
**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 'D20'

## Effective from Academic Year 2020-21

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

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

**Signed by**

**Chairman – BOS** **Chairman – Academic Board**

# Contents

## Vision statement of Institute

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

## Mission statement of Institute

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

## Core Values

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

## Vision statement of Department

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

## Mission statement of Department

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

## Program Educational Objectives (PEO)

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

The Graduates would demonstrate

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

**Program Outcomes**

**Engineering Graduates will be able to:**

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

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

## Program Specific Outcomes (PSOs)

Graduates shall have the ability to:

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

Vishwakarma Institute of Technology
Title : Course Structure

Issue 01 : Rev No. 1 : Dt. 01/07/18
FF No. 653

## Final Year B.Tech - Instrumentation and Control Engineering Structure for Pattern D-20, Module-7 with effect from Semester-1 of Academic Year 2020-21

| 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-OE1 | MD4201 | Engineering and Managerial Economics | 2 | 0 | 0 | 2 | 2 | 20 | | | | 30 | 30 | 20 | 100 |
| S1-OE1 | MD4202 | Project Management | | | | | | | | | | | | | |
| S2-OE2 | IC4201 | Industrial Electronics | 2 | 0 | 0 | 2 | 2 | 20 | | | | 30 | 30 | 20 | 100 |
| S2-OE2 | IC4251 | Human Computer Interaction | | | | | | | | | | | | | |
| S2-OE2 | IC4253 | Natural Language Processing | | | | | | | | | | | | | |
| S2-OE2 | IC4254 | Advanced Communication | | | | | | | | | | | | | |
| S2-OE2 | IC4256 | Design and Analysis of Algorithm | | | | | | | | | | | | | |
| S3-OE3 | IC4215 | DCS and Communication Protocols | 2 | 0 | 0 | 2 | 2 | 20 | | | | 30 | 30 | 20 | 100 |
| S3-OE3 | IC4261 | Network Security | | | | | | | | | | | | | |
| S3-OE3 | IC4262 | Cloud Computing | | | | | | | | | | | | | |
| S3-OE3 | IC4263 | Deep Learning | | | | | | | | | | | | | |
| S3-OE3 | IC4264 | Pattern Recognition | | | | | | | | | | | | | |
| S3-OE3 | IC4265 | CMOS RF Integrated Circuits | | | | | | | | | | | | | |
| S3-OE3 | IC4266 | Computer Vision | | | | | | | | | | | | | |
| S4 | IC4243 | Major Project | 0 | 20 | 0 | 20 | 10 | | 50 | | | | 50 | | 100 |
| | | **Total** | **6** | **20** | **0** | **26** | **16** | | | | | | | | |

Vishwakarma Institute of Technology
Title : Course Structure

Issue 01 : Rev No. 1 : Dt. 01/07/18
FF No. 653

## Final Year B.Tech - Instrumentation and Control Engineering Structure for Pattern D-20, Module-8 with effect from Semester-2 of Academic Year 2020-21

| 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 | 32 | 0 | 32 | 16 | | | | | 50 | 50 | | 100 |
| S1 | IC4224 | Global Internship | | | | | | | | | | | | | |
| S1 | IC4226 | Research Internship | | | | | | | | | | | | | |
| S1 | IC4240 | Project Internship | | | | | | | | | | | | | |
| | | **Total** | **0** | **32** | **0** | **32** | **16** | | | | | | | | |

*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*

# SEMESTER I

**FF No. : 654**

# 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 either for power supply, control, conversion and other applications. Power electronics is also involved in electric vehicles and renewable energy systems which have a great scope currently and also in future.

| SECTION-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.<br><br>**Power dissipation and heat sink design:** Static and dynamic switching losses in power devices. Power dissipation calculations, cooling requirement, heat sink design and selection. Over current and overvoltage protection of power devices.<br><br>**Power device drivers and protection techniques:** Various driver ICs such as isolated, non isolated, low side, high side etc. Interfacing power devices with digital logic circuits and microcontrollers based systems. 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. Driving requirement for power devices. |

**SECTION-1I**

**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.

**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.

**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. Solar photovoltaic power converters. Power converters for electric vehicles. Wireless power transmission.

**List of Course Seminar Topics:**

1. Silicon carbide power devices
2. Ferrite cores for power electronic transformers
3. Resettable fuses and applications
4. Electric vehicles
5. Hybrid electric vehicles
6. Overcurrent protection circuits for power devices
7. Super capacitors and applications
8. Smart grids
9. Resonant converters
10. Power electronics in robotics

**List of Course Group Discussion Topics:**

1. Scope for power electronics in various fields
2. Selection of fuses for over-current protection
3. HVDC transmission
4. IOT and power electronics
5. Selection of batteries for electric vehicles
6. Energy storage medium for power electronics
7. TRIAC applications
8. Renewable energy systems
9. Over-current sensing techniques
10. Power electronics in industrial process control

**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. Sepic converter

**Case Study:**

1. Power converters in electric vehicles
2. Power electronic in wind energy system
3. Power electronics in locomotives
4. High power UPS systems
5. Rooftop solar photovoltaic system

**Blog**

1. GaN power devices and applications
2. Solar photovoltaic plants
3. SiC MOSFETs applications
4. Fuel cell
5. Electric vehicle battery charging

**Surveys**

1. Ferrite cores types and applications
2. Energy storage systems
3. Solar microinverters
4. Snubber circuits
5. Wind generators types and applications

**Assessment Scheme:** Course Assessment: Total : 100 mks

1. Mid Semester Examination: 30 marks based on Section I
2. End Semester Examination: 30 marks based on on Section II
3. Home Assignment : 10 mks (Total: 100 marks: Case study, Design work, Survey, Blog) *100 marks converted to 10*
4. Viva : 20 mks (at the end of semester); *100 marks converted to 20*
5. Seminar : 10 mks (at the end semester); *100 marks converted to 10*

**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:** www.nptelvideos.in
http://www.nptelvideos.in/2012/11/power-electronics.html
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. Select suitable protection devices and driver ICs for power devices
3. Design a required heatsink for cooling requirement of the power devices
4. Analyse power electronic circuits
5. 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 | PSO -1 | PSO -2 | PSO -3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1** | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 2 | 2 | 2 |
| **2** | 2 | 3 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 2 | 2 | 2 |
| **3** | 2 | 3 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 3 | 3 | 3 |
| **4** | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 2 | 1 | 1 |
| **5** | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 |

**CO attainment levels**

| CO No. | IC3203_CO1 | IC3203_CO2 | IC3203_CO3 | IC3203_CO4 | IC3203_CO5 |
|---|---|---|---|---|---|
| **Attainment Level** | 2 | 3 | 5 | 4 | 3 |

**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 and solar photovoltaic power plants.

**FF No. : 654**

# IC4251:: HUMAN-COMPUTER INTERACTION

## Course Prerequisites: Mathematics

## Course Objectives:

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

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

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

| SECTION-1 |
| --- |
| **Fundamentals of Human Computer Interaction (HCI):** Definition of HCI, Interdisciplinary Nature, Related Disciplines, Goals of System Engineering, Usability, Types of Usability, User Interface (UI), Measurable Human Factors, Accessibility, Differently-abled Users, Accessibility Guidelines.<br><br>**Interaction Concepts and Models:** User Persona, User Categorization, Golden Rules of Interface Design, Miller's Principle, Norman's Action Model, Task Analysis - GOMS, Contextual Inquiry, Work Models, Interaction Styles, Empathy Maps.<br><br>**Design Process:** Design Concept, Three Pillars of Design, Process of Design, Ethnographic Observations, Participatory Design, Internationalization, Interaction Design Patterns. |
| |

**SECTION-1I**

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

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

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

**List of Course Seminar Topics:**

**1.** Accessibility guidelines
**2.** Empathy maps
**3.** Internationalization
**4.** SIGCHI
**5.** Ethnography with IT applications
**6.** Design thinking
**7.** Participatory design
**8.** Color schemes in user interfaces
**9.** Design of home screens
**10.** Human errors

**List of Course Group Discussion Topics:**

**1.** Which is better - human skills or computer abilities?
**2.** What adds more value - aesthetics or gamification?
**3.** Are accessibility guidelines affordable?
**4.** Is multilingual support essential in mobile apps?
**5.** Should users be involved in the UI design process?
**6.** Is user-based evaluation better than expert-based evaluation?
**7.** Is heuristic evaluation more valuable than cognitive walkthrough?
**8.** Is internationalization essential in IT applications?
**9.** Are websites easier to design than mobile apps?
**10.** Are documents designed?

**List of Home Assignments:**

**Design:**

**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 Study:**

**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

**Blog**

**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

**Suggest an assessment Scheme:**

***Suggest an Assessment scheme that is best suited for the course. Ensure 360 degree assessment and check if it covers all aspects of Blooms Taxonomy.***

*Home Assignments, PPTs ,GD,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:** ***(As per IEEE format)***

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

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

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

**Moocs Links and additional reading material:**

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 capture the ethnographic observations in user community

**3)** Students will be able to follow usability standards and accessibility guidelines

**4)** Students will be able to design user interfaces as per interface theory and user requirements

**5)** Students will be able to apply a suitable usability evaluation method to identify the usability issues

**6)** Students will be able to enhance UI designs as per desired web, CSCW 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

**FF No. : 654**

# IC4253 :: 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-1I** |
| 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

**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

**Suggest an assessment Scheme:**

1. Seminar – 10 Marks
2. Group Discussion – 10 Marks
3. Home Assignment – 10 Marks
4. Course Viva – 20 Marks
5. MSE – 15 Marks
6. ESE – 15 Marks
7. Lab work –10 Marks
8. Course project -10 Marks

**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 ( Co Attainment level -3)

2. Get acquainted with the algorithmic description of the main language levels: morphology, syntax, semantics, and pragmatics ( Co Attainment level -3)

3. Apply mathematical models and algorithms in applications of NLP ( Co Attainment level - 4)

4. Design and implementation issues in various NLP applications such as information retrieval and information extraction ( Co Attainment level - 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. ( Co Attainment level - 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. ( Co Attainment level - 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.

**FF No. : 654**

# IC4254 :: ADVANCED COMMUNICATION ENGINEERING

## Course Prerequisites:

Communication Engineering, Digital Signal Processing, Wireless Communication

## Course Objectives:

1. .Analyze the path loss and shadowing effects in wireless communication.
2. Understand diversity techniques of communication.
3. Understand wireless channel modelling.
4. Analyze Orthogonal Frequency Division Multiplexing system.
5. Evaluate the performance of Multiple Input Multiple Output systems.
6. Simulate MIMO receivers

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

## Course Relevance:

Future generations of cellular communication requires higher data rates and a more reliable transmission link.The transmission data rates can be increase by increasing transmission bandwidth and using higher transmitter power.Wireless communication channels suffer from various factors.Fading problem is the major impairment problem.To improve the performance of those fading channels , diversity techniques are used.Advanced Communication Engineering begins with wireless channel modelling.Also it covers Bit Error Rate performance in fading wireless channel. It covers deep fading issues in wireless communication.Also it covers how to solve fading problems. It also covers advanced technologies like OFDM(Orthogonal Frequency Division Multiplexing) and MIMO(Multiple Input Multiple Output . An integral part of the course is MATLAB based computer assignments , which are designed to reinforce theoretical concepts.

**SECTION-1**

**Wireless Communication and Diversity**

Path Loss and Shadowing, Wireless Channel Modelling, Bit Error Rate(BER) performance in Additive White Gaussian Noise(AWGN) communication channel-Analysis , Bit Error Rate(BER) performance in fading wireless channel , Deep fade phenomenon in wireless channels.

**Diversity in Wireless System**

Multiple antenna Wireless Systems, optimal receiver combining, Bit Error Rate(BER) performance with diversity, Types of diversity , Deep Fade Analysis with Diversity.

**SECTION-1I**

**Orthogonal Frequency Division Multiplexing**

Multicarrier modulation , Introduction to Orthogonal Frequency Division Multiplexing (OFDM),OFDM system model , IFFT/ FFT Transceiver Model, OFDM -BER and SNR performance, multiuser OFDM.

**Multiple Input Multiple Output(MIMO) Technology**

MIMO System model, MIMO- Zero-Forcing(ZF) and Minimum Mean Square Error (MMSE) Receivers , Singular Value Decomposition (SVD),MIMO channel capacity, Optimal water filling power allocation.

**List of Course Seminar Topics:**

1. Performance analysis of multiple-input multiple-output singular value decomposition transceivers.
2. Modeling the Indoor MIMO Wireless Channel
3. Channel Modelling for 5G mobile Communication
4. Comparison of Indoor Geolocation methods in DSSS and OFDM Wireless Lan Systems
5. Analysis of MIMO system through Zero Forcing and MMSE detection scheme
6. SVD for Engine design of High Throughput MIMO OFDM system
7. Measured capacity gain using waterfilling in frequency selective MIMO Channels
8. MIMO channel capacity in Co-channel interference.
9. OFDM Channel estimation using Singular value decomposition
10. Increase in capacity of Multiuser OFDM system

**List of Course Group Discussion Topics:**

1. Fading Environment
2. Deep Fade Phenomenon in Wireless Communication
3. OFDM versus CDMA
4. Filtered -OFDM & OFDM modulation
5. OFDM vs MIMO-OFDM
6. OFDM for Optical Communication
7. MIMO -opportunities and challenges
8. MIMO Radar
9. Massive MIMO for next generation wireless systems
10. 5G - Spectrum, Deployment & Customer Trends

**List of Home Assignments:**

**Design:**

1. Design of OFDM for UWB environment
2. Design of 4G MIMO OFDM wireless system
3. OFDM for underwater Acoustic communication
4. Design LMSE algorithm for equalization
5. Design Zero forcing Algorithm

**Case Study:**

1. Role of digital communication in digital transformation
2. Digital Communication over fading channels
3. Network coding for wireless Mesh Networks
4. Capacity of wireless communication systems employing antenna arrays
5. MIMO OFDM

**Blog**

1. 5G and Industrial IoT
2. Equalization Techniques for MIMO
3. Diversity Techniques for 4G wireless Communication
4. Massive MIMO
5. Will 5G change the world?

**Surveys**

1. Diversity techniques in Wireless Communication
2. Space time coding scheme for MIMO
3. Survey on resource allocation techniques in OFDM (A) networks
4. Survey on Mobile WiMax
5. Performance Analysis in MIMO OFDM system

**Suggest an assessment Scheme:**

**Suggest an Assessment scheme that is best suited for the course. Ensure 360 degree assessment and check if it covers all aspects of Blooms Taxonomy.**

1. Seminar

2. Group Discussion

3. Home Assignment

4. Course Viva

5. MSE

6. ESE

**Text Books:**

1.Principles of Modern wireless communication systems .Theory and practice , Aditya K. Jagannatham ,McGraw –Hill publication.

2. Wireless Communications-Andrea Goldsmith –Cambridge university press.

3.Wireless Communications- Principle and practice- Theodore S, Rappaport, Pearson.

4.Digital communications -Fundamentals and applications –Bernard Sklar,
Prentice Hall

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

1. Baseband Receiver Design for wireless MIMO-OFDM communications, Tzi-Dar Chiueh, Pei-Yun Tsai, I-Wei Lai, Wiley-IEEE Press, 2012.

2.Theory and applications of OFDM and CDMA : Wideband Wireless COmmunications , Henrik Schulze, Christian Lueders, Wiley, 2005.

3. Radio Propagation and Adaptive Antennas for Wireless Communication Networks, Nathan Blaunstein, Christos G. Christodoulou, Wiley , 2014.

4. Fundamentals of Wireless Communication , David Tse, Pramod Vishwanath, Cambridge University Press, 2005

**Moocs Links and additional reading material:**

www.nptelvideos.in
Advanced 3G, 4G Wireless Mobile Communications
https://nptel.ac.in/courses/117/104/117104099/#

**Course Outcomes:**

1) Calculate received power by system and keep required margin
2) Differentiate between diversity techniques
3) Understand channel modelling
4) Illustrate OFDM System
5) Discuss performance behaviour of MIMO systems
6) Differentiate between ZF & MMSE receivers

**CO PO Map**

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

**CO attainment levels**

CO1:- Level 2

CO2:- Level 4

CO3:- Level 4

CO4:- Level 5

CO5:- Level 3

CO6:- Level 3

**Future Courses Mapping:** 1. Mobile Communication

**Job Mapping:**

Students will have good opportunities in the communication industry as service engineers for operations and maintenance, network planning, software product developer, analytics engineer and so many.

**FF No. : 654**

# IC4256::DESIGN AND ANALYSIS OF ALGORITHMS

**Course Prerequisites:** Basic courses on programming, data structures, Discrete structures

**Course Objectives:**

1. Formulate a given computational problem in an abstract and mathematically precise manner.

2. Choose a suitable paradigm to design an algorithm for given computational problems.

3. Understand asymptotic notations and apply suitable mathematical techniques to find asymptotic time and space complexities of algorithms.

4. Understand notions of NP-hardness and NP-completeness and their relationship with the intractability of decision problems.

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

**Course Relevance:** This is an important course for Information Technology Engineering which helps to develop algorithmic thinking capability of students. It also facilitates in systematic study of any other domain which demands logical thinking. Designing algorithms using suitable paradigms and analyzing the algorithms for computational problems has a high relevance in Industry as well as research. This course is also relevant for students who want to pursue research careers in theory of computing, computational complexity theory, advanced algorithmic research.

## SECTION-1

**Basic introduction and time and space complexity analysis:**

Asymptotic notations (Big Oh, small oh, Big Omega, Theta notations). Best case, average case, and worst-case time and space complexity of algorithms. Overview of searching, sorting algorithms. Using Recurrence relations and Mathematical Induction to get asymptotic bounds on time complexity. Proving correctness of algorithms.

**Divide and Conquer:** General strategy**,** Binary search and applications, Analyzing Quick sort, Merge sort, Finding a majority element, Order statistics (deterministic algorithms), Josephus problem using recurrence, Efficient algorithms for Integer arithmetic (Euclid's algorithm, Karatsuba's algorithm for integer multiplication, fast exponentiation).

**Dynamic Programming:** General strategy, simple dynamic programming based algorithms to compute Fibonacci numbers, Matrix Chain multiplication, Optimal binary search tree (OBST) construction, 0-1 Knapsack, Traveling Salesperson Problem, All pair shortest path algorithm.

**SECTION-II**

**Greedy strategy**: General strategy, Analysis and correctness proof of minimum spanning tree and shortest path algorithms, fractional knapsack problem, Huffman coding, conflict free scheduling.

**Backtracking strategy**: General strategy, n-queen problem, backtracking strategy for some NP-complete problems (e.g. graph coloring, SUDOKU)

**Branch and Bound strategy:** LIFO Search and FIFO search, Assignment problem

**Introduction to complexity classes and NP-completeness:** Complexity classes P, NP, coNP, and their interrelation, Notion of polynomial time many one reductions reduction, Notion of NP-hardness and NP-completeness, Cook-Levin theorem and implication to P versus NP question, NP-hardness of halting problem. NP-Complete problems (some selected examples from - vertex cover problem, independent set problem, clique problem, Hamiltonian-circuit problem), reducing NP problems to Integer Linear Programming.

**List of Projects:**

1. Applications of A* algorithm in gaming
2. Pac-Man game
3. Creation / Solution of Maze (comparing the backtracking based solution and Dijkstra's algorithm)
4. Knight tour algorithms
5. Network flow optimization and maximum matching
6. AI for minesweeper game
7. AI for shooting games
8. AI for Hex, connect-4, sokoban games
9. SUDOKU solver
10. Algorithms for factoring large integers

**List of Course Seminar Topics:**

1. Complexity classes
2. Divide and Conquer Vs Dynamic Programming
3. Space complexity
4. Greedy strategy Vs Backtracking strategy
5. Dynamic Programming Vs Greedy
6. Computational Complexity
7. Comparison of P Vs NP problems
8. Compression Techniques
9. NP-hardness
10. Real world applications of Graph theoretic algorithms

**List of Course Group Discussion Topics:**

1. Greedy Algorithms Vs. Dynamic Programming strategy
2. Dynamic Programming Vs Greedy
3. NP-completeness
4. P Vs NP problems
5. Paradigms for algorithm design
6. Different Searching techniques
7. Relevance of Cook-Levin theorem
8. Backtracking strategy
9. Branch and Bound strategy
10. Application of Recursion

**List of Home Assignments:**

**Design:**

1. Divide and Conquer strategy for real world problem solving
2. Dynamic Programming strategy for real world problem solving
3. Greedy strategy for real world problem solving
4. Problems on NP completeness
5. Branch and Bound strategy

**Case Study:**

1. Encoding techniques
2. Network flow optimization algorithms
3. Huffman Encoding, LZW encoding
4. Sorting techniques
5. AKS primality test

**Blog:**

1. Analysis of P Vs NP Problems and their solutions
2. Study and comparison of Complexity classes
3. Applications of Computational Geometry Algorithms
4. Role of number-theoretic algorithms in cryptography
5. Performance analysis of Graph Theoretic Algorithms

**Surveys:**

1. Primality Testing Algorithms
2. Integer Factoring Algorithms
3. Shortest Path Algorithms
4. Algorithms for finding Minimum Weight Spanning Tree
5. SAT solvers

**Suggest an assessment Scheme:**

1.Home Assignment
2.MSE/ESE
3.CVV
4.Seminar
5.Group Discussion

**Text Books:**

1. Cormen, Leiserson, Rivest and Stein "Introduction to Algorithms" ,PHI 3nd edition, 2009. ISBN 81-203-2141-3

2. Jon Kleinberg, Eva Tardos "Algorithm Design", Pearson, 1st edition, 2005. ISBN 978-81-317-0310-6

3. Dasgupta, Papadimitriu, Vazirani "Algorithms" McGraw-Hill Education; 1st edition (September 13, 2006), ISBN-10: 9780073523408, ISBN-13: 978-0073523408

**Reference Books:**

1. Motwani, Raghavan "Randomized Algorithms", Cambridge University Press; 1st edition (August 25, 1995), ISBN-10: 0521474655, ISBN-13: 978-0521474658.

2. Vazirani, "Approximation Algorithms", Springer (December 8, 2010), ISBN-10: 3642084699, ISBN-13: 978-3642084690

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

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

1) To formulate computational problems in abstract and mathematically precise manner
2) To design efficient algorithms for computational problems using appropriate algorithmic paradigm
3) To analyze asymptotic complexity of the algorithm for a complex computational problem using suitable mathematical techniques.
4) To differentiate among Complexity classes, and understand their interrelation
5) To establish NP--completeness of some decision problems, grasp the significance of the notion of NP--completeness and its relationship with intractability of the decision problems.
6) To incorporate appropriate data structures, algorithmic paradigms to craft innovative scientific solutions for complex computing problems.

**CO PO Map:**

| CO1 | CO2 | CO3 | CO4 | CO5 | CO6 |
|---|---|---|---|---|---|
| PO2 | PO4 | PO9 | PO10 | PO11 | PSO3 |
| 3 | 3 | 3 | 2 | 1 | 3 |

**CO attainment levels:**

| CO | CO1 | CO2 | CO3 | CO4 | CO5 | CO6 |
|---|---|---|---|---|---|---|
| Level | 1 | 3 | 2 | 3 | 4 | 4 |

**Future Courses Mapping:** Advanced Algorithms, Computational Geometry, Algorithmic Number Theory, Motion planning and Robotics

**Job Mapping:** Algorithm design is an essential component of any job based on programming. All Industries in IT Engineering always look for a strong knowledge in Algorithm design and Data structures for positions like Developer, Architect, Principal Engineer, Backend lead engineer, Full stack developers, Solution architect, Solution / Senior engineer, Technical lead etc

**FF No. : 654**

# IC4215 :: DCS AND COMMUNICATION PROTOCOLS

**Course Prerequisites**: Basic automation concepts

## Course Objectives:

1. To understand working of DCS system
2. To understand different DCS hardware
3. To select medium for various types of data transmission.
4. To understand the Serial data communications
5. To understand of Modbus and HART communication protocol
6. To understand of Foundation field bus and profibus protocol

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

**Course Relevance:** This course gives knowledge of DCS and its industrial applications. Almost in all process industries, DCS are used for monitoring and control of process equipments.

**SECTION-1** *[IC4215_CO1, IC4215_CO2]*

**DCS Introduction:** Location of DCS in Plant, advantages and limitations, Comparison of DCS with PLC, DCS components/ block diagram DCS Architecture Functional requirements at each level, Database management.

**DCS Hardware:** Layout of DCS, Controller Details Redundancy, I/O Card Details Junction Box and Marshalling Cabinets Operator Interface, Workstation Layout different types of control panels, types of Operating Station Programming as per IEC 61131-3, Advantages, Overview of Programming Languages, Device Signal Tags Configuration, Programming for live Process.

**Database and Alarm management Database management**: Historical data using in log, report and trend display. System status display, Process reports different types of logs and reports. Philosophies of alarm management, alarm reporting, type of alarm generated and accepted of alarms. Functional Layered Models - OSI reference model, System engineering approach, Input / Output Structures, Control Unit Structure, Protocols, Communication principles and modes: network topology, transmission media, noise, cable characteristic and selection; bridges, routers and gateways, Instrumentation and control devices Explain functions of following network devices: Repeater, Hub, Bridge, Switch, Router, Gateway, Access point, Wireless Access points.

**SECTION-1I** *[IC4215_CO3, IC4215_CO4, IC4215_CO5, IC4215_CO6]*

**Serial data communications:** Serial data communications interface standards, balanced and unbalanced transmission lines, RS-232. standard, RS-449 interface standard, RS-423 interface standard, RS-422 interface standard, Comparison of RS/EIA interface standard ,Universal Serial Bus (USB),Parallel data communication interface standard ISO-OSI Model, Modbus, CSMA/CD, CA protocol, OSI implementation for Industrial communications, Industrial control applications: ASCCII- based protocol – ANSI

**HART Communication Protocol:**
Architecture - physical, data link, application layer, communication technique, normal and burst mode of communication, benefits of HART.

**AS – I (Actuator sensor interface ):** OSI layer, CAN communication protocol, SPI, I2C
**Introduction Fieldbus and ProfiBus:** Introduction to Foundation Fieldbus : Physical layer and wiring rules Data Link layer Application layer User layer Wiring and installation practice with Fieldbus Termination Preparation ,Installation of the complete system. Introduction to ProfiBus standard: ProfiBus protocol stack Physical layer Data Link layer Application layer.

**List of Course Seminar Topics:**
1).DCS junction box and Marshell cabinet.
2).Alarm managment system in DCS
3).DeltaV trends and faceplate
4).hub and switch network
5).Serial communication using DeltaV DCS
6).Controller card
7). Different I/O card in DCS
8).PID configuration in Delta-V DCS
9).Database management in DCS
10).Electronic Marshalling in DCS

**List of Course Group Discussion Topics:**
1).Compare performance for foundation fieldbus and profbus
2).Compare HART and MODBUS communication for control CSTR loop
3).Control water level loop using MODBUS and simple AI/AO communication
4).Latest technology in DCS manufacturing
5).Compare ASI and Profibus DP
6).Compare DCS and PLC for Batch process control .
7).Architecture of different DCS
8).Compare Profibus and HART
9). Compare fieldbus and simple 4-20mA
10.Application of CAN -BUS

**List of Home Assignments:**

**Design:**

1.Design boiler interloop in DCS
2.Design of simulation for cascade control of distillation column
3.Develop control strategies for Distillation column
4.Develop serial communication for Process loop
5.Develop SFC logic for control any one chemical plant
6.Develop FBD logic to control Spray dryer
7.Develop FBD logic to control Heat exchanger
8.Develop interface step for DCS and profibus DP communication.

**Case Study:**

1.Case study - startup sequence of boiler
2.Case study of a distillation column of chemical industry
3.Network Topology used in DeltaV DCS.
4.DeltaV DCS use for serial commmunication.
5.visit industry for DCS control plant
6.automation spray dryer milk powder
7.autoamtion for Heat exchanger
8.Profibus DP in automobile industry
9.Foundation fieldbus in process industry

**Blog**

1.Advance control strategies for boiler
2.Comparison of control strategies for distillation column.
3.PID based 3 element boiler control system
4.Use modbus card in DCS for communication
5.DCS system for chemical plant
6.control strategies for spray dryer
7.Latest trends profibus .
8.Latest trends Foundation fieldbus

**Surveys**

1.Communication Protocols in DCS
2.Survey of Distillation column
3.Serial data communication in DCS
4.Simulation of petrol chemical plant
5.Automation on Spray dryer
6.Application of Heat exchanger ‘
7.Profibus DP application in industry
8.Foundation fieldbus application in industry

**Assessment Scheme:** Course Assessment: Total : 100 mks

1. Mid Semester Examination : 15 marks (Total : 30 marks based on Section I)
   *30 marks converted to 15*
2. End Semester Examination: 15 marks (Total : 30 marks based on on Section II)
   *30 marks converted to 15*
3. Lab Assessment: Lab Assignments - 10 marks (10 assignments-10 marks each)
   (*100 marks converted to 10)*
4. Course Project : 10 marks (*100 marks converted to 10)*
5. Home Assignment : 10 mks (Total : 100 marks: Case study, Design work, Survey, Blog)
   *100 marks converted to 10*
6. Viva : 20 mks (at the end of semester); *100 marks converted to 20*
7. Seminar : 10 mks (at the end semester); *100 marks converted to 10*
8. Group Discussion: 10 mks (at the Mid of semester); *100 marks converted to 20*

**Text Books:**

1. Computer Based Process Control", Krishna Kant, Prentice Hall of India.
2. Computer Networks Tannebaum Andrew Pearson, New Delhi, 5th Edition, 2011

**Reference Books:**

Distributed Computer Control for Industrial Automation", Popovik-Bhatkar, Dekkar Publications

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

**Course Outcomes:**

1. IC4215_CO1: Understand working of DCS system [1] (PO1, 5, PSO3)
2. IC4215_CO2: To understand different DCS hardware [2] (PO1, 5, PSO3)
3. IC4215_CO3: Select medium for various types of data transmission. [4] (PO1, 5, 12, PSO3)
4. IC4215_CO4: Understand the Serial data communications [3] (PO12, PSO3)
5. IC4215_CO5: Understand of Modbus and HART communication protocol [3] (PO1, 5, 12, PSO2)
6. IC4215_CO6: Understand of Foundation field bus and profibus protocol [2] (PO1, 5, 12, PSO2,3)

**Future Courses Mapping:** Advanced Process Automation

**Job Mapping:**

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

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

**FF No. : 654**

# IC4261 :: NETWORK SECURITY

**Course Prerequisites:** Computer Networks

## Course Objectives:

1. Learners must be able to discover the programming bugs that will be malicious code, they also must be able to explain various attacks and resolve the bugs to mitigate the treats.
2. Learners must be able to apply various cryptographic techniques to secure the systems developed.
3. Discover and explain various authentication and authorization methods with the access control
4. Articulate the use of various standard security protocols for the layered architecture.
5. Formulate mathematical solutions to security problems
6. Articulate the security threats to critical infrastructures

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

**Course Relevance:** Digitization and widespread use of internet communication, most of the users on the network are vulnerable to the various attacks. It is need of time to know the various types of attack and vulnerabilities which lead to attack. Also it becomes of paramount importance to study the techniques to secure the network and transfer of data through the network. It is very important at this time to know how to secure the transmission of the data.

**SECTION-1**

Introduction to Attacks and Hacking: Introduction to Security: Vulnerabilities, Threats, Threat Modeling, Risk, attack and attack types, Avoiding attacks, Security services. Trustworthiness, Ethical issues and practices, Tradeoffs of balancing key security properties - Confidentiality, Integrity, and Availability. Protocol Vulnerabilities: DoS and DDoS, session hijacking, ARP spoofing, Pharming attack, Dictionary Attacks. Software vulnerabilities: Phishing, buffer overflow, Cross-site scripting attack, Virus and Worm Features, Trojan horse, Social engineering attacks, ransomware, SYN-Flooding, SQL- injection, DNS poisoning, Sniffing,

**Cryptography:**

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

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

**SECTION-1I**

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

Authentication and Authorization: Network Access Control: Network Access Control, Extensible Authentication Protocol, SHA-512, Kerberos, X.509 authentication service

IP Security, Database Security, File Security, Mobile Security

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

Email security: PGP and SMIME

**List of Course Seminar Topics:**

**1.** Blcokchain architecture and its implementation

2. Cloud Security

3. Mobile Security

4. IoT and Security Issues/ Security Models for IoT

5. Darkweb

6. Docker Security

7. Access control methods for online social media and various organizations

8. Security of Android Vs IOS

9. Machine learning and SCADA Security

10. Security Applications for Smart Cities

**List of Course Group Discussion Topics:**

**1**. Security Issues in Android and IOS devices

2. Industry 4.0 and security

3. Blockchain and E-voting system

4. Security of Aadhar Card and other digital cards

5. Automated Home Appliances and Security

6. Programming Bugs and Malicious code in information security

7. Indian Cyber laws and Deficiencies

8. Social Media and Cyber Security

9. Child abuse on online social media and security

10. Need of cyber crime and security in school education.

**List of Home Assignments:**

**Design:**

**1**. Design a secure system using cryptography techniques for security of multimedia files.

2. Design a secure system using steganography for hiding data files in image/video

3. Design a system for educational institutes using authentication and authorization techniques, also give details about the access control policies that must be implemented for the design of system by various places.

4. Design a secure system using SSL/TLS/IPSec for the various organizations

5. Design a system for the analysis of cyber crime using various cyber forensic techniques and compare each technique with respect to integrity, confidentiality, availability

**Case Study:**

**1.** How to improve the security of social media? Write a detail case study

2. Find out the vulnerability issues in educational institutes websites/online systems and give

solutions to these problem. Perform a detailed case study of the various issues.

3. Write a detail case study about the banking security flows and solutions to these flows.

4. Give a detail case study of the antivirus system giving the flows and solutions to it.

5. Perform the detail case study of various operating systems used for mobile devices and give a secure solution to one for widely used OS.

**Blog**

**1**. Dark Web

2. Crypto currency and Economy

3. Cyber crime and solutions

4. Authentication and Access control for social media

5. Cyber forensic and Cyber laws

**Surveys**

**1.** Survey on various blockchain related issues/ cryptocurrency/ application systems developed using blockchain

2. Survey on various authentication and access control methods for different applications

3. Steganography and Biometric Systems for authentication

4. Survey of various attacks and its effect on Indian economy and its analysis

5. Problems over Integer Lattices: A Study

**Assessment Scheme:**

Home Assignment(20)
MSE(20)
Technical Seminar(10)
GD(10)
ESE(20)
Viva(20)

**Text Books:**

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

**Reference Books:**

**1.** *M. Speciner, R. Perlman, C. Kaufman, "Network Security: Private Communications in a Public World", Prentice Hall, 2002*
*2. Michael Gregg, "The Network Security Test Lab: A Step-By-Step Guide", Dreamtech Press, 2015, ISBN-10:8126558148, ISBN-13: 978-8126558148.*
*3. Matt Bishop, "Computer Security: Art and Science", 1st Edition, Pearson Education, 2002, ISBN 0201440997.*
*4. Charlie Kaufman, Radia Perlman and Mike Spencer, "Network security, private communication in a public world", 2nd Edition, Prentice Hall, 2002, ISBN 9780130460196.*
*5. V.K. Pachghare, "Cryptography and Information Security", 2nd Edition, PHI, 2015, ISBN-978-81-203-5082-3.*

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

**Course Outcomes:**

1) Analyze cryptographic techniques using a mathematical approach by examining nature of attack.
2) Identify and establish different attacks on the system
3) Justify various methods of authentication and access control for application of technologies to various sections of industry and society.
4) 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
5) Estimate future needs of security for a system by researching the current environment on a continuous basis for the benefit of society.
**6)** Analyze various types of threats in the networking attack.

**CO PO Map**

| Programme Outcomes | | | | | | | | | | | | Program Specific Outcome | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 | PSO4 |
| | | 3 | | 3 | 2 | 2 | 1 | | | | | | | 3 | |

**CO attainment levels**

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

**Future Courses Mapping:**

Blockchain Technologies, Ethical Hacking and Network Defense, Cloud and Data Security

**Job Mapping:**

Security Engineer/Network Security Engineer

Information Security Analyst, Cyber Security Analyst

Cyber Security Associate, Manager-Information Security Secvices

Security Consultant, Penetration Testing Engineer

**FF No. : 654**

# IC4262 :: 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-1**

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

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

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

**SECTION-1I**

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

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

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

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

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

**List of Course Seminar Topics:**

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

**List of Course Group Discussion Topics:**

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

**List of Home Assignments:**

**Design:**

1. Serverless Web App to order taxi rides using AWS lambda.
2. Deploying App on Kubernetes
3. Serverless web Application ( GCP Cloud Functions)
4. Demonstration of EBS, Snapshot, Volumes
5. Single Node Cluster Implementation (Hadoop)

**Case Study:**

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

**Blog**

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

**Surveys**

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

**Suggest an assessment Scheme:** *MSE, ESE, GD, Seminar, HA*

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

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

**FF No. : 654**

# IC4263 :: 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** **Teaching 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-1** |
|---|
| 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 |
| **SECTION-1I** |
| 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

**Suggest an assessment Scheme:**

1. Seminar – 10 Marks
2. Group Discussion – 10 Marks
3. Home Assignment – 10 Marks
4. Course Viva – 20 Marks
5. MSE – 25 Marks
6. ESE –25Marks

**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 Autoencoders 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, Defence

**FF No. : 654**

# IC4264 :: PATTERN RECOGNITION

## Course Prerequisites:

1. Knowledge of following courses is desirable:
2. Linear algebra, probability theory and statistics, Digital signal processing or image processing

## Course Objectives:

1. To introduce the students to the basic concepts and methods for the recognition of patterns in data
2. To provide the student with a working knowledge of pattern recognition application development process
3. Understand and apply both supervised and unsupervised classification methods to detect and characterize patterns in real-world data
4. Apply different algorithmic approaches for the detection and characterization of patterns in multi-dimensional data
5. To introduce the curse of dimensionality and various methods of dimensions reduction

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

## Course Relevance:

Pattern recognition techniques are used to automatically classify objects like handwritten characters, fruits, vehicles etc. or abstract multidimensional patterns into known or possibly unknown number of categories. Several commercial pattern recognition systems are available for character recognition, signature recognition, document classification, fingerprint classification, speech and speaker recognition etc.

A pattern recognition system can be designed based on a number of different approaches: (i) template matching, (ii) geometric (statistical) methods, (iii) structural (syntactic) methods, and (iv) neural (deep) networks. This course will introduce the fundamentals of statistical pattern recognition with examples from several application areas. The course will cover techniques for visualizing and analyzing multi-dimensional data along with algorithms for projection, dimensionality reduction, clustering and classification

**SECTION-1**

Pattern recognition systems, design cycle, learning and adaptation. Bayes decision theory, minimum error rate classification, Discriminant Functions, and Decision Surfaces, Normal density, discriminant functions for normal density. Parametric Techniques: maximum likelihood (ML) estimation, Bayesian parameter estimation. Non-parametric techniques: density estimation, Parzen windows, nearest neighbor estimation.

**SECTION-1I**

Linear discriminant functions. Unsupervised learning and clustering: Mixture Densities, Maximum-Likelihood Estimates, unsupervised Bayesian Learning. Criterion functions for clustering. Algorithms for clustering: K-Means, Hierarchical, Gaussian mixture models. Dimensionality reduction: Fisher discriminant analysis, Principal component analysis.

Applications of pattern recognition to real world problems.

**List of Course Seminar Topics: Pattern recognition applications in**

1. Radar signal classification
2. Agriculture
3. Music analysis
4. Speech recognition
5. Image segmentation
6. Aerial photo interpretation
7. Handwriting Recognition
8. Text Classification
9. Diagnostic Systems
10. Military Applications

**List of Course Group Discussion Topics:**

1. Classification of alphanumeric characters
2. Classification of Devanagari and Roman scripts
3. Selection of classifier for classifying geometric objects
4. Selection of classifier for classifying fruits
5. Different methods to classify types of grains
6. Supervised and unsupervised classifiers
7. Discriminant analysis: Linear Vs Quadratic
8. Parametric and nonparametric techniques: Pros and cons
9. Linear and nonlinear classifiers
10. Machine Learning Vs Deep Learning

**List of Home Assignments:**

**Design:**

1. Shadow detection and removal
2. Classification of vehicles for parking purpose
3. Identifying people without mask for COVID-19
4. Design an algorithm to calculate the value of a resistor from it's image
5. Develop an application of pattern recognition for Automated Inspection System

**Case Study:**

1. Pattern recognition methods for texture analysis
2. Pattern Recognition: Plant Taxonomy
3. Bayes Estimator for multivariate Gaussian density
4. Pattern recognition of sport performance data
5. Identifying patterns in human affect (emotion) recognition

**Blog**

1. Pattern Recognition applications
2. Performance measure of different Pattern Recognition algorithms
3. Pattern Recognition: Generative methods
4. Pattern Recognition: Discriminative methods
5. Hidden Markov Model

**Surveys**

1. Component Analysis Techniques
2. Image pattern recognition in big data
3. Pattern recognition methods for image and video retrieval by contents
4. Edge detection techniques for identifying patterns
5. Biometric pattern recognition

**Suggest an assessment Scheme:**

MSE- 20%
Home assignment - 10%
Project-30%
Seminar - 20%
ESE- 20%

**Text Books:**


1. R.O. Duda, P.E. Hart, G.G.Stork, "Pattern Classification," John Wiley and sons, 2004.
2. Theodoridis, Koutrombas "Introduction to Pattern Recognition," Academic Press, 3rd Edition.
3. C.M.Bishop, "Pattern Recognition & Machine Learning," Springer, 2006


**Reference Books:**


1. Morton Nadier and Eric Smith P "Pattern Recognition Engineering," John Wiley & Sons, New York, 1993
2. Robert J. Schalkoff, "Pattern Recognition : Statistical, Structural and Neural Approaches," John Wiley & Sons Inc., New York, 2007


**Moocs Links and additional reading material:**

1. https://nptel.ac.in/courses/106/106/106106046/
2. https://nptel.ac.in/courses/117/106/117106100/
3. https://nptel.ac.in/courses/117/105/117105101/
4. https://nptel.ac.in/courses/117/108/117108048/
5. https://nptel.ac.in/courses/106/108/106108057/
6. http://www.cse.msu.edu/~cse802/
7. https://lme.tf.fau.de/teaching/free-deep-learning-resources/

**Course Outcomes:**

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

1. Collect and critically interpret relevant information to design a simple pattern recognition system
2. Identify the strengths and weaknesses of different pattern classification techniques
3. Implement different pattern classifiers
4. Apply pattern recognition techniques to real-world problems
5. Evaluate the result from a simple pattern recognition system
6. Apply various dimensionality reduction methods for feature selection or feature extraction

**CO PO Map**

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

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

**CO attainment levels**
**Co1 -Level 4**
**Co2 - Level 5**
**Co3 - Level 3**
**Co4 - Level 3**
**Co5 - Level 4**
**Co6 - Level 2**

**Future Courses Mapping:**

Artificial intelligence, Machine Learning, Deep Learning

**Job Mapping:**

Students studying pattern recognition ( machine learning) will have a wide array of opportunities before them, as our society is moving to automate significant numbers of processes performed by human beings today. Careers in pattern recognition and machine learning are increasing in demand, as algorithms are needed in more industries.

**FF No. : 654**

# IC4265 :: CMOS RF INTEGRATED CIRCUITS

**Course Prerequisites:** Good Understanding of Semiconductor Devices (more specifically MOSFET), Knowledge of Analog Circuit Design**,** SPICE Simulations, Frequency response of Devices and Circuits..

**Course Objectives:** The overall objective of this course is to present the concepts of design and analysis of modern RF and wireless communication integrated circuits.

**1.** Introduce to the students the RF and Wireless Technology (the Big Picture)

**2.** Understand the MOSFET from RF perspective

**3.** Learn analysis of circuits at high frequencies using Scattering parameters

**4.** Understand the issue of Input Matching and then learn various LNA topologies

**5.** Design of Loop Filters, VCO and PLL

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

**Course Relevance:**

The rapid expansion of wireless communications services over the last decade has led to an explosion in the development of integrated circuit approaches in the RF area. Highly integrated RF components, low-noise and power amplifiers, and frequency synthesizers, are now commonplace, replacing hybrid circuits employing discrete semiconductor devices. The successive growth of electronics, Internet-of-Things (IoT), and wireless communication have been advanced due the development of complementary-metal-oxide-semiconductor (CMOS) technology. These developments result in low-power and high-performance integrated circuit (IC) designs for analog and radio-frequency applications especially in the area of new generation handheld devices. With exploration and development of CMOS technology, we could have low cost, small size and low voltage circuitry promising to integrate the whole system on a single chip. The challenges are continuous and imply motivation in exploration of RF Architectures.

| SECTION-1 |
| --- |
| Introduction to RF and Wireless Technology, Basic Concepts in RF Circuits, MOSFET - RF perspective, Transmission media and Reflections, Passive Components - Resistor, Inductor, Capacitor, Series and Parallel RLC networks, S parameters |
| **SECTION-1I** |
| Noise, Low Noise Amplifier (LNA), HF Power Amplifier, Mixer, Voltage Controlled OScillator (VCO), Phase-Locked Loop (PLL), Integrated Circuit Fabrication process (various steps), materials, and techniques involved in IC Fabrication. |
| **List of Course Seminar Topics:**<br>1. Mobile RF Communications<br>2. Wireless Standards<br>3. Transceiver Architectures<br>4. Oscillators<br>5. Noise in Electronics<br>6. Frequency Synthesizers<br>7. Power Amplifier - Classes<br>8. Digital Modulation<br>9. Multiple Access Techniques<br>10. TCAD Tools for RF Design |

**List of Course Group Discussion Topics:**

1. Impact of On-Chip Interconnections on CMOS RF Integrated Circuits

2. CMOS-compatible RF-MEMS devices for integrated circuit design

3. Impact of semiconductor technology scaling on CMOS RF and digital circuits for wireless application

4. CMOS integrated digital RF MEMS capacitors

5. SiGe BiCMOS and CMOS platforms for Optical and Millimeter-Wave Integrated Circuits

6. Improving Yield on RF-CMOS ICs

7. CMOS LNA for healthcare applications

8. Efficiency improvement techniques for RF power amplifiers in deep submicron CMOS

9. Track-and-Hold circuit in 0.18 µm CMOS process for RF applications

10. Nano-Power CMOS Voltage References for RF-Powered Systems

**List of Home Assignments:**

**Design:**

1. Low power CMOS low noise amplifier for wideband wireless systems
2. Differential LNA using 180 nm CMOS Technology
3. Digitally controlled oscillator in 65-nm CMOS technology
4. Design and optimization of a CMOS power amplifier
5. RF MEMS Capacitive Shunt Switch

**Case Study:**

1. Cryogenic performance of a 3–14 GHz bipolar Si - Ge low-noise amplifier
2. On chip miniaturized antenna in CMOS technology
3. RF Schottky diode in 22-nm CMOS
4. Zero-IF double-balanced mixer for WiMAX receivers
5. Linearity of RF mixers in GHz applications

**Blog**

1. RF LDMOS Transistors
2. RF SOI Devices
3. Tri-state inverter based DCO
4. A direct digital-to-RF converter (DRFC)
5. Thermoelectric Generators: Technologies and common applications

**Surveys**

1. Linear wideband LNA
2. RF transistors: Recent developments and roadmap toward terahertz applications
3. CMOS based capacitive sensors
4. GaN HEMT broadband power amplifiers
5. Materials: Silicon and beyond

| |
|---|
| **Suggest an assessment Scheme: HA, Project - 50 Marks, CVV - 50 Marks**<br><br>**(Assessments to be carried twice in Semester)** |
| **Text Books: (As per IEEE format)** |
| 1. RF Microelectronics, 2nd Edition, by Behzad Razavi, Prentice Hall<br><br>2. The Design of CMOS Radio-Frequency Integrated Circuits, by Thomas H. Lee |
| **Moocs Links and additional reading material:** www.nptelvideos.in |
| **Course Outcomes: The students will be able to**<br><br>1) differentiate between HF and LF MOSFET model<br><br>2) calculate S - parameters<br><br>3) perform impedance matching<br><br>4) identify various LNA topologies<br><br>5) list the techniques of improving MIXER linearity<br><br>6) draw the basic block schematic of PLL |

**CO PO Map**

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

**CO attainment levels**

**CO1 - level 5**

**CO2 - level 3**

**CO3 - level 4**

**CO4 - level 3**

**CO5 - level 4**

**CO6 - level 2**

**Future Courses Mapping:**

RF Circuit Design, CMOS Mixed Circuit Design

**Job Mapping:**

This course will begin with the notion of Radio Frequency, CMOS and Integrated Circuits (in fact, the whole course will revolve around these three words). Brief contents - MOS device (from RF perspective), RF Architectures, Passive Components, HF Amplifier design, Low Noise Amplifier (LNA), Phase Locked Loop (PLL), Mixers, Oscillators, etc. Alongside, the students will also learn about some fundamentals like impedance matching, power measurements, bandwidth estimation and so on. The course will also glance through the captivating Integrated Circuit Fabrication process and the various steps, materials, and techniques involved in IC Fabrication. Overall, the course will enhance knowledge of the learner about Radio Frequency Design which is applied in most of the jobs available in ALL Wireless and Telecommunication based companies designing RF products.

**FF NO. : 654**

# IC4266 :: COMPUTER VISION

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

1. MSE
2. ESE
3. GD
4. PPT
5. Viva etc

**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.

**FF No. : 654**

# IC4243 :: MAJOR PROJECT

**Credits:** 10 **Teaching Scheme:** Lab: 20 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

**FF No. : 654**

# IC4211:: INDUSTRY INTERNSHIP

**Credits:** 16 **Teaching Scheme:** Working in Industry 32 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:** 16 **Teaching Scheme:** Working in Industry 32 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) | **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 | |
| **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 | |

**FF No. : 654**

# IC4226:: RESEARCH INTERNSHIP

**Credits:** 16

**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:** 16

**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 | |

**FF No. : 654**

# IC4244:: MAJOR PROJECT

**Credits:** 10 **Teaching Scheme:** Lab:20 Hours/Week

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

**List of Project areas:**

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

**Course Outcomes:**

Students will be able to

1. IC4244_CO1: Design solutions for given engineering problem [4] (PO-1,2,3,4,5,6,7 PSO- 1,2,3)
2. IC4244_CO2: Demonstrate practical knowledge by constructing models/algorithms for real time applications [4] (PO-1,2,3,4,5,6,7 PSO- 1,2,3)
3. IC4244_CO3: Express effectively in written and oral communication. [3] (PO-8,10,12 PSO- 1)
4. IC4244_CO4: Exhibit the skills to work in a team [2] (PO- 8,9,12 PSO-2)
5. IC4244_CO5: Prepare a time chart and financial record for execution of the project[1] ( PO-8,11,12 PSO-3)