy of problem of vanishing gradient and exploding gradient in RNN

List of Home Assignments:

Design:

1.Deep learning for library shelf books identification

2.Development of control system for fruit classification based on convolutional neural networks

3. Classifying movie review using deep learning

4. Sentiment analysis of the demonetization of economy 2016 India

5. Predicting Students Performance in Final Examination

Case Study:

1. Deep learning for security

2. Bag of tricks for efficient text classification

3. Convolutional Neural Networks for Visual Recognition

4. Deep Learning for Natural Language Processing

5. Scalable object detection using deep neural networks

Blog

1. Brain tumor segmentation with deep neural networks

2. Region-based convolutional networks for accurate object detection and segmentation

3. Human pose estimation via deep neural networks

4. Content Based Image Retrieval

5. Visual Perception with Deep Learning

6. Music genre classification system

Surveys:

1. Machine translation using deep learning - survey

2. Shaping future of radiology using deep learning

3. Training Recurrent Neural Networks

4. Text generation with LSTM

5. Deep learning applications in Biomedicine

Assessment Scheme :

Course Assessment: Total : 100 mks

1. Mid Semester Examination   : 30 marks (Total : 30 marks based on Section I)

30 marks converted to 30

2. End Semester Examination: 30 marks (Total : 30 marks based on Section II)

30 marks converted to 30

3. Home Assignment : 10 mks (Total : 100 marks: Case study, Design work, Survey, Blog)

100 marks converted to 10

4. Viva : 30 mks (at the end of semester); *100 marks converted to 30*

Text Books:

1. Goodfellow, I., Bengio, Y., and Courville, A., Deeep Learning, MIT Press, 2016.
2. C., M., Pattern Recognition and Machine Learning, Springer, 2006.

Reference Books: (As per IEEE format)

1. Yegnanarayana, B., Artificial Neural Networks PHI Learning Pvt. Ltd, 2009.
2. Golub, G.,H., and Van Loan,C.,F., Matrix Computations, JHU Press,2013.
3. Satish Kumar, Neural Networks: A Classroom Approach, Tata McGraw-Hill Education, 2004.

Moocs Links and additional reading material: www.nptelvideos.in

1. https://nptel.ac.in/noc/courses/noc20/SEM1/noc20-cs11
2. https://nptel.ac.in/noc/courses/noc20/SEM1/noc20-cs50

Course Outcomes: Students will be able to

1) Demonstrate understanding of a logistic regression model, structured as a shallow neural network

2) Build and train a deep Neural Network

3) Apply techniques to improve neural network performance

4) Demonstrate understanding of functionality of all layers in a convolutional neural network

5)   Implement convolutional networks for image recognition/classification tasks

6) Demonstrate Understanding of Recurrent nets and their applications

CO PO Map

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	4	3	3	2	4	1	-	1	1	1	-	2	1	1
2	4	3	3	2	4	2	-	1	1	1	-	2	3	3
3	4	3	3	3	4	2	-	1	1	1	-	2	3	3
4	4	3	3	3	4	2	-	1	1	1	-	2	3	3
5	4	4	3	3	4	2	-	1	1	1	-	2	3	3
6	4	4	3	3	4	2	-	1	1	1	-	2	3	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

CO attainment levels
Co1 -Level 3
Co2 - Level 3
Co3 - Level 5
Co4 - Level 4
Co5 - Level 5
Co6 - Level 4

Future Courses Mapping:

Advanced course on Deep learning including Auto encoders and Boltzmann machines, Reinforcement Learning etc

Job Mapping:

Deep learning engineer, Data Scientist and Algorithm Architect with industries in domains Healthcare, Industrials & Energy, Automobiles, Finance & Insurance, Human Resources, Agriculture, Cybersecurity, Ad & Marketing, Media and Entertainment, Government, Defense

FF NO. : 654

IT4216:: DATA MANAGEMENT, PROTECTION AND GOVERNANCE

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

Course Objectives:

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

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

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

SECTION-1

Image Formation Models : Fundamentals of Image Processing, Monocular imaging system, Radiosity: The 'Physics' of Image Formation, Color Model etc, Camera model and Camera Calibration, Construction of 3D Model from images.
Image Processing and Feature Extraction-Image preprocessing-Image Enhancement techniques, Image representations (continuous and discrete), Histogram Processing, Statistical & Geometric Transformation.
Shape Representation and Segmentation : Edge detection, Image segmentation techniques: Edge Based approaches to segmentation, Gradient using Masks, LOG, DOG, Canny, Edge Linking, Line detectors (Hough Transform), Corners – Harris, Region Growing, Region Splitting.

SECTION-1I

Motion Estimation: Regularization theory, Optical computation, Stereo Vision, Motion estimation, Structure from motion**.**
Object Recognition: Object Recognition, Feature Detectors, Classifications-Supervised and Unsupervised Machine Learning for Image Classification, Principal Component Analysis, Singular Value Decomposition Shape priors for recognition.
Applications: Photo album – Face detection – Face recognition, Object tracking, Surveillance etc.

List of Projects:

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

List of Course Seminar Topics:

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

List of Course Group Discussion Topics:

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

List of Home Assignments:

Design:

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

Case Study:

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

Blog:

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

Surveys:

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

Assessment Scheme:

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3. Home Assignment : 10 mks (Total : 100 marks: Case study, Design work, Survey, Blog)
             100 marks converted to 10
4. Viva : 30 mks (at the end of semester); *100 marks converted to 30*

Text Books:

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

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

Reference Books:

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

Moocs Links and additional reading material: www.nptelvideos.in

Course Outcomes:
The student will be able –

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

CO PO Map:

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

CO attainment levels:

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

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

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

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)	**S**eek knowledge, select appropriate technologies, and apply it to different areas	[5] PO-1, PO-3, PO-4, PO-6 PSO-1, PSO-2 PSO-3
b)	Develop a technical artifact requiring new technical skills.	
c)	Improve problem-solving and critical thinking skills.	
d)	Acquire and evaluate information	
e)	Analyze or visualize data to create information	
IC4211_CO2: Skill Development / Modern Tool Usage : Ability to		
a)	learn modern engineering tools	[4] PO-5 PSO-1, PSO-2
b)	Effectively utilize appropriate software tool to complete a task	
c)	Effectively utilize modern engineering tools necessary for engineering practices	
IC4211_CO3: Communication & Presentation Skills: Ability to		
a)	Communicate ideas orally and in written form	[3] PO-9, PO-10
b)	Report effectively the status of task completion	
c)	Effectively Participate as a team member	
d)	Listen effectively	
e)	Present effectively	
IC4211_CO4: Professionalism: Ability to		
a)	Demonstrate understanding of professional customs and practices.	[2] PO-8, PO-12
b)	Organize and maintain information	
c)	Identify, understand and work with professional standards	
d)	Behave professionally and ethically	
IC4211_CO5: Technical Writing: Ability to		
a)	Write requirements documentation	[2] PO-10, PO-12
b)	Write Maintenance and troubleshoot report	
c)	Prepare documentation of task completed	

FF No. : 654

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)	**S**eek 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)	**S**eek 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	

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
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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)

IT4219 :: FROM CAMPUS TO CORPORATE

Course Outcomes

The goals of the program are the following:

1. Enable insights and knowledge on real world working of companies,
2. Understand essential skills to develop and thus the experience to look forward to for students joining the Industry
3. Demystify the gap between theory and practice and learn via case studies on application of knowledge

Credits: 02   **Teaching Scheme:** Theory: 2 Hours/Week

Section I

Understanding Domains, Industry and Companies

Understanding the evolution of technology

Understanding Innovation

Types of companies and typical organization - Who does What

Understanding companies - Domain, Offering, Customers, Strategy

Company Culture & Professionalism

Making money or not - Understanding companies financially

Planning and Execution

Product Development - Understanding beyond the theory

Quality - Understanding beyond the theory

Product Management

Solutioning and Design - A key step between requirements and delivery

Site Reliability, Devops, Support - Understanding beyond the theory

Common metrics and measurements in a software delivery organization

Section II

Planning and Execution

Key Tool types and processes - End to End product lifecycle management

Issues Management and Lifecycle - A key aspect of customer Satisfaction

Software delivery models and Release cycles - how they work in the real world

Usability by end user - UI/UX and other key concepts and its importance

Useful Skills

Continuous learning and improvement - An essential skill

Ownership and Leadership

Analyzing ones career path and making educated judgements

Time management and multi tasking model

Being a effective Mentee and Mentor

Structure and syllabus of Final Year. B.Tech . Instrumentation Engineering. A.Y. 2022-23

Structure and syllabus of B.Tech . Instrumentation Engineering. A.Y. 2022-23

Being Inquisitive: Why asking questions is more difficult than giving answers? Hands on exercise
Effective Articulation and Colaboration
Introducing yourself & Making Effective Presentations
Problem breakdown and resolving model
Effective project and program management
Mind Mapping - A powerful technique to learn
Must have tips to succeed in any career

Structure and syllabus of Final Year. B.Tech . Instrumentation Engineering. A.Y. 2022-23

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