An Autonomous Programme Structure of
M. Tech. Instrumentation and Control Engineering
Specialization: Automation
(AY: 2019-2020)
SEMESTER I

INA 1101 Advanced Mathematics and Statistical Methods

Teaching Scheme
Lecture: 3 Hrs/Week
Tutorial: 1 Hr/Week

Examination Scheme
In Sem: 50 Marks
End Sem: 50 Marks
Credit: 4

Course Objectives:
1. Gain knowledge of Laplace and Z Transforms.
2. Gain knowledge of the principles of inferential statistics & descriptive statistics.
3. Gain knowledge of the basic principles and concepts of elementary statistical techniques.

Course Outcomes:
1. Able to use Laplace and Z transforms on various applications.
2. Able to perform various test like t-test, F-test, chi-square test for data analysis.
3. Able to perform linear regression analysis & able interpret results in view of research to provide critical comment.

Unit I: Laplace & Z Transform [6 Hrs]
Basics of Laplace and Z Transform and relation between LT & ZT, Properties and Theorems in LT, LT of standard functions, Application of LT for solving Linear Differential Equations, ZT of standard sequences, Inverse Z, Solution of Differential Equations.

Unit II: Descriptive Statistics & Principles of Inferential Statistics [6 Hrs]
Introduction to basics of Statistics, Probability, random variables, Mean, Median, Kurtosis, Skewness, Standard Deviation, Correlation, Covariance and application of basis terms to various data sets. Population Distribution, Sample Distribution, Central Limit Theorem, Hypothesis Testing, p-value, Confidential Interval

Unit III: Concepts of Elementary Statistics [6 Hrs]
Need of various statistical tests, single sided tests and two-sided tests, t-test: its basics and result interpretation, F-test: its basics and result interpretation, chi-square test: its basics and result interpretation

Unit IV: Regression Analysis [6 Hrs]
Similarities and difference between the various techniques, Basics of Regression, Linear Regression Analysis, Applications and Interpretation, Quadratic Regression Analysis, Applications and Result Interpretation.

Unit V: Stochastics Simulation and Parametric Bootstrapping [6 Hrs]
Probability Distribution, ANOVA, Standard Parametric Statistical Models, Introduction to 'R' widely used Statistical Language.

Unit VI: Application of Statistical Data Analysis and Interpretation [6 Hrs]
Selection of data for analysis, Application of correct test for the analysis of data, Interpretation of results. Case study discussion.

Reference Books:

1. C. R. Wylie, L.C. Barrette, "Advanced Engineering Mathematics", McGraw Hill Publications, New Delhi, 6th Edition, 2003, ISBN-13: 978-0070721883.
2. Erwin Kreyszig, "Advanced Engineering Mathematics" Wiley Eastern Ltd, 8th Edition, 2004, ISBN: 047-115-4962.
3. S. P. Gupta, "Statistical Methods", Sultan Chand & Sons Publications, New Delhi, 28th Edition, ISBN10: 818-054-7396.
4. P. S. G. Kumar, "Research Methods and Statistical Techniques", BR Publisher, 2004, ISBN-10: 978-817-646-4451.

List of Tutorials: Tutorials should be conducted using MATLAB/Excel

1. Calculate Mean, Median, Skewness, Kurtosis, Standard Deviation for any data set.
2. Calculate Covariance & Correlation between the two data sets.
3. Application of Single Sided t-test and its Interpretation.
4. Application of Two-Sided t-test and its Interpretation.
5. Application of F-test and its Interpretation.
6. Linear Regression Analysis and its Interpretation.
7. Quadratic Regression Analysis and its Interpretation.
8. ANOVA Test

INA 1102 Research Methodology

Teaching Scheme	Examination Scheme
Lectures: 3 Hrs/Week	In Sem: 50 Marks
Tutorial: 1 Hr/Week	End Sem: 50 Marks
	Credits: 4

Course Objectives:

1. To understand basic concepts of research and research methodology
2. To understand principles behind Research problem formulation
3. To study Instrumentation schemes for Data collection
4. To understand Statistical methods for Data Analysis
5. To prepare a research/ project proposal

Course Outcomes: Student will be able to

1. Formulate Research Problems
2. Decide Instrumentation schemes for Data collection
3. Apply Statistical methods for Data Analysis
4. Write research proposals, and present Technical Papers

Unit I: Research Problem [7 Hrs]

Meaning of research problem, Sources of research problem, Criteria / Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem

Unit II: Basic Instrumentation [7 Hrs]

Instrumentation schemes, Static and dynamic characteristics of instruments used in experimental set up, Performance under flow or motion conditions, Data collection using a digital computer system, Linear scaling for receiver and fidelity of instrument, Role of DSP is collected data contains noise.

Unit III: Applied Statistics [6 Hrs]

Regression analysis, Parameter estimation, Multivariate statistics, Principal component analysis, Moments and response curve methods, State vector machines and uncertainty analysis, Probable errors in the research, Error analysis

Unit IV: Modeling and Prediction of Performance [8 Hrs]

Setting up a computing model to predict performance of experimental system, Multi-scale modeling and verifying performance of process system, Nonlinear analysis of system and asymptotic analysis, Verifying if assumptions hold true for a given apparatus setup, Plotting family of performance curves to study trends and tendencies, Sensitivity theory and applications.

Unit V: Developing a Research Proposal [8 Hrs]

Format of research proposal, Individual research proposal, Institutional proposal, Proposal of a student –a presentation and assessment by a review committee consisting of Guide and external expert only, Other faculty members may attend and give suggestions relevant to topic of research

Reference Books:

1. S. Melville, W. Goddard, "Research Methodology: An introduction for Science & Engineering students", Juta and Company, 1996.
2. R. Kumar, "Research Methodology: A Step by Step Guide for Beginners", Pearson Education, 2nd Edition, 2005.
3. Dr. C. R. Kothari, "Research Methodology: Methods and Techniques", New Age Publication, 2nd Edition, 2010.
4. R. Panneerselvam, "Research Methodology", PHI Learning (2 edition), 2014.
5. S. Gupta, "Research Methodology and Statistical Techniques", Deep and Deep, 2005.
6. N.J. Rajagopalan, "Research Methodology", Depti Civil (Rev. Edition), 1994.

List of Tutorials:

1. Searching a correct/related Research Papers.
2. Reading of Research Paper.
3. Synthesis of Research Paper.
4. Classification of Research Papers based on Types of Research.
5. How to write a Review Paper.
6. How to write a Research based Conference & Journal Paper.
7. Presentation on Research Proposal – Business Case (10 Slides only)

INA 1103 Industrial Internet of Things

Teaching Scheme
Lectures: 3 Hrs/Week

Examination Scheme
In Sem: 50 Marks
End Sem: 50 Marks
Credit: 3

Course Objectives:

1. To study technology compliant to Industry 4.0.
2. To study various connectivity technologies and protocols for IIoT.
3. To study the adaptability of industrial sector to Industry 4.0.

Course Outcomes: Student will be able

1. To understand the structure and components of IIoT
2. To apply suitable connectivity technologies and protocols for different applications
3. To configure IIoT enabled devices using different platforms
4. To discuss actual applications and security used in different sectors in industry

Unit I: Introduction to IIoT **[6 Hrs]**

IoT Basics, Components, Architecture, Interdependencies, Categories, Gateways, Associated Technologies, Challenges, Considerations, Scalability IIoT Business Model, Reference Architecture
Role of Sensors, Actuators and Networks in IIoT.

Unit II: Connectivity Technologies of IIoT **[6 Hrs]**

Connectivity Technologies: Introduction, Features, Working Principle, Addressing, Routing and Applications of 6LoWPAN, RFID, Introduction, Features, Components, Methods, Variants, Communication, Response Models, Message Types and Applications of MQTT, CoAP, XMPP, AMQP or Equivalent**.**

Unit III: Communication Protocols in IIoT **[6 Hrs]**

Introduction, Features, Components, Methods, Variants, Communication, Topologies, Response Models, Message Types and Applications of IEEE802.15.4, Zigbee, HART and Wireless HART, Bluetooth, Zwave, ISA100.11.A, NFC and Equivalent.

Unit IV: Platforms in IIoT **[6 Hrs]**

Definition, Roll, Selection: Scalability, Ease of Use, Third Party Integration, Deployment Option, Data Security, Function of IOT Platform, Types of Platform: Application Enablement and Development, Network, Data and Subscriber Management, Device Management. Using a Web Interface– Programming, APIs / Packages, Arduino Interfaces, Integration of Sensors and Actuators with physical devices lke Arduino/Raspberry Pi.

Unit V: Security in IIoT **[6 Hrs]**

Introduction, Features, Components, Multihop Paths, Challenges of WSN, Detection and Connectivity, Event Aware Topology Management, Information Theoretic Self Management of WSN, Applications, Introduction to Big Data Analytics and Cloud Computing, Data Security, IIoT Privacy, Security and Governance Introduction, Overview of Governance.

Unit VI: Case Study and applications in Industrial Sector **[6 Hrs]**

IOT Applications in Home - Infrastructures, Buildings, Security, Industries, Home Appliances. Applications in Factories, Food Industry, Health Care, Inventory Management and Equivalent.

Text Books:

8. Pethuru Raj and Anupama C. Raman, "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", by CRC Press.
9. Arshdeep Bahga and Vijay Madisetti, "Internet of Things: A Hands-on Approach", Universities Press.
10. Daniel Minoli, "Building the Internet of Things with IPv6 and MIPv6: The Evolving". World of M2M Communications, ISBN: 978-1-118-47347-4, Wiley Publications.

Reference Books:

1. Dieter Uckelmann, Mark Harrison, Florian, "Architecting the Internet of Things", Springer.
2. "The Internet of Things: Key Applications and Protocols", by, Wiley
3. Olivier Hersent, David Boswarthick, Elloumi, Daniel Kellmereit, Daniel Obodovski, "The Silent Intelligence: The Internet of Things", Publisher: Lightning Source Inc; 1st Edition (15 April 2014). ISBN-10: 0989973700, ISBN-13: 978- 0989973700.

INA 1104 Robotic Process Automation

Teaching Scheme
Lectures: 3 Hrs/Week

Examination Scheme
In Sem: 50 Marks
End Sem: 50 Marks
Credit: 3

Course Objectives:

1. To introduce the basic concepts, parts of robots and types of robots.
2. To make the student familiar with the various drive systems for robot, sensors and their applications in robots and programming of robots.
3. To select the robots according to its usage.
4. To select suitable major control components required to automate a process or an activity

Course Outcomes: After the successful completion of this course, the student will be able

1. To explain the basic principles of Robotic technology, configurations, control and programming of Robots.
2. To Design an industrial robot which can meet kinematic and dynamic constraints.
3. To identify potential areas for automation and justify need for automation
4. To identify suitable automation hardware for the given application.

Unit I: Introduction **[6 Hrs]**

Automation and Robotics, Historical Development, Basic Structure of Robots, Robot Anatomy, Classification of Robots, Fundamentals about Robot Technology, Factors related to use Robot Performance, Basic Robot Configurations.

Unit II: Control System in Robotics **[6 Hrs]**

Concepts about Basic Control System, Control Loops of Robotic Systems, Different Types of Controllers -Proportional, Integral, Differential, PID controllers. Sensors in robotics

Unit III: Control Technologies in Automation **[6 Hrs]**

Industrial Control Systems, Process Industries Versus Discrete- Manufacturing Industries, Continuous Versus Discrete Control, Computer Process and its Forms. PLC programming as per IEC61131-3 standard.

Unit IV: Computer Based Industrial Control **[6 Hrs]**

Introduction & Automatic Process Control, Building Blocks of Automation Systems: LAN, Analog & Digital I/O Modules, SCADA Systems & RTU. Distributed Control System: Functional Requirements, Configurations & some popular Distributed Control Systems.

Unit V: Transforms and Kinematics in Robotics **[6 Hrs]**

Forward and inverse kinematics, DH matrix transformation, Jacobian and differential motion, Static and dynamic analysis

Unit VI: Trajectory Planning **[6 Hrs]**

Introduction, General Design Consideration on Trajectories, Joint- interpolated trajectories. Applications of robotics.

Text Books:

1. ‘Process Automation’ by Gary dunning
2. ‘Industrial Process Automation Systems’ by B. R. Mehta, Y. Jaganmohan Reddy
3. ‘Introduction to Industrial Automation’ by Stamatios Manesis, George Nikolakopoulos
4. Robotics, control vision and intelligence - Fu, Lee and Gonzalez. McGraw Hill International, 2nd edition, 2007.
5. Introduction to Robotics - John J. Craig, Addison Wesley
6. M.P.Groover, “Automation, Production Systems and Computer Integrated Manufacturing”, Pearson Education, 5th edition, 2009.
7. Krishna Kant, “Computer Based Process Control”, Prentice Hall of India, 2nd edition, 2010.
8. S.K.Singh, “Computer Aided Process Control”, Prentice Hall of India, 1st edition, 2004.

Reference Books:

1. ‘Process Automation Handbook’ by Jonathan Love
2. ‘Computer Control of Processes’ by M Chidambaram
3. Robotics for Engineers – Yoram Koren, McGraw Hill International, 1st edition, 1985.
4. Industrial Robotics - Groover, Weiss, Nagel, McGraw Hill International, 2nd edition, 2012.
5. Robotic Engineering - An Integrated approach, Klafter, Chmielewski and Negin, PHI, 1st edition, 20

PEINA 1101 A Building Automation System

Teaching Scheme
Lectures: 3 Hrs/week

Examination Scheme
In Sem: 50 Marks
End Sem: 50 Marks
Credit: 3

Prerequisite: Basics of Electrical, Electronics and Instrumentation

Course Objectives :

1. To understand Building automation systems
2. To understand the working of various Building automation components.
3. To learn the Building automation with applications.

Course Outcomes: Student will be

1. Able to understand working of Building Automation System.
2. Able to design Building Automation Systems.
3. Able to implement Building Automation System.

Unit I Fire Alarm Systems **[6 Hrs]**
Introduction, Block diagram of FAS, Fire –Meaning, Fire Development Stages, Fire Sensors & Detectors, Notification appliances, Fire Extinguishers.

Unit I FAS types and Architectures **[6 Hrs]**
FAS Loops, FAS Communication Protocols, Fire Standards, FAS Power Supply Design, Cause & effect matrix.

Unit III Security Systems **[6 Hrs]**
Introduction, Access Control Concept and Components, Communication Protocols, Biometrics Systems.

Unit IV CCTV Systems **[6 Hrs]**
Introduction, CCTV Camera types, Types of CCTV systems, Video Recording and Digital Video Management System.

Unit V HVAC System Parameters **[6 Hrs]**
Basic HVAC Science, HeatTransfer Principles, Psychrometry, HVAC Sensors & Transducers, Valves and Actuators.

Unit VI HVAC Components **[6 Hrs]**
AHU, Water Systems, Refrigeration Cycles.

Text/Reference Books:

1. Robert Gagnon, Design of Special Hazards and Fire Alarm Systems.
2. Damjanovski, Vlado, CCTV, Butterworth-Heinemann , 3rd ed.
3. Benantar M., Access Control System
4. Montgomery R, Fundamentals of HVAC Control Systems , Elsevier Publications

PEINA 1101 B Asset Management System

Teaching Scheme
Lectures: 3 Hrs/Week

Examination Scheme
In Sem: 50 Marks
End Sem: 50 Marks
Credit: 3

Course Objectives:
1. To learn fundamentals of asset management.
2. To learn how to choose appropriate solution for a design and automation.
3. To learn common and latest automation solutions for warehouse.

Course Outcomes: Students will be
1. Able to create an asset storage design and reflect on alternate design methodologies.
2. Able to create data integration workflows
3. Able to evaluate an organization for data warehouse maturity

Unit I: Asset Management Overview **[7 Hrs]**
Types of assets, Characteristics of assets, Asset behaviour, Asset quality, Asset concentration, Asset maturity-income-mix management, Asset management strategies.

Unit II: Related technologies **[7 Hrs]**
Various technologies used for Asset Tracking. For eg: RFID, GPS,....

Unit III: Related software support systems **[7 Hrs]**
Software support systems for asset tracking and management

Unit IV: Reliability **[7 Hrs]**
Reliability concepts related to asset management

Unit V: Applications and Case studies **[8 Hrs]**
Study of various applications and case studies. For eg: ornithology, luggage management, inventory management, applications in process industry

Reference Books:

1. N. A. J. Hastings, "Physical Asset Management", Springer International Publishing Switzerland 2015, 2nd Edition, ISBN: 978-3-319-14777-2.
2. Theresa Regli, "Digital & Marketing Asset Management", Published by Louis Rosenfeld, 1st Edition, ISBN: 1-933820-72-1.
3. Lisa Disselkamp, "Workforce Asset Management Book of Knowledge", Published by Wiley, ISBN: 978-1-118-36757-5.
4. Chris Lloyd, "International Case Studies in Asset Management", Published by ICE Publishing, London, ISBN: 978-0-7277-3653-6.

PEINAI 1101 C Computer Vision

Teaching Scheme **Examination Scheme**

Lectures: 3 Hrs/week

In Semester: 50 Marks
End Semester: 50 Marks
Credit: 3

Prerequisites: Basics of Digital Signal and Digital Image Acquisition

Course Objectives:
1. To learn the fundamental concepts of Digital Image Processing.
2. To study basic image processing operations.
3.To understand image analysis algorithms.
4.To expose students to current applications in the field of digital image processing

Course Outcomes:
1. Develop and implement algorithms for digital image processing.
2. Apply image processing algorithms for practical object recognition applications
3.To apply concepts of Digital image processing for advanced systems.
4. To apply various image enhancement techniques for real time applications.

UNIT I: Fundamentals of Digital Image Fundamentals [6 Hrs]
Digital image representation, Color image models,Various Image Format, Sampling and quantization, Relationship between pixels, Statistical parameters

UNIT II: Image Enhancement [6 Hrs]
Enhancement by point processing, spatial filtering, enhancement in the frequency domain. Contrast intensification: linear stretching, nonlinear stretching, histogram specification, Smoothing

UNIT III: Image Transforms [6 Hrs]
Basic transformations, Perspective transformation, 2-D Transforms: Fourier transform, Discrete cosine transform, Short time Fourier transform, Gabor transform, Radon transform, SVD, Wavelet Transforms, Hough Transform, Watershed Transform

UNIT VI: Image segmentation and Image Compression [6 Hrs]

Segmentation: detection of discontinuities, edge linking and boundary detection, thresholding, region oriented segmentation Representation and description: Representation schemes, descriptors, regional descriptors.

UNIT V: **Object Recognition [6 Hrs]**
Feature extraction, Patterns and Pattern Classes, Representation of Pattern classes, Types of classification algorithms.

UNIT VI: Image data compression [6 Hrs]
Arithmetic coding, Huffman coding, LZW coding, RLE, Bit plane coding,compression predictive coding Lossy compression : JPEG, Subband coding, Vector quantization, Image compression standard, Fidelity criteria

Text Books:

1. Gonzalez and Woods, Digital Image Processing with Matlab, Pearson Education,

2. Arthur Weeks Jr., Fundamentals of Digital Image Processing, Prentice-Hall International.
3. W. Pratt, Digital Image Processing, Wiley Publication, Fourth Edition, 2013.

Reference Books:

1. Madhuri Joshi, Digital Image Processing, Prentice-Hall International.
2. A.K. Jain, Fundamentals of Digital Image Processing, Prentice Hall of India.
3. K. R. Castleman, Digital Image Processing, Prentice-Hall International.
4. Pratt William, Digital Image Processing, John Wiley & Sons

INA 1105 Industrial Internet of Things Lab

Teaching Scheme
Lab: 2 Hrs/Week

Examination Scheme
In Sem: 25 Marks
Credit: 1

Course Objectives:

1. To study technology compliant to Industry 4.0.
2. To study various connectivity technologies and protocols for IIoT.
3. To study the adaptability of industrial sector to Industry 4.0.

Course Outcomes: Student will be able

1. To implement IoT connectivity to basic devices
2. To develop their own application based on IIoT
3. To comment on hardware, software and components in an application

List of Experiments:

Any 4 Practicals from 1-5 on Raspberry Pi / Arduino Board

1. Manipulating status of given output device.
2. Interfacing of any sensor.
3. Reading and displaying Analogue input voltage.
4. LED intensity variation depending upon potentiometer variation.
5. Speed variation of dc motor.

Any one application like

1. Interfacing of Raspberry Pi &/ Arduino Board with computer using any protocol.
2. Interfacing of sensor and sending data to mobile as SMS or to computer.
3. Wireless communication between two boards.
4. Sending sensor data to google sheets or any spread sheet. etc

Study, documentation, hardware and software design and component identification for any application in industrial sector as case study

INA 1106: Robotic Process Automation Lab

Teaching Scheme

Examination Scheme

Lab: 2 Hrs/Week | Practical: 25 Marks
Credit: 1

Course Objectives:

1. To study different automation tools like PLC, SCADA and DCS.
2. To study the sensors and control systems related to robotics
3. To understand the mathematical analysis of motion control of a robot.

Course Outcomes: By the end of the course, students should be able to

1. Develop PLC programs for various applications using different PLC instructions
2. Use DCS system for developing control loops
3. Develop HMI for any loop using SCADA
4. Simulate the motion analysis and control equations related to robotics

List of Experiments:

1. Develop & implement any PLC program as per IEC61131-3 standard.
2. Interfacing of PLC to any SCADA.
3. Developing and implementing any control loop using PLC system.
4. Developing and implementing any control loop using DCS system
5. Developing and configuring Graphic User Interface for any control loop.
6. Configure and implement different alarms in PLC and/or DCS system.
7. Velocity and position measurement using optical encoder
8. Simulation of forward kinematics and inverse kinematics
9. Simulation of trajectory path

PEINA 1102 A Building Automation System Lab

Teaching Scheme | **Examination Scheme**
Lab: 2 Hrs/Week | Oral: 25 Marks

Credit: 1

Course Objectives:

1. To understand Building automation systems.
2. To understand the working of various Building automation components.
3. To learn the Building automation with applications.

Course Outcomes: Student will be

1. Able to understand working of Building Automation System.
2. Able to design Building Automation Systems.
3. Able to implement Building Automation System.

List of Experiments :

Students are expected to perform minimum eight experiments from the above syllabus.
The tentative list of experiments: (not limited to this list only):

1. To study Architecture of BMS & IBMS
2. To study FAS systems and components
3. To study SLC wiring and loops classifications
4. To study cause and effect matrix-Fire alarm system
5. To study Access Control System Architecture and components.
6. To study CCTV System Architecture and types of cameras
7. To study Psychometric chart and various parameters
8. To study different types of Air Handling Units
9. To study various terminal unit systems (CAV, VAV)
10. To study Chilled Water System and loops
11. To study Hot Water System and loops
12. Case study of FAS system.
13. Case study of CCTV system.
14. Case study of Access Control System.
15. Case study of HAVC system.

PEINA 1102 B Asset Management System Lab

Teaching Scheme
Lab: 2 Hrs/Week

Examination Scheme
Oral: 25 Marks

Credit: 1

Course Objectives:

1. To learn fundamentals of asset management.
2. To learn why asset management is required for the organization.
3. To learn how asset management is carried out in various domains.

Course Outcomes:

1. Able to study and suggest alternate design methodologies.
2. Able to create data integration workflows
3. Able to evaluate an organization for area for improvement as per the asset management.

List of Experiments:

1. Study and characterization of RFID sensor
2. Application based on RFID interface
3. Application based on RFID interface
4. Study and characterization of RFID sensor
5. Study and characterization of GPS sensor
6. Application based on GPS interface
7. Application based on GPS interface
8. Case study on Asset Tracking and Management
9. Case study on Asset Tracking and Management

PEINA 1102 C Computer Vision Lab

Teaching Scheme
Lab: 2 Hrs/Week

Examination Scheme
Oral: 25 Marks
Credit: 1

Course Objectives:

1. To learn the fundamental concepts of Digital Image Processing.
2. To study basic image processing operations.
3. To understand image analysis algorithms.
4. To expose students to current applications in the field of digital image processing

Course Outcomes:

1. Develop and implement algorithms for digital image processing.
2. Apply image processing algorithms for practical object recognition applications
3. To apply concepts of Digital image processing for advanced systems.
4. To apply various image enhancement techniques for real time applications.

List of Experiments:

Students are expected to perform Minimum Eight Experiments
1. Study of various image formats and their handling in Matlab.
2. study of Image Enhancement techniques:
3.Arithmetic operations on image.
4. Gray level transformations such as contrast stretching, negative, power law transformation etc.
2. Study of statistical properties mean, standard deviation, variance, etc.
5. Spatial Domain filtering- smoothing & sharpening filters.
6. Frequency domain filtering, DFT/IDFT of given image.
7. DCT/IDCT of given image.
8. Edge detection using Sobel, Prewitt and Roberts operators.
9. Image Compression Using any method.
10. Case Study Digital Imaging Device.

Case Study on the following applications:

Applications of Digital watermarking, Biometric authentication (face, finger print, signature image processing recognition), Vehicle number plate detection and recognition, Content Based Image Retrieval, Text Compression.

An Autonomous Programme Structure of
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Specialization: Automation
(AY: 2019-2020)
SEMESTER II

INA 1201 Computer Organization

Teaching Scheme
Lecture: 3 Hrs/Week

Examination Scheme
In sem: 25 Marks
End sem: 50 Marks
Credit: 3

Prerequisite: Basic computer skills and logic development skills

Course Objectives:

1. To provide better understanding of functions of different operating systems
2. To provide knowledge of software testing and communication protocols
3. To understand the software development life cycle

Course Outcomes: Students will be able to

1. To explain the operating system functions in detail.
2. To differentiate real time operating system and operating system.
3. To evaluate the performance of any developed software.
4. To use the proper communication channel and software for transforming and storing the data

Unit I: Operating System Overview [6 Hrs]

Concepts of Operating System and its services, Types of operating systems Process Management: Concept, scheduling, operations on process CPU scheduling: Basic concepts, CPU scheduling algorithms Deadlocks: Characterization, Handling, Recovery Disk scheduling algorithms

Unit II: Memory and File Management [8 Hrs]

Memory Management: Address Binding, Overlays, Swapping, Contiguous memory allocation, Paging, Segmentation

Virtual memory: Concept, Demand paging, Prepaging, Page size considerations, Page replacement algorithms, Thrashing

File system management: Concept, file access methods, directory structures, file allocation methods

Unit III: RTOS, Parallel Computers [6 Hrs]

Real Time & embedded System OS: Concepts, Types, their differences, Handheld Operating Systems.

Parallel Computers: Basic concepts, Types of parallelism, Classification of Parallel Systems, Flynn's Taxonomy, Array Processors, Clusters, and NUMA Computers.

Multiprocessor Systems : Structure & Interconnection Networks,Multi-Core Computers: Introduction, Organization and Performance.

Unit IV: Computer Communication [6 Hrs]

Computer Communication: ISO-OSI Seven Layer model, The TCP/IP reference model Introduction to LAN, LAN topologies, IEEE standards for networking- IEEE 802.3, IEEE 802.4, IEEE 802.5, Circuit switching and Packet switching networks, Features and capabilities of TCP/IP, Industrial Ethernet, Introduction to IEEE 1394, its configuration and advantages.

Unit : Database management System [4 Hrs]

Introduction to DBMS, Disadvantages of File Processing System, characteristics of DBMS Data Model, SQL Programing.

Unit VI: Software Testing [6 Hrs]

Software Development Life Cycle and its models: a. Linear Sequential b. Rapid development c. Incremental d. Component based Software Analysis, Software Design, Software Implementation

Software Testing: fundamentals, white box, black box testing, control structure testing, specific environment testing, comparison testing, orthogonal testing, strategic approach to testing, unit testing, integrated testing, validation testing, system testing, CASE tools
Software debugging: Standard guidelines, debugging techniques- use of break points, test macros, output files for sampled inputs, instruction set simulation, laboratory tools
Software maintenance: Preventive, Corrective, Adaptive, Enhancement, System Re-engineering

Text Books:

1. Operating System Concepts by Silberschatz, Galvin, Gagne
2. Parallel Computer architecture and programming by V. Rajaraman, C. SivaRam Murthy, PHI
3. Computer Networks by Andrew Tanenbaum, Prentice Hall.
4. Introduction To Data Compression by Khalid Sayood, Morgan Kaufmann Publishers, Inc.
5. Software Engineering by Ian Somerville, 4th edition, Addison Wesley publication

Reference Books:

1. Computer Architecture and Parallel processing by Kai Hwang, Faye Briggs, McGraw Hill International Editions
2. Computer Networks Protocols, Standards and Interfaces by Uyless Black, PHI
3. High Speed Networks TCP/IP and ATM design principles by William Stallings.
4. Software Engineering, A practitioner's Approach, 6th edition, McGraw Hill International Editions

INA 1202 Manufacturing Execution Systems

Teaching Scheme	**Examination Scheme**
Lecture: 3 Hrs/Week	In Sem: 50 Marks
Tutorial: 1 Hr/Week	End Sem: 50 Marks

Credit: 4

Course Objectives:

1. To learn basics of MES and Technologies.
2. To learn how to implement MES in Production Systems.
3. To study various Applications and Case Studies of MES.

Course Outcomes: After having the course, students are expected to

1. Understand what and why MES in modern production systems
2. Setup, analysis, and giving possible application of MES
3. Know the connection of function within production systems to MES

Unit I: Introduction **[6 Hrs]**

Historical Development of Manufacturing Execution Systems. Definition of Terms. Shortfalls of Existing Architectures and Solutions. Demands of Future Production Management Systems

Unit II: Concept and Technologies **[6 Hrs]**

Commonalities between Existing Approaches and MES, Norm & Guidelines, Recommendations, Adjacent Areas, Product Lifecycle Management, Production Flow-Oriented Design: Cross-System Cohesiveness. Data Model for Product Definition, Data Model for Resource Management, System and Auxiliary Data, Order Fulfillment Data.

Unit III: Core Function – Production Flow – Oriented Planning **[6 Hrs]**

Integration within Overall Process, Order Data Management, Supply Management within the MES, The Planning Process, The Importance of The Control Station, Personnel Planning and Release of Orders, Order Processing: General Information on Order Processing, Order Preparation and Setup, Order Control, Performance Data, Maintenance Management.

Unit IV: Software Architecture and IT Systems **[6 Hrs]**

Software Architecture, Database, Interface with Other IT Systems, User Interfaces, Evaluation of Cost Effectiveness of MES: General Information on cost-Effectiveness, General Information on Evaluation, The Benefits of an MES, The Cost of an MES.

Unit V: Implementing an MES in Production **[6 Hrs]**

Implementing IT Systems in General, Preparation of Implementing Project, Analysis of the Actual Situation, Creation of a Project Plan, Contract Specifications, Selection of a Suitable System, Implementation Process.

Unit VI: Applications & Case Studies **[6 Hrs]**

Merging the Systems, The MES as a Medium of Product-Development Management, Standardization of Function Modules, Merging Consultancy Activities and IT Systems, Application and case studies.

Reference Books:

1. Heiko Meyer, Franz Fuchs, Klaus Thiel, “Manufacturing Execution Systems”, McGraw-Hill, 2009.

2. Heiko Meyer, Franz Fuchs, Klaus Thiel, “Manufacturing Execution Systems (MES): Optimal Design, Planning, and Deployment”, McGraw-Hill, 2009.

List of Tutorials:

1. Concepts and Technologies: Norms and Guidelines
2. Supply Management within the MES
3. Interaction between the ERP System and the MES
4. Software Architecture in MES
5. Data Management and Archiving
6. Evaluation of the Cost-Effectiveness of MES
7. Implementing an MES in Production
8. Examples for Application (Case studies)

INA 1203 Advanced Control Systems

Teaching Scheme
Lectures: 3 Hrs/week

Examination Scheme
In Sem: 50 Marks

End Sem: 50 Marks
Credit: 3

Prerequisite: Basics of Electrical, Electronics and Instrumentation

Course Objectives :

1. To understand Advanced Control Concepts
2. To understand the desigining of Advanced Control algorithms
3. To learn the Advanced Control Systems with applications.

Course Outcomes: Student will be

1. Able to understand various Control Strategies.
2. Able to design and Implement Advanced Control Strategies.
3. Able to choose appropriate Control for various Applications.

Unit I: Stability Analysis **[6 Hrs]**

Time domain and Frequency domain analysis, Controller Tuning.

Unit II: Special Control Techniques **[6 Hrs]**

Control loops and Control Techniques

Unit III: Multivariable Control Analysis **[6 Hrs]**

Introduction to state -space methods, Control degrees of freedom analysis and analysis, Interaction, Bristol arrays, Tuning of multivariable controllers.

Unit IV: Advanced Control Techniques/Strategies **[6 Hrs]**

Sliding Mode Control, Adaptive Control, Model Predictive Controller, Multi Loop Control.

Unit V: Control Loops **[6 Hrs]**

Development of control loops, Instrumentation scheme for various Industrial Units like Boiler, Heat Exchanger, Evaporator, etc.

Unit VI: Fuzzy Logic and Neural Networks in Control applications **[6 Hrs]**

Design of controller(PI-PID, etc) based on fuzzy logic and neural networks,
Introduction to statistical process control, Case studies.

Text Books:

1.Process Control, F. G. Shinskey, McGraw Hill Book Company.
2.Process, Modeling, Simulation and Control for Chemical Engineers, W. L. Luyben, McGraw Hill.
3.Process Control Modeling, Design, and Simulation, B. W. Bequette, PHI

Reference Books:

1.Process Control, Bela G Liptak, CRC Press, 2005
2.Chemical Process Control, Stephanopoulos George, PH

INA 1204 Artificial Intelligence & Machine Learning

Teaching Scheme
Lectures: 3 Hrs/week

Examination Scheme
In-Sem: 50 marks
End-Sem: 50 marks

Credit: 3

Prerequisite: Concepts of Mathematics and Computational techniques

Course Objectives:
1. To explore the statistical analysis techniques for various kinds of data.
2. To understand the concepts and types of Artificial Intelligence and Machine Learning Algorithms.
3. To be familiar with a set of well-known supervised, semi-supervised and unsupervised learning algorithms.

Course Outcomes: The students will be able to
1. Formalize a given problem in the different AI methods.
2. Implement basic AI algorithms.
3. Evalutae decision tree learning algorithms.
4. Analyze research based problems using Machine Learning Techniques.

Unit I: Fundamentals of Artificial Intelligence [7 Hrs]
Unit 1: Introduction, A.I. Representation, Non-AI & AI Techniques, Representation of Knowledge, Knowledge Base Systems, State Space Search, Production Systems, Problem Characteristics, types of production systems.

Unit II: Searching [7 Hrs]
Depth First Search, Breadth First Search, Generate & test, Hill Climbing, Best First Search, A* and AO* Algorithm.

Unit III: Planning [7 Hrs]
Blocks world, STRIPS, Implementation using goal stack, Continuous Planning Machine Learning Algorithms.

Unit IV: Knowledge Representation [7 Hrs]
Knowledge based agents, Propositional Logic: Representation, Inference, Reasoning Patterns, Resolution, First order Logic,Basics of PROLOG.

Unit V: Machine Learning [7 Hrs]
Types of Learning: Supervised, Unsupervised, Reinforcement.
Learning System:Well posed learning problem, Designing a learning system, Issues in machine learning. Hypothesis, Target Function, Cost Function, Gradient, Training, Testing, Cross-validation, Evaluating hypothesis accuracy.

Unit VI: Algorithms [7Hrs]
SVM: Kernel functions, Linear SVM, Nonlinear SVM. Hidden Markov model, Genetic algorithm, Regression analysis, Multivariable regression Clustering Algorithm and recurrent Networks: k-means algorithm, k-nearest neighbor learning, weighted majority algorithm, Principal component Analysis (PCA), Collaborative Filtering.

Text Books:

1. Elaine Rich and Kevin Knight: "Artificial Intelligence." Tata McGraw Hil
2. Stuart Russell & Peter Norvig : "Artificial Intelligence : A Modern Approach", Pearson Education, 2nd Edition.
3. T. Mitchell, Machine Learning,", McGraw-Hill, 1997.
4. Anup Kumar Srivastava, Soft Computing, Alpha Science International limited. 2009.

Reference Books:

1. Ethem Alpaydin, "Introduction to Machine Learning", MIT press, 2004.
2. Jacek M. Zurada, “Introduction to Artificial neural System”, JAICO publishing house,2002,

PEINA 1201 A Power Generation and Management

Teaching Scheme
Lectures: 3 Hrs/Week

Examination Scheme
In Sem: 50 Marks
End Sem: 50 Marks

Credit: 3

Course Objectives:

1. To understand the need and sources of energy generation.
2. To study the power generation schemes based on renewable energy sources.
3. To identify potential uses and opportunities of various energy generation methods.
4. To understand the importance and need of energy audit.

Course Outcomes: Student will be able to

1. Understand the energy demand scenario in terms of growth and supply.
2. Get knowledge of various power generation methods and its applicability for the society.
3. Identify, analyse and compare different types of power generation methods.
4. To apply the knowledge of energy audit for managing energy.

Unit I: Introduction [4 Hrs]

Energy Demand - Growth and Supply, Historical Perspectives, Fossil Fuels: Consumption and Reserve. Environmental Impacts of Burning of Fossil Fuels, Sustainable Development and Role of Renewable Energy Sources. Sources of Electrical Power - Wind, Solar, Tidal, Geo-thermal, Hydro-electric, Thermal-Steam, Nuclear Power Plants (block diagram approach only).

Unit II: Nuclear Power Plant [6 Hrs]

Introduction, Pros and Cons of Nuclear Power Generation, Selection of Site, Cost, Components of Reactors, Description of Fuel Sources, Safety of Nuclear Power Reactor, Nuclear Waste & Its Disposal, Types of Nuclear Waste, Effects of Nuclear Radiation, Radioactive Waste Disposal System, Gas Disposal System. Safety Rules: Personal Monitoring, Radiation Protection (Radiation Workers, Non-Radiation Workers, Public at large), Radiation Dose (Early effect, Late effect, hereditary effect)

Unit III: Hydro & Thermal Power Generation [6 Hrs]

Hydro Power Generation: Selection of site. Classification of Hydro-electric Plants. General Arrangement and Operation. Hydroelectric Plant Power Station Structure and Control.
Thermal Power Generation: Introduction, Main parts of a Thermal Power Plant, Working, Plant Layout.

Unit IV: Solar Energy [7 Hrs]

Sun as Energy Source and its movement in the sky, Solar Energy received on the Earth, Primary and Secondary Solar Energy. Solar Concentrators and Tracking, Dish and Parabolic trough Concentrating Generating Systems, Central Tower Solar Thermal Power Plants, Solar Ponds, Basic Principle of Power Generation in a PV cell, Band Gap and efficiency of PV Cells, Application of PV, Brief Outline of Solar PV Stand-alone System Design, Storage and Balance of System.

Unit V: Wind Power Generation [6 Hrs]

Types of Turbines, Coefficient of Power, Betz Limit, Wind Electric Generators, Power Curve, Wind Characteristics and Site Selection, Wind Farms for Bulk Power Supply to Grid, Potential of Wind Electricity Generation in India and its current growth rate.

Unit VI: Energy Management Audit **[6 Hrs]**

Definition, Energy Audit- need, Types of Energy Audit, Energy Management (audit) approach-understanding energy costs, Bench Marking, Energy Performance, Matching Energy use to Requirement, Maximizing System Efficiencies, Optimizing the Input Energy Requirements, Fuel and Energy Substitution, Energy Audit Instruments,

Text Books:

1. John W. Twidell & Anthony D.Weir, "Renewable Energy Resources".

2. Geofrey Boyle, "Renewable Energy: Power for a Sustainable Future", OUP in assn with Open University, 1996.

3. B. H. Khan: Non-Conventional Energy Sources

Reference Books:

1. Renewable Sources of Energy and Conversion Systems: N.K.Bansal and M.K.Kleeman.
2. Principles of Thermal Process: Duffie -Beckman.
3. Solar Energy Handbook: Kreith and Kreider (McGrawHill)
4. Solar Cell: Marteen A. Green

PEINA 1201 B Vehicle Intelligence

Teaching Scheme

Lectures: 3 Hrs/Week

Examination Scheme

In Sem: 50 Marks

End Sem: 50 Marks

Credit: 3

Course Objectives:

1. To develop advanced skills to critically analyse and solve problems in vehicles.
2. To be able to evaluate Vehicle Intelligence requirements.
3. To be able to identify potential users and opportunities for intelligent vehicles.

Course Outcomes: Student will have

1. Comprehensive fundamental and technical knowledge sensors/transducers used in vehicle intelligence.
2. Ability to understand analyse and use various SI and CI management systems.
3. Ability to use On Board Diagnostics.

Unit I: Fundamentals [4 Hrs]

Automotive Electric Systems, Batteries, Alternator, Starter Motor, Ignition System, Headlamps, Horns, Wiper Motor etc.

Unit II: Sensors and Actuators [8 Hrs]

sensors for speed, pressure, crank shaft position, cam position, Mass Air Flow Rate (MAF), Throttle position, Oxygen Concentration. Various types of actuaters for vehicle

Unit III: Electronic Ignition System [6 Hrs]

Power Train, SI Engine Management, Layout Components of SI CI Systems, Throttle Body, MPFI, Principle of Operation of ignition systems, Contact Less Electronic Ignition Systems, Electronic Spark Timing Control.

Unit IV: CI Engine Management [6 Hrs]

Fuel Injection System, Parameters Affecting Combustion, Noise and Emission in CI Engines, Electronically Controlled Unit Injection System, Layout of the Common Rail Fuel Injection System, Working of Components like Fuel Injector, Fuel Pump, Rail Pressure Limiter, Flow Limiter.

Unit V: On Board Diagnostics and Efficiency Monitoring [6 Hrs]

Indian Scenario Transmission Systems: OBDI, Chassis Control System, ABS, Active Suspension System. Battery condition monitoring system, Tyre pressure monitoring system, vehicle lighting and control, Parking assistant system, Test-bench instrumentation for Vehicle-Performance Analysis.

Unit VI: Recent Trends in Vehicles and Automation [6 Hrs]

E-call system, Curse control system, Lane departure warning system, overtake assist system, Infotainment system, Autonomous vehicle systems, Self-navigating system, safety systems, Automatic parking system. Electric vehicles, Hybrid vehicles

Text Books:

1. C. P. Nakra, “Basic Automotive Electrical Systems”, Dhanpat Rai Publications 33.
2. A. W. Judge, “Modern Electrical Equipments”.
3. P. L. Kohali, “Automotive Electrical Equipments”, TMH
4. N. R. Khatawale, “Automotive Electrical Auxiliary Systems”.

Reference Books:

1. Young and Griffith, “Automotive Electrical Systems”, Butterworth Pub.
2. William H. Grouse, “Automotive Mechanics”, TMH.
3. Morris Mano, “Digital Logic and Computer Design”, Prentice Hall.

PEINA 1201 C System Modeling and Simulation

Teaching Scheme
Lectures: 3 Hrs/Week

Examination Scheme
In Sem: 50 Marks
End Sem: 50 Marks
Credit: 3

Course Objectives:

1. Introduces the methods of model building skills.
2. Introduces the techniques of model building skills.
3. Use of the SIMULINK package for dynamic modelling.

Course Outcomes: Student will be able

1. To develop an ability to build effective first principles dynamic models.
2. To develop Process Plant Models for analysis and control system design purposes.
3. Understand how models of processes are developed and so can concentrate on using them.

Unit I: Introduction **[7 Hrs]**

Purpose, Uses and Benefits of System Modelling, Types of Model, Physical Equations of Systems: Algebraic and Differential, Constraint Equations: Equality and Inequality, Time Domain Solutions: Steady State and Dynamic.

Unit II: Modelling Techniques **[7 Hrs]**

Formation of Lumped Parameter Models, Classical Assumptions, Analogies with Electrical and Mechanical Systems, Significance of Capacity for Energy Storage, Absolute and Deviation Variables, Linearization, Laplace Transformations, Conversion into Transfer Function Models. Translation into Block Diagrams.

Unit III: System Models **[7 Hrs]**

Modelling of Control Loop Elements, Integration of Process and Control Models, System Block Diagrams, Validation of Models, Zero Capacity Systems, Hydrodynamic and Electromechanical Models,, State Space Modelling of Multivariable Systems,

Unit IV: Process Models **[7 Hrs]**

Dynamic Models of a plant components Models of a variety of plant operations

Unit V: Simulation **[7 Hrs]**

Simulation of Linear & Non-linear Dynamic Systems, Selection of Numerical Integration Routines, Choice of Step Length & Run Time, Setting up Initial and Boundary Conditions, Applying Forcing Functions and Disturbances, Use of Discrete Event Simulation Languages (e.g. Stateflow), Documentation & Flow Charts, Interpretation of Error Messages & Debugging, Functional Testing and Validation.

Reference Books:

1. Dabney J B & Harman T L, “The Student Edition of Simulink (Version 2) User’s Guide”, Prentice Hall, 1998.
2. Hanselman D & Littlefield B, “The Student Edition of Matlab (Version 5) User’s Guide”, Prentice Hall, 1997.
3. Love J, “Process Automation Handbook”, Springer, 2007.

4. Roffel B & Betlem B, “Process Dynamics and Control”, John Wiley & Sons, 2006.
5. Seborg D, Edgar T, Mellichamp, D and Doyle F, “Process Dynamics and Control”, 3rd Edition, Wiley, 2011.
6. Wilkie, J, Johnson M and Katebi R, “Control Engineering: An Introductory Course”, McMillan (Palgrave), 2002.

INA 1205 Advanced Control Systems Lab

Teaching Scheme
Lab: 2 Hrs/Week

Examination Scheme
Practical: 25 Marks
Credit: 1

Course Objectives:

1. To understand Advanced Control Concepts
2. To understand the designing of Advanced Control algorithms
3. To learn the Advanced Control Systems with applications.

Course Outcomes: Student will be

1. Understand various Control Strategies.
2. Able to Design and Implement Advanced Control Strategies.
3. Able to choose appropriate Control for various Applications.

List of Experiments:

1. Identify and obtain the model of the given system.
2. Analyze the given system in time domain and determine the time domain specifications of the same.
3. Analyze the given system in frequency domain and determine the frequency domain specifications of the same.
4. Design a controller for a multivariable system.
5. Implement model predictive controller for a typical process on simulation platform.
6. Implement sliding mode controller for a typical process on simulation platform.
7. Implement Neural network based (PID) controller for a typical process on simulation platform.
8. Implement Fuzzy logic (PID) controller for a typical process on simulation platform.

INA 1206: Artificial Intelligence and Machine Learning Lab

Teaching Scheme	**Examination Scheme**
Lab: 2 Hrs/Week	Oral: 25 Marks
	Credit: 1

Course Objectives:

1. To explore the statistical analysis techniques for various kinds of data.

2. To understand the concepts & types of Artificial Intelligence & Machine Learning Algorithms.
3. To be familiar with a set of well-known supervised, semi-supervised and unsupervised learning algorithms.

Course Outcomes: The students will be able to

1. Formalize a given problem in the different AI methods.
2. Implement basic AI algorithms.
3. Evaluate decision tree learning algorithms.
4. Analyse research based problems using Machine Learning Techniques.

List of Experiments:

1. Analysis of AI and Non-AI technique by implementing any two player game.
2. Implementation of Expert system in PROLOG.
3. Implementation of any real time problem using PROLOG.
4. Implement the Back Propagation Algorithm on a dataset obtained from UCI ML repository.
5. Implement Support Vector Machine algorithms on a dataset.
6. Implement Genetic algorithm algorithms on a dataset.
7. Implement K-means algorithms on a dataset.
8. Implement PCA algorithms on a dataset.

PEINA 1202 A Power Generation and Management Lab

Teaching Scheme
Lab: 2 Hrs/Week

Examination Scheme
In Sem: 25 Marks
Credit: 1

Course Objectives:

1. To understand the need and sources of energy generation.
2. To study the power generation schemes based on renewable energy sources.
3. To identify potential uses and opportunities of various energy generation methods.

4. To understand the importance and need of energy audit.

Course Outcomes: Student will be able to

1. Understand the energy demand scenario in terms of growth and supply.
2. Get knowledge of various power generation methods and its applicability for the society.
3. Identify, analyse and compare different types of power generation methods.
4. To apply the knowledge of energy audit for managing energy.

List of Experiments:

1. Case study of Solar Power Plant
2. Case study of Hydro Power Plant
3. Case study of Thermal Power Plant
4. Case study of Wind Power Plant
5. Case study of Nuclear Power Plant
6. Visit to any one Power Plant
7. Study of Energy Audit Instruments and Procedure

PEINA 1201 B Vehicle Intelligence

Teaching Scheme **Examination Scheme**

Lectures: 3 Hrs/Week

In Sem: 50 Marks
End Sem: 50 Marks
Credit: 3

Course Objectives:
1. To develop experimentation skills in vehicles.
2. To be able to evaluate Vehicle Intelligence requirements.
3. To be able to understand advanced systems in vehicles.

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Course Outcomes: Student will have
1. Comprehensive fundamental and technical knowledge sensors/transducers used in vehicle intelligence.
2. Ability to understand and analyse instrumentation system for vehicle
3. Ability to design or modify an instrumentation system for vehicle.

List of Experiments:
lab./ assignments on the syllabus
1. Non contact speed measurements for petrol engine.
2. Specific fuel consumption of vehicle(average as km/lit.of fuel)
3. pressure controlled air filling system for tyre
4. Max. Acceleration measurement
5. Breaking distance measurement.
6. Max. Speed detection for vehicle.
7. Battery monitoring system
8. Lamp failure detection.
9. Anti- pinch control for windshield

PEINA 1202 C System Modeling and Simulation Lab

Teaching Scheme
Lab: 2 Hrs/Week

Examination Scheme
In Sem: 25 Marks

Credit: 1

Course Objectives:

1. Introduces the methods of model building skills.
2. Introduces the techniques of model building skills.
3. Use of the SIMULINK package for dynamic modelling.

Course Outcomes: Student will be able

1. To develop an ability to build effective first principles dynamic models.
2. To develop Process Plant Models for analysis and control system design purposes.
3. Understand how models of processes are developed and so can concentrate on using them.

List of Experiments: Experiments can be performed using MATLAB, Simulink & State Flow

1. Transfer Function based system formation using MATLAB.
2. Response of the System to any given Input using MATLAB.
3. System formation using Simulink.
4. Response of System to given Input using Simulink.
5. Comparison of System Response by Parameter Tuning in Simulink.
6. Stirrer Tank or any other Process Model Formation in Simulink.

Any three experiments based on State Flow Language.

An Autonomous Programme Structure of

M. Tech. Instrumentation and Control Engineering

Specialization: Automation

(AY: 2019-2020)

SEMESTER III

PEINA 2101 A Safety and Automation Systems

Teaching Scheme	**Examination Scheme**
Lecture: 3 Hrs/Week	In Sem: 50 Marks

End Sem: 50 Marks
Credit: 3

Course Objectives:

1. To make the students aware of basic concepts of safety instrumented system,
2. To make the students aware of standards
3. To make the students aware of risk analysis techniques.

Course Outcomes: The student will be able to

1. Differentiate between process control and safety control and identify the role of safety instrumented system in the industry.
2. Identify and analyse the process hazards.
3. Select the Safety integrity level.
4. Analyze the performance of different logic system technologies and field devices with optimum risk levels.

Unit I: Introduction **[6 Hrs]**

Safety Instrumented System (SIS) - need, features, components, difference between basic process control system and SIS, Risk: how to measure risk, risk tolerance, Safety integrity level, safety instrumented functions, review of Standards and Regulations related to Safety,

Unit II: Safety Life Cycle **[6 Hrs]**

Hazard and risk analysis, allocation of safety functions to protective layers, develop safety requirements specification, SIS design & engineering, installation commissioning and validation, operations and maintenance, modifications, decommissioning.

Unit III: Determining the Safety Integrity Level (SIL) **[6 Hrs]**

Evaluating Risk, Safety Integrity Levels, SIL Determination Method: As Low As Reasonably Practical (ALARP), Risk matrix, Risk Graph, Layers of Protection Analysis (LOPA)

Unit IV: Technology Selection **[6 Hrs]**

Covers the safety requirements specification (SRS) and the pros and cons of pneumatic, relay and microprocessor logic systems, PLC systems for safety system development. Issues Relating to Field Devices: importance of field devices: impact of field devices such as sensors, final elements on system performance.

Unit V: Reliability of SIS **[6 Hrs]**

Covers reliability issues and helps make sense of the minimum hardware fault tolerance requirement, Likelihood analysis: estimation and statistical analysis, fault propagation, event tree analysis and fault tree analysis, Quantitative layer of protection analysis: multiple initiating events, estimating initiating event frequencies and IPL failure probabilities

Unit VI: Case Study **[6 Hrs]**

The safety life cycle and its importance, furnace/fired heater safety shutdown system, scope of analysis, define target SILs, develop safety requirement specification (SRS), SIS conceptual design, lifecycle cost analysis, verification of SIL satisfaction, detailed design, installation, commissioning and pre-start-up tests, operation and maintenance procedures.

Reference Books:

1. Paul Gruhn and H Jarry L. Cheddie, “Safety Instrumented systems: Design, Analysis and Justification”, ISA, 2nd edition, 2006.
2. Dr. Eric W Scharpf, Heidi J Hartmann, Harlod W Thomas, “Practical SIL target selection: Risk Analysis per the IEC 61511 Safety Lifecycle”, exida, 2012.
3. Ed Marszal, Eric W Scharpf, “Safety Integrity Level Selection”, ISA.

PEINA 2101 B Quality Assessment and Testing

Teaching Scheme
Lecture: 3 Hrs/Week

Examination Scheme
In Sem: 50 Marks
End Sem: 50 Marks
Credit: 3

Pre-requisites:
Knowledge of basic statistics

Course Objectives:
1. To know scope of application in manufacturing and services, including public and service sectors.
2. To get knowledge of different methodologies, tools and techniques proposed for product and process improvement.

Course Outcomes:

1. Explain the different meaning of quality concept and its influence.

2. Understand quality control and improvement method.
3. Able to do design and analysis of experiment (DOE).
4. They are able to apply knowledge of six sigma, quality audit for quality assessment and testing.

Unit I: **[6 Hrs]**
Concepts of product and service quality. Dimensions of quality. Deming's, Juran's, Crosby's quality philosophy. Quality Cost

Unit II: **[6 Hrs]**
Process quality improvement-Introduction to process quality. Graphical and statistical techniques for process quality improvement. Graphical tools for data representation. 7 QC tools.

Unit III: **[6 Hrs]**
Process capability analysis. Measurement system analysis. Design and analysis of experiment (DOE).

Unit IV: **[6 Hrs]**
Acceptance sampling plan. Total quality management-TQM
Lean and JIT Quality Philosophy, Benchmarking,

Unit V: **[6 Hrs]**
Process failure mode and effect analysis (PFMEA), Service Quality, Six sigma. ISO 9001 and QS 9000, Quality Audit, Quality Circles

Unit VI: **[6 Hrs]**
Product quality improvement-Quality Function deployment. Robust design and Taguchi Method. Product reliability analysis. Improved Failure Mode and Effect Analysis as per the specifications of the Automotive Industry.

Reference Books:
1. D. C. Montgomery, Introduction to Statistical Quality Control, John Wiley & Sons, 3rd Edition.
2. Mitra A., Fundamentals of Quality Control and Improvement, PHI, 2nd Ed., 1998.
J Evans and W Linsay, The Management and Control of Quality, 6'th Edition, Thomson, 2005
3. Besterfield, D H et al., Total Quality Management, 3rd Edition, Pearson Education, 2008.

4.D. C. Montgomery, Design and Analysis of Experiments, John Wiley & Sons, 6th Edition,2004
5.D. C. Montgomery and G C Runger, Applied Statistics and Probability for Engineers, John Wiley & Sons, 4th Edition.

PEINA 2101 C Smart Manufacturing

Teaching Scheme
Lectures: 3 Hrs/Week

Examination Scheme
In-Sem: 50 Marks
End-Sem: 50 Marks
Credit: 3

Course Objectives: The Students will be able,

1. To understand Digital manufacturing systems.
2. To develop an understanding of the performance measurement of manufacturing systems.
3. To be familiar with basic tools of design and manufacturing system and its types.

Course Outcomes: After the successful completion of this course, the student will be able:

1. To recognize manufacturing systems.
2. To understand the performance measurement & management in modern day manufacturing systems.
3. To analyse manufacturing systems to improve performance.
4. To recommend appropriate modelling and simulation tool for the given manufacturing application.

Unit I: Overview of Smart Manufacturing Processes [6 Hrs]

Additive Manufacturing processes – Engineering polymers, metals, ceramics, Stereolithography Selective Laser Sintering, Fused Deposition Modelling, Polyjet, LENS, Layered object manufacturing, Additive Manufacturing processes – Advanced materials, Electronic Materials, Bioprinting, Food Printing

Unit II: Fundamentals of Geometric Representations for Digital Manufacturing [6 Hrs]

Solid representations, Boundary representations, Function representations, Voxel representations Algorithmic design for digital manufacturing: Parametric Models, Vibrational Geometry, Generative models, Topology optimization, Machine Control

Unit III: **Algorithmic Design for Digital Manufacturing [6 Hrs]**

Parametric Models, Vibrational Geometry, Generative models, Topology optimization, Machine Control, Gantry positioning approaches STL/AMF Slicing

Unit IV: Material Handling Systems [6 Hrs]

Overview of Material Handling- Rotary feeders, oscillating force feeder, vibratory feeder, elevator type and Centrifugal type feeders, Principles and Design Consideration, Material Transport Systems, Storage Systems.

Unit V: Automated Manufacturing Systems [6 Hrs]

Components, Classification and Overview of Manufacturing Systems, Manufacturing Cells, GT and Cellular Manufacturing, FMS, FMS and its Planning and Implementation, Flow lines & Transfer, Mechanisms, Fundamentals and Analysis of Transfer Lines, product design for automatic assembly.

Unit VI: Modelling and Simulation for Manufacturing Plant Automation [6 Hrs]

Introduction/ need for system modelling, Building Mathematical Model of a manufacturing Plant, Modern Tools Artificial neural networks in manufacturing automation, AI in manufacturing, Fuzzy decision and control, robots and application of robots for automation

Text Books:

1. “Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing” by Ian Gibson and David Rosen
2. G. Chryssolouris, Manufacturing Systems: Theory and Practice. 2Nd edition, Springer, 2006. ISBN: 978
3. M. P. Groover, Automation, Production systems and Computer Integrated Manufacturing. 3Rd edition, Pearson Education, 2015. ISBN: 978

Reference Books:

1. E. Turban, L. Volonino, Information Technology for Management: Transforming Organizations in the Digital Economy, 7th edition, Wiley India Private Limited, 2010. ISBN: 978
2. R. Askin and C. Standridge, Modelling and Analysis of Manufacturing Systems, 1st edition, John Wiley, 1992. ISBN: 978