GOVERNMENT COLLEGE OF ENGINEERING, JALGAON [M.S]

(An Autonomous Institute of Government of Maharashtra)

"Globally Accepted Engineers with Human Skills"

Curriculum for

Final Year B. Tech. Instrumentation Engineering

2021-22

Scheme for Semester VII of B. Tech. (Instrumentation Engineering) OPTION I

GOVERNMENT COLLEGE OF ENGINEERING, JALGAON

Department of Instrumetation Engineering

Scheme for Semester VII of B. Tech. (Instrumentation Engineering) with effect from academic year 2021-22 OPTION I

Course Code	Name of the Course	Group	Teaching Scheme				Evaluation Scheme						Credit
							Theory			Practical		Total	
			L	T	P	Total	MSE	ISA	ESE	ICA	ESE		
IN401U	Machine Learning and Data Analytics	PC	3	…	…	3	30	10	60	…	…	100	3
IN402U	Instrumentation Project Management	HM	3	…	…	3	30	10	60	…	…	100	3
IN403U	Professional Elective- III	PE	3	…	…	3	30	10	60	…	…	100	3
IN404U	Professional Elective- IV	PE	3	…	…	3	30	10	60	…	…	100	3
IN405U	Open Elective-III	OE	3	…	…	3	30	10	60	…	…	100	3
IN406U	Industrial Lecture	PS	1	…	…	1	…	…	…	25	…	25	1
IN407U	Machine Learning and Data Analytics Lab	PC	…	…	2	2	…	…	…	25	25	50	1
IN408U	Instrumentation Project Management Lab	HM	…	…	2	2	…	…	…	25	25	50	1
IN409U	Professional Elective- III Lab	PC	…	…	2	2	…	…	…	25	25	50	1
IN410U	Professional Elective- IV Lab	PE	---	…	2	2	…	…	…	50	25	75	1
IN411U	Project Phase I	PS	…	…	2	2	…	…	…	50	50	100	2
Total			16	0	10	26	150	50	300	200	150	850	22

Professional Elective-III	**Professional Elective-IV**	**Open Elective-III**
A. Neural Network and Fuzzy based	**A.** Automotive Instrumentation	**A.** Building Automation
B. Instrumentation System Design	**B.** Robotics	**B.** Agricultural Instrumentation
C. Wireless Sensor Networks	**C.** Digital Image Processing	**C.** MEMS and NanoInstrumentation
D. Nonlinear Control System	**D.** Digital Control	**D.** Sensor and Transducers

L : Lecture **T: Tutorial** **P: Practical** **MSE: Mid Semester Examination**

ISA :Internal Sessional Assessment **ESE: End Semester Examination** **ICA : Internal Continuous Assessment**

Note:

1. **ESE (TH) duration for all theory courses is three hours.**
2. **MSE (TH) duration for all theory courses is two hours**

Scheme for Semester VIII of B. Tech. (Instrumentation Engineering) OPTION I

GOVERNMENT COLLEGE OF ENGINEERING, JALGAON

Department of Instrumetation Engineering

Scheme for Semester VIII of B. Tech. (Instrumentation Engineering) with effect from academic year 2021-22 OPTION I

Course Code	Name of the Course	Group	Teaching Scheme				Evaluation Scheme						Credit
							Theory			Practical		Total	
			L	T	P	Total	MSE	ISA	ESE	ICA	ESE		
SH481U	Accounts and Finance for Entrepreneurs	HM	2	…	…	2	30	10	60	…	…	100	2
IN451U	Biomedical Instrumentation	PC	3	…	…	3	30	10	60	…	…	100	3
IN452U	Analytical Instrumentation	PC	2	…	…	2	30	10	60	…	…	100	2
IN453U	Professional Elective - V	PE	3	…	…	3	30	10	60	…	…	100	3
IN454U	Professional Elective- VI	HM	3	…	…	3	30	10	60	…	…	100	3
IN455U	Biomedical Instrumentation Lab	PC	…	…	2	2	…	…	…	25	25	50	1
IN456U	Professional Elective-V Lab	PE	…	…	2	2	…	…	…	25	25	50	1
IN457U	Seminar	PS	…	…	2	2	…	…	…	50	…	50	1
IN458U	Professional Internship	PC	…	…	…	…	…	…	…	75	…	75	2
IN459U	Project Phase II	PS	…	…	4	4	…	…	…	50	100	150	4
Total			13	…	10	23	150	50	300	225	150	875	22

	Professional Elective-V		Professional Elective-VI
A.	Embedded System	**A.**	Industrial Pollution Control and Management
B.	Fiber Optics & Laser Instrumentation	**B.**	Industrial Safety and Hazards Management
C.	Artificial Intelligence	**C.**	Entrepreneurship and Buissness Management
D.	Human Ergonomics	**D.**	Industrial Psychology

L : Lecture **T: Tutorial** **P: Practical** **MSE: Mid Semester Examination**

ISA :Internal Sessional Assessment **ESE: End Semester Examination** **ICA : Internal Continuous Assessment**

Note:
1. **ESE (TH) duration for all theory courses is three hours.**
2. **MSE (TH) duration for all theory courses is two hours**

Scheme for Semester VII of B. Tech. (Instrumentation Engineering) OPTION II

GOVERNMENT COLLEGE OF ENGINEERING, JALGAON

Department of Instrumetation Engineering

Scheme for Semester VII of B. Tech. (Instrumentation Engineering) with effect from academic year 2021-22

Option-II

Course Code	Name of the Course	Group	Teaching Scheme				Evaluation Scheme						Credit
							Theory			Practical		Total	
			L	T	P	Total	MSE	ISA	ESE	ICA	ESE		
IN401U	Machine Learning and Data Analytics	PC	3	…	…	3	30	10	60	…	…	100	3
IN402U	Instrumentation Project Management	HM	3	…	…	3	30	10	60	…	…	100	3
IN403U	Professional Elective- III	PE	3	…	…	3	30	10	60	…	…	100	3
IN404U	Professional Elective- IV	PE	3	…	…	3	30	10	60	…	…	100	3
IN405U	Open Elective-III	OE	3	…	…	3	30	10	60	…	…	100	3
IN406U	Industrial Lecture	PS	1	…	…	…	…	…	…	25	…	25	1
IN407U	Machine Learning and Data Analytics Lab	PC	…	…	2	2	…	…	…	25	25	50	1
IN408U	Instrumentation Project Management Lab	HM	…	…	2	2	…	…	…	25	25	50	1
IN409U	Professional Elective- III Lab	PC	…	…	2	2	…	…	…	25	25	50	1
IN410U	Professional Elective- IV Lab	PE	---	…	2	2	…	…	…	50	25	75	1
IN451U	**Biomedical Instrumentation**	**PC**	**3**	**…**	**…**	**3**	**30**	**10**	**60**	**…**	**…**	**100**	**3**
IN455U	**Biomedical Instrumentation Lab**	**PC**	**…**	**…**	**2**	**2**	**…**	**…**	**…**	**25**	**25**	**50**	**1**
Total			19	0	10	28	180	60	360	175	125	900	24

Professional Elective-III	**Professional Elective-IV**	**Open Elective-III**
A. Neural Network and Fuzzy based	**A.** Automotive Instrumentation	**A.** Building Automation
B. Instrumentation System Design	**B.** Robotics	**B.** Agricultural Instrumentation
C. Wireless Sensor Networks	**C.** Digital Image Processing	**C.** MEMS and NanoInstrumentation
D. Nonlinear Control System	**D.** Digital Control	**D.** Sensor and Transducers

L : Lecture **T: Tutorial** **P: Practical** **MSE: Mid Semester Examination**

ISA :Internal Sessional Assessment **ESE: End Semester Examination** **ICA : Internal Continuous Assessment**

Note:

1. **ESE (TH) duration is three hours and MSE (TH) duration is two hours for all theory courses .**
2. **Studen can complete IN454U Professional Elective-VI through SWAYAM/MOOC in VIIth or VIIIth semester. Credits earned will be considered in VIIIth semester**

Scheme for Semester VIII of B. Tech. (Instrumentation Engineering) OPTION II

GOVERNMENT COLLEGE OF ENGINEERING, JALGAON

Department of Instrumetation Engineering

Scheme for Semester VIII of B. Tech. (Instrumentation Engineering) with effect from academic year 2021-22

Option-II

Course Code	Name of the Course	Group	Teaching Scheme				Evaluation Scheme						
							Theory			Practical		Total	Credit
			L	T	P	Total	MSE	ISA	ESE	ICA	ESE		
IN454U	Professional Elective- VI*	HM	3	…	…	3	30	10	60	…	…	100	3
IN457U	Seminar	PS	…	…	2	2	…	…	…	50	…	50	1
IN458U	Professional Internship	PC	…	…	…	…	…	…	…	75	…	75	2
IN460U	Industrial Project	PS	…	…	4	4	…	…	…	50	100	150	6
Total			3	0	6	9	30	10	60	175	100	375	12

Professional Elective-VI

A. Industrial Pollution Control and Management

B. Industrial Safety and Hazards Management

C. Entrepreneurship and Buissness Management

D. Industrial Psychology

L : Lecture **T: Tutorial** **P: Practical** **MSE: Mid Semester Examination**

ISA :Internal Sessional Assessment **ESE: End Semester Examination** **ICA : Internal Continuous Assessment**

Note: **Studen can complete IN454U Professional Elective-VI through SWAYAM/MOOC in VIIth or VIIIth semester. Credits earned will be considered in VIIIth semester**

IN401U MACHINE LEARNING AND DATA ANALYTICS

Teaching Scheme: 03L+ 00 T; Total: 03 **Credits:** 03
Evaluation Scheme: 30 MSE + 10 ISA + 60 ESE **Total Marks:** 100
ESE Duration: 3 Hrs.

COURSE DESCRIPTION:

This course covers theoretical foundations as well as essential algorithms for supervised and unsupervised learning. Also prepares students to gather, describe, and analyze data, and use advanced tools to make decisions on different aspects of the system.

COURSE OBJECTIVES:

The objective of course are as follows
1. To introduce students to the basic concepts and techniques of Machine Learning.
2. To develop skills of using recent machine learning software for solving practical problems.
3. To gain experience of doing independent study and research.

.DESIRABLE AWARENESS/SKILLS:

Sensors and transducers, measurement system. Electronic instrumentation.

COURSE OUTCOMES:

CO	After the completion of the course the student will be able to	Bloom's Cognitive	
		Level	Descriptor
CO1	Understand Supervised, unsupervised and semi-supervised machine lea algorithm	1,2	Remember, Understand
CO2	Select and implement machine learning techniques and C comp environment that are suitable for the applications under consideration.	2,3	Understand, Apply
CO3	Recognize and implement various ways of selecting suitable model parameters for different machine learning techniques.	2,3,4	Understand, Apply, Analyze
CO4	find meaning in data so that the derived knowledge can be used to make informed decisions.	2,3	Understand, Apply,
CO5	Apply algorithms to build machine intelligence	3,4,5	Apply, Analyze, Evaluate

RELEVANCE OF POS AND STRENGTH OF CORRELATION:

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

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

Course Content

Introduction : Data representation, , domain knowledge for productive use of machine learning, Diversity of data: structured/unstructured, Overview of Machine learning concepts – Bias/variance, over fitting and train/test splits., basic linear algebra in machine learning techniques

Supervised and Statistical Learning: Learning from observations, bias and variance, Metrics for accessing regression accuracy, Metrics for accessing classification accuracy.

Unsupervised learning: Engineering the data, Overview of basic clustering methods, K-Means and Hierarchical clustering, Partitioning Vs. Hierarchical, advantages and disadvantages

Linear and Logistic Regression: Empirical models, Least Square Method, coefficient of determination, Estimation, Prediction of Regression Model Residual Analysis: Validating Model Assumptions, Multiple Regression Model, Testing for Significance- F test, T test. Logistic regression equation, testing the significance of Logistic regression coefficients, Comparison of Linear Regression model and Logistic regression model.

Data Analytics: Variable, measurement and data, Importance of data, Data Analytics vs Data Analysis, Classification and importance of Data Analytics, Descriptive, Diagnostic, Predictive, perspective analytics, Levels of Data. Central Tendency and Dispersion: Arithmetic mean, weighted mean, median, percentile, Measures of variability, Mean Absolute Deviation, coefficient of variation

Decision Tree Learning: Introduction to Classification and Regression Trees (CART), Attribute selection measures, Decision tree algorithm, information gain, gain ratio, gain index, gini index

Text Books:

1. M. Gopal, Applied Machine Learning, McGraw Hill Education

Reference Books:

1. Ethem Alpaydm, Introduction to Machine Learning, MIT Press Cambridge, London

2. Tom Mitchell, “Machine Learning”, McGraw-Hill

3. McKinney, W. (2012). Python for data analysis: Data wrangling with Pandas, NumPy, and IPython. “O’Reilly Media, Inc.".

4. David W. Hosmer, Stanley Lemeshow (2000). Applied logistic regression (Wiley Series in probability and statistics). “Wiley-Inter science Publication”.

IN407U MACHINE LEARNING AND DATA ANALYTICS LAB

Teaching Scheme: 02P Total: 02 **Credit:** 01
Evaluation Scheme: 25 ICA+ 25 ESE **Total Marks:** 50
Duration of ESE: 03Hrs

COURSE DESCRIPTION:

The lab course covers essential algorithms for supervised and unsupervised learning. Classes on theoretical and algorithmic aspects are complemented by practical lab sessions.

COURSE OBJECTIVES:

This course will enable students to
1. Make use of Data sets in implementing the machine learning algorithms
2. Implement the machine learning concepts and algorithms in any suitable language of choice.

COURSE OUTCOMES:

CO	After the completion of the course the student will be able to	Bloom's Cognitive	
		Level	Descriptor
CO1	Understand the implementation procedures for the machine learning algorithr	1,2	Remember, Understand
CO2	Design programs for various Learning algorithms.	2,3	Understand, Apply
CO3	Apply appropriate data sets to the Machine Learning algorithms.	2,3,4	Understand, Apply, Analyze

RELEVANCE OF POS AND STRENGTH OF CORRELATION:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	1	-	-	-	-	-	-	-	-	1	-	-	-
CO2	3	2	1	-	2	1	-	-	-	-	-	-	1	-	2
CO3	3	3	3	2	3	-	-	-	-	-	-	-	2	3	-

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

Minimum Ten experiments shall be performed to cover entire curriculum of course IN401U.

The list given below is just a guideline.

1. Write a programme to predict the class of the flower based on available attributes.
2. Write a programme to predict if a loan will get approved or not.
3. Write a programme to predict the traffic on a new mode of transport.
4. Write a programme using simple linear regression
5. Write a programme using coefficient of determination (eg. Number of TV ads and the number of cars sold)
6. Write a programme using multiple regression (e.g. for a trucking company, estimation of total daily travel time for drivers)
7. Write a programme using Logistic Regression.
8. Write a programme using decision tree algorithm.
9. Write a programme using measures of attribute selection.
10. Write a programme using classification and regression trees (CART)
11. Write a programme using Gini Index.
12. Write a programme for visualizing decision tree
13. Write a programme for interpretation of CART model.
14. Write a programme for central tendency and dispersion.
15. Introduction and application of PHYTHON and Weka 3.8.5.

ICA – Internal Continuous Assessment shall support for regular performance of practical and its regular assessment. In addition; it shall be based on knowledge/skill acquired and record submitted by student (journal) based on practical performed by him/her. The performance shall be assessed experiment wise using internal continuous assessment format **(S 10).**

ESE – The End Semester Examination (ESE) for this laboratory course shall be based on performance in one of the experiments performed by student in the semester followed by sample questions to judge the depth of understanding/knowledge or skill acquired by the student. It shall be evaluated by two examiners out of which one examiner shall be out of institute

IN402U INSTRUMENTATION PROJECT MANAGEMENT

Teaching Scheme: 03L+ 00 T; Total: 03 **Credits:** 03
Evaluation Scheme: 30 MSE + 10 ISA + 60 ESE **Total Marks:** 100
ESE Duration: 3 Hrs.

COURSE DESCRIPTION:

For Instrumentation and Control engineer it is very important to know the kind of standard documents available in manufacturing processes along with necessary design, test and calibration procedure. This subject will help student to understand the project procedures and various stages of project like planning, estimation, designing, installation, testing, calibration and commissioning of instruments and systems. Last topic of the syllabus will introduce student with quality manufacturing process.

COURSE OBJECTIVES:

1. Apply the basic concepts of industrial organization and management for instrumentation projects.
2. To understand life cycle phases and activities involve in instrumentation projects.
3. To know the use of various standards in instrumentation projects.
4. To know front end engineering design and its documentation.
5. To learn the detail engineering design and its documentation

COURSE OUTCOMES:

CO	After the completion of the course the student will be able to	Bloom's Cognitive	
		Level	Descriptor
CO1	Estimate different types of projects and its management.	01,02	Remembering, Understanding
CO2	Interpret the design information from the documents. Design and evaluate tools to be used.	03	Applying,
CO3	Prepare different instrumentation documents.	02	Understanding
CO4	Role and responsibilities in the project organization structure	03	Applying,

RELEVANCE OF POS AND STRENGTH OF CORRELATION:

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

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

Course Content

Introduction to project management

Definition of project purpose - Scope, time, quality and organization structure. Basic and detailed engineering: Degree of automation, Project S curves, manpower considerations, inter-department and inter-organization interactions, Multi agency interaction. Types of projects and types of contracts e.g. EPC, BOOT etc.

Project Planning and Scheduling

Project Planning: Introduction and basic requirements, establishing project objectives, Statement of work (SOW), project specifications, Work Breakdown structure (WBS). Project scheduling: Introduction and basic requirements, milestone scheduling, Network scheduling techniques: Network fundamentals, GERT, PERT, CPM, concept of crash time. Types of estimates, pricing process.

Procurement activities

Pre-Qualification Evaluation of Vendor, Vendor registration, Tendering and bidding process and required documents, Bid evaluation, Purchase orders

Instrumentation Preliminary and FEED Project Engineering Documents and Standards

Introduction to ISA standards: ISA S-5.1, 5.2, 5.3, 5.4, 5.5 and S-20. Preliminary Engineering Documents: PFD, P&ID (ISA S-5.1, 5.3), Process Control Narratives. Front End Engineering and Design (FEED) documents: Plant and piping layouts, Instrument schedule, I/O schedule, Instrument specification sheets (ISA S-20), logic diagram (ISA S-5.2), sizing and calculation documents, Instrument layout, Junction box layout, system Architecture and network layout diagrams, Control room layouts

Instrument Project Control Project engineering documents and drawing:

Process flow sheets, Mechanical flow sheets, Instrument index sheets, loop wiring diagram, panel drawings and specifications, plot plans, installation details, special drawings, purchase requisition, other documents. Information required: Process information, Instrument specifications and standards, piping specifications, Electrical specifications, bid documents, Project procedure, project schedule, Equipment Information, Vendor drawing Work coordination: Project manager, process engineer, equipment engineer, Piping design supervisor, Structural, architectural and civil, Electrical, purchasing and expediting and others Planning hints and Project check list

Introduction to International quality systems - ISO 9000

Quality management practices worldwide, certifying agencies. Quality, customers and ISO 9000 ISO 9000-A management overview ISO 9000- Quality system Inspection, Test standards and Calibration

Text Books:

1. Applied Instrumentation in Process Industries by W.G. Andrew and H.B. Williams, Gulf Professional Publishing, 3rd ed. 2008, ISBN-13: 978-0872010475.
2. Project management: A systems approach to planning scheduling and controlling by Harlod Kerzner and Van Nostrand, John Wiley & Sons, 11th ed., 2013, ISBN: 978-1-118-02227-6.
3. Successful Instrumentation & Control Systems Design, by Michael D. Whitt, 2 nd Edition, 2012, ISA, ISBN: 978-1-93600-745-5.
4. ISO- 9000 Concepts, Methods & Implementation by Tapan B. Bagchi, Wheeler pub., 1995. ISBN-81-85814-24-4
5. ISO- 9000 Guidelines for the chemical & process industries : By ASQC (American Society of Quality Control) , ISBN-13: 978-0873893527, www.asq.org

Reference Books:

1. Instrument Engineers Handbook: Process Control by Bela G Liptak, CRC Press, 3rd ed., 1995,

IN408U INSTRUMENTATION PROJECT MANAGEMENT LAB

Teaching Scheme: 02 P, Total: 02 **Credits:** 01
Evaluation Scheme: 25 ICA + 25 ESE **Total Marks:** 50
ESE Duration: 3 Hrs.

COURSE DESCRIPTION:

For Instrumentation and Control engineer it is very important to know the kind of standard documents available in manufacturing processes along with necessary design, test and calibration procedure. This subject will help student to understand the project procedures and various stages of project like planning, estimation, designing, installation, testing, calibration and commissioning of instruments and systems. Last topic of the syllabus will introduce student with quality manufacturing process.

COURSE OBJECTIVES:

1. To introduce the biomedical signal origin & dynamics
2. To give the basic knowledge of signal processing on biomedical signals
3. To give the knowledge about events detection (viz. P, QRS and T wave in ECG)
4. To study the filtering techniques, Neurological Signal Processing techniques
5. To study the various biomedical signal Data compression techniques

COURSE OUTCOMES

After successful completion of this course, students will be able to

1. Define the origin, source and characteristics of biomedical signals,
2. Differentiate the basics of signal processing techniques
3. Demonstrate the event detection algorithms and inferences in ECG waveform
4. Demonstrate the auto regressive models for EEG waveform signal analysis
5. Implement, categorize the data compression techniques with algorithm

RELEVANCE OF POS AND STRENGTH OF CORRELATION:

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

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

LIST OF EXPERIMENT:

Minimum Ten experiments shall be performed to cover entire curriculum of course IN402U. The list given below is just a guideline.

List of Experiment:

1. Study of standards and symbols (ANSI / ISA Std.)
2. Study of specification sheets.
3. Development of Process & Instrument diagram of typical process.
4. Development of Loop Wiring diagram.
5. Cable scheduling.
6. GA and mimic diagram of a control panel.
7. Development of Bar charts for certain project.
8. Prepare the cost estimation sheet for the project under consideration
9. Hands on experience for engineering management software such as MS Project, Primavera, etc.
10. Designing of control valve for liquid/gas/vapour applications as per standard
11. Design of orifice plates for liquid/gas/vapour as per ISO 5167
12. Operating range calculation for transmitters considering different applications.
13. Develop SOW, project specifications and WBS for any instrumentation project.
14. Preparation of Inquiry, Quotation, Comparative statement, Purchase orders.
15. Study of standards and symbols (ANSI / ISA S-5.1).
16. Development of Process & Instrument diagram of typical process.
17. Develop Instrument index sheet for a P&ID
18. Develop specification sheets for transmitters and actuators (ISA S-20 Format).
19. Prepare a loop wiring diagram and Cable schedule.
20. Prepare a Hook up drawings for installation of transmitters and control valve.
21. Develop GA and mimic diagram of a control panel.
22. Prepare documents required for FAT of a control panel.

Note:

- **ICA –** Internal Continuous Assessment shall support for regular performance of practical and its regular assessment. In addition; it shall be based on knowledge/skill acquired and record submitted by student (journal) based on practical performed by him/her. The performance shall be assessed experiment wise using internal continuous assessment format.
- **ESE –** The End Semester Examination (ESE) for this laboratory course shall be based on performance in one of the experiments performed by student in the semester followed by sample questions to judge the depth of understanding/knowledge or skill acquired by the student. It shall be evaluated by two examiners out of which one examiner shall be out of institute.

IN403U A. NEURAL NETWORK AND FUZZY BASED SYSTEM

(Professional Elective-III)

Teaching Scheme: 03L+ 00 T; Total: 03 **Credits:** 03
Evaluation Scheme: 30 MSE + 10 ISA + 60 ESE **Total Marks:** 100
ESE Duration: 3 Hrs.

COURSE DESCRIPTION:

This course introduces the basic theories and techniques for neural network and fuzzy logic. The course is primarily meant to develop on hand experience in applying these basics to the detail neural and fuzzy logic instrumentation.

COURSE OBJECTIVES:

1. To expose the students to the concepts of feed forward neural networks.
2. To provide adequate knowledge about feedback neural networks.
3. To teach about the concept of fuzziness involved in various systems. To provide adequate knowledge about fuzzy set theory.
4. To provide comprehensive knowledge of fuzzy logic control and adaptive fuzzy logic and to design the fuzzy control using genetic algorithm.
5. To provide adequate knowledge of application of fuzzy logic control to real time systems.

COURSE OUTCOMES:

CO	After the completion of the course the student will be able to	Bloom's Cognitive	
		Level	Descriptor
CO1	Develop the skills to gain a basic understanding of neural network theory and fuzzy logic theory.	01,02	Remembering, Understanding
CO2	Explore the functional components of neural network classifiers or controllers, and the functional components of fuzzy logic classifiers or controllers.	03	Applying,
CO3	Design the fuzzy control using genetic algorithm.	03, 04	Apply, Analyze
CO4	Develop and implement a basic trainable neural network or a fuzzy logic system for a typical control, instrumentation application.	03, 04	Applying, Analyze

RELEVANCE OF POS AND STRENGTH OF CORRELATION:

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

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

Course Content

Introduction Neural Networks

Neuron, Nerve structure and synapse, Artificial Neuron and its model, activation functions, neural network architecture: single layer and multilayer feed forward networks, recurrent networks. Various learning techniques; perception and convergence rule, Auto-associative and hetro- associative memory.

Back propagation networks

Perceptron model, solution, single layer artificial neural network, multilayer perception model; back propagation learning methods, effect of learning rule co-efficient; back propagation algorithm, factors affecting back propagation training, applications

Introduction Fuzzy Logic

Basic concepts of fuzzy logic, Fuzzy sets and Crisp sets, Fuzzy set theory and operations, Properties of fuzzy sets, Fuzzy and Crisp relations, Fuzzy to Crisp conversion.

Fuzzy Membership & Rules

Membership functions, interference in fuzzy logic, fuzzy if-then rules, Fuzzy implications and Fuzzy algorithms, Fuzzy-fications & Defuzzifications, Fuzzy Controller, Industrial applications.

Fuzzy Logic Based Control

Fuzzy Controllers: Preliminaries – Fuzzy sets in commercial products – basic construction of fuzzy controller – Analysis of static properties of fuzzy controller – Analysis of dynamic properties of fuzzy controller – simulation studies –case studies – fuzzy control for smart cars.

Neuro – Fuzzy based system & controller

Neuro – Fuzzy and Fuzzy – Neural Controllers Neuro – fuzzy systems: A unified approximate reasoning approach – Construction of rule bases by self-learning: System structure and learning algorithm – A hybrid neural network based Fuzzy controller with self-learning teacher. Fuzzified CMAC and RBF network based self-learning controllers.

Text Books:

1. Neural Networks, Fuzzy Logic and Genetic Algorithm: Synthesis and Applications, S. Rajsekaran & G.A. VijayalakshmiPai, Prentice Hall of India.
2. Fuzzy Logic with Engineering Applications, Timothy J. Ross, Wiley India.
3. Neural Networks and Fuzzy Systems: A Dynamic Approach to Machine Intelligence, Kosco B, Prentice Hall of India, New Delhi, 1992.
4. Introduction to Artificial Neural Systems, Jacek M. Zuarda, Jaico Publishing House, 1997.
5. Fuzzy sets, Uncertainty and Information, Klir G.J and Folger T.A, Prentice Hall of India, New Delhi 1994.

References:

1. Neural Networks. Siman Haykin, Prentice Hall of India
2. Artificial Intelligence and Intelligent Systems, N. P. Padhy, Oxford University Press.
3. Neural Networks, Kumar Satish, Tata McGraw Hill
4. Artificial Neural Networks, Bose and Liang, Tata Mc-graw Hill, 1996.
5. Neural Networks, Simon Haykin, ISA, Research Triangle Park, 1995

IN409U A. NEURAL NETWORK AND FUZZY BASED SYSTEM LAB

(Professional Elective-III)

Teaching Scheme: 02 P ; Total: 02 **Credits:** 01
Evaluation Scheme: 25 ICA + 25 ESE **Total Marks:** 50
ESE Duration: 3 Hrs.

COURSE DESCRIPTION:

This course introduces the basic theories and techniques for neural network and fuzzy logic. The course is primarily meant to develop on hand experience in applying these basics to the detail neural and fuzzy logic based system.

LIST OF EXPERIMENT:

Minimum Ten experiments shall be performed to cover entire curriculum of course IN403UA. The list given below is just a guideline.
List of Experiment:

List of Experiment:

1. Write a program to implement single layer perception algorithm.
2. Write a program to implement back propagation learning algorithm
3. Design multilayer feed forward network using back propagation algorithm
4. Study of fuzzy inference system
5. To study fuzzy logic controller using fuzzy logic toolbox
6. Write a program to implement SDPTA
7. Write a program to implement RDPTA
8. To Study various defuzzification techniques
9. Write a program to implement of fuzzy set operation
10. Applications and analysis of process using fuzzy system.
11. Applications and analysis of process using fuzzy PID system.
12. Applications and analysis of MIMO process using fuzzy system.

Note:

- **ICA –** Internal Continuous Assessment shall support for regular performance of practical and its regular assessment. In addition; it shall be based on knowledge/skill acquired and record submitted by student (journal) based on practical performed by him/her. The performance shall be assessed experiment wise using internal continuous assessment format. **(S 10).**
- **ESE –** The End Semester Examination (ESE) for this laboratory course shall be based on performance in one of the experiments performed by student in the semester followed by sample questions to judge the depth of understanding/knowledge or skill acquired by the student. It shall be evaluated by two examiners out of which one examiner shall be out of institute.

IN403UB INSTRUMENTATION SYSTEM DESIGN
(Professional Elective-III)

Teaching Scheme: 03L+ 00 T; Total: 03 **Credits:** 03
Evaluation Scheme: 30 MSE + 10 ISA + 60 ESE **Total Marks:** 100
ESE Duration: 3 Hrs.

COURSE DESCRIPTION:
The course provides an overview of static and dynamic performance characteristics of instruments. Selection criteria for flow, temperature transducers. Design considerations for transducers such as thermocouple, RTD, orifice plates, Rota meter. Calibration and installation procedure for different transducers. The subject also specifies noise free controller and control panel design techniques.

COURSE OBJECTIVES:
The objective of course are as follows
1. To understand the signal conditioning of different transducers.
2. To learn the reliability concepts.
3. Design noise free instruments, control panels, and controllers.

. DESIRABLE AWARENESS/SKILLS:
Sensors and transducers, measurement system. Electronic instrumentation.

COURSE OUTCOMES:

CO	After the completion of the course the student will be able to	Bloom's Cognitive	
		Level	Descriptor
CO1	Understand sensor design, selection and application	1,2	Remember, Understand
CO2	Understand transducer signal conditioning and instrumentation	2,3	Understand, Apply
CO3	To study concept of reliability engineering and their applications	2,3,4	Understand, Apply, Analyze
CO4	Understand various aspect of Noise Free Design and apply them for ISD	2,3	Understand, Apply,
CO5	Design control panels and controllers	3,4,5	Apply, Analyze, Evaluate

RELEVANCE OF POS AND STRENGTH OF CORRELATION:

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

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

Course Content

Basic Concepts of Transducer Design:
General transducer design consideration, testing of transducer, and selection criteria of transducer. Design of temperature measurement system based on RTD, Thermocouple and thermistors, Design of Displacement measurement system based using LVDT, Potentiometer, Ultrasonic transducer, complete signal conditioning circuits for above temperature and Displacement transducers.

Design aspects of flow & Pressure transducers:
Design of orifice, rotameter, and venture based flow system and signal conditioning circuits for above system. Design of level sensors and its signal conditioning circuits, design of pressure gauge, diaphragm based pressure gauge, Load cell and its signal conditioning, study of P/I and I/P converters, Design of smart transmitters

Reliability:
Concept of reliability definition, Distinction between Quality and reliability, failures, Availability, Maintainability, (MTBF, MTTF, MTTR) Life Cycle and Bathtub curve, Reliability Modeling Exponential, Weibull and Gamma Distribution, Hazard rate and Derivation of MTTF Failure Density Function, Cumulative Distribution Function and Reliability, availability, maintainability, quality assurance.

Noise Free Design:
Guidelines for enclosure: components and accessories, Grounding and shielding techniques noise in electronic circuits, EMI/ EMC protection against EMI, ESD selection of cables, connectors, types of knobs, mechanical fixture PCB holders, clamps, control panel layout ergonomics, types of' gear boxes and drives. Ingress protection authorized regulatory bodies for certifying instruments in Hazardous location (BASEEFA, FM, PTB, UL, CESI, LLIE, CSA, DEMKO, and IEC & CENELEC).

Design of control panels & controllers:
Control Panel Design: Design considerations, Type of control panel designs, Ergonomics in design of control, control room layout, cabling, wiring details. Pneumatic controllers using flapper-nozzle mechanism, Electronics controller using op-amps, considerations in design of data presentation elements, recorders, and monitors

Text Books:
1. Measurement Systems, Doeblin E. O. and D. Mannik, 5th Edition,
2. Application and Design, McGraw Hill International Edition, 2006.
3. Process Control Instrumentation Technology, Johnson C. D, Pearson Education, New Delhi, 7th Edition, 2003.
4. Reliability Engineering, E. Balguruswamy, PHI.

Reference Books:

1. Electrostatic Discharge and Electronic Equipment, Warren Boxleitner, IEEE press..
2. Applications of Analog Integrated Circuit, S. Soclof, PHI.
3. Instrument Engineers Handbook, Process Measurement Volume I and Process Control Volume II, Liptak B. G, Chilton Book Company, 2001
4. A Course in Mechanical Measurements and Instrumentation, Sawhney A. K. and Puneet Sawhney, Dhanpat Rai and Co. (P) Ltd, New Delhi, 1998.
5. Applied Instrumentation in the Process Industries Vol. I and Vol. II, Andrew Williams, GWF Publishing Company.

IN409UB INSTRUMENTATION SYSTEM DESIGN LAB
(Professional Elective-III)

Teaching Scheme: 02P, Total: 02 **Credit:** 01
Evaluation Scheme: 25 ICA+ 25 ESE **Total Marks:** 50
Duration of ESE: 03Hrs

COURSE DESCRIPTION:

Instrumentation design deals with specification of equipment, layouts, wiring. All activity handled by instrumentation design engineer. The course provides an overview of static and dynamic performance characteristics of instruments. Selection criteria for flow, temperature transducers. Design considerations for transducers such as thermocouple, RTD, orifice plates, Rotameter. It also includes design of controllers and control panels.

Minimum Ten experiments shall be performed to cover entire curriculum of course IN403UB.

The list given below is just a guideline.

1. Design of signal conditioning circuit for resistive displacement transducer.
2. Design of signal conditioning circuit for Capacitive/Inductive displacement transducer.
3. Design signal conditioning circuit for strain gauge
4. Design of signal conditioning for load cell
5. Design of signal conditioning circuit for RTD (Pt-100)
6. Design of signal conditioning for thermocouple (J/K/R/S/T/E Type)
7. Calibration of I/P & P/I converter
8. Calibration of D.P. Transmitter for flow
9. Calibration of D.P. Transmitter for level
10. Smart transmitter.
11. Enclosure design for circuit and instrument.
12. Design electronic PID controller.
13. Any other experiments related to the subject.
14. Practical related to reliability engineering.

ICA – Internal Continuous Assessment shall support for regular performance of practical and its regular assessment. In addition; it shall be based on knowledge/skill acquired and record submitted by student (journal) based on practical performed by him/her. The performance shall be assessed experiment wise using internal continuous assessment format **(S 10).**

ESE – The End Semester Examination (ESE) for this laboratory course shall be based on performance in one of the experiments performed by student in the semester followed by sample questions to judge the depth of understanding/knowledge or skill acquired by the student. It shall be evaluated by two examiners out of which one examiner shall be out of institute

IN403UC WIRELESS SENSOR NETOWRKS
(Professional Elective-III)

Teaching Scheme: 03L+ 00 T; Total: 03 **Credits:** 03
Evaluation Scheme: 30 MSE + 10 ISA + 60 ESE **Total Marks:** 100
ESE Duration: 3 Hrs.

COURSE DESCRIPTION:
This course includes introduction to the wireless sensor network system. This course is designed to introduce the students to the basic principles of wireless sensors, nodes and network architecture and their application to various system

COURSE OBJECTIVES:
The objective of course are as follows
1. To learn basic concepts of Wireless sensor networks
2. To be familiar with architecture and protocols used in Wireless sensor networks
3. To provide knowledge of deployment and security issued of Wireless sensor networks

.DESIRABLE AWARENESS/SKILLS:
Sensors and transducers, wireless protocols. Concepts of sensor node and network.

COURSE OUTCOMES:

Co	After The Completion Of The Course The Student Will Be Able To	Bloom's Cognitive	
		Level	Descriptor
CO1	Explain various concepts and terminologies used in WSN	1,3	Remember, Understand
CO2	Explain various wireless standards and protocols associated with WSN	1,2	Understand, Apply
CO3	Recognize importance of localization and routing techniques used in WSN	2,3,3	Understand, Apply, Analyze
CO4	Understand Techniques Of Data Aggregation And Importance of Security In WSN.	2,3	Understand, Apply,
CO5	Examine the issues involved in design and deployment of WSN	2,1,3	Apply, Analyze, Evaluate

RELEVANCE OF POS AND STRENGTH OF CORRELATION:

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

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

Course Content

Introduction:

Basics of Wireless Sensor Networks, Wireless Sensor Node, Anatomy of a Sensor Node, architecture of WSN , Performance metrics in WSNs, types of WSN

Architectures:

Single-Node Architecture - Hardware Components, Energy Consumption of Sensor Nodes , Operating Systems and Execution Environments, Network Architecture, Sensor Network Scenarios, Optimization Goals and Figures of Merit, Gateway Concepts. Concepts of Routing and its protocol.

Wireless Standards and Protocol Stack

WSN Standards- IEEE802.15.4 Low rate WPAN, ZigBee, Wireless HART, ISA 100.11a, 6LoWPAN, IEEE802.15.3, Wibree, BLE, Zwave, ANT, Insteon, Wavenis, Protocol stack of WSNs, Cross Layer Protocol Stack

Networking Sensors

Physical Layer and Transceiver Design Considerations, MAC Protocols for Wireless Sensor Networks, Low Duty Cycle Protocols And Wakeup Concepts - S-MAC, The Mediation Device Protocol, Wakeup Radio Concepts, Address and Name Management, Assignment of MAC Addresses, Routing Protocols- Energy-Efficient Routing, Geographic Routing.

Infrastructure Establishment

Topology Control, Clustering, Time Synchronization, Localization and Positioning, Sensor Tasking and Control. Cyber security – Principal, law, and applications.

Designing and Deploying WSN Applications:

Designing and Deploying WSN Applications, Early WSN Deployments, General Problems, General Testing and Validation, Requirements Analysis, The Top-Down Design Process, Bottom-Up Implementation Process.

Text Books:

1. Kazem Sohraby, Daniel Minoli and Taieb Znati, ― Wireless Sensor Networks Technology, Protocols, and Applications―, John Wiley & Sons, 2007.
2. Holger Karl and Andreas Willig, ―Protocols and Architectures for Wireless Sensor Networks‖, John Wiley & Sons, Ltd, 2005.
3. Feng Zhao & Leonidas J. Guibas, "Wireless Sensor Networks- An Information Processing Approach", Elsevier, 2007.

Reference Books:

1. Hossam Fahmy, ―Wireless Senor Networks: Concepts, Application, experimentation and analysis‖, Springer Publication
2. Anna Forster, ―Introduction to Wireless Sensor Networks‖, IEEE Press, Wiley Publication
3. Anna Hac, ―Wireless Sensor Network Designs‖, John Wiley & Sons Ltd, 2003.

IN409UC WIRELESS SENSOR NETWORK LAB
(Professional Elective-III)

Teaching Scheme: 02P Total: 02 **Credit:** 01
Evaluation Scheme: 25 ICA+ 25 ESE **Total Marks:** 50
Duration of ESE: 03Hrs

COURSE DESCRIPTION:

This course is designed to introduce the basic principles and applications of wireless sensor network (WSN). It also includes the study of different concepts of WSN such as sensor node, architecture, protocols, networking etc

Minimum Ten experiments shall be performed to cover entire curriculum of course IN403UC.

The list given below is just a guideline.

1. Introduction of Wireless sensor network applications and its simulation.
2. Network Simulator installation of wireless sensor network.
3. Write any script for transmission between nodes.
4. Study the architecture of WSN
5. Write any script for sensor nodes with different parameters.
6. Write simple application using wireless HART
7. Write and analyze simple application using ZIGBEE
8. Study other wireless sensor network simulators
9. Analyze MAC Protocols for Wireless Sensor Networks,
10. Implementation of routing protocol in NS2 any protocol
11. Analyze and details of application of WSN in industrial control application
12. Analyze the concepts of Infrastructure Establishment
13. Infrastructure establishment with Sensor Tasking and Control: A short review

ICA – Internal Continuous Assessment shall support for regular performance of practical and its regular assessment. In addition; it shall be based on knowledge/skill acquired and record submitted by student (journal) based on practical performed by him/her. The performance shall be assessed experiment wise using internal continuous assessment format **(S 10).**

ESE – The End Semester Examination (ESE) for this laboratory course shall be based on performance in one of the experiments performed by student in the semester followed by sample questions to judge the depth of understanding/knowledge or skill acquired by the student. It shall be evaluated by two examiners out of which one examiner shall be out of institute

IN403UD NONLINEAR CONTROL SYSTEM
(Professional Elective-III)

Teaching Scheme: 03L+ 00 T; Total: 03 **Credits:** 03
Evaluation Scheme: 30 MSE + 10 ISA + 60 ESE **Total Marks:** 100
ESE Duration: 3 Hrs.

COURSE DESCRIPTION:
This course includes introduction to characteristics of nonlinear systems. It is designed to introduce the students to the basic principles of stability analysis of nonlinear systems. It also includes design of various control schemes for nonlinear systems.

COURSE OBJECTIVES:

The objective of course are as follows
To introduce the need and concept of nonlinear system.
To impart knowledge about different strategies adopted in the analysis of nonlinear systems.
To familiarize with the design of different types of nonlinear controllers.

DESIRABLE AWARENESS/SKILLS:
Classical control systems and Modern control system.

COURSE OUTCOMES:

CO	After the completion of the course the student will be able to	Bloom's Cognitive	
		Level	Descriptor
CO1	Understand concept of nonlinear system.	1,2	Remember, Understand
CO2	Understand concept of stability theory.	2,3	Understand, apply
CO3	Design controllers for nonlinear systems.	2,3,4	Understand, apply, analyze
CO4	Apply the method of feedback linearization to specific systems	2,3	Understand, apply,

RELEVANCE OF POS AND STRENGTH OF CORRELATION:

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

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

Course Content

Nonlinear system:
Introduction - Characteristics of nonlinear systems, why nonlinear control? Examples, Classification of equilibrium points, Analysis of systems with piecewise constant inputs using phase plane analysis. Periodic orbits - limit cycles-Poincare-Bendixson criterion, Existence and uniqueness of solutions, Lipschitz condition.

Fundamentals of Liapunov theory:
Nonlinear systems and equilibrium points, Concepts of stability, Linearization and local stability, Lyapunov's direct method, Invariant set theorems, Lyapunov analysis of LTI systems, Krasovskii's method, Variable gradient method, physically motivated Lyapunov functions, and Performance analysis. Control design based on Liapunov's direct method.

Advanced stability theory:
Concepts of stability for Non-autonomous systems, Lyapunov analysis of non-autonomous systems, instability theorems, Existence of Lyapunov functions, Barbalat's Lemma and stability analysis, Positive real systems: PR and SPR Transfer functions, The Kalman-Yakubovich Lemma, The passivity Formalism: passivity in linear systems. Absolute stability.

Nonlinear control systems design:
Control problems- stabilization via linearization - integral control via linearization- Gain scheduling Feedback linearization-stabilization and tracking via state feedback control. Sliding mode control Regulation via integral control- Lyapunov redesign- stabilization and nonlinear damping Backstepping- Passivity based control- High gain observers. Linear Quadratic Regulators/Linear Quadratic Guassian Regulators-Numerical Solution for Riccatti Equations.

Text Books:

1. Nonlinear Control Systems: An Introduction by Alberto Isidori, Springer-Verlag, 1985
2. Nonlinear Systems by Hassan K Khalil, Prentice - Hall International (UK), 2002.
3. Applied Nonlinear Control by Jean-Jacques E. Slotine and Weiping Li, Prentice-Hall, NJ, 1991.

Reference Books:
1. Nonlinear Systems Analysis by M. Vidyasagar, Prentice-Hall, India, 1991.
2. Nonlinear System Analysis, Stability and Control by Shankar Sastry, Springer, 1999.

IN409UD NONLINEAR CONTROL SYSTEM LAB
(Professional Elective-III)

Teaching Scheme: 02P, Total: 02 **Credit:** 01
Evaluation Scheme: 25 ICA+ 25 ESE **Total Marks:** 50
Duration of ESE: 03Hrs

COURSE DESCRIPTION:
This course is designed to introduce the basic principles and concepts of Nonlinear Systems. Design of various control strategies for Nonlinear Systems.

Minimum Eight experiments shall be performed to cover entire curriculum of course IN403U D.

The list given below is just a guideline.

1. Solution of Ordinary Differential Equation.
2. Modeling of Physical Systems using MATLAB.
3. Modeling of Physical Systems using SIMULINK.
4. Design control scheme for Mechanical and electrical nonlinear system.
4. Case Study: Inverted Pendulum.
5. Design of Sliding mode control for Inverted Pendulum.
6. Design of back stepping control for Inverted Pendulum
7. Design of Feedback linearization based control.
8. Linear Quadratic Regulator Study.

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ESE – The End Semester Examination (ESE) for this laboratory course shall be based on performance in one of the experiments performed by student in the semester followed by sample questions to judge the depth of understanding/knowledge or skill acquired by the student. It shall be evaluated by two examiners out of which one examiner shall be out of institute

IN404UA AUTOMOTIVE INSTRUMENTATION

(Professional Elective-IV)

Teaching Scheme: 03L+ 00 T; Total: 03 **Credits:** 03
Evaluation Scheme: 30 MSE + 10 ISA + 60 ESE **Total Marks:** 100
ESE Duration: 3 Hrs.

COURSE DESCRIPTION:

Automobile Industry is one of the most important industries. The automobiles are getting converted from mechanical system to highly modernized Electro-mechanical systems and from driver to driverless vehicle. The manufacturers of automobiles are increasing usage of sensors and control system to improve safety measures and also to increase comfort of users. This subject is intended to make student aware with sensors and other technologies used in modern automobiles.

COURSE OBJECTIVES:

1 To evaluate the sensor and measuring system of automobile.
2 To acquire knowledge of various automotive standards and Protocols.
3 To design the basic modeling and control scheme for automotive systems.

COURSE OUTCOMES:

CO	After the completion of the course the student will be able to	Bloom's Cognitive	
		Level	Descriptor
CO1	evaluate the sensor and measuring system of automobile	01,02	Remembering, Understanding
CO2	Acquire knowledge of various automotive standards and Protocols.	01,02	Remembering, Understanding
CO3	Design the basic modelling and control scheme for automotive systems and instruments for automotive applications.	03	Applying
CO4	Analyze the use of instruments in automotive industry.	03,04	Applying, Analyzing

RELEVANCE OF POS AND STRENGTH OF CORRELATION:

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

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

Course Content

Introduction:

Introduction of automobile system, current trends in automobiles with emphasis on increasing role of electronics and software, overview of generic automotive control ECU functioning, overview of typical automotive subsystems and components, AUTOSAR.

Engine management systems

Basic sensor arrangement, types of sensors such as oxygen sensors, crank angle position sensors, Fuel metering/ vehicle speed sensors, flow sensor, temperature, air mass flow sensors, throttle position sensor, solenoids etc., algorithms for engine control including open loop and closed loop control system, electronic ignition, EGR for exhaust emission control.

Vehicle power train and motion control

Electronic transmission control, adaptive power Steering, adaptive cruise control, safety and comfort systems, anti-lock braking, traction control and electronic stability, active suspension control. Hardware in loop testing of automotive ECU using available software/hardware platform Simulation.

Active and passive safety system

Body electronics including lighting control, remote keyless entry, immobilizers etc., electronic instrument clusters and dashboard electronics, aspects of hardware design for automotive including electro-magnetic interference suppression, electromagnetic compatibility etc., (ABS) antilock braking system, (ESP) electronic stability program, air bags

Automotive standards and protocols

Automotive standards like CAN protocol, Lin protocol, flex ray, OBD-II, CAN FD, automotive Ethernet etc. Automotive standards like MISRA, functional safety standards (ISO 26262).

System design, energy management and EV

BMS (battery management system), FCM (fuel control module), principles of system design, assembly process of automotive and instrumentation systems. Electric Vehicle: Introduction and EV development, challenges, basic concepts of electric traction and architecture of an electric car, electric power generation, energy storage, conversion to mechanical power, power train, drive train and electric drives.

Text Books:

1. A. K. Babu, Automotive Electrical and Electronics, Khanna Book Publishing, 2016

Reference Books:

1. William B. Riddens, "Understanding Automotive Electronics", 5th Edition,(Buterworth Heinemann Woburn)(1998)
2. Tom Weather Jr and Cland C. Hutter," Automotive Computers and Control system" Prentice Hall Inc. New Jeresy
3. Jiri Marek,Hans Peter trah ,"Sensors applications, sensors for automotive Technology" 1st Edition.
4. T.Mellard, Automotive Electronics System "1987 by Heinenmann Professional.

IN410UA AUTOMOTIVE INSTRUMENTATION LAB

(Professional Elective-IV)

Teaching Scheme: 02 P; Total: 02 **Credits:** 01
Evaluation Scheme: 50 ICA + 25 ESE **Total Marks:** 75
ESE Duration: 3 Hrs.

COURSE OBJECTIVES:

1. To evaluate the sensor and measuring system of automobile.
2. To acquire knowledge of various automotive standards and Protocols.
3. To design the basic modeling and control scheme for automotive systems.

COURSE OUTCOMES:

CO	After the completion of the course the student will be able to	Bloom's Cognitive	
		Level	Descriptor
CO1	evaluate the sensor and measuring system of automobile	01,02	Remembering, Understanding
CO2	Acquire knowledge of various automotive standards and Protocols.	01,02	Remembering, Understanding
CO3	Design the basic modelling and control scheme for automotive systems and instruments for automotive applications.	03	Applying
CO4	Analyze the use of instruments in automotive industry.	03,04	Applying, Analyzing

RELEVANCE OF POS AND STRENGTH OF CORRELATION:

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

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

Minimum Ten experiments shall be performed to cover entire curriculum of course IN404UA. The list given below is just a guideline.

List of Experiment:

1 To study the current automation trends in automobiles industry.
2 overview of generic automotive control ECU functioning.
3 Analyze the use of instruments in automotive industry.
4 To design the characteristics of oxygen sensors.
5 To study the characteristics of Fuel metering/ vehicle speed sensors
6 To study adaptive cruise control system.
7 To study anti-lock braking, traction control system.
8 To study automotive standards like CAN protocol.
9 To study of automotive standards like MISRA etc.
10 To study of automotive Ethernet.
11 To study the fuel control module FCM.
12 To study the assembly process of automotive and instrumentation systems.

Note:

- **ICA –** Internal Continuous Assessment shall support for regular performance of practical and its regular assessment. In addition; it shall be based on knowledge/skill acquired and record submitted by student (journal) based on practical performed by him/her. The performance shall be assessed experiment wise using internal continuous assessment format.
- **ESE –** The End Semester Examination (ESE) for this laboratory course shall be based on performance in one of the experiments performed by student in the semester followed by sample questions to judge the depth of understanding/knowledge or skill acquired by the student. It shall be evaluated by two examiners out of which one examiner shall be out of institute.

IN404UB ROBOTICS

(Professional Elective-IV)

Teaching Scheme: 03L+ 00 T; Total: 03 **Credits:** 03
Evaluation Scheme: 30 MSE + 10 ISA + 60 ESE **Total Marks:** 100
ESE Duration: 3 Hrs.

COURSE DESCRIPTION:

This course provides a knowledge on the science and engineering of mechanical manipulation and discusses the control technique for working of robotic manipulators. In this course, various methodology of modelling of robotics, kinematics and dynamics will be studied. Further, concepts of controller design and application will also be discussed. The theory is supported by numerical examples, practical examples and MATLAB programming.

DESIRABLE AWARENESS:

Knowledge of basic control systems components, mathematics and computer skills, modeling, and control strategies.

COURSE OBJECTIVES:

Course Learning Objectives

1. To understand the basic concepts, parts of robots and their types.
2. To introduce various trajectory planning and tracking techniques.
3. To discuss about the various applications of robots
4. To design and apply robotic control techniques.

COURSE OUTCOMES:

CO	After the completion of the course the student will be able to	Bloom's Cognitive	
		Level	Descriptor
CO1	To study robotics fundamentals and apply the same to Engineering problems.	1,2	Remember, Understand
CO2	Accomplish mathematical modeling of robots	2,3	Understand, Apply
CO3	Exercise kinematics and dynamics of manipulators.	2,3,4	Understand, Apply, Analyze
CO4	Design the controller techniques	2,3	Understand, Apply,
CO5	Suggest and apply the robotic manipulator system for Specific application.	3,4,5	Apply, Analyze, Evaluate

RELEVANCE OF POS AND STRENGTH OF CORRELATION:

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

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

Course Content

Introduction: - Basic Concepts such as Definition degrees of freedom, Structure, Classification and Specifications of Robots, Industrial Robots. – Different types of robots. Manipulators, Drives, Sensors, End Effectors, Robotic system components- Notations- Position definitions.

Modeling of Robots: Coordinate Frames, Link description and connections, Manipulator kinematics, Mapping and Transformation; Direct Kinematic Model; Inverse Kinematics; Manipulator Differential Motion; Static Analysis; Jacobian, velocities and static forces.

Manipulator Dynamics: Acceleration of a rigid body, mass distribution, Newton's equation, iterative Newton - Euler dynamic formulation, Lagrangian formulation of manipulator dynamics, Inclusion of nonrigid body effects, Trajectory Planning, description and generation.

Linear and Non Linear Control of Manipulators: feedback and closed-loop control, control law partitioning, trajectory following control, multi-input multi output control systems, Cartesian based control scheme. Current industrial-robot control systems, Force Control of manipulators: hybrid position/force control

Robot Programming, Robot Programming for Manufacturing and Other Applications, Robotic vision systems, image representation, object recognition and categorization, Robots in welding, Spray painting, assembly operation, cleaning, robot for underwater applications, design of multiple degrees of freedom, active and passive grippers -Factors influencing the choice of a robot, robot performance testing- Impact of robot on industry and society. New Trends & recent updates in robotics and Future scope.

Text Books:

1. Introduction to Robotics (Mechanics and Control), John J. Craig, Addison-Wesley, 2nd Edition,2004
2. Robotics: Control, Sensing, Vision and Intelligence, K.S. Fu, R.C. Gonzales, C.S.G. Lee, McGraw Hill, 1987.
3. Robotics and Control, Mittal R. K. and Nagrath I. J., Tata McGraw Hill, New Delhi , 2003
4. Industrial Robotics: Technology, Programming and Applications, Mikell P. Groover et. al. McGraw – Hill International, 1986.
5. Handbook of Industrial Robotics, Shimon Y. Nof, John Wiley Co, 2001.

Reference Books:

1. Robotic Engineering: An Integrated Approach, Richard D. Klafter, Thomas A. Chemielewski, Michael Negin, Prentice Hall India, 2002
2. Introduction to Robotics, S. K. SAHA, Tata McGraw-Hill Education, 2008

IN409UB ROBOTICS LAB

(Professional Elective-IV)

Teaching Scheme: 02P, Total: 02 **Credit:** 01
Evaluation Scheme: 50 ICA+ 25 ESE **Total Marks:** 75
Duration of ESE: 03Hrs

COURSE DESCRIPTION:

. This course provides practical examples of robotics and MATLAB programming.

Minimum Ten experiments shall be performed to cover entire curriculum of course IN404UB. The list given below is just a guideline.

1. Study components of an industrial robot (PUMA, KUKA, FANUC, MTAB, UR, etc.) and its DH parameters.
2. Forward kinematics and validation using a software (Robo Analyzer/ MATLAB or any other free software tool).
3. Inverse kinematics of an industrial robot and validation using any open source software.
4. Industrial Robot programming using VAL II or equivalent.
5. Microcontroller lab – programming (free software /open source)
6. Integration of assorted sensors (IR, Potentiometer, strain gages etc.), micro controllers and ROS (Robot Operating System) in a robotic system. (Free software, MATLAB)
7. Control experiment using available hardware or software. (Open source or MATLAB).
8. Use of open source computer vision programming tool/ MATLAB, open CV.
9. Research related experiment in AI, e.g. multi agent system, unmanned systems control using ROS, etc.
10. Small group project work relevant to Industrial automation.
11. Other practical based on the equipment in laboratories.

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ICA – Internal Continuous Assessment shall support for regular performance of practical and its regular assessment. In addition; it shall be based on knowledge/skill acquired and record submitted by student (journal) based on practical performed by him/her. The performance shall be assessed experiment wise using internal continuous assessment format **(S 10).**

ESE – The End Semester Examination (ESE) for this laboratory course shall be based on performance in one of the experiments performed by student in the semester followed by sample questions to judge the depth of understanding/knowledge or skill acquired by the student. It shall be evaluated by two examiners out of which one examiner shall be out of institute.

IN404UC DIGITAL IMAGE PROCESSING
(Professional Elective-IV)

Teaching Scheme: 03L+ 00 T; Total: 03 **Credits:** 03
Evaluation Scheme: 30 MSE + 10 ISA + 60 ESE **Total Marks:** 100
ESE Duration: 3 Hrs.

COURSE DESCRIPTION:
Digital Image processing is has important applications in various industries ranging from process industry to medical field. This course is introduced to understand the fundamentals of image processing to students. The students can able to apply various processes and techniques on images for image understanding. The course also includes the design aspects and realization of image processing applications.

COURSE OBJECTIVES:
The objective of course are as follows
1. Learn digital image fundamentals.
2. Learn to represent image in form of features.
3. Be exposed to simple image processing techniques.
4. Be familiar with image compression and segmentation techniques.

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DESIRABLE AWARENESS/SKILLS:
Fundamentals of signal processing, discrete systems, 2D computation and mathematical algebra and calculus

COURSE OUTCOMES:

CO	After the completion of the course the student will be able to	Bloom's Cognitive	
		Level	Descriptor
CO1	Discuss digital image fundamentals	1,2	Remember, Understand
CO2	Apply image enhancement and restoration techniques.	1,3	Understand, Apply
CO3	Use image compression and segmentation Techniques.	3,3	Apply, Analyze
CO4	Represent features of images	2,3	Understand, Apply,
CO5	Apply image processing algorithms	2,1,3	Apply, Analyze, Evaluate

RELEVANCE OF POS AND STRENGTH OF CORRELATION:

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

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

Course Content

Introduction to fundamentals:
Introduction , Origin – Steps in Digital Image Processing, Components, Elements of Visual Perception, Image Sensing and Acquisition, Image Sampling and Quantization, Relationships between pixels , color models.

Image Enhancement:
Spatial Domain: Gray level transformations, Histogram processing, Basics of Spatial Filtering, Smoothing and Sharpening Spatial Filtering , Frequency Domain: Introduction to Fourier Transform, Smoothing and Sharpening frequency domain filters, Ideal, Butterworth and Gaussian filters.

Image Restoration and Reconstruction:
Noise Models, Noise Reduction, Inverse Filtering, MMSE (Wiener) filtering, color image processing.

Image Compression:
Fundamentals of redundancies, Basic Compression Methods: Huffman coding, Arithmetic coding, LZW coding, JPEG Compression standard.

Image Segmentation:
Point, line and edge detection, Thresholding, Regions Based segmentation, Edge linking and boundary detection, Hough transform. Morphological processing- erosion and dilation

Applications of image processing:
Object Recognition- patterns and pattern classes, recognition based on decision, theoretic methods, structural methods, case studies, and image analysis. Application of Image processing in process and defense industries

Text Books:
1. Gonzalez & Woods, ―Digital Image Processing‖, 3rd ed., Pearson education, 2008
2. Jain Anil K., ―Fundamentals Digital Image Processing‖, Prentice Hall India, 2010

Reference Books:
1. Milan Sonka, Vaclav Hlavav, Roger Boyle, ―Image Processing, Analysis and Machine Vision‖, 2nd ed., Thomson Learning, 2001
2. Rangaraj M. Rangayyan, ―Biomedical Image Analysis‖, CRC Press, 2005
3. Pratt W.K, ―Digital Image Processing‖, 3rd ed., John Wiley & Sons, 2007
4. Digital Image Processing, 3rd Edition, by Rafael C Gonzalez and Richard E Woods. Publisher: Pearson Education

IN410U C DIGITAL IMAGE PROCESSING LAB

(Professional Elective-IV)

Teaching Scheme: 02P Total: 02 **Credit:** 01
Evaluation Scheme: 50 ICA+ 25 ESE **Total Marks:** 75
Duration of ESE: 03 Hrs.

COURSE DESCRIPTION:

In the image processing laboratory, students will implement image processing techniques that will learn during the frontal course. Work in the lab will be carried out in any software of high computation, under the suitable operating system (Windows/Linux). The prior knowledge of digital processing and systems are required for the work in the lab.

Minimum Ten experiments shall be performed to cover entire curriculum of this course IN404UC. The list given below is just a guideline.

1. Write a program to display grayscale image using read and write operation..
2. To create a vision program to find histogram value and display histograph of a grayscale and color image.
3. Write a vision program for Nonlinear Filtering technique using edge detection.
4. To create a vision program to determine the edge detection of an image using different operators.
5. To create a program to discretize an image using Fourier transformation..
6. To create a program to eliminate the high frequency components of an image.
7. Write a program to implement various low pass filters and high pass filter in frequency domain.
8. Write a program for image segmentation
9. To create a color image and perform read and write operation.
10. Write a program for image compression
11. To obtain the R, B, G color values and resolved color values from a color box by choosing any color.
12. To create a program performs discrete wavelet transform on image.
13. To create a program for segmentation of an image using watershed transforms.
14. Write a program for image morphology
15. Write a program for Image Restoration
16. Write a program for Edge detection
17. Implement Image compression using DCT Transform
18. Implement various noise models and their Histogram

ICA – Internal Continuous Assessment shall support for regular performance of practical and its regular assessment. In addition; it shall be based on knowledge/skill acquired and record submitted by student (journal) based on practical performed by him/her. The performance shall be assessed experiment wise using internal continuous assessment format **(S 10).**

ESE – The End Semester Examination (ESE) for this laboratory course shall be based on performance in one of the experiments performed by student in the semester followed by sample questions to judge the depth of understanding/knowledge or skill acquired by the student. It shall be evaluated by two examiners out of which one examiner shall be out of institute

IN404U D DIGITAL CONTROL

(Professional Elective-IV)

Teaching Scheme: 03L+ 00 T; Total: 03 **Credits:** 03
Evaluation Scheme: 30 MSE + 10 ISA + 60 ESE **Total Marks:** 100
ESE Duration: 3 Hrs.

COURSE DESCRIPTION:

The core course in Instrumentation engineering introduces the fundamental concepts, principles and application of digital control system analysis and design to the undergraduate students. The topics cover classical control design methods as well as the modern control design techniques

COURSE OBJECTIVES:

1. Exposed to an appropriate modern paradigm for the study of larger scale multi-input-multioutput systems.
2. Able to use linear algebra and matrix theory in the analysis and design of practical control systems
3. Motivated to implement modern control systems using a digital computer.
4. Analyse stability of open loop and closed loop discrete-time systems.

COURSE OUTCOMES:

CO	**After the completion of the course the student will be able to**	**Bloom's Cognitive**	
		Level	**Descriptor**
CO1	Understand the basic sampling theory and converter.	01,02	Remembering, Understanding
CO2	Understand the basic sampling theory and converter.	02	Applying,
CO3	Analyze stability of open loop and closed loop discrete-time systems.	03	Understanding
CO4	Design state feedback and output feedback controllers.	03	Applying,

RELEVANCE OF POS AND STRENGTH OF CORRELATION:

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

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

Course Content

Digital Control Systems

Introduction, description of some physical systems, continuous versus digital control, Discrete-time signals, discrete time systems, sampling and reconstruction, digitizing analog controllers.
Introduction to digital control

The Z Transforms

Definition and evaluation of Z-Transform, mapping between the s-plane and the z-plane, the inverse z-transform, theorems of z-transform, imitation of z-transform method. The pulse transfer function, pulse, transfer function of zero order hold, responses between the sampling instants, signal flow graph method applied to digital systems, stability of digital control systems, jury stability criterion

State Space Theory

Introduction, state description of digital processors, state description of sampled continuous- time plant, state description of systems with dead time and sample and hold discrete state models using phase physical and canonical variables. Relation between state equation and transfer function and solution of state difference equations, controllability and observability.

Controller Design Controller Design Using Transform Techniques

Root locus and frequency domain analysis compensator design. : Discretising the differential equation of continuous PID controllers, Parameter optimized discrete control algorithms of low order, PID control algorithm through Z transformations, Deadbeat algorithm, Dahlin‟s algorithm, Digital Equivalent of convention controller, Smith Predictor algorithm, Internal Model control, Analytical Predictor Algorithm, Kalman algorithm, Algorithm of Gautam and Mutharasan, Treatment of noisy process signals.

Pole-Placement Design and Digital State Observer

Stability improvement by state feedback, digital control systems, with state feedback, dead beat control by state feedback, design of the full order and reduced- order state observers, linear digital regulator design (Finite time and infinite time problems).

Text Books:

1. Discrete Time Control Systems, Prentice Hall India, 2nd edition, 2005.
2. Digital Control and state variable methods, M. Gopal, Tata McGraw Hill, 3rd edition. 2008
3. Digital control system, Kuo B. C. 2nd edition Orlando florida saunders college publishing 1992.
4. Digital control systems, Houpls C. H. and G. B.Lamont , McGraw Hill 1984.

Reference Books:

1. Digital Control Systems, R. Isermann,Vol 1&2, Springer-Verlag, 1991
2. Digital Control System, B. C. Kuo, Oxford University Press, 2nd edition. 2007.

IN410U D DIGITAL CONTROL LAB

(Professional Elective-IV)

Teaching Scheme: 02 P ; Total: 02 **Credits:** 01
Evaluation Scheme: 50 ICA + 25 ESE **Total Marks:** 75
ESE Duration: 3 Hrs.

COURSE DESCRIPTION:

This course deals with practical aspects of control engineering. It is intended as a companion course for **IN404U** (Digital Control), and serves to augment and demonstrate concepts presented in the classroom. You will use Matlab and Simulink extensively. Prior familiarity with Matlab and Simulink is assumed.

COURSE OBJECTIVES:

1. To introduce digital control tool box for simulation
2. To understand Sampling, aliasing, zero-order hold.
3. To give the knowledge about Discrete-time plant modelling
4. To understand effect of tuning parameter.
5. To implement digital control system for real plant

COURSE OUTCOMES

After successful completion of this course, students will be able to

1. Represent physical system in mathematical from
2. Differentiate the basics of continues and digital system
3. Apply the different digital control techniques for control the plant
4. Implement, categorize the different algorithm in digital control

RELEVANCE OF POS AND STRENGTH OF CORRELATION:

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

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

LIST OF EXPERIMENT:

The list given below is just a guideline based on syllabus in IN404U D.
List of Experiment:
Study and perform simulation through MATLAB or SCILAB software and list conclusion with advantages of the applied techniques in control engineering field

1. Discrete-time simulation with Simulink.
2. Observe the effects during simulation
3. Sampling, aliasing, zero-order hold.
4. Discrete-time plant modelling.
5. Filter structure and finite-precision effect
6. Transfer Function Controller Design
7. Frequency-response controller design.
8. Numeric optimal PID controller design.
9. Effect of tuning parameter.
10. State-Space Controller Design
11. State-feedback controller design.
12. State estimation and control design.
13. Implement digital control system to level control setup in real time mode

Note:

- **ICA –** Internal Continuous Assessment shall support for regular performance of practical and its regular assessment. In addition; it shall be based on knowledge/skill acquired and record submitted by student (journal) based on practical performed by him/her. The performance shall be assessed experiment wise using internal continuous assessment format.
- **ESE –** The End Semester Examination (ESE) for this laboratory course shall be based on performance in one of the experiments performed by student in the semester followed by sample questions to judge the depth of understanding/knowledge or skill acquired by the student. It shall be evaluated by two examiners out of which one examiner shall be out of institute.

IN405U A. BUILDING AUTOMATION
(Open Elective-III)

Teaching Scheme: 03L+ 00 T; Total: 03 **Credits:** 03
Evaluation Scheme: 30 MSE + 10 ISA + 60 ESE **Total Marks:** 100
ESE Duration: 3 Hrs.

COURSE DESCRIPTION:
This course Building Automation will help the students to understand the various aspects of different systems seen in well-structured building. It includes Building Automation System (BAS), is computer-based control system installed in building to control and monitor Mechanical and electrical parameters.

COURSE OBJECTIVES:
The objective of course are as follows
1. To introduce the need and concept of intelligent buildings.
2. To impart knowledge about different HVAC systems.
3. To familiarize with the design of different types of Energy Management System and Concept of Green Building.

DESIRABLE AWARENESS/SKILLS:
Sensors and transducers, Electronic instrumentation, Automation.

COURSE OUTCOMES:

CO	After the completion of the course the student will be able to	Bloom's Cognitive	
		Level	Descriptor
CO1	Understand concept of Building automation systems.	1,2	Remember, Understand
CO2	Understand Fire Alarm System and security system such as CCTV	2,3	Understand, Apply
CO3	Design controllers for AHU, Chilled water system etc.	2,3,4	Understand, Apply, Analyze
CO4	Apply knowledge on Energy Management in Building Automati	2,3	Understand, Apply,

RELEVANCE OF POS AND STRENGTH OF CORRELATION:

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

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

Course Content

Introduction Building automation:
Lifecycle of building, Evolution of intelligent buildings. BAS System Hierarchy –Field level components, Direct Digital Control (DDC), Supervisory Controller, Server, and Operator Workstation (OWS). Different systems in BAS which includes HVAC, security, fire, lighting systems. Importance of each system in BAS. Process of BAS design, Role of different stakeholders (Architect, contractor, consultant, application engineer and engineer) in BAS system design, Comfort parameters for human being- temperature, humidity, flow, pressure, clean air, CO2%.

HVAC Basic Concepts:
Air handling unit. Design, working of different components in AHU- damper, filter, cooling coil, heating coil, fan, heat recovery wheel, humidifier. Concept of Variable Air Volume (VAV) system- Design, working, use of different types of VAV- CAV, Design, working. Chilled Water Systems: Working and design, Hot water systems: Working and design

Access Control & BMS Protocols:
Concept of automation in access control system for safety. Physical security system with components, RFID enabled access control with components. Computer system access control – DAC, MAC, RBAC. Open Protocols -BACnet, LON, Profibus, Modbus, M-bus, Proprietary Protocols- N2, CBUS, Introduction to wireless – Wireless filed devices, controllers, routers, coordinators.

Fire, Alarm and CCTV System:
Concept of automation in access control system for safety. Physical security system with components, RFID enabled access control with components. Computer system access, CCTV Surveillance.

Energy Management System and Concept of Green Building:
Concept of energy management system, occupancy sensors, fans & lighting controller, Green building concept.

Text Books:
1. Understanding Building Automation Systems (Direct Digital Control, Energy Management, Life safety, Security, Access Control, Lightning, and Building Management Programs) by Reinhold A. Carlson and Robert A. Di Giandomenico.
2. HVAC Systems Design Handbook by Roger W. Haines, Fifth Edition.

Reference Books:
1. HVAC Systems Design Handbook by Roger W. Haines, Fifth Edition.
2. HVAC Fundamentals by James E. Brumbaugh, volume 1 to 3
3. Basics of Air Conditioning by ISHRAE, Indian Society of Heating, Refrigerating & Air Conditioning Engineers
4. Building Control Systems, Application Guide (CIBSE Guide), CIBSE, 2000.
5. Smart Buildings by Jim Sinopoli, Butterworth-Heinemann imprint of Elsevier, 2010.
6. Design of Special Hazards and Fire Alarm Systems by Robert Gagnon.

IN405UB AGRICULTURAL INSTRUMENTATION
(Open Elective-III)

Teaching Scheme: 03L+ 00 T; Total: 03 **Credits:** 03
Evaluation Scheme: 30 MSE + 10 ISA + 60 ESE **Total Marks:** 100
ESE Duration: 3 Hrs.

COURSE DESCRIPTION:
This course includes introduction to the Agricultural Instrumentation and Measurement system. This course is designed to introduce the students to the applications of Instrumentation used in agriculture. It includes the study of different types of sensors used in agriculture and also covers the application of systems like SCADA, PLC in agriculture. It also includes study of soil basic.

COURSE OBJECTIVES:
The objectives of this course are as follows
1. Understand sensors used in agriculture field
2 Know continuous and batch process
3. Know greenhouse automation schemes

DESIRABLE AWARENESS/SKILLS:
Sensors and transducers, measurement system. Electronic instrumentation.

COURSE OUTCOMES:

CO	After The Completion Of The Course The Student Will Be Able To	Bloom's Cognitive	
		Level	Descriptor
CO1	Understand Necessity Of Instrumentation In Agriculture	1,2	Remember, Understand
CO2	Select Suitable Sensors For Agricultural Application	2,3	Understand, Apply
CO3	Perform The Soil Analysis	2,3,4	Understand, Apply, Analyze
CO4	Apply Automation Techniques In Agricultural Processes	2,3,5	Understand, Apply,
CO5	Apply Modern Instrumentation Tools In Agriculture	3,4,5	Apply, Analyze, Evaluate

RELEVANCE OF POS AND STRENGTH OF CORRELATION:

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

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

Course Content

Introduction to Agricultural Instrumentation:
Necessity of instrumentation & control for agriculture, engineering properties of soil: fundamental definitions & relationships, index properties of soil, permeability & seepage analysis, shear strength, Mohr's circle of stress, active & passive earth pressures, stability & slopes, Sensors: introduction to sonic anemometers, hygrometers, fine wire thermocouples, open & close path gas analyzers, brief introduction to various bio-sensors..

Irrigation Systems:
Irrigation systems: necessity, irrigation methods: overhead, center pivot, lateral move, micro irrigation systems & its performance, comparison of different irrigation systems, soil moisture measurement methods: resistance based method, voltage based method, thermal based method, details of gypsum block soil moisture sensor, irrigation scheduling, irrigation efficiencies, design considerations in irrigation channels.

Batch Processes:
Flow diagram of sugar plant & instrumentation set up for it, flow diagram of fermenter & control(batch process),flow diagram of dairy industry & instrumentation set up for it, juice extraction control process & instrumentation set up for it.

Automation in Green House:
Application of SCADA for DAM parameters & control, irrigation control management upstream & down - stream control systems, green houses & instrumentation: ventilation, cooling & heating, wind speed, temperature & humidity, rain gauge carbon dioxide enrichment measurement & control. Specific applications in Food industry and cold storage

Automation in Earth Moving Equipment:
Automation in earth moving equipment & farm equipment, application of SCADA & PLC in packing industry and cold storage systems, implementation of hydraulic, pneumatic & electronics control circuits in harvesters cotton pickers, tractor etc. classification of pumps: pump characteristics, pump selection & installation**:**

Leaf area length evaporation, transpiration, temperature, wetness & respiration measurement & data logging, electromagnetic radiations photosynthesis, infrared & UV bio sensor methods in agriculture, agro metrological instrumentation weather stations, surface flux measurement, soil water content measurement using time-domain reflectometry (TDR),ground water occurrence confined & unconfined aquifers, evaluation of aquifer properties, ground water recharge.

Text Books:
1. Process control and instrumentation technology, C.D. Johnson, PHI.
2. Non-Conventional Energy Resources, G.S. Sawhney, PHI Learning Private Limited, 1st ed., 2012.
3. Process Instrumentation and control handbook, Considine D. M., McGraw Hill publication

Reference Books:
1. Instrumentation Engineers handbook- process measurement volume1 and process control volume 2", B. G. Liptak, Chilton Book Company, 2001.
2. Mineral Processing Technology, Wills B.A., Pergamon Press, 4th Edition.

IN405UC MEMS AND NANO INSTRUMENTATION

(Open Elective-III)

Teaching Scheme: 03L+ 00 T; Total: 03 **Credits:** 03

Evaluation Scheme: 30 MSE + 10 ISA + 60 ESE **Total Marks:** 100

ESE Duration: 3 Hrs.

COURSE DESCRIPTION:

To inspire the students to expect to the trends in development and synthesizing of MEMS and Nano systems and measuring systems to Nano scale. To expose the students to the evolution of Nano systems, to the various fabrication techniques. Also to impart knowledge to the students about Nano materials and various nano measurements techniques.

COURSE OBJECTIVES:

1. To study basic of MEMS/NANO sensor and their uses.
2. To expose the students to the evolution of Nano technology
3. Introduction of Nano scale manufacturing
4. To inculcate skill of student for various sensors principle and their industrial application.

COURSE OUTCOMES:

CO	After the completion of the course the student will be able to	Bloom's Cognitive	
		Level	Descriptor
CO1	To understand the basic of MEMS/NANO sensor	1, 2	Remembering, Understanding
CO2	To Identify, define, names various types of sensors for thermal energy sensors and electrical parameter measuring sensors temperature	3	Applying,
CO3	Characteristic techniques of micro system fabrication process	2, 3	Understanding
CO4	To study the correlation between Bio-mimetics and nervous systems.	1, 2, 3	Remember, Understand and Applying,

RELEVANCE OF POS AND STRENGTH OF CORRELATION:

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

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

Course Content

Introduction

Historical background development of microelectronics, evolution of micro sensors, MEMS, emergence of micro machines. Packaging and characterization of sensors, Method of packaging at zero level, dye level and first level.-Thermal energy sensors -temperature sensors, heat sensors electromagnetic sensors- electrical parameter measuring sensors

MEMS Materials and Processing

Overview, metals, semiconductors, ceramic, polymeric and composite materials, Micro-stereo=lithography: Introduction, Scanning Method, Projection Method, Applications. LIGA Process: Introduction, Basic Process and Application.

Electronic and Photonic Materials

Single Electron Tunnelling phenomena- Coulomb blockade-Coulomb staircase - RSD and Resonant tunneling transistor- Quantum structures based LEDs - OLED and photo detectors Magnetic quantum dots and their applications.

NANO-technology

Introduction to Nanotechnology, The nanoscale. Consequences of the nanoscale for technology and society. - Technologies for the Nanoscale, Top-down versus bottom-up assembly. Visualization, manipulation and characterization at the nanoscale, proximal probe technologies. Self-assembly.

NANO-and MICRO systems:

Classification and considerations, Biomimetic, Biological analogies, and design–Biomimetic Fundamentals, Biomimetic for NEMS and MEMS, Nano-ICs and Nano computer architectures, Bio-mimetics and nervous systems.

Text Books:

1. Nano Technology, Mark Ratner & Daniel Ratner, Pearson Education, 2003.
2. Nano Electronics and Information Technology, W. Ranier Wiley, (2003).
3. Nano systems, K.E. Drexler Wiley, (1992).
4. MEMS & MICROSYSTEMS Design and Manufacturing, Tai – Ran Hsu, TATA McGraw- HILL, 2002

Reference Books:

1. Fundamentals of Microfabrication, Marc J. Madou, II Edition, CRC Press, 2002.
2. The MEMS Handbook, Mohamed Gad-el-Hak, CRC Press, 2002
3. Mechanical Microsensors, M. Elwenspoek, R.Wiegerink, Springer-Verlag Berlin Heidelberg, 2001.

IN405UD SENSORS AND TRANSDUCERS
(Open Elective-III)

Teaching Scheme: 03L+ 00 T; Total: 03 **Credits:** 03
Evaluation Scheme: 30 MSE + 10 ISA + 60 ESE **Total Marks:** 100
ESE Duration: 3 Hrs.

COURSE DESCRIPTION:
The course is intended to develop the basic understanding as well as the competency to install, calibrate and test various transducers and sensors for measuring displacement, temperature and other parameters.

COURSE OBJECTIVES:
1. To make students familiar with the constructions and working principle of different types of sensors and transducers.
2. To make students aware about the measuring instruments and the methods of measurement and the use of different transducers

DESIRABLE AWARENESS/SKILLS:
Basic knowledge of measurement fundamentals

COURSE OUTCOMES:

CO	After the completion of the course the student will be able to	Bloom's Cognitive	
		Level	Descriptor
CO1	Define the principals of displacement ,temperature and flow etc. transducers	1	Remember
CO2	Classify and compare the transducers	2	Understand
CO3	Apply the principles of transducers for applications	3	Apply
CO4	Analyze the transducers according to applications	4	Analyze
CO5	Understand the basic concept of smart sensor	2, 3	Understand Apply

RELEVANCE OF POS AND STRENGTH OF CORRELATION:

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

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

Course Content

Displacement Measurement: Resistive: Potentiometer, Linear and rotary, Loading Effect types, strain gauges and its types. Inductive: LVDT and Eddy current type Transducers. Capacitive: Capacitance pickups, Differential capacitive cells. Piezoelectric, Ultrasonic transducers and Hall Effect transducers Optical transducers, applications of displacement sensors.

Temperature Measurement: Temperature Scales, Standards and Units and relations, Classification of temperature sensors Bimetallic Thermometer, Filled system thermometers, SAMA classifications, Resistance Temperature Detectors (RTD), Thermistor, Thermocouples, Study of thermocouple tables (calculation of intermediate temperature and voltage), Lead wire compensation, Cold junction compensation techniques, Protection (Thermo well), Thermopiles, Pyrometers, Temperature IC sensors (AD590 and LM35).

Flow Measurement: Units, Newtonian and non-Newtonian Fluids, Reynolds number, Laminar and turbulent flows, Velocity profile, Bernoulli's equation for incompressible flow, Density, Beta ratio, Reynolds number correction, Square root relation, Head type flow meters, Variable area type, Open channel flow measurement, Turbine , Electromagnetic , Ultrasonic , Vortex shedding, Positive displacement, Anemometers , Mass flow meters.

Miscellaneous Sensors: pH and conductivity sensors: PH. scale and standards, principle of pH measurement, different types of reference and measuring electrodes, principle of conductivity measurement, conductivity cells and bridges their application, effect of temperature on PH and conductivity sensors. Humidity and miscellaneous transducers: pyrometer, hygrometer (hair, wire and electrolysis type), dew point meter, piezoelectric humidity meter, infrared conductance and capacitive type probes for moisture measurement, flow detectors, leak detectors acoustic transducers and sound level measurement.

Smart Sensors: Introduction to smart sensor, Primary sensors, Excitation, Amplification, Filters, Converters, Compensation, Nonlinearity, Approximation and regression, Noise and interference, response time, drift, cross-sensitivity, Information Coding/Processing, Data communication, standards for smart sensor interface, the Automation.

Text Books:

1. "Instrumentation and Measurement Principles", D.V.S. Murthi PHI, New Delhi, Second ed. 2003.
2. "Principle of Industrial Instrumentation", D. Patranabis, Tata McGraw Hill, Second ed., 1999.
3. "Instrumentation Measurements and Analysis" by, B. C. Nakra and K. K. Choudhari, Tata McGraw Hill Education, Second ed., 2004**.**

Reference Books:

1. "Process Measurement & Analysis", B.G. Liptak, Chilton Book Company, Fourth ed., 2003.
2. "Measurement Systems", E.O. Doebelin, McGraw Hill, Fifth ed., 2003.
3. "Sensors Handbook",Sabrie Soloman, McGraw Hill Publication, First ed., 1998.
4. "Electrical & Electronic Instruments & Measurement", A. K. Sawhney, Dhanpat Rai and Sons, Eleventh ed., 2000.
5. "Engineering Metrology", R. K. Jain, Khanna Publisher, Delhi, Eighteenth ed., 2002.
6. "Silicon Sensors", Middlehook S. and Audet S. A., Academic Press, London

IN406U INDUSTRIAL LECTURES

Teaching Scheme: Expert talks from industry (Min 2Hrs) **Credits:** 01
Evaluation Scheme: -ICA 25 **Total Marks:** 25

COURSE DESCRIPTION:

This course includes an interaction with the industry persons. The industry person of highly experienced or working/worked at higher level shall be invited by department to deliver expert talks for the students. This course will give the slight insight of the industry culture and recent technologies. This course is designed to bridge the gap of education institute and real industry world for the final year students who will be starting their career with best possible knowledge.

COURSE OBJECTIVES:

The objective of course are as follows

1. To learn recent technology in industry
2. To be familiar with industrial environment to provide appropriate exposure to world of work.
3. To provide knowledge of employment and interaction with industry experts
4. To know and understand the industrial experience, attitudes, needs, and viewpoints of industrial expert to students.
5. To denote and understand the role of various parties' viz., employers, employees, and state in maintaining industrial relations.
6. To improve industry institute interaction.

.DESIRABLE AWARENESS/SKILLS:

Soft and employability skills,

COURSE OUTCOMES:

CO	After the completion of the course the student will be able to	Bloom's Cognitive	
		Level	Descriptor
CO1	Demonstrate the ability to face industrial environment/ World of work.	2,3	Understand, Analyze
CO2	Fulfill expectations of industry w.r.t. expertise, attitude and View point.	1,2,1	Understand, Apply, Evaluate
CO3	To understand work culture in industrial environment either as employee or self-employed (entrepreneur) with comfort.	2,3,3	Understand, Apply, Analyze

RELEVANCE OF POS AND STRENGTH OF CORRELATION:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	2	3	2	-	-	-	-	-	-	-	2	2	1
CO2	2	2	3	2	-	-	-	-	-	-	-	-	2	2	2
CO3	2	2	3	2	2	1		3	-	-	1	2	2	2	2

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

Course Content cum-Instructions

There shall be minimum 4 lectures of minimum 45 minutes (max. 2Hrs/session) duration. The lecture-cum-expert talk shall include presentation, informal discussions with students- faculty, and laboratory tours (if required).

Topics of Industrial Lectures shall be technical or industry informative in nature and should not be the specific or extended part of the curriculum.

Typically speakers should talk about:

i. Their own career role and responsibilities (the talk can be from industry expert or research organization or academic institutions or university experts or administrative experts having job nature such as of IAS/IPS/CEO/MD/HR/Manager/Director/VC/Pro-VC/University Registrar, Principal/Director of Educational institutes, Director/Dy. Director of Technical and Higher education, Secretary/Dy. Secretary of Govt. organizations, Chairman/Vice-Chairman/President/Vice President of industry, Head of section in industry having listed in MCA. Scientist, Research person from academic/research organizations having good publications (min 1 patent or citation more than 100) or Industry person having experience more than 5 years, alumni of institute (no any min. experience required), Training and placement officers, industry trainers, Employee of Government or autonomous bodies having basic pay more or equivalent to Assistant professor in technical institute or equivalent.. OR any person from any organization with mutual understanding of department head/Principal/Director of institute and institute/department course coordinator
ii. Interesting jobs/projects experts have had worked on.
iii. The areas of work they are currently involved in.
iv. The type of work engineering graduates can expect.
v. Current job opportunities that may be available for engineering graduates in general and electronics and telecommunication engineering graduates in particular.
vi. Any suggestions for students with regard to job hunting / CV writing / interviews etc. vii. Latest technology used in the industry which is not the part of curriculum or routine training programs.
vii. Any other suitable topic/information which provides industrial exposure and improves entrepreneurship quality/ employability of the students.

Course coordinator shall discuss with students on the content of lecture and may conduct oral or give written assignments to judge the depth of understanding of students.

Students shall submit the report based on minimum 4 lectures giving summary of the lecture delivered. · The summary should contain brief resume of the expert, brief information of his organization and brief summary of the lecture in the format provided by institute/department.

Industrial Lecture deliverables: An industrial lecture report as per the specified format (available on in the department and institutes website) and assignments given by course coordinator (if any). (Note: List of renowned experts/Officials from Industries/Government Organizations/Private Sectors/Public Sectors / R&D Labs etc shall be prepared by the committee appointed by HoD and shall be approved by principal. After approval from the principal, minimum six Industrial Lectures shall be arranged, which shall be delivered by experts to cover the various aspects of course content)

Evaluation System: It includes Internal Continuous Assessment (ICA). The ICA shall be evaluated by course coordinator. Course coordinator shall judge the students on the principle of continuous evaluation and contribution of individual student. It shall be evaluated on the basis of deliverables of industrial lecture

and depth of understanding (oral conducted by course coordinator). Course coordinator shall maintain the record of continuous evaluation (oral) and include in the record of sixth semester received from HoD. Total of sixth and eighth semester marks shall be converted out of 25.

IN411U PROJECT PHASE-I

Teaching Scheme: 02 P ; Total: 02 **Credits:** 02
Evaluation Scheme: 50 ICA + 50 ESE **Total Marks:** 100
ESE Duration: 3 Hrs.

COURSE DESCRIPTION:

The project is one of the most important work in the degree program. It is introduced in curriculum to put into practice some of the techniques that have been taught to students in earlier years. It also provides the opportunity to students to demonstrate independence and originality, to plan and organize a large project over a long period. The project topic should be selected to ensure the satisfaction of the need to establish a direct link between the techniques they learnt and productivity. Thus it should reduce the gap between the world of work and the world of study.

COURSE OBJECTIVES:

The objectives of offering this course are:

1. to develop ability to synthesize knowledge and skills previously gained and to put some of them into practice.
2. to make students capable to select from different methodologies, methods and forms of analysis studied to produce a suitable system or sub-system.
3. to inculcate ability to present the findings of their technical solution in a written report.
4. to plan and organise a large project over a long period.

COURSE OUTCOME:

On successful completion of this course students shall be

1. Able to apply the knowledge and skills previously gained into practice.
2. Take appropriate decision wrt various parameters related to production of a system or sub-system.
3. Demonstrate the leadership quality along with ability to work in a group.
4. Prove the ability to present the findings in a written report or oral presentation.

RELEVANCE OF POS AND STRENGTH OF CORRELATION:

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

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

Course Content

- The project shall be carried out in-house i.e. in the department's laboratories/centres by a group 2 – 4 students. In any case the group shall not consist of more than four students.
- The project shall consist of design and implementation of any suitable instrumentation application system, sub system or software based on knowledge and skills previously gained. ·
- The project outline (synopsis) on the selected topic should be submitted to the course coordinator for approval within one week from the commencement of the term.
- Student is expected to detail out specifications, methodology, resources required, critical issues involved in design and implementation.

Project Deliverables: A project report as per the specified format (available on in the department and institutes website), developed system in the form of hardware and/or software. In addition, student shall maintain a record of attendance and continuous progress (log book in appropriate format available on institute/department's web site) duly signed by course coordinator and present as mini project deliverable along with report.

Evaluation System:

It includes Internal Continuous Assessment (ICA) and End Semester Examination (ESE). Guidelines for ICA and ESE are given bellow.

Internal Continuous Assessment (ICA)

- The ICA shall be evaluated twice in the semester. A committee comprising of three examiners (one of them should be guide) nominated by head of department, will take the review of the project work twice in a semester. Committee shall judge the students on the principle of continuous evaluation and contribution of individual student in the group. Average of two reviews shall be considered as overall performance of the student.
- It shall be evaluated on the basis of deliverables of project and depth of understanding.
- Course coordinator shall maintain the record of continuous evaluation in appropriate format available on institute/department's web site.

End Semester Examination (ESE)

- The End Semester Examination for this course shall be based on demonstration of the system or sub system developed by the group of students, deliverables of project and depth of understanding (oral examination). It shall be evaluated by two examiners out of which one examiner shall be out of institute.

SEMESTER VIII
Instrumentation Engineering

SH481U ACCOUNTS AND FINANCE FOR ENTREPRENEURS

Teaching Scheme: 02L+ 00 T; Total: 02 **Credits:** 02
Evaluation Scheme: 30 MSE + 10 ISA + 60 ESE **Total Marks:** 100
ESE Duration: 3 Hrs.

COURSE DESCRIPTION:

The course is intended to provide basic understanding of accounting and finance to engineering students with the basic concept of accounting and finance. This course introduces the student to the fundamental concepts of financial management; the basic rules and principles of accounting, financial markets and sources of finance. Students will study the financial accounting, statement preparation. Students will learn leverage analysis as well as working capital management.

DESIRABLE AWARENESS/SKILLS:

Knowledge of basic accounting and finance

COURSE OBJECTIVES:

The objectives of offering this course are

1. To understand the fundamentals of financial accounting
2. To know preparation of financial statement
3. To develop the interest towards financial management
4. To create awareness about budget and budgetary control
5. To understand and solve leverage analysis and working capital management

COURSE OUTCOMES:

On the successful completion of this course; student shall

1. know the basic concept of financial accounting
2. able to demonstrate the ability to prepare financial accounting.
3. understand and implement the fundamental concepts financial management
4. understand the budget and budgetary control
5. analyze the leverage and working capital management

Course Content

Introduction to Financial Accounting: Introduction to accounting, meaning, evolution of accounting, importance of accounting, users of financial statements, financial, cost and management accounting, accounting concepts and conventions

Financial Statement Preparation: Meaning, classification of accounts, rules and principles governing double entry, book-keeping system, meaning, preparation of journal, ledger, & trial balance, preparation of financial statement, profit & loss account, balance sheet

Budget and budgetary control: Introduction, definition of budget and budgetary control, objectives, essential requirements, advantages and disadvantages, types of budgets- cash and flexible

Introduction to Financial Management: Finance and other discipline, nature and scope of financial management, functions of financial management, objectives of the firm, sources of finance, long term sources, short term sources, international sources

Leverage Analysis and Working Capital Management: Operating leverage, financial leverage, combined leverage, working capital management: operating cycle, determinants of working capital, types of working capital, importance of working capital, components of working capital, measuring working capital requirements

Text books

1. Financial Accounting by Rajasekaran V. Pearson publications 2011.
2. Basic Financial Accounting by Karsten Wiborg, 1st edition, academica publications.
3. Financial Accounting by W. Albrecht, Earl Stice, James Stice, 11th edition, South Western cengage learning.
4. Financial Accounting by V.K. Goyal, 2nd edition, Excel books Delhi

Reference Book

1. Accounting and financial management by M.E. Thukaram Rao, New Age International publishers
2. Financial, Cost & Management Accounting by Dr. P. Pariasamy, 2014 Himalaya Publishing House
3. Financial Management by Khan & Jain, 8th edition, Tata Mcgraw Hill
4. Financial Management by Dr. P. C. Tulsian, 5th edition, S. Chand and company.
5. Financial Management by Ravi Kishore, 8th edition, Taxmann Publications Pvt. Ltd

IN451U BIOMEDICAL INSTRUMENTATION

Teaching Scheme: 03L+ 00 T; Total: 03 **Credits:** 03
Evaluation Scheme: 30 MSE + 10 ISA + 60 ESE **Total Marks:** 100
ESE Duration: 3 Hrs.

COURSE DESCRIPTION:

This course includes introduction to the Biomedical Instrumentation and Measurement system. This course is designed to introduce the students to the basic principles of sensors and biomedical instrumentation system and their application to heart, brain and muscular system. Different types of biomedical signals and imaging techniques are also included.

COURSE OBJECTIVES:

The objective of course are as follows
1. To make understand human anatomy and physiology.
2. To select the appropriate transducer/sensor for biomedical application
2. To make student learn the design and operation of biomedical equipment

. DESIRABLE AWARENESS/SKILLS:

Sensors and transducers, measurement system. Electronic instrumentation.

COURSE OUTCOMES:

CO	After the completion of the course the student will be able to	Bloom's Cognitive	
		Level	Descriptor
CO1	Understand working of different systems in human body	1,2	Remember, Understand
CO2	Understand bio-potentials and select transducers to measure Them.	2,3	Understand, Apply
CO3	To evolve an instrumentation system for diagnosis, therapy, supplementation of body functions.	2,3,4	Understand, Apply, Analyze
CO4	Apply Imagine techniques in medical field and suggest safety measures.	2,3	Understand, Apply,
CO5	Apply modern BMI tools in medical field.	3,4,5	Apply, Analyze, Evaluate

RELEVANCE OF POS AND STRENGTH OF CORRELATION:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	-	-	-	-	-	-	-	-	-	1	-	2	-
CO2	2	-	1	-	1	1	-	-	-	-	-	1	-	2	-
CO3	3	3	3	2	2	5	-	-	2	-	-	2	2	3	2
CO4	-	3	2	2	3	2	2	-	2	-	-	2	2	3	-
CO5	-	3	2	3	3	2	1	3	2	2	2	2	2	3	2

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

Course Content

Man Instrument System:

Introduction to gross anatomy of human body, generalized medical measurement system, Problems encountered in measuring a living system, Transducers for biomedical applications, Cell and its structure, Resting and action potential, Propagation of action potentials, The heart and cardiovascular system - Electrophysiology of cardiovascular system, Physiology of the respiratory system, Nervous system , Electrode theory – Bio-potential electrodes, Introduction to biomedical instruments, classification and justification.

Transducers for biomedical instrumentation:

Types and selection of biomedical transducers, cardiovascular system, Structure of heart, rhythmicity, Cardiac cycle and heart sounds, cardiac output, blood pressure measurement, direct, indirect, Sphygmomanometer, Digital B. P. Cardiovascular instrumentation: ECG electrodes, and leads, Einthoven's triangle, ECG quantification, PC based ECG analysis. Wearable Biosensors, Smart Biosensors in Medical Care.

Instruments BMI System

Central Nervous system, the Brain, Receptors, sensory pathway and motor systems, evoked potential, electroencephalogram, EEG analysis, EMG. Mechanics of Respiration, transport between lungs and tissue cells, Spirometer, Artificial respiration. Ventilators – working and classification, Modern Ventilators.

Therapeutic Equipment:

Need of pacemaker, types of pacemakers, need of Defibrillator, types of defibrillators, Biotelemetry, bedside monitors, ICU, Heart Lang machine, phonocardiography, plethysmograph, Artificial Kidney, Blood cell counters. Telemedicine, Automated Drug Delivery Systems. Biomedical robotics.

Biomedical Imaging Techniques

Introduction to imaging system, X-ray imaging, CT Scan, Ultrasonography, MRI, Endoscopy,

Electrical safety:

Significance of electrical danger, Physiological effects of electrical current, Ground shock hazard, and methods of accident prevention

Text Books:

1. Handbook of Biomedical Instrumentation, by R. S. Khandpur, TMH, 2003.
2. Biomedical Instrumentation and Measurement, by Cromwell, PHI, latest edition.

Reference Books:

1. Introduction to Biomedical instrumentation, S G Kahalekar,
2. Handbook of Biomedical Instrumentation, Webster.

IN455U BIOMEDICAL INSTRUMENTATION LAB

Teaching Scheme: 02P, Total: 02 **Credit:** 01
Evaluation Scheme: 25 ICA+ 25 ESE **Total Marks:** 50
Duration of ESE: 03Hrs

COURSE DESCRIPTION:

This course is designed to introduce the basic principles and applications of biomedical sensor. It also includes the study of different biomedical instruments used for recording and analyzing the monitoring signal generated by different physiological systems of Human.

Minimum Ten experiments shall be performed to cover entire curriculum of course IN451U.

The list given below is just a guideline.

1. Measurement of Biomedical Parameters.
2. Measurement of cardiovascular parameters
3. ECG measurement and Analysis.
4. EEG measurement and Analysis.
5. EMG measurement and Analysis.
6. Measurement and analysis of blood sugar.
7. Measurement of heartbeats using heart beat monitor and analysis.
8. Measurement of lung capacity using spirometer.
9. Demonstration of defibrillator.
10. Demonstration of different imaging modalities
11. Measurement of blood pressure by indirect method.
12. Study and hands-on on Electrical safety measures used in hospitals.
13. Visit to nearby specialty hospital and crate BMI report based on that.

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ICA – Internal Continuous Assessment shall support for regular performance of practical and its regular assessment. In addition; it shall be based on knowledge/skill acquired and record submitted by student (journal) based on practical performed by him/her. The performance shall be assessed experiment wise using internal continuous assessment format **(S 10).**

ESE – The End Semester Examination (ESE) for this laboratory course shall be based on performance in one of the experiments performed by student in the semester followed by sample questions to judge the depth of understanding/knowledge or skill acquired by the student. It shall be evaluated by two examiners out of which one examiner shall be out of institute

IN452U ANALYTICAL INSTRUMENTATION

Teaching Scheme: 02 L+ 00 T; Total: 02 **Credits:** 02
Evaluation Scheme: 30 MSE + 10 ISA + 60 ESE **Total Marks:** 100
ESE Duration: 3 Hrs.

COURSE DESCRIPTION:

This course provides the knowledge of different analytical methods used in chemical analysis and role of instrumentation in it.

COURSE OBJECTIVES:

1. To understand principles of analytical instrumental analysis.
2. To study the theory and design of analytical instruments.
3. To develop problem-solving skills applicable to real-world problems.

DESIRABLE AWARENESS/SKILLS:

Basic sensor and transducers, Instrumentation and Measurements system.

COURSE OUTCOMES:

CO	After the completion of the course the student will be able to	Bloom's Cognitive	
		Level	**Descriptor**
CO1	Understand the capabilities and limitations of analytical instruments.	01,02	Remembering, Understanding
CO2	Learn the advances in analytical instrumentation.	01,02	Understanding
CO3	Select and apply an analytical instrument in the physical, chemical and biological world.	03	Applying
CO4	Analyze and select proper instrument and appreciate the role of instrumentation for given application	03,04	Analyzing Evaluating

RELEVANCE OF POS AND STRENGTH OF CORRELATION:

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

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

Course Content

Chemical Analysis and Analytical methods

Classification of Analytical Methods: Classical and instrumental methods, comparison of these methods, classification of instrumental methods (spectral, electro analytical and separative methods)

UV Visible and Spectroscopy: Laws of photometry, Beer and Lambert's law, monochromator.

design and monochromator performance, colorimeters, single beam and double beam spectrophotometers, dual wavelength and double monochromatic systems, direct reading multichannel spectrophotometers, diode array rapid scanning spectrophotometers, reverse optics technique.

IR spectroscopy: Instrumentation, sources, detectors, FTIR. Raman Spectrometry, Raman effect, Raman spectrometer components, LASER Raman spectrophotometer Emission and Absorption Spectroscopy.

Emission Spectroscopy: Principle of emission spectroscopy, sources of excitation, DC arc, AC arc, AC spark and Plasma excitation sources, Flame photometry: Principle, instrumentation constructional details, fuel gases, atomizer, burner, optical system, recording system. Interferences in flame photometry, applications, Atomic Absorption Spectroscopy (AAS): Principle, instrumentation-hollow cathode lamps, burners and flames, plasma excitation sources, optical and electronic systems, interferences in AAS, applications.

Nuclear Magnetic Resonance (NMR) Spectrometry:

Principle, nuclear spin, nuclear energy levels, resonance condition, NMR absorption spectra, chemical shift, constructional details of NMR spectrometer, sensitivity enhancement techniques, spin decoupler, Fourier transform NMR spectroscopy;

Mass Spectrometry:

Principle and components of mass spectrometer. Magnetic deflection type, time of flight, radio frequency, double focusing, quadrupole type, gas chromatograph mass spectrometer (GCMS) system resolution of mass spectrometer, applications in industry.

Electron and Ion Spectroscopy: Surface spectroscopic techniques, electron spectroscopy for chemical analysis (ESCA), Auger spectroscopy (AES), secondary ion mass spectrometry (SIMS) and ion scattering spectroscopy (ISS). Radio Chemical Instrumentation: Radio chemical methods, radiation detectors, ionization chamber, Geiger Muller counter, proportional counter, scintillation counter, semiconductor detectors, pulse height analyzer. Principle and constructional details of Electron Spin Resonance (ESR) Spectrometry.

X-ray Spectrometry:

X-ray spectrum, Instrumentation for X-ray spectrometry, X-ray diffractometers, and X-ray absorption meter. X-Ray fluorescence spectrometry. Electron probe micro analyzer.

Chromatography

Chromatography: classification, Basic definitions**.** Principle and basic parts of gas chromatograph. Components of gas chromatograph like carrier gas, sample injection system, thermal compartment, temperature programming. Detectors-thermal conductivity, flame ionization, electron capture.

Liquid Chromatography: Introduction and its classification, HPLC, Applications of Chromatographs in industries such as process, food and pharmaceuticals.

Text Books:

1. Handbook of Analytical Instruments by R.S. Khandpur, Second ed., 2006. Tata McGrawHill.
2. Instrumental Methods of Analysis by Willard, Merritt, John Aurie Dean, CBS Publishers & Distributors, New Delhi, Seventh ed., 1988.
3. Instrumental Methods of Chemical Analysis by B. K. Sharma, Goyal publications house Meerut, 23th edi., 2004.

Reference Books:

1. Principles of Industrial Instrumentation by D. Patranabis, second edition, Tata McGraw
2. Instrumental Methods of Chemical Analysis by G. W. Ewing, 4th Edi, McGraw Hill, 1975.
3. Analytical Instrumentation Handbook by Bela G Liptak, Chilton, Second ed., 1994.
4. Principles of Instrumental Analysis by Skoog, Holler, Nieman, Thomson books-cole publications, Sixth ed., 2006.

IN453UA EMBEDDED SYSTEM

(Professional Elective-V)

Teaching Scheme: 03L+ 00 T; Total: 03 **Credits:** 03
Evaluation Scheme: 30MSE + 10 ISA + 60 ESE **Total Marks:** 100
ESE Duration: 3 Hrs

COURSE DESCRIPTION:

An Embedded system is a system that has embedded software and computer hardware, which makes it a system dedicated for an application(s) or specific part of an application or product or part of an application or product or part of a larger product.

COURSE OBJECTIVES:

1. Student can improve his/her problem solving and system design skills using modelling practices and learn more key concepts in embedded hardware architecture, interfaces, buses, software programming design and RTOSes..
2. Imparting knowledge about the fundamental aspects that form the basis of hardware and software designing of embedded systems.

COURSE OUTCOMES:

CO	After the completion of the course the students will be able to	Blooms Cognitive	
		Level	Descriptor
CO1	Acquire the knowledge of the fundamental aspects that form the basis of hardware and software designing of embedded systems.	4	Remembering, Understanding
CO2	Learn embedded system with real word applications.	3,4	Understanding
CO3	Understand embedded hardware architecture, interfacing techniques, buses and protocols, hardware and software interrupts.	3,4,5	Understanding, Apply
CO4	Experiment with Embedded software programming tools and model, simulation and debug the embedded model inter-process synchronization and real time operating system	3	Experiment, Apply
CO5	Design real time embedded systems using the concept of RTOS.	3,4	Apply, Create

RELEVANCE OF POS AND STRENGTH OF CORRELATION:

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

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

Course Content

Introduction to Embedded system

Embedded system, embedded hardware units, Devices and software in a system, Examples of embedded system, Embedded SOC, Design process in embedded system, Design examples, Classification, Advanced architectures, Processor and memory organization and selection. **Devices, Communication Bus, Device Driver,** Interrupt IO Types, Serial communication Devices, Parallel device ports, Wireless devices, Timer and counting devices, Watchdog timer, Real time clock, Networked embedded systems, Serial bus communication protocols, Parallel bus device protocols, Internet enabled systems Network protocols, Wireless and mobile system protocols, ISR concept, Interrupt sources and handling, Multiple interrupts, Context, context switching, Interrupt latency and deadline, Direct Memory Access **Programming Concepts, Embedded Programming, Program Modeling and Intercrosses Communication and Synchronization of Processes**

Software programming in Assembly Language (ALP) and in High Level Language 'C', Embedded programming in C++, Embedded Programming in Java, Programs Models, DFG Model, State Machine Programming Models for Event controlled Program Flow, Modelling of Microprocessor System, UML Modelling, Multiple processes in an Application, Multiple Threads in an Application, Task and Data, Concepts of Semaphores, Shared Data, Inter-process Communication, Signal Functions, Semaphore Functions, Message Queue Functions, Mailbox Functions, Pipe Functions, Socket Functions, RPC Functions

Real Time Operating Systems and programming

OS Services, Process Management, Timer Function, Event Function, Memory Management, Device, File and IO Subsystems Management, Interrupt Routines in RTOS Environment and Heading of Interrupt source Calls, Real Time Operating System, Basic Desing Using an RTOS, RTOS task Scheduling Models, Interrupt Latency and Response of the Tasks as Performance Metrics, OS Security Review, Basic Function and Types of RTOSES, RTOS mCOS-II, RTOS Vxworks

Embedded Software Development Process and Tools

Introduction to Embedded Software Development and Tools, Host and target Machines, Linking and Locating Software, Getting Embedded Software into the Target System, Issue and Hardware-Software Design and Co-Design, Testing, Simulation and Debugging Techniques and Tools, Testing and Host Machine, Simulators, Laboratory Tools

Text Books

1. Embedded Systems, Architecture, Programming and Design, Raj Kamal, Tata McGraw-Hill Education, 2011
2. Fundamentals of Embedded software, Daniel W. Lewis, Prentice Hall of India, 2013.

Reference Books

1. An Embedded software primer, David E. Simon, Pearson Education, 2005
2. Embedded System Design – A unified hardware and software Introduction, Frank Vahid, John Willey
3. Embedded Real Time Systems Programming, Sriram V. Iyer, Pankaj Gupte, Tata McGraw Hill
4. Embedded System Design, Steve Heath, 2nd edition, Newnes, 2003.

IN456UA EMBEDDED SYSTEM LAB

(Professional Elective-V LAB)

Teaching Scheme: 02 P ; Total: 02 **Credits:** 01
Evaluation Scheme: 25 ICA + 25 ESE **Total Marks:** 50
ESE Duration: 3 Hrs.

COURSE DESCRIPTION:

An Embedded system is a system that has embedded software and computer hardware, which makes it a system dedicated for an application(s) or specific part of an application or product or part of an application or product or part of a larger product.

COURSE OBJECTIVES:

1. Student can improve his/her stimulating learning experience and system design skills using modelling practices and learn more key concepts in embedded hardware architecture, interfaces, buses, software programming design and RTOSes.
2. Imparting knowledge about the fundamental aspects that form the basis of hardware and software designing of embedded systems.

Minimum Ten experiments shall be performed to cover entire curriculum of course IN453UA Embedded system. Practical using different tools and hardware are to be designed as per requirements. Mini project can be given to students for further learning and implementations.

Note:

- **ICA –** Internal Continuous Assessment shall support for regular performance of practical and its regular assessment. In addition; it shall be based on knowledge/skill acquired and record submitted by student (journal) based on practical performed by him/her. The performance shall be assessed experiment wise using internal continuous assessment format.
- **ESE –** The End Semester Examination (ESE) for this laboratory course shall be based on performance in one of the experiments performed by student in the semester followed by sample questions to judge the depth of understanding/knowledge or skill acquired by the student. It shall be evaluated by two examiners out of which one examiner shall be out of institute.

IN453UB FIBER OPTICS AND LASER INSTRUMENTATION
(Professional Elective-V)

Teaching Scheme: 03L+ 00 T; Total: 03 **Credits:** 03
Evaluation Scheme: 30 MSE + 10 ISA + 60 ESE **Total Marks:** 100
ESE Duration: 3 Hrs.

COURSE DESCRIPTION:
To contribute to the knowledge of Fiber optics and Laser Instrumentation and its Industrial and Medical Applications.

COURSE OBJECTIVES:
1 To understand the basic concepts of optical fibers and their properties
2 To provide adequate knowledge about the Industrial applications of optical fibers
3 To understand the Laser fundamentals and Industrial application of lasers.

COURSE OUTCOMES:

CO	After the completion of the course the student will be able to	Bloom's Cognitive	
		Level	Descriptor
CO1	Acquire the knowledge of system of units, classification and essentials of measuring instruments.	01,02	Remembering, Understanding
CO2	Design the construction and operation of various measuring instruments.	01,02	Remembering, Understanding
CO3	Identify the measuring instruments and apply them for quantifying measurements of parameters.	02	Understanding
CO4	Analyze and select proper instrument for given application	03	Applying,

RELEVANCE OF POS AND STRENGTH OF CORRELATION:

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

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

Course Content

Introduction

Principle of light propagations through a fiber, different types of fibers and their properties. Fiber material and their characteristics- transmission characteristics of fibers, absorption losses, scattering losses, dispersion, measurement on optical fibers, optical sources and detectors, LED's.

Measurement Techniques

Fiber optic instrumentation system, fiber optic sensors, different types of modulators. Application in instrumentation- Interferometric method of measurement, measurement of temperature, pressure, current, voltage, liquid level and strain. OTDR and its applications. Analog and digital communication link, Optical power budget

Laser fundamentals and types

Fundamental characteristics of Laser, three level and four level lasers, properties of laser, laser modes, optical resonator, Q switching, cavity dumping, mode locking, types of laser, Gas laser, solid laser, liquid laser, semiconductor laser.

Laser Applications

Laser for measurement of current, voltage and atmospheric effects, spatial frequency filtering. Holography- basic principle, methods, holographic interferometry, Holography for non-destructive testing, Holographic components. Applications in material processing. Laser drilling, laser cutting, laser tracking, medical applications of laser, laser and tissue interaction, laser instrumentation for surgery.

References:

1. Optical fiber communications, John M. Senior, Pearson Publications, 2nd edition.
2. Optical fiber communications, Gerd Keiser, Tata McGraw Hill Pub, 4th edition.
3. Fiber Optic Communication- Systems and Components, Vivekanand Mishra and Sunita P. Ugale, Wiley-India Pub.
4. Laser Systems and Applications, Nityanand Chaudhary and Richa Verma, PHI Learning Pvt. Ltd.

IN456UB FIBER OPTICS AND LASER LAB

(Professional Elective-V LAB)

Teaching Scheme: 02 P ; Total: 02 **Credits:** 01
Evaluation Scheme: 25 ICA + 25 ESE **Total Marks:** 50
ESE Duration: 3 Hrs.

COURSE DESCRIPTION:

In this laboratory course emphasis will be on propagation characteristics of optical fiber. Different measurement techniques, data analysis and fault detections.

COURSE OBJECTIVES:

1. To understand the basic concepts of optical fibers and their properties
2. To provide adequate knowledge about the Industrial applications of optical fibers
3. To understand the Laser fundamentals and Industrial application of lasers.

COURSE OUTCOMES:

CO	After the completion of the course the student will be able to	Bloom's Cognitive	
		Level	Descriptor
CO1	Acquire the knowledge of system of units, classification and essentials of measuring instruments.	01, 02	Remembering, Understanding
CO2	Design the construction and operation of various measuring instruments.	01, 02	Remembering, Understanding
CO3	Identify the measuring instruments and apply them for quantifying measurements of parameters.	02	Understanding
CO4	Analyze and select proper instrument for given application	03	Applying,

RELEVANCE OF POS AND STRENGTH OF CORRELATION:

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

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

LIST OF EXPERIMENTS

Minimum Eight experiments shall be performed to cover entire curriculum of course **IN453UB**. The list given below is just a guideline.

1. To study attenuation losses in optical fiber.
2. To study bending losses in optical fiber.
3. Measurement of numerical aperture of an optical fiber.
4. Study of analog fiber optic communication link.
5. Study of digital fiber optic communication link.
6. To study characteristic curve for optical source and detector.
7. Study of Nd-Yag Laser.
8. Study of OTDR and measurement techniques on OTDR.
9. Study of analog modulation technique.
10. Study of digital modulation technique.

Note:

- **ICA –** Internal Continuous Assessment shall support for regular performance of practical and its regular assessment. In addition; it shall be based on knowledge/skill acquired and record submitted by student (journal) based on practical performed by him/her. The performance shall be assessed experiment wise using internal continuous assessment format.

- **ESE –** The end semester examination (ESE) for this laboratory course shall be based on oral examination to judge the depth of understanding/knowledge or skill acquired by the student. It shall be evaluated by two examiners out of which one examiner shall be out of institute.

IN453UC ARTIFICIAL INTELLIGENCE

(Professional Elective-V)

Teaching Scheme: 03L+ 00 T; Total: 03 **Credits:** 03
Evaluation Scheme: 30 MSE + 10 ISA + 60 ESE **Total Marks:** 100
ESE Duration: 3 Hrs.

COURSE DESCRIPTION:

This course introduce the student to artificial intelligence (AI) as a multidisciplinary field that requires a range of skills in statistics, mathematics, predictive modeling, analysis and their applications in engineering.

DESIRABLE AWARENESS:

Calculus, Linear Algebra, Statistics and Predominant Programming Language.

COURSE OBJECTIVES:

The objectives of offering this course are to-

1. Provide the most fundamental knowledge to the students so that they can understand AI.
2. Identify problems where artificial intelligence techniques are applicable.
3. Participate in the design of systems that act intelligently and learn from experience.

COURSE OUTCOMES:

On the successful completion of this course, students will be able to -

1. Acquainted with the expert system architecture and artificial intelligence
2. Select appropriate AI technique for a given real world problem
3. Develop neural network, fuzzy logic, genetic algorithm and hybrid system for control system applications
4. Understand the basics of learning and training algorithms
5. Apply the principles of machine learning and AI for practical applications.

RELEVANCE OF POS AND STRENGTH OF CORRELATION:

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

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

Course Content:

Introduction to Artificial Intelligence and Expert systems: The concept and importance of Artificial Intelligence (AI), Course structure and policies, History of AI, Proposing and evaluating AI applications, Case study: Google Duplex, Expert systems, Expert system architecture, Functions of various parts, Mechanism and role of inference engine, Types of Expert system, Tuning of expert systems, Role of Expert systems in instrumentation and process control.

Artificial Neural Networks: Structure and function of a single neuron, Artificial neuron models, Types of activation functions, Neural network architectures, Neural learning, Evaluation of networks, Supervised learning, Back propagation training algorithm, Application of neural networks for Classification−algorithm, Unsupervised learning, winner Clustering, Pattern associations, Function approximation, Forecasting. Neural Networks in Control Systems Direct Adaptive Control, Self-Tuning Controller, Indirect Adaptive Control, Model Reference Adaptive Control, Internal Model Control; Predictive Control.

Fuzzy Logic: Fuzzy sets and systems, Operations on Fuzzy sets, Fuzzy relations, Membership functions, Fuzzy rule base, Fuzzification and defuzzifications module, Scaling factors, Fuzzy controllers.

Genetic Algorithms: Introduction and concept, Coding, Reproduction, Cross Applications, Swarm intelligence, and their applications.

Hybrid systems: Neuro-fuzzy hybrid systems, genetic neuro hybrid systems, genetic fuzzy hybrid and fuzzy genetic hybrid systems, simplified fuzzy ARTMAP, Applications: A fusion approach of multispectral images with SAR, optimization of traveling salesman problem using genetic algorithm approach, soft computing based hybrid fuzzy controllers.

Text books:

1. Neural Networks, Fuzzy Logic, and Genetic Algorithms: Synthesis and Applications, by S. Rajasekaran and G. A. Vijayalakshmi Pai, 2nd Edition, PHI Learning, 2003.
2. Soft Computing: Neuro-Fuzzy and Genetic Algorithms by Samir Roy and Udit Chakraborty, 1st Edition, Pearson, 2006.

Reference books:

1. Introduction to Artificial Intelligence and Expert Systems by Dan W. Patterson, 3rd edition, Prentice-Hall International, 2000.
2. Introduction to Artificial Systems by J. M. Zurada, 5th Edition, Jaico Publishing House, 2004.
3. An Introduction to Neural Networks by James A. Anderson, 2nd edition , Prentice Hall of India, New Delhi, 1999.
4. An Introduction to Fuzzy Control by D. Drainkov, H. Hellendoorn and M. Reinfrank,, 6th edition , Springer-Verlag Berlin Heidelberg Publisher, 2008.
5. Fuzzy Logic with Engineering Applications by T. J. Ross, 3rd edition, MIT Press, Inc 2011.
6. Neural Networks and Fuzzy Systems: A Dynamical Systems Approach to Machine Intelligence by Kosko Bart, Prentice Hall of India, New Delhi, 2001.
7. An Introduction to Genetic Algorithms by Melanie Mitchell, 2nd Edition, MIT Press, 1999.

IN456UC ARTIFICIAL INTELLIGENCE LAB

(Professional Elective-V LAB)

Teaching Scheme: 02 P ; Total: 02 **Credits:** 01
Evaluation Scheme: 25 ICA + 25 ESE **Total Marks:** 50
ESE Duration: 3 Hrs.

COURSE DESCRIPTION

Minimum Ten experiments shall be performed to cover entire curriculum of course **IN453UC**. The list given below is just a guideline.

COURSE OBJECTIVES:

The objectives of offering this course are to-

1. Provide the most fundamental knowledge to the students so that they can understand AI.
2. Identify problems where artificial intelligence techniques are applicable.
3. Participate in the design of systems that act intelligently and learn from experience.

COURSE OUTCOMES:

On the successful completion of this course, students will be able to -

1. Acquainted with the expert system architecture and artificial intelligence
2. Select appropriate AI technique for a given real world problem
3. Develop neural network, fuzzy logic, genetic algorithm and hybrid system for control system applications
4. Understand the basics of learning and training algorithms
5. Apply the principles of machine learning and AI for practical applications.

RELEVANCE OF POS AND STRENGTH OF CORRELATION:

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

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

LIST OF EXPERIMENTS

1. Learning rules and activation functions in neural network
2. Development of logic using multilayer perceptron and hebb neuron model
3. Development of supervised learning using neural network (NN) Toolbox
4. Development and testing of perceptron neural network algorithm
5. Development of error back propagation algorithm for control application.
6. Development of auto associative network using outer product rule
7. Development of fuzzy membership functions and fuzzy set properties
8. Development and verification of logic using fuzzy relations
10. Design of a fuzzy controller systems using Fuzzy Logic Toolbox
11. Application development using NN/Fuzzy logic
12. Implementation of Simple Genetic Application
13. Study of adaptive neuro-fuzzy inference system ANFIS Architecture

Note:

- **ICA –** Internal Continuous Assessment shall support for regular performance of practical and its regular assessment. In addition; it shall be based on knowledge/skill acquired and record submitted by student (journal) based on practical performed by him/her. The performance shall be assessed experiment wise using internal continuous assessment format.

- **ESE –** The end semester examination (ESE) for this laboratory course shall be based on oral examination to judge the depth of understanding/knowledge or skill acquired by the student. It shall be evaluated by two examiners out of which one examiner shall be out of institute.

IN453UD HUMAN ERGONOMICS

(Professional Elective-V)

Teaching Scheme: 03L+ 00 T; Total: 03 **Credits:** 03
Evaluation Scheme: 30 MSE + 10 ISA + 60 ESE **Total Marks:** 100
ESE Duration: 3 Hrs.

COURSE DESCRIPTION:

This course includes introduction to the overview of Ergonomics and design relevance. The course explores Man machine environment interaction system and user-friendly design practice, Human compatibility, comfort and adaptability and fundamentals of Ergonomics

COURSE OBJECTIVES:

1. To introduce the fundamentals and scope of Human Ergonomics
2. To give the knowledge of Anthropometry in Human Ergonomics
3. To give the knowledge of the workstation design for human comfort
4. To study the effect of environmental factors on Human body

COURSE OUTCOMES

After successful completion of this course, students will be able

CO	After the completion of the course the student will be able to	Bloom's Cognitive	
		Level	Descriptor
CO1	To define the need of ergonomics for human comfort	2,3	Understand, Analyze
CO2	To demonstrate the body dimension measuring techniques for ergonomics design	1,2,3	Understand, Apply, Evaluate
CO3	To suggest the workstation design criterion for human compatibility	2,3,4	Understand, Apply, Analyze
CO4	To work in interdisciplinary team for designing the infrastructure in concern to HE	3,4	Apply, Analyze

RELEVANCE OF PO'S AND STRENGTH OF CORRELATION

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

1 – Weakly correlated 2 Moderately Correlated 3 Strongly Correlated

Course Contents

Introduction:
Domain, Physiology objective, Ergonomics/Human factor fundamentals, Scope and Application of Ergonomics

Anthropometry: Basic definitions, Body dimensions and importance, anthropometric measuring technique

Muscular Skeletal disorders: Muscular energy, Dynamic and static effort, postures, Types of disorders their courses and remedies, fatigue, Boredom.

Workstation design: Design of furniture and lighting computer and office workstations, Operations theatre equipment and their arrangement, Dental chair, Wheel chair.

Environmental Factors: Effects of noise and vibration on the human body, Remedies- Measurements of vibration and noise levels, effect of temperature and humidity on human body.
Design ergonomics in India Scope for exploration

Text Books:

1. Bridger RS ,Introduction to Ergonomics,2nd Edition Taylor and Francis ,2003
2. D. .Majumdar and W. Selvamurthy, "Advances in Ergonomics, occupational Health and Safety", New Age international Ltd.
3. Dul.J and Weerdmeester .B, Ergonomics for beginners ,a quick reference guide Taylor and Francis 1993
4.

Reference Books:

1. Grandjaen, Fitting the task to Man", Taylor Pub, 1982
2. Sanders, Human factors in Engg. & Design, MGH, 1993
3. Green W S and Jordan W Human factors in product design ,Taylor and Francis 1999
4. Singh S Ergonomics Interventions for Health and Productivity ,Himanshu Publication, Udaipur New Delhi 2007

IN456UD HUMAN ERGONOMICS LAB

(Professional Elective-V LAB)

Teaching Scheme: 02 P ; Total: 02 **Credits:** 01

Evaluation Scheme: 25 ICA + 25 ESE **Total Marks:** 50

ESE Duration: 3 Hrs.

COURSE DESCRIPTION:

This course includes introduction to the overview of Ergonomics and design relevance. The course explores Man machine environment interaction system and user-friendly design practice, Human compatibility, comfort and adaptability and fundamentals of Ergonomics

COURSE OBJECTIVES:

1. To introduce the fundamentals and scope of Human Ergonomics
2. To give the knowledge of Anthropometry in Human Ergonomics
3. To give the knowledge of the workstation design for human comfort
4. To study the effect of environmental factors on Human body

COURSE OUTCOMES

After successful completion of this course, students will be able

1. To define the need of ergonomics for human comfort
2. To demonstrate the body dimension measuring techniques for ergonomics design
3. To suggest the workstation design criterion for human compatibility
4. To work in interdisciplinary team for designing the infrastructure in concern to HE

RELEVANCE OF PO'S AND STRENGTH OF CORRELATION

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

1 – Weakly correlated 2 Moderately Correlated 3 Strongly Correlated

LIST OF EXPERIMENTS

This lab consisting of the assignments/study of design/Design procedures/ergonomic standards consideration/case studies/visit to ergonomic lab or hospital based on **IN353UD**

Note:

ICA – Internal Continuous Assessment shall support for regular performance of practical and its regular assessment. In addition; it shall be based on knowledge/skill acquired and record submitted by student (journal) based on practical performed by him/her. The performance shall be assessed experiment wise using internal continuous assessment format.

ESE – The end semester examination (ESE) for this laboratory course shall be based on oral examination to judge the depth of understanding/knowledge or skill acquired by the student. It shall be evaluated by two examiners.

IN454UA POLLUTION CONTROL AND MANAGEMENT

(Professional Elective-VI)

Teaching Scheme: 03L+ 00 T; Total: 03 **Credits:** 03
Evaluation Scheme: 30 MSE + 10 ISA + 60 ESE **Total Marks:** 100
ESE Duration: 3 Hrs.

COURSE DESCRIPTION:

This course covers the sources, characteristics and effects of pollution and the methods of controlling the same. The student is expected to know about source inventory and control mechanism.

COURSE OBJECTIVES:

1. To identify the sources of air, noise and water pollution.
2. To understand the concepts involved in control technologies.

COURSE OUTCOMES:

CO	After the completion of the course the student will be able to	Bloom's Cognitive	
		Level	**Descriptor**
CO1	acquire the knowledge of system of units, classification and essentials of measuring instruments.	01,02	Remembering, Understanding
CO2	design the construction and operation of various measuring instruments.	01,02	Remembering, Understanding
CO3	identify the measuring instruments and apply them for quantifying measurements of parameters.	03	Applying
CO4	analyze and select proper instrument for given application	03,04	Applying, Analyzing
CO5	calibrate and monitor a variety of electronic instruments	03	Applying

RELEVANCE OF POS AND STRENGTH OF CORRELATION:

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

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

Course Content

Introduction

Industrial scenario – Uses of Water by industry – Sources and types of industrial wastewater – Industrial wastewater disposal and environmental impacts – Reasons for treatment of industrial wastewater – Regulatory requirements – Industrial waste survey. – Individual and Common Effluent Treatment Plants – Joint treatment of industrial wastewater.

Industrial Water Pollution Control and Treatment

Advanced wastewater treatment. Industry specific wastewater treatment for chloro-alkali, electroplating, distillery, tannery, pulp and paper, fertilizer, etc.

Sequencing batch reactors – High Rate reactors. Chemical oxidation – Ozonation – Photocatalysis – Wet Air Oxidation – Evaporation – Ion Exchange – Membrane Technologies – Nutrient removal – Land Treatment.

Air Pollution Control

Dust control and abatement measures in mines; role of green belts. Control devices for gaseous pollutants with special emphasis on adsorption, absorption, mass transfer, condensation, and combustion. Control of motor vehicle emissions. Indoor air pollution control.

Noise Pollution Control

Noise pollution and management in Mines, Washeries, Power plants, Fertilizer plants, Cement plants, etc. Human Vibration whole body vibration problems in opencast mines, health effects and control measures. Ground vibration and air blast, Environmental and health effects; strategic control and abatement measures.

Case Studies

Industrial manufacturing process description, wastewater characteristics and waste treatment flow sheet for Textiles – Tanneries – Pulp and paper – metal finishing – Petroleum Refining – Chemical industries – Sugar and Distilleries –Dairy – Iron and steel – fertilizers Details of Pollution control Low, regulating authorities, Government norms, and approval process.

Text Books:

1. Air Pollution Control Engineering by N.D. Nevers (1995) MC-Graw Hill
2. Air Pollution by H.C. Perkins MC Graw Hill (latest edition)
3. Noise Pollution by Tripathy, Debipras (latest edition)

References:

1. Eckenfelder, W.W., (1999) “Industrial Water Pollution Control”, Mc-Graw Hill.
2. Arceivala, S.J., (1998) “Wastewater Treatment for Poll. Control”, Tata McGraw Hill.
3. World Bank Group (1998)”Pollution Prevention and Abatement Handbook – Towards Cleaner Production “, World Bank and UNEP, Washington D.C.

IN454U INDUSTRIAL SAFETY AND HAZARD MANAGEMENT

(Professional Elective- VI)

Teaching Scheme: 03L+ 00 T; Total: 03 **Credits:** 03
Evaluation Scheme: 30 MSE + 10 ISA + 60 ESE **Total Marks:** 100
ESE Duration: 3 Hrs.

COURSE DESCRIPTION:

This course shall give the importance of industrial safety and its management. This will make the students familiar with industrial safety programs, industrial laws and regulations.

COURSE OBJECTIVES:

The objectives of this course are as follows

1. To know about Industrial safety programs and toxicology, Industrial laws, regulations and source models.
2. To understand about fire and explosion, preventive methods, relief and its sizing methods
3. To analyze industrial hazards and its risk assessment.

DESIRABLE AWARENESS/SKILLS:

Sensors and transducers, measurement system. Electronic instrumentation.

COURSE OUTCOMES:

CO	After the completion of the course the student will be able to	Bloom's Cognitive	
		Level	Descriptor
CO1	state the industrial laws, regulations and source models	1,2	Remember, Understand
CO2	appreciate the relief and its sizing methods	2,3	Understand, apply
CO3	select the suitable method of hazard identification and suggest preventive measures	2,3,4	Understand, apply, analyze
CO4	apply the methods of prevention of fire and explosions	2,3,5	Understand, apply,
CO5	analyze the effect of release of toxic substances	3,4,5	apply, analyze, evaluate

RELEVANCE OF POS AND STRENGTH OF CORRELATION:

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

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

Course Content

Industrial safety:

Safety programs, engineering ethics, accident and loss statistics, acceptable risk, public perceptions, nature of the accident process, inherent safety, seven significant disasters toxicology, effect of toxicants on biological organisms, toxicological studies, dose versus response, models for dose and response curves, relative toxicity, threshold limit values, National Fire Protection Association (NFPA) Diamond.

Industrial Hygiene:

Government Laws and Regulations, OSHA: process safety management, epa: risk management plan, dhs: chemical facility anti-terrorism standards (CFATS) industrial hygiene, anticipation and identification, evaluation, control. Source models, introduction to source models, flow of liquid through holes, and pipes, flow of gases or vapors through holes and pipes, flashing liquids, liquid pool evaporation or boiling, conservative analysis

Fires and Explosions:

The fire triangle, distinction between fires and explosions, definitions, flammability characteristics of liquids and vapors, limiting oxygen concentration and inerting, flammability diagram, ignition energy , auto ignition , auto-oxidation , adiabatic compression, ignition sources, sprays and mists, explosions, Concepts to prevent fires and explosions, inerting, static electricity and its control, explosion-proof equipment and instruments, ventilation, sprinkler systems, miscellaneous concepts for preventing fires and explosions.

Reliefs and Sizing:

Relief Concepts, definitions, location of reliefs, relief types and characteristics, relief scenarios, data for sizing reliefs, relief systems. relief sizing , conventional spring-operated reliefs in liquid and in vapor or gas services, rupture disc reliefs in liquid in vapor or gas services, two-phase flow during runaway reaction relief , pilot-operated and bucking-pin reliefs, deflagration venting for dust and vapor explosions, venting for fires to external process, vessels, reliefs for thermal expansion of process fluids.

Hazards Identification and Risk Assessment:

Process hazards checklists, hazards surveys, hazards and operability studies, safety reviews, other methods, Review of Probability Theory, Event Trees, Fault Trees, QRA and LOPA, s. Ingress protection authorized regulatory bodies for certifying instruments in Hazardous location (BASEEFA, FM, PTB, UL, CESI, LLIE, CSA, DEMKO, IEC&CENELEC).

IN454UC ENTREPRENEURSHIP AND BUSINESS MANAGEMENT

(Professional Elective-VI)

Teaching Scheme: 03L+ 00 T; Total: 03 **Credits:** 03
Evaluation Scheme: 30 MSE + 10 ISA + 60 ESE **Total Marks:** 100
ESE Duration: 3 Hrs.

COURSE DESCRIPTION:

This course earnestly attempts to present the various aspects of entrepreneurship and what a prospective entrepreneurship and what a prospective entrepreneurs must know before embarking on an industrial, business venture.

COURSE OBJECTIVES:

1. To introduce and understand Entrepreneurship and its types.
2. To understand how to evaluate risk in entrepreneurial ventures
3. To understand different type of finances available and financing methods
4. To understand detailed information about the principles, practices and tools involved in all aspects of the sales processes

COURSE OUTCOMES:

CO	After the completion of the course the student will be able to	Bloom's Cognitive	
		Level	Descriptor
CO1	Understand the basic concept of entrepreneurship development	01,02	Remembering, Understanding
CO2	Classification of companies and organization	03	Applying,
CO3	Study the terminology in sales and operation.	02	Understand,
CO4	Study any corporate company organization structure	03	Applying,

RELEVANCE OF POS AND STRENGTH OF CORRELATION:

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

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

Course Content

Entrepreneurship Development

Meaning, objectives, scope & philosophy, type of entrepreneurs, factors affecting entrepreneurship, entrepreneurial qualities, need for promotion of entrepreneurship & small business, linkage between entrepreneurship and economic development, problem of increasing unemployment, creativity & entrepreneurship, harnessing locally available resources.

Types of Companies and Organizations

Company/ Organization Types, Legal Aspects, Taxation, Government Liaison, Building the Team, Mergers and Acquisitions. Shares and Stakes, Valuation, Finance Creation (Investors / Financers), Revenue Plans and Projections, Financial Ratios, Business Lifecycle.

Concept of Marketing

Marketing Basics, Marketing Strategy and Brand Positioning, Plans and Execution Techniques, Marketing Analytics, Online Marketing

Sales and operation management

Understanding Sales, Pitching Techniques, Sales strategies, Inside Sales v/s Outside Sales, RFP. Operational Basics, Process Analysis, Productivity, Quality

Start-ups

Start-up Basics, Terms, Start-up Financing, Start-up Incubation, Start-up Incubation, Getting Listed

Text Books:

5. Hisrich, R. D. & Peters, M. P. (2001). Entrepreneurship: Starting, developing, and managing a new enterprise (5th Ed.). New York: McGraw-Hill.
6. Bhargava, S. (2003). Transformational leadership: Value based management for Indian Organizations (Ed.). New Delhi: Response-Sage.
7. Prasanna Chandra: Protect Preparation, Appraisal, Implementation; Tata McGraw Hill.

Reference Books:

1. Holt: Entrepreneurship-New Venture Creation; Prentice Hall of India. New Delhi

IN454UD INDUSTRIAL PSYCHOLOGY
(Professional Elective- VI)

Teaching Scheme: 03L+ 00 T; Total: 03 **Credits:** 03
Evaluation Scheme: 30 MSE + 10 ISA + 60 ESE **Total Marks:** 100
ESE Duration: 3 Hrs.

COURSE OBJECTIVES:

The objective of this course is to inculcate the traits of performance management, organization leadership, motivation and managerial psychology among the students

COURSE OUTCOMES:

CO	After the completion of the course the student will be able to	Bloom's Cognitive	
		Level	Descriptor
CO1	learn and apply different scientific management techniques.	1,2	Remember, Understand
CO2	analyze the existing jobs and design suitable jobs to provide certain amount of challenge and job satisfaction	2,3	Understand, apply
CO3	analyze and resolve the real life conflicts	2,3,4	Understand, apply, analyze
CO4	have sufficient knowledge to undertake behavioral research projects in the organizations	2,3	Understand, apply,
CO5	develop an ability to work in the work groups and communicate effectively	3,4,5	apply, analyze, evaluate

RELEVANCE OF POS AND STRENGTH OF CORRELATION:

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

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

Course Content

Introduction to Industrial Psychology: Definitions & Scope. Major influences on industrial Psychology-Scientific management and human relations schools, Taylorism and scientific management, Hawthorne Experiments

Individual in Workplace: Motivation and Job satisfaction, stress management. Organizational culture, Leadership & group dynamics. Work Environment & Engineering Psychology-fatigue. Boredom, accidents and safety. Job Analysis, Recruitment and Selection, test of special abilities and personality assessment, attitudes, morale and adjustment, Reliability & Validity of recruitment tests. Organization Behavior.

Performance Management: Training & Development. Basic motivation concepts and their applications, Understanding work teams, communication, conflict management and negotiations, Organizational culture, Organizational change and factors contributing to the development, Case studies and problem solving sessions,

Managerial psychology: The functions performed by effective managers, The manager as a decision-maker, Psychological models of managerial decision-making, And The manager as a motivator: major models of work motivation. Managerial motivation. Goal-setting, intrinsic motivation and self-efficacy in work settings. The manager as a communication link: superior-subordinate communication. Determinants of and barriers to effective communication at the managerial level, The manager as a conflict-resolver: major psychological approaches to conflict management, resolution and handling, The manager as a reward allocator. Basic principles of distributive and procedural fairness from a managerial perspective

Books Recommended

1. Miner J.B. (1992) Industrial/Organizational Psychology. N Y: McGraw Hill.
2. Blum & Naylor (1982) Industrial Psychology. Its Theoretical & Social Foundations CBS Publication.
3. Aamodt, M.G. (2007) Industrial/Organizational Psychology: An Applied Approach (5th edition) Wadsworth/Thompson: Belmont, C.A.
4. Aswathappa K. (2008). Human Resource Management (fifth edition) New Delhi: Tata McGraw Hill.
5. Arnold & Randall, “Work Psychology", Pearson.

IN457U SEMINAR

Teaching Scheme: 02P Total: 02 **Credit:** 01
Evaluation Scheme: 50 ICA **Total Marks:** 50

COURSE DESCRIPTION:

This course explores the knowledge of presentation and communication. Also, it develops ability to work on identify, formulate and solve engineering problems in view of economic, environmental and social aspect..

COURSE OBJECTIVES:

1. To develop the ability to express our views and improve presentation skills.
2. To study various international, national journals to identify, understand and formulate the problem.
3. To apply effective strategies in literature searches

. DESIRABLE AWARENESS/SKILLS:

Communication skill and MS office.

COURSE OUTCOMES:

CO	After the completion of the course the student will be able to	Bloom's Cognitive	
		Level	Descriptor
CO1	Understand literature survey for selection of seminar topics.	1,2	Remember, Understand
CO2	Apply knowledge of mathematics, science and engineering for effective presentation.	2,3	Understand, Apply
CO3	Identify, formulate and solve engineering problems by understanding professional as well as ethical responsibility	2,3,4	Understand, Apply, Analyze

RELEVANCE OF POS AND STRENGTH OF CORRELATION:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	1	2	-	1	-	1	1	2	-	3	-	-	-
CO2	3	2	1	2	2	1	-	1	2	3	-	3	1	-	2
CO3	3	3	3	2	2	2	-	3	2	3	-	3	2	3	-

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

Course Content

Course Content

1 Each student shall select a topic for seminar which is not covered in curriculum. Seminar topic should not be repeated and registration of the same shall be done on first come first serve basis.

2. Topic of seminar shall be registered within a three weeks from commencement of VIII semester and shall be approved by the committee.

3. The three member committee appointed by Head of Department shall be constituted for finalizing the topics of seminar. Seminar shall be related state of the art topic of his/her choice approved by the committee.

4. Each student should deliver a seminar in a scheduled period (Specified in time framed by the Department) and submit the seminar report (spiral bound).

Guidelines for ICA: Assessment of the seminar for award of ICA marks shall be done jointly by the guide and a departmental committee, as per the evaluation parameters given in **Table-I**

Table-I

Sr. No.	Name of Student	Seminar Topic	Topic Selection	Literature Survey	Delivery	Contents	Depth of Understanding	Report Writing	Total
			10	**10**	**10**	**05**	**05**	**10**	**50**

IN458U PROFESSIONAL INTERNSHIP

Teaching Scheme: Internship in industry **Credits:** 02
Evaluation Scheme: -ICA 75 **Total Marks:** 75

COURSE DESCRIPTION:

This course gives opportunity to students to explore the knowledge of industry organization, new trends in manufacturing, maintenance and safety and also gives actual work experience with exposure to industrial environment or boosts entrepreneurial aspirations or analytical skills to solve real life problem as per student interest.

COURSE OBJECTIVES:

The objective of course are as follows

1. Introduce the basic industries and the process/product development cycle.
2. be familiar with the industrial environment and work culture
3. Learn the importance of entrepreneurial skills.
4. emphasizes intuitive understanding and practical implementations of the theoretical concepts

.DESIRABLE AWARENESS/SKILLS:

Listening, understanding and analyzing ability along with the knowledge of concepts, principles and techniques studied earlier.

COURSE OUTCOMES:

CO	After the completion of the course the student will be able to	Bloom's Cognitive	
		Level	Descriptor
CO1	Demonstrate the ability to face industrial environment/ world of work.	2,3	Understand, Analyze
CO2	Evaluate and analyze the role of various sections such as manufacturing, material handling, maintenance, safety and environmental considerations, HR and top and middle management in industry.	1,2,3	Understand, Apply, Evaluate
CO3	To understand work culture in core or IT industry as a employee or employer	1,2,3	Understand, Apply, Analyze

RELEVANCE OF POS AND STRENGTH OF CORRELATION:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	1	3	-	-	-	3	-	1	2	3	2	3
CO2	3	1	-	2	-	1	2	1	3	-	2	2	2	2	2
CO3	2	3	2	3	2	3	2	2	3	3	3	3	2	2	3

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

Course Content

Course Content-cum-instructions:

This course shall be completed preferably during the summer vacation after sixth semester but in exceptional cases can be completed during the winter vacation after seventh semester or during the weekends of seventh semester. Under any circumstances; this course shall be completed before the commencement of eighth semester. Industrial visit Industry visits for minimum four industries local or outstation shall be carried out by each student. Department shall arrange the industrial visits during the summer/winter vacations after sixth/seventh semester or in exceptional cases weekends during the seventh semester. Industries shall be related to solar energy/ power electronics/ telecom sector/ computer hardware-software/ manufacturing/ automobile automation/ bio-tech-agriculture sector/power station, Tv-radio station/ sugar-chemical factory/ any other relevant industry approved by course coordinator.

For this course, the instructions andr guidelines of AICTE shall be followed. The guidelines, instructions and various format Can be obtained using following link:

https://www.aicte-india.org/sites/default/files/AICTE%20Internship%20Policy.pdf

In addition to above Industrial Training:

Individual or group of students shall undergo industrial training in any industry of own interest and convenience related to any interdisciplinary topic/field/ nature for minimum one week fulltime or two weeks part time so that total training period should be more than 40 hours

Course Deliverable

Every student shall submit the appropriate (visit/training/attendance/visit for special study) certificate along with a report in the format provided by department/course coordinator duly signed by course coordinator and HoD. Evaluation system It includes Internal Continuous Assessment (ICA) and Guidelines for ICA are given bellow.

Internal Continuous Assessment (ICA)

The ICA shall be evaluated by course coordinator appointed by the HoD. Course coordinator shall judge the student on the basis of presentation, deliverables of the course described earlier. The guidelines and format prescribed by AICTE may be used for ICA

https://www.aicte-india.org/sites/default/files/AICTE%20Internship%20Policy.pdf

IN459U PROJECT PHASE-II

Teaching Scheme: 04 P ; Total: 04 **Credits:** 04
Evaluation Scheme: 50 ICA + 100 ESE **Total Marks:** 150
ESE Duration: 3 Hrs

COURSE DESCRIPTION:

The project is one of the most important work in the degree programmer. It is introduced in curriculum to put into practice some of the techniques that have been taught to students in earlier years. It also provides the opportunity to students to demonstrate independence and originality, to plan and organize a large project over a long period. The project topic should be selected to ensure the satisfaction of the need to establish a direct link between the techniques they learnt and productivity. Thus, it should reduce the gap between the world of work and the world of study.

COURSE OBJECTIVES:

The objectives of offering this course are:

1. to develop ability to synthesize knowledge and skills previously gained and to put some of them into practice.
2. to make students capable to select from different methodologies, methods and forms of analysis studied to produce a suitable system or sub-system.
3. to inculcate ability to present the findings of their technical solution in a written report.
4. to plan and organise a large project over a long period.

COURSE OUTCOME:

CO	After the completion of the course the student will be able to	Bloom's Cognitive	
		Level	Descriptor
CO1	Apply the knowledge and skills previously gained into practice.	2,3	Understand, Analyze
CO2	Take appropriate decision w.r.t. various parameters related to production of a system or sub-system.	3,2,1	Understand, Apply, Evaluate
CO3	Demonstrate the leadership quality along with ability to work in a group.	1,2,3	Understand, Apply, Analyze
CO4	Prove the ability to present the findings in a written report or oral presentation.	1,2,3	Understand, Apply, Analyze

RELEVANCE OF POS AND STRENGTH OF CORRELATION:

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

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

Course Content

- The project shall be carried out in-house i.e. in the department's laboratories/centres by a group 2 – 4 students. In any case the group shall not consist of more than four students.
- The project shall consist of design and implementation of any suitable instrumentation application system, sub system or software based on knowledge and skills previously gained. ·
- Student is expected to detail out specifications, methodology, resources required, critical issues involved in design and implementation.

Project Deliverables: A project report as per the specified format (available on in the department and institutes website), developed system in the form of hardware and/or software. In addition, student shall maintain a record of attendance and continuous progress (log book in appropriate format available on institute/department's web site) duly signed by course coordinator and present as mini project deliverable along with report.

Evaluation System:

It includes Internal Continuous Assessment (ICA) and End Semester Examination (ESE). Guidelines for ICA and ESE are given bellow.

Internal Continuous Assessment (ICA)

- The ICA shall be evaluated twice in the semester. A committee comprising of three examiners (one of them should be guide) nominated by head of department, will take the review of the project work twice in a semester. Committee shall judge the students on the principle of continuous evaluation and contribution of individual student in the group. Average of two reviews shall be considered as overall performance of the student.
- It shall be evaluated on the basis of deliverables of project and depth of understanding.
- Course coordinator shall maintain the record of continuous evaluation in appropriate format available on institute/department's web site.

End Semester Examination (ESE)

- The End Semester Examination for this course shall be based on demonstration of the system or sub system developed by the group of students, deliverables of project and depth of understanding (oral examination). It shall be evaluated by two examiners out of which one examiner shall be out of institute.

IN460U INDUSTRIAL PROJECT

Teaching Scheme: 04 P ; Total: 04 **Credits:** 06

Evaluation Scheme: 50 ICA + 100 ESE **Total Marks:** 150

ESE Duration: 3 Hrs

COURSE DESCRIPTION:

Industry requests engineers prepared to solve open problems in a sustainable way by applying theoretical knowledge in a real-world context. With the aim to fulfil this demand, the course cooperates closely with industry, providing real industrial project enabling learning focused on the application knowledge. The vision is to give students an opportunity to make their first traces in the industrial reality and start building a personal network, an important prerequisite for a successful industry career.

The purpose of the course is therefore that the students, through active collaboration in a project group, will learn how to solve real industrial problems by following established engineering methods, working in teams, and effectively communicating with various stakeholders.

COURSE OBJECTIVES:

The objectives of offering this course are:

1. to develop ability to apply theoretical knowledge in a real-world context.
2. to allow learning focused on the application knowledge.
3. to inculcate ability to present the findings of their technical solution in a written report.
4. to plan and organise a large project over a long period.

COURSE OUTCOME:

CO	After the completion of the course the student will be able to	Bloom's Cognitive	
		Level	Descriptor
CO1	Able to formulate a clear problem and create a project plan	2,3	Understand, Analyze
CO2	Take appropriate decision wrt various parameters related to production of a system or sub-system.	3,2,1	Understand, Apply, Evaluate
CO3	Demonstrate the leadership quality along with ability to work in a group.	1,2,3	Understand, Apply, Analyze
CO4	Prove the ability to present the findings in a written report or oral presentation.	1,2,3	Understand, Apply, Analyze

RELEVANCE OF POS AND STRENGTH OF CORRELATION:

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

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

Course Content

Project will be carried out in industry full time throughout semester

Evaluation System:
It includes Internal Continuous Assessment (ICA) and End Semester Examination (ESE). Guidelines for ICA and ESE are given bellow.

Internal Continuous Assessment (ICA)

- The ICA shall be evaluated twice in the semester. A committee comprising of two examiners (Two members- Guide from Industry and Internal guide from Institute) nominated by head of department, will take the review of the project work twice in a semester. Committee shall judge the students on the principle of continuous evaluation and contribution of individual Average of two reviews shall be considered as overall performance of the student.
- It shall be evaluated on the basis of deliverables of project and depth of understanding.
- Course coordinator shall maintain the record of continuous evaluation in appropriate format available on institute/department's web site.

End Semester Examination (ESE)

- The End Semester Examination for this course shall be based on demonstration of the system or sub system developed by the student, It shall be evaluated by two examiners out of which one examiner shall be out of institute.