Autonomous Program Structure of
Final Year B. Tech. Eighth Semester
(Instrumentation & Control Engineering)
Academic Year: 2023-2024
onwards

Course Code	Course Title	Teaching Scheme Hours /Week			Examination Scheme				Marks	Credit
		Lecture	Tutorial	Practical	In Semester	End Semester	Oral	Practical		
20IN801	Process Data Analytics	3	0	0	50	50	0	0	100	3
20PEIN801	Program Elective-IV	3	0	0	50	50	0	0	100	3
20PEIN802	Program Elective-V	3	0	0	50	50	0	0	100	3
20OE801	Open Elective-III	3	0	0	50	50	0	0	100	3
20OE802	Open Elective-IV*	3	0	0	50	50	0	0	100	3
20IN801L	Process Data Analytics lab	0	0	2	25	0	25	0	50	1
20PEIN801L	Program Elective–IV Lab	0	0	2	25	0	25	0	50	1
	Total	**15**	**0**	**4**	**300**	**250**	**50**	**0**	**600**	**17**
	Grand Total	**19**			**600**				**600**	**17**

Programme Elective-IV	**Programme Elective-IV Lab**
20PEIN801A Process Modelling and Optimization 20PEIN801B Artificial Intelligence and Machine Learning 20PEIN801C Medical Device Technology	20PEIN801LA Process Modelling and Optimization 20PEIN801LB Artificial Intelligence and Machine Learning 20PEIN801LC Medical Device Technology

Programme Elective-V
20PEIN802A Safety Instrumentation Systems
20PEIN802B Computer Techniques and Operating Systems
20PEIN802C Environmental Instrumentation

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MKSSS's Cummins College of Engineering
For Women, Pune-411052

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20OE801 Open Elective-III			Eligible Departments				
Sr. No.	Course Code	Course Title	EnTC	Comp	IT	Mech	Instru
1	20OE801A	Big Data and Analytics	Y	Y	Y	Y	Y
2	20OE801B	Cyber Physical Systems	Y	Y	Y	N	Y
3	20OE801C	Digital Control	Y	N	N	Y	Y
4	20OE801D	Industrial Engineering and Management	Y	Y	Y	Y	Y
5	20OE801E	Introduction to Cyber-crime and Forensics	Y	Y	Y	Y	Y
6	20OE801F	Instrumentation in Food and Agriculture	Y	Y	Y	Y	Y
7	20OE801G	Medical IoT	Y	Y	Y	N	Y
8	20OE801H	Quantum Computing	Y	Y	Y	N	Y
9	20OE801I	Renewable Energy Sources	Y	Y	Y	Y	Y
10	20OE801J	Soft Computing	Y	Y	Y	Y	Y
11	20OE801K	Software Testing and Quality Assurance	Y	Y	Y	Y	Y

20OE802 Open Elective-IV			Eligible Departments				
Sr. No.	Course Code	Course Title	EnTC	Comp	IT	Mech	Instru
1	20OE802A	Applied statistics with R Programming	Y	N	N	Y	Y
2	20OE802B	Automobile Engineering	Y	Y	Y	N	Y
3	20OE802C	Autonomous Robots	N	Y	Y	Y	N
4	20OE802D	Building Automation and Energy Audit	Y	Y	Y	Y	N
5	20OE802E	Data Analysis and Visualization	Y	N	Y	Y	Y
6	20OE802F	Data Science using Python	Y	N	Y	Y	Y
7	20OE802G	Industrial Drives and Control	Y	Y	Y	Y	N
8	20OE802H	Smart Sensors and Systems	Y	Y	Y	Y	N
9	20OE802I	Wireless Networks	N	Y	Y	N	Y

20IN801 Process Data Analytics

Teaching Scheme:
Lectures: 3 Hrs/week

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

Prerequisites: -

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 student will be able to
1. Apply standard statistical inference procedures to draw conclusions from data analysis.
2. List and define the basic concepts of artificial intelligence and machine learning.
3. Compare and select various machine learning algorithms for solving practical problems.
4. Implement various machine learning algorithms to different domains.

Unit 1: Introduction to data analytics **(07)**

Need of data analytics in process industries, types of data analytics (Descriptive analytics, Diagnostic analytics, Preventative analytics and Prescriptive analytics), Application of each type of analytics in various process and manufacturing industries. Data types: Structured, unstructured data and challenges with unstructured data, numerical and categorical data.

Unit 2: Data Acquisition and Preprocessing **(07)**

Sources of data: internal and external. Data acquisition: data access, Data handling at different levels of data access modes, ownership of data, data security, data reliability

Data Preparation: Data restoration, Identification of tables/fields of interest, Importing into the analytical tool, Merging and splitting data files, Data cleaning, Missing values and other data preparation steps, Data integration: linking multiple databases.

Unit 3: Descriptive Statistics **(07)**

Compute measures of central tendency (mean, mode, median), measures of variability (Range, variance, standard deviation, degrees of freedom), normal distribution (Characteristics of normal distribution, skewness, kurtosis), confidence interval.

Unit 4: Inferential Statistics **(07)**

Hypothesis and hypothesis testing, Chi square test, t test, correlation, Linear regression, multi regression, Logistic regression, Goodness of fit, Analysis via linear models, Non-linear model: ANOVA, Test decision rules

Unit 5: Supervised and Unsupervised Learning Methods **(07)**

Compare supervised and unsupervised learning, Supervised learning algorithms: Neural networks, Naive Bayes, Linear regression, Logistic regression and random forest

Unsupervised learning methods: Clustering, Associative Rule Mining, Introduction to Big Data and Challenges for big data analytics. Case studies and applications of algorithms in process applications.

Unit 6:Clustering and Classification **(07)**

Basics of clustering and classification, classification metrics, classification via Bayes rule, Identifying clusters in your data, Clustering and classifying using nearest neighbors algorithm: Average nearest neighbor, k nearest neighbor , Decision trees. Case studies and applications of algorithms in process applications.

Text Books:

1. Montgomery, Douglas C. and Runger, George C. (2014) Applied Statistics
2. Probability for Engineers, 6 th edition, John Wiley & Sons, Inc (ISBN-978-1118539712).
3. An Introduction to R, by Venables and Smith and the R Development Core Team.
4. Data Analysis and Graphics Using R; An Example-based Approach, by John Maindonald and John Braun. Cambridge Series in Statistical and Probabilistic Mathematics, 2003.
5. Sheldon M. Ross,"Introduction to Probability and Statistics for Engineers and Scientists", 4th edition, Academic Press; 2009.

Reference Books:

1. Michael Berthold, David J. Hand, "Intelligent Data Analysis", Springer, 2007.
2.Arshdeep Bahga, Vijay Madisetti, "Big Data Science & Analytics: A Hands-On Approach", VPT, 2016
3. E. Alpaydin, "Machine Learning", MIT Press, 2010.
4. K. Murphy, "Machine Learning: A Probabilistic Perspective", MIT Press, 2012.
5. C. Bishop, "Pattern Recognition and Machine Learning, Springer", 2006.
6. Shai Shalev-Shwartz, Shai Ben-David, "Understanding Machine Learning: From Theory to Algorithms", Cambridge University Press, 2014.
7. John Mueller and Luca Massaron, "Machine Learning For Dummies", John Wiley & Sons, 2016.

8. Chandan K. Reddy and Charu C Aggarwal, "Healthcare data analytics", Taylor & Francis, 2015
9. Hastie, Trevor, et al. "The elements of statistical learning". Vol. 2. No. 1. New York: springer, 2009.
10. Montgomery, Douglas C., and George C. Runger. "Applied statistics and probability for engineers" John Wiley & Sons, 2

20PEIN801A Process Modelling and Optimization

Teaching Scheme:
Lectures: 3 Hrs/Week

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

Prerequisites: Process Instrumentation, Automatic Control System, Control system Design

Course Objectives:
1. Understand and develop system's mathematical models.
2. Learn the use of Numerical methods in solving the model equations.
3. To learn to various optimization techniques.

Course Outcomes: The student will be able to
1. Define and list types of mathematical models.
2. Develop mathematical model of process.
3. Simulate and analyse the system performance.
4. Apply the optimization techniques and analyse the results.

Unit 1: Modelling Aspects & Mathematical Models (07)
Definition of process model, physical and mathematical modelling, deterministic and stochastic process. Introduction, uses of mathematical models, classification of mathematical methods, scope of coverage, principles of formulation, fundamental laws, continuity equations, energy equations, equation of motion, transport equation, equation of state, equilibrium, kinetics

Unit 2: Mathematical Modelling of Mechanical & Chemical Engineering Systems (08)
Process models of some typical systems in differential equations form, , dead time, first and second order models, higher order models, Behaviour of first order and second order system

Unit 3: Mathematical Models (08)
Mathematical Models of Tanks in series, Tanks in parallel Reaction dynamics, Modelling the chemical reactions, CSTR models, Plug flow reactor model, modelling of flash drum, distillation columns, evaporators, dryers, heat exchangers.

Unit 4: Basic concept of Optimization **(07)**

Optimization: Concept, need, Essential features of optimization Problem, Concepts of objective functions, Equality and Inequality Constraints, Payback period, Return of Investment, Net present Value, Internal Rate of Return. Classification of optimization problem, Continuity of functions, convex and concave functions, Convex Region, Extremum of the objective functions, quadratic approximation, Feasible region.

Unit 5: Optimization of Unconstrained Functions & Linear Programming **(06)**

One-Dimensional search numerical methods for optimizing a function of one variable , scanning and bracketing procedures, Newton, Quasi Newton and Secant methods, Runge Kutta method.

Unit 6: Unconstrained Multivariable Optimization **(06)**

Simplex method, Direct Methods, Indirect Methods, Steepest Descent method. Linear Programming: Basics of Linear Programming, Simplex Algorithm

Text Books:

1. W. L. Luyben, Process, Modelling, Simulation and Control for Chemical Engineers• by McGraw Hill, 1973.
2. Thomas Edgar, David Himmelblau, Optimization of Chemical Processes• Second edition, McGraw Hill, 2001.

Reference Books:

1. W. F. Stoecker, Design of Thermal Systems International Education, McGraw hill 1989.
2. J. Malley, Practical Process Instrumentation and Control • McGraw Hill.
3. Deo Narsingh ,System Simulation with digital Computer • Prentice Hall India, New Delhi.
4. Singiresu S.Rao,Engineering Optimization (Therory & Practice),third Edition,New Age International(p) Ltd,Publishers.

20PEIN801B Artificial Intelligence and Machine Learning

Teaching Scheme:
Lectures: 3 Hrs/Week

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

Prerequisites: Basics of Mathematics, 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. Explore Machine Learning Methodology
2. Analyse research-based problems using Machine Learning Techniques.
3. Formalize a given problem in the different AI methods.
4. Implement basic AI algorithms.

Unit 1: Machine Learning **(08)**
Machine learning -examples of machine learning applications
Types of Learning: Supervised, Unsupervised, Issues in machine learning. Hypothesis, Target Function, Cost Function, Gradient, Training, Testing, Cross-validation, Evaluating hypothesis accuracy.

Unit 2: ML Algorithms **(09)**
Classification Algorithms , Regression Algorithms, Clustering Algorithms,
Deep Learning,

Unit 3: Fundamentals of Artificial Intelligence **(08)**
Introduction, What is AI, Applications of AI, Types of AI, A.I. Representation, Non-AI & AI Techniques, Representation of Knowledge, Knowledge Base Systems, Production Systems, Problem Characteristics, Types of production systems.

Unit 4: State Space Search **(09)**
Search Algorithms: Depth Bounded DFS, Heuristic Search: Heuristic Functions, Best First Search, Hill Climbing, Optimal Search: A* algorithm, Iterative Deepening A*, AO* search.

Unit 5: Applications of AIML **(08)**
Case Study: Uber Alternative routing, Credit card fraud analysis, Sentiment Analysis, Camera Age Analysis, etc

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.

20PEIN801C Medical Device Technology

Teaching Scheme:
Lectures: 3 Hrs/week

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

Prerequisites: Physiology of human body organs

Course Objectives:
1. To study diagnostic and operating instruments
2. To study life saving devices
3. Get the knowledge of laser technology
4. To learn various instruments used for checking performance of sensory organs

Course Outcomes:
1. Suggest the use of life saving devices for cardiovascular diseases
2. Justify the need and working of continuous monitoring devices
3. Describe use of lasers for various medical applications
4. Summarise use of diagnostic instruments

Unit 1: Cardiac Assistive and Coronary Care Devices: (06)
Pacemaker, Types of pacemakers: External and Internal, Programmable Pacemaker, Defibrillators: AC and DC Defibrillator, Implantable defibrillator, Heart Lung Machine.

Unit 2: Clinical Lab Instrumentation (06)
Blood and its composition and function, Blood Cell Counters, Electrophoresis, Pulse Oximetry- principle, Invitro and In vivo Oximeter, Telemetry- Time division and Frequency division multiplexing, Telemedicine.

Unit 3: Respiratory and Kidney Therapy Equipment (06)
Spiro meters, Ventilators, Dialysis System- Haemodialysis and Peritoneal dialysis Artificial Kidney-types (Coil type, parallel plate type), Lithotripsy

Unit 4: Laser Applications and Rehabilitation Engineering (06)
Types of lasers, Properties of laser, Basic Endoscopes system and its characteristics ,Laser applications in ophthalmology- Diabetic Retinopathy, glaucoma and Retinal hole and detachment treatment , Dermatology- Tattoo, port wine treatment.
Orthotics & Prosthetic devices, overview of various orthotics and prosthetic devices along with its materials. Wheelchair types, material used in wheelchair.

Motor Rehabilitation: Functional Electrical Stimulation - Robotics in rehabilitation - Sports, stroke and geriatric Rehabilitation - Assistive technology for dyslexia - Computer & internet access for challenged people - Neural engineering in rehabilitation engineering -

Unit 5: ICU Operating Room Instrumentation, Electrical & Fire Safety: (06)

Drug Delivery System, ICU layout: organization, bedside monitor. Operating room instrumentation: Electro surgical Unit, Anaesthesia Machine. Sources of Shocks, Macro and Micro Shocks, monitoring and Interrupting the operation from leakage current-Elements of Fire, causes of fire and protection.

Unit 6: Sensory Assist Devices (06)

Basic Audiometer; Pure tone audiometer; Audiometer system Bekesy; Evoked response Audiometer system, Hearing Aids, Visual acuity, Slit Lamp, Tonometer, Ophthalmoscope, Perimeter.

Assistive Devices for Visual and hearing Impairments, application of DSP in hearing aids - Cochlear implants - Voice synthesizer, speech trainer - Ultra sonic, Infrared and LASER canes - Intra ocular lens - Braille Reader - Tactile devices for visually challenged - Text voice converter - Screen readers.

Text Books:

1. Medicine and Clinical Engineering by Jacobsons& Webster, PHI
2. Introduction to Biomedical Equipment Technology ByCarr& Brown
3. Biomedical Instrumentation and Measurements by Cromwell, PHI
4. Handbook of Biomedical Instrumentation by R. S. Khandpur, TMH

Reference Books:

1. The Biomedical Engineering Handbook, Bronzino, IEEE Press
2. Applied Chemical Engineering Feenberg,
3. Principles of Medical Imaging.-By: K. Kirk Shung, Michael B. Smith, BenjaminTsui.-Pub: Academic Press.
4. Medical Laser Applications -By Carruth
5 .Biomedical Instrumentation and Measurement, R.Anandanatarajan

20PEIN802A Safety Instrumentation Systems

Teaching scheme:
Lectures: 3Hrs /week

Examination scheme:
In semester: 50 Marks
End Semester: 50 Marks
Credit: 3

Prerequisites: -

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 systems in the industry.
2. Identify and analyse the process hazards.
3. Select the Safety integrity level.
4. Analyse the performance of different logic system technologies and field devices with optimum risk levels.

Unit 1: Introduction **(07)**
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 2: Safety Life Cycle **(08)**
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 3: Determining the Safety Integrity Level (SIL) **(07)**
Evaluating Risk, Safety Integrity Levels, SIL Determination Method: As Low As Reasonably Practical (ALARP), Risk matrix, Risk Graph, Layers of Protection Analysis (LOPA)

Unit 4: Technology Selection **(08)**
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 5: Reliability of SIS **(06)**

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 6: Case Study **(06)**

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, life cycle 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, 2 nd 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.

20PEIN802B Computer Techniques and Operating Systems

Teaching Scheme:
Lectures: 3 Hrs/week

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

Prerequisites: -

Course Objectives:
1. To understand the functions of operating systems
2. To understand the software development cycle and its blocks
3. To learn the current trends in software engineering

Course Outcomes: The students will be able to
1. Illustrate functionalities of operating system
2. Compare parallel computer architecture and functions
3. Identify methods in software engineering
4. Compare trends and techniques used in software engineering

Unit 1: Operating System Overview **(07)**
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 2: Memory and File Management **(08)**
Memory Management: Address Binding, Overlays, Swapping, Contiguous memory allocation, Paging, Segmentation
Virtual memory: Concept, Demand paging, Preparing, Page size considerations, Page replacement algorithms, Thrashing
File system management: Concept, file access methods, directory structures, file allocation methods

Unit 3: RTOS, Parallel Computers **(07)**
Real Time & embedded System OS: Concepts, Types, their differences, Handheld Operating Systems. Interrupt Routines in RTOS environment, RTOS Tasks and their Scheduling models, Strategy for synchronization between the processes,
Parallel Computers: Basic concepts, Types of parallelism, Intertask dependencies, classification of parallel computers, vector computers, Array processors, Systolic Arrays
Introduction to Tensor Processing Units

Data Compression, Encryption and decryption

Unit 4: Introduction to Software Engineering (08)

Nature of Software, software process model, Application domains, web applications, mobile applications Preliminaries: Discipline, layers, process, practice and myths

Process models: Generic, Process assessment and improvement, prescriptive models, specialized models

Software Development Life Cycle and its models:

a. Linear Sequential

b. Rapid development

c. Incremental

Component based Software Analysis, Software Design, Software Implementation

Unit 5: Software Testing (06)

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

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

Unit 6: Trends in Software Engineering (06)

CASE, Risk Management, Software Configuration Management Tools like GitHub

Agile Development Process, SCRUM, Cleanroom methodology

Project Management trends such as ERP, SAP, Global Software Development, Test-driven development

Text books:

1. Operating System Concepts by Silberschatz, Galvin, Gagne
2. Parallel Computer architecture and programming by V. Rajaraman, C. SivaRam Murthy, PHI
3. Introduction to Data Compression by Khalid Sayood, Morgan Kaufmann Publishers, Inc.
4. 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. Operating Systems: Internals and Design Principles by William Stallings
3. Modern Operating Systems by Andrew S. Tanenbaum
4. Software Engineering: A practitioner's approach by Ian Somerville
5. A Gentle Introduction to Agile and Lean Software Development by Stephen Haunts

20PEIN802C Environmental Instrumentation

Teaching Scheme:
Lectures: 3 Hrs/week

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

Prerequisites: Sensor & Transducer, Analytical Instrumentation

Course Objectives:
1. To learn necessity of Instrumentation in Environmental Engineering.
2. To describe various components in Environmental Instrumentation.
3. To understand different types of Pollutions and various control strategies.

Course Outcomes: The student will be able to
1. Identify the Instrumentation related to Environment.
2. Analyse various aspects of disaster management and ecosystem
3. Select various sensors and instruments for measurement of weather parameters.
4. Select various sensors and instruments for measurement of air and water quality parameters

Unit 1: Sensors, Detectors, Analysers for Environmental Instrumentation (08)
Necessity of instrumentation & control for environment, sensor requirement for environment, Instrumentation methodologies: Detectors & Analyzer

Unit 2: ICT- Automatic Weather Station (08)
Instruments in Weather stations like Barometer, Rain gauge, Ceilometer etc. Global environmental analysis, Virtual Instruments in Environmental Engineering Laboratory, Rover Environmental Monitoring Station (REMS).

Unit 3: Water Quality Parameters and Water Treatment (09)
Standards of raw & treated water, sources of water & their natural quality, effects of water quality, Water quality parameters & their application, conductivity analysers & their application, Water treatment

Unit 4: Air Pollution and Sound Monitoring Systems (09)
Definitions, energy environment relationship, importance of air pollution, Air sampling methods & equipment, analytical methods for air pollution studies. Control of air pollution, Instruments used for air pollution control. Sound pollution: basics of sound pollution, its effect to environment. Acoustic noise measurement & monitoring, control methods

Unit 5: Geoinformatics **(08)**

Introduction to Geo-informatics, Role of Geo-informatics in Environmental Monitoring and Control

Text Books:

1. Water treatment technology by Walter J. Weber.
2. Air pollution engineering by M. N. Rao & H. V. N. Rao.
3. Air pollution control technology by Wark & Warner.
4. 'Environmental Engineering' by Peany Howard S, Donal R Rowe and George TachoBanoylous Teddy

Reference Books:

1. Environmental Instrumentation & Analysis Handbook by Randy D. Down.
2. Environmental Instrumentation & Analysis Handbook, by Randy D. Down & Jay H. Lehr, Wiley.
3. Environmental noise pollution by Patrick F. Cunniff, Wiley, May 1977
4. Environmental Engineering and Science by Gilber M Masters, Pearson Education (1997)

20OE801C Digital Control

Teaching Scheme:
Lectures: 3 Hrs/Week

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

Prerequisites: Basics of Control Systems

Course Objectives: To
1. Understand the basic components of a digital control system.
2. Design various Digital Controllers and Study response of those controllers.
3. Learn and understand the stability of the system in the Z plane.
4. Introduce Optimal Control Design and Its need.

Course Outcomes: Students will be able to
1. Analyse system design in various planes S-W-Z and its mapping.
2. Analyse system stability in the S and Z plane.
3. Design and analyse systems using classical methods and State Space.
4. Design Optimal Control for a Discrete System.

Unit 1: Introduction to Discrete Time Control System (08)
Basic building blocks of Discrete Time Control System, Sampling Theorem, Choice of Sampling Rate, Z Transform and Inverse Z Transform for applications of solving Differential Equations, Impulse Sampling, Reconstruction – Zero Order Hold

Unit 2: Pulse Transfer Function and Digital Controllers (08)
Pulse Transfer Function, Pulse Transfer Function of Open Loop and Closed Loop System, Pulse Transfer Function of Digital PID Controller, Design of Deadbeat Controller

Unit 3: Stability Analysis of Discrete Control System (08)
Stability regions in S plane W plane and Z plane, Mapping between three planes, Stability Tests for Discrete Systems

Unit 4: Design of Discrete Control System by State Space Approach (07)
Different Canonical Forms, Relation between Pulse Transfer Function and State Equation, Solution of Discrete Time State Space Equations, Eigen Values, Eigen Vectors

Unit 5: Pole Placement and Observer Design (07)
Concept of Controllability and Observability, Pole Placement Design by State Feedback, Design of Feedback Gain Matrix by Ackerman's Formula, State Observer Types.

Unit 6: Introduction to Optimal Control **(05)**

Basics of Optimal Control, Quadratic Optimal Control, Performance Index.

Text Books:

1. K. Ogata, "Discrete Time Control Systems", Prentice Hall, Second Edition.
2. M. Gopal, "Discrete Control and State Variable Methods", Tata McGraw Hill.
3. Kannan Moudgalya, "Digital Control", John Wiley and Sons.

Reference Books:

1. G. F. Franklin, J. David Powell, Michael Workman, "Digital Control of Dynamic Systems", Addison Wesley, Third Edition.
2. M. Gopal, "Digital Control Engineering", Wiley Eastern LTD.
3. Forsytheand W, Goodall R, "Digital Control".
4. Contantine H. Houpis, Gary B. Lamount, "Digital Control Systems", McGraw Hill International, Second Edition.

20OE801F Instrumentation in Food and Agriculture

Teaching Scheme:
Lectures: 3 Hrs/Week

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

Prerequisites: Basics of sensors and transducers, knowledge of Unit operations and basics of process control, PLC and pneumatic and hydraulic instrumentation

Course Objectives:
1. To know the scope of Instrumentation in agriculture field
2. To know greenhouse, food packaging automation schemes
3. Understand sensors used in agriculture field and weather monitoring stations
4. To get acquainted with food quality standards

Course Outcomes: The student will be able to
1. Identify the different unit operations, process control equipments involved in different types of process industries
2. Select appropriate measurement techniques for measurement of various process parameters related to soil, green house, Dam and agro-metrology
3. Analyse and develop various control loops for processes involved in various food processing plants
4. Assess various automation tools to develop automation strategy to Dam, Green house, food processing and packaging in accordance to various food standards

Unit 1: Process Control in Agriculture and Food Industries (08)
Sensors in Agriculture (Hygrometers, Anemometers, fine wire thermocouple, etc), Sensors in Food (ph, temperature sensor for pasteurization, brix sensor, etc), Flow diagram of some continuous processes like sugar plant, dairy, juice extraction, etc & batch process (Fermentation)

Unit 2: Instrumentation in Irrigation and Green House (09)
SCADA for DAM parameters & control, irrigation canal management systems, Auto drip & sprinkler irrigation systems
Green House Automation: Construction of green houses, Sensors for greenhouse, Control of ventilation, cooling & heating, wind speed, temperature & humidity

Unit 3: Instrumentation in Farm equipments, Food Safety and Sanitation (09)

Instrumentation for farm equipment: Implementation of hydraulic, pneumatic and electronic control circuits in harvesters cotton pickers, tractors, etc; Classification of pumps, pump characteristics, selection and installation.

Food safety standards (Food safety and standards bill 2005, Agmark, Bureau of Indian Standards, Codex Standards, recommended international code of hygiene for various products)

Sanitation regulatory requirements: Sanitation standards operating procedure (SSOP's), Sanitation performance standards (SPS), 11 principles of sanitary facility design, Sanitation best practices.

Unit 4: Automation in Food Packaging (08)

Ware house management, Cold Storage Units, PLC and SCADA in food packaging

Unit 5: Smart Instrumentation in Agriculture and Food Industries (08)

Wireless sensors, Application of IOT in agriculture and food industries, application of Image processing in agriculture and food industries, application of robots in agriculture and food industries, Case studies.

Text Books:

1. D. Patranabis, "Principles of Industrial instrumentation", TMH (2010), ISBN-13: 978-0070699717
2. Michael. A.M, " Irrigation : Theory and Practice" , Vikas Publishing House Pvt Ltd, Second edition (2008), ISBN-13: 978-8125918677
3. Curtis D. Johnson, " Process control and instrumentation technology", , 8th Edition, 2015,Person, ISBN: 9789332549456, 9332549451
4. Akalank Kumar Jain , Vidhi Jain "Food Safety and Standards Act, Rules & Regulations", Akalank Publications; 13th Edition edition (2015), ISBN-13: 978-8176393584

Reference books:

1. Rosana G. Moreira, "Automatic Control for Food Processing Systems (Food Engineering Series)", Springer; 2001 edition (28 February 2001), ISBN-13: 978-0834217812
2. Bela G. Liptak , "Instrument Engineers' Handbook, Process Control and Optimization", CRC Press; 4 edition (29 September 2005), ISBN-13: 978-0849310812.
3. Robert H. Brown, " CRC Handbook of Engineering in Agriculture, Volume II: Volume 1 (C R C SERIES IN AGRICULTURE)", CRC Press; 1 edition (30 June 1988), ISBN-13: 978-084933862

20OE801G Medical IoT

Teaching Scheme:
Lectures: 3 Hrs/week

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

Prerequisites: -

Course Objectives:
1. To understand smart Objects and IoT Architecture
2. To learn sensor Interfacing
3. To learn IoT Protocols
4. To build simple IoT based Health care system

Course Outcomes:
1. Ascent the basic concepts of IOT in healthcare
2. Relate the existing hardware platforms and sensor interfaces for various healthcare-based Applications
3. Comprehend the ways of communication between the client and the server in IOT
4. Build various applications in healthcare using IOT based approach with appropriate case studies.

Unit 1: Medical Measurements (06)
Cardiovascular system, respiratory system, nervous system etc. Measurement of Heart, Brain and Muscle activity using wearable sensors. Monitor health parameters like Blood Pressure, ECG, EMG, EEG, HR, RR, SPO2 etc.

Unit 2: Sensors & Smart Patient Devices (08)
Role of Wearables, Challenges and Opportunities, Future of Wearables, Social Aspects, Wearable Haptics, Intelligent Clothing, Industry Sectors' Overview – Sports, Healthcare, Military, Environment Monitoring, Mining Industry, Public Sector and Safety.

Unit 3: Wearable mechatronics device (08)
Accelerometers, Gyroscopic Sensors; In – Shoe Force and Pressure Measurement its applications. Physical Activity Monitoring: Human Kinetics, Cardiac Activity.
Cuffless Blood Pressure Monitor, Study of Flexible and Wearable Piezo resistive Sensors for Cuffless Blood Pressure Measurement, Wearable Pulse Oximeter, Wearable Sweat Analysis, Wearable Heart Rate Measurement**.**

Unit 4: Device Connectivity and Security / Biomedical Sensors with Internet connectivity (08)
Gateway, Embedded Systems for devices like RPi, Arduino, etc, Protocols as applied to medical devices.

Sensor interface: Temperature sensor, pressure sensor, optical sensor etc. Wireless body area network. IoT Privacy and Security.

Unit 5: Data Analytics for Medical Applications (06)

Real Time Data Analytics, Continuous IoT Monitoring, Approach to Predict and Diagnosis of Heart and Chest diseases, Alzheimer, Diabetic Retinopathy etc. through data analytics.

Unit 6: IoT in Biomedical Applications - Case Studies (06)

Secured architecture for IoT enabled Personalized Healthcare Systems, Healthcare Application development in mobile and cloud Environments.

Case Study1: Wireless Patient Monitor system; Design an IoT System for Vital Sign Monitors, Weight measuring device, Blood pressure measuring device, ECG, Blood glucose measuring, Heart rates measuring devices and Pulse Oximeters etc.

Case Study2: Wearable Fitness & Activity Monitor; Walking time measuring device ii. Step counting device iii. Speed measuring device iv. Calorie spent measuring device v. Time spent in rest or sleeping measuring device.

Text Books:

1. Joseph D. Bronzino, "Handbook of Biomedical Engineering", 2nd edition –Volume II, CRC press, 2010.
2. Edward Sazonov and Michael R. Neuman, "Wearable Sensors -Fundamentals, Implementation and Applications", Elsevier Inc., 2014.
3. Pethuru Raj and Anupama C. Raman, "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", by CRC Press.
4. Arshdeep Bahga and Vijay Madisetti, "Internet of Things: A Hands-on Approach", Universities Press.

Reference Books:

1. Subhas Chandra Mukhopadhyay and Tarikul Islam, "Wearable Sensors - Applications, design and implementation" IOP Publishing Ltd 2017.
2. Shantanu Bhattacharya, A K Agarwal, Nripen Chanda, Ashok Pandey and Ashis Kumar Sen, "Environmental, Chemical and Medical Sensors", Springer Nature Singapore Pte Ltd. 2018.
3. Dieter Uckelmann, Mark Harrison, Florian, "Architecting the Internet of Things", Springer.
4. "The Internet of Things: Key Applications and Protocols", by, Wiley
5. Olivier Hersent, David Boswarthick, Elloumi, Daniel Kellmereit, Daniel Obodovski, "The
6. Silent Intelligence: The Internet of Things", Publisher: Lightning Source Inc; 1st Edition (15 April 2014). ISBN-10: 0989973700, ISBN-13: 978- 0989973700.

20OE802D Building Automation and Energy Audit

Teaching Scheme:
Lectures: 3 Hrs/Week

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

Prerequisites: Basics of Electronics and Instrumentation

Course Objectives:
1. To understand Need and Applications Building automation systems.
2. To understand the working of various Building automation components.
3. To Select and Implement Building automation with various applications.

Course Outcomes: The student will be able to
1. Investigate the system requirements for developing building automation systems.
2. Compare and choose the suitable building automation systems for the applications
3. Design building automation system for required application.
4. Evaluate the performance of the designed building automation system.

Unit 1: Fire Alarm Systems I **(08)**
Introduction: to BAS, Need and Applications of BAS, Block diagram of BAS.FAS: Need and Applications of FAS, Types of FAS, Block diagram of FAS, Fire, Fire Development Stages, Fire Signatures, Initiation Devices, Notification Appliances, IDC Placements, NAC Placements, Fire Suppression: Fire Extinguishers & Its Classification, Fire Suppression Systems.

Unit 2: Fire Alarm Systems II **(08)**
IDC, NAC, SLC, FAS Wiring Standards, FAS Communication Protocols, Voltage Drop Analysis, Battery Capacity Analysis, Cause & Effect Matrix.

Unit 3: Access Control Systems **(06)**
Introduction to Security Systems, Types of Security systems, Access Control Systems: Introduction, Applications, Concept, Generic Model, Components, Card Technologies, Communication Protocols for ACS, Biometrics for ACS, CCTV System Types: CCTV Components, Digital Video Management System

Unit 4: HVAC- Air Systems **(06)**
Human Comfort Parameters and Air Properties Need of HVAC System, HVAC Block Diagram. AHU: Concept, Working, AHU Functions, AHU Components: Dampers, Filters, Cooling coil, Heating coil, etc., AHU Configurations, AHU Locations, AHU Terminal Units: CAV, VAV, Measurement and Control Loops for Air Systems.

Unit 5: HVAC- Water Systems **(07)**

Cold Water System: Refrigeration Cycles, Chillers, Cooling Towers, Types of chilled water system, Concept of Free Cooling : Direct Waterside, Series Waterside, Parallel Waterside. Hot Water Systems: Heating Circuits, Boilers, Types of Boilers, Heat Exchangers: Steam Input and Hot Water Input, Solar Hot Water System, Measurement and Control Loops for Water Systems.

Unit 6: Building Energy Management System **(07)**

Overview of Building Energy Management Systems, BEMS Control systems overview, Benefits of BEMS, Energy System Monitoring, Application of Energy Efficient Strategies, Effective Energy management, Computerized Energy Management Systems.

Text 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
5. Roger W. Haines "HVAC Systems Design Handbook", Fifth Edition
6. James E. Brumbaugh "HVAC Fundamentals", volume 1 to 3
7. "Basics of Air Conditioning" ISHRAE, Indian Society of Heating, Refrigerating & Air Conditioning Engineers (product code: B0004 for online shopping)

Reference Books:

1. "All About AHU's", ISHRAE. Indian Society of Heating, Refrigerating & Air Conditioning Engineers (product code: B0005 for online shopping)
2. "Chillers Basics", ISHRAE. Indian Society of Heating, Refrigerating & Air Conditioning Engineers (product code: B0009 for online shopping)
3. "HVAC Handbook Part-1", Indian Society of Heating, Refrigerating & Air Conditioning Engineers
4. "Handbook – Industrial Ventilation Application", 2004, Indian Society of Heating, Refrigerating & Air Conditioning Engineers

20OE802G Industrial Drives and Control

Teaching Scheme:
Lectures: 3 Hrs/Week

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

Prerequisites: -

Course Objectives:
1. To evaluate and select a suitable drive for a particular application.
2. To analyse the basic drive system dynamics
3. To develop the basic design of an electric drive system.

Course Outcomes:
1. Selection of appropriate drive for the given application
2. Selection of suitable control system scheme along with the interlocking for given application
3. Analysis of the control drive dynamics for the desired drive system
4. Design of the total electric drive system based on desired application

Unit 1: Introduction to Industrial Drives (07)
Concept of electric drive, Power modulators, Motors used in drives, types of loads choice of drives, classification of drives Multi quadrant operation of Drives.

Unit 2: Introduction to Control Systems (07)
Open and closed loop systems with examples, automatic control, speed control of motors

Unit 3: Electrical Control of Machines (08)
Manual control – Magnetic control – Semi-automatic and Automatic control of Modern machinery – Development of Control circuits–Two wire and Three wire control – Remote control –

Unit 4: Interlocking of drives (08)
Control circuit components –Symbols for control components–Fuses, Switches and Fuse Switch units.

Unit 5: Dynamics and Control of Electric Drives (06)
D.C. motor drives, Induction motor drives, Synchronous and Brushless D.C. motor drives.

Unit 6: Industrial process and drives **(06)**

Process flow diagram of paper mill, cement mill, sugar mill, steel mill, Hoists and cranes, centrifugal pumps and compressors, solar powered pump drives, selection of drives for the above processes

Text Books:

1. Electrical Motor Drives, R. Krishnan [PHI-2003]
2. Electric Drives, Vedam Subrahmaniam [TMH-1994]
3. Industrial Drives and Control, Sandeep M. Chaudhari, Nilesh R. Ahire [Nirali Prakashan]

Reference Books:

1. Control of Electric Drives,W. Leonard, [Springer- 2001]
2. Electrical Drives, Second Edition, S.A. Nasar, Boldea [CRC Press - 2006]

20OE802I Smart Sensors and Systems

Teaching Scheme:
Lectures: 3 Hrs/Week

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

Prerequisites: -

Course Objectives:

1. Theoretical understanding of various physical phenomena behind the operation of different types of sensors and microsystems
2. Overview of micro/nano fabrication process
3. Develop a complete sensor or sensor system, MEMS device or microsystem

Course Outcomes:

1. Selection of suitable sensor along with the associated electronics and fabrication process for given application
2. Selection of appropriate smart sensors for the desired application in the field of Automobile, Biomedical, Military, Space and Défense.
3. Design of application-based sensors in the field of Military, Défense, Spacecraft and environment
4. Analysis of the system designed for applications in the field of Biomedical and Automobile

Unit 1: Introduction to Smart Sensors and Systems (07)

Principles of Sensing, Classification and Terminology of Sensors. Introduction to micromachining - Fabrication and miniaturization techniques
Digital Signal Controllers (Microcontrollers and Digital Signal Processors) for Smart sensors
Key features, Certain case studies - for eg: temperature, fingerprint recognition

Unit 2: Microfabrication process (08)

Fabrication and miniaturization techniques, Steps involved in fabrication

Unit 3: Smart sensors in Biomedical field (08)

Bio-analytical [sample preparation and detection of compound] sensors & systems, Transduction modes & classifications,
Hall Effect sensors and associated signal conditioning circuits, Sensors for displacement (linear and angular), velocity, acceleration, force, torque, vibration and shock measurements. Sensor measurements for conductivity and viscosity. Electrochemical transducer in Biology

and medicine Biochemical Transducer, Enzyme-based electrochemical biosensors, electronic tongue, few related Case studies

Unit 4: Smart sensors in Automobile industry (07)

Introduction to Modern Automotive Systems and need for electronics in Automobiles, Sensors for vehicle body management, Sensors for automotive vehicle convenience and security systems, Sensors for chassis management, Powertrain sensors, Air Bag and Seat Belt Pre tensioner Systems, Case studies explaining the Modern Trends and Technical Solutions, Related communication systems

Unit 5: Smart sensors related to Environment and in Spacecraft (06)

Human Toxicology Ecotoxicology, Water and air pollution sources

E nose for Sensitive and Selective Chemical Sensing, Chemical sensors, Ocean environment Smart sensors in spacecraft - in monitoring applications, Smart Instrumentation Point Bus (SIP), Solid state micro-gyroscopes, related Case studies

Unit 6: Smart sensors in Military and Defence (06)

Types of sensors (Accelerometers, Inertial Sensors, Pressure Sensors, Force Sensors, Motion Sensors, Gyroscopes, Temperature Sensor and Others), Device-based Sensor, Clothing-based Sensor, Application based sensors - Wrist Wear, Foot Wear, Eye Wear, Body Wear and Neck Wear, intelligent sensor technology for surveillance and electronic intelligence, Case studies, related communication systems

Text Books:

1. Understanding Smart Sensors, Randy Frank [Artech House, Boston London]
2. Smart Sensors for Environmental and Medical Applications, Hamida Halilil, Hadi Heidari [Wiley]
3. Smart Sensors and MEMS: Intelligent Devices and Microsystems for Industrial Applications, S Nihtianov, Antonio Luque [Science Direct]

Reference Books:

1. Smart Sensors and Systems, Lin, Y.-L., Kyung, C.-M., Yasuura, H., Liu, Y. [Springer]
2. Smart Sensor Systems, Gerard Miejer [Wiley]

20IN801L Process Data Analytics Lab

Teaching Scheme:
Practical: 2 Hrs/week

Examination Scheme:
In Semester: 25 Marks
Oral: 25 marks
Credit: 1

Course Outcomes: The student will be able to
1. Apply standard statistical inference procedures to draw conclusions from data analysis.
2. Analysis of data using various statistical methods.
3. Develop programming logic for various machine learning algorithms.
4. Implement various machine learning algorithms to process industries.

List of Practical Assignments:
1. Introduction to linear and multiple regression function in MATLAB
2. Applying linear & multiple regression to process data from a typical process plant
3. Implement ANOVA for a database
4. Data Analysis using K nearest neighbour Regression
5. Introduction to programming in R
6. Linear regression in R
7. Implementation of Neural Networks for standard data set
8. Implementation of Fuzzy logic for classification of standard data set

Or similar type of practical assignments based on the course contents

20PEIN801LA Process Modelling and Optimization Lab

Teaching Scheme:
Practical: 2 Hrs/Week

Examination Scheme:
In Semester: 25 Marks
Oral: 25 Marks
Credit: 1

Course Outcomes: The student will be able to
1. Analyze the system model.
2. Identify mathematical models of processes.
3. Analyze the system performance.
4. Apply the optimization techniques and analyze the results.

List of Practical Assignments:
Students are expected to perform Minimum 8 Experiments
1. Analysis of first/second order systems by using step and ramp input.
2. Simulation of mathematical modeling of electrical/ mechanical systems by first principle.
3. Simulation of mathematical modeling of liquid level systems.
4. Study of distillation columns.
5. Study of Heat Exchanger.
6. Identification of second order process by prediction error method and compare it with modeling by first principle.
7. Obtaining unknown parameters of second order process by least square technique.
8. Obtaining Relative gain array of any MIMO physical system.
9. Obtaining inverse Nyquist array of any Physical system.
10. Design of optimal control system by using quadratic approximation.
11. Analysis and comparisons of Quasi Newton and secant methods.
12. Finding optimal solution using Simplex Method system

Or similar type of practical assignments based on the course contents

20PEIN801LB Artificial Intelligence and Machine Learning Lab

Teaching Scheme:
Practical: 2 Hrs/Week

Examination Scheme:
In Semester: 25 Marks
Oral: 25 Marks
Credit: 1

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 Practical Assignments:
Any Software/Programming Language: PROLOG/Matlab/Python etc
1. Write a program to implement simple Chat-bot.
2. Implement Tic-Tac-Toe using A* algorithm.
3. Implement alpha-beta pruning graphically with proper example and justify the pruning.
4. Write a python program to implement Water Jug Problem.
5. Use Heuristic Search Techniques to Implement Best first search (Best-Solution but not always optimal) and A* algorithm (Always gives optimal solution).
6. Use Heuristic Search Techniques to Implement Hill-Climbing Algorithm.
7. Write a program to implement Hangman game.
8. Write a program to solve the Monkey Banana problem.
9. Write a program to implement Simple Calculator program.
10. Write a program to POS (Parts of Speech) tagging for the given sentence using NLTK
11. Solve 8-puzzle problem using best first search.
12. Solve Robot (traversal) problem using means End Analysis.
13. Implementation of Image features Processing
14. Write a program to implement Naïve Bayes Algorithm
15. Implement Support Vector Machine algorithms on a dataset.
16. Implement Genetic algorithm algorithms on a dataset.
17. Implement K-means algorithms on a dataset.
18. Implement PCA algorithms on a dataset.

Or similar type of practical assignments based on the course contents

20PEIN801LC Medical Device Technology Lab

Teaching Scheme:
Practical: 2 Hrs/Week

Examination Scheme:
In Semester: 25 Marks
Oral: 25 Marks
Credit: 1

Course Outcomes: The students will be able to
1. Identify various biomedical Instruments Involved in diagnosis, treatment and surgery.
2. Identify various controls of Instruments.
3. Record the response of the sensory organ.
4. Analyze and interpret the recorded data.

List of Practical Assignments:
1. Record and Monitor parameters using BSM.
2. Implementation of various modes using electrosurgical machine.
3. Design ECG telemetry system.
4. Recording and analysis of audiogram for different subjects using audiometer.
5. Design a signal conditioning to monitor and to remove the leakage current.
6. Develop an algorithm for Text to Voice Conversion in MATLAB/Suitable Language.
7. Develop an algorithm for Voice to Text Conversion in MATLAB/Suitable Language.
8. Design/Develop Ultrasonic Cane for Navigational Aid.
9. Pressure Measurement using In Shoe Pressure Sensor.
10. Fall Detection using Accelerometer and Flex Sensor
11. Hospital visit Report