GOVT. COLLEGE OF ENGINEERING,

AMRAVATI

B. Tech.

(Instrumentation Engineering)

VII and VIII Semester

Department of Instrumentation Engineering

2015-16

(AS PER ACADEMIC BOARD MEETING 25 JUNE 2013 & 5/12/2014)

GOVERNMENT COLLEGE OF ENGINEERING, AMRAVTI

DEPARTMENT OF INSTRUMENTATION ENGINEERING

Scheme for B. Tech. First Year SEM I

Course Code	Name of the Course	Teaching Scheme				Evaluation Scheme							Credits
						Theory				Practical		Total	
		Theory Hrs/week	Tutorial Hrs/wee	Practical Hrs/week	Total	TA	CT1	CT2	ESE	ICA	ESE		
SHU101	Engineering Mathematics-I	3	1	-	4	10	15	15	60	---	---	100	4
SHU102	Applied Physics	4	-	-	4	10	15	15	60	---	---	100	4
SHU104	Living Systems	2	-	-	2	4	8	8	30	---	---	50	0
CSU101	Computer Science	3	-	-	3	10	15	15	60	---	---	100	3
CEU101	Engineering Mechanics	3	1	-	4	10	15	15	60	---	---	100	4
ETU101	Basic Electronics Engineering	2	-	-	2	4	8	8	30	---	---	50	2
MEU101	Workshop Practice-I	---	-	2	2	---	---	---	---	50	---	50	1
SHU103	Applied Physics LAB	---	-	2	2	---	---	---	---	50	---	50	1
CSU102	Computer Science LAB	---	-	4	4	---	---	---	---	50	---	50	2
CEU102	Engineering Mechanics LAB	---	-	2	2	---	---	---	---	50	---	50	1
ETU102	Basic Electronics Engineering LAB	---	-	2	2	---	---	---	---	50	---	50	1
Total		17	2	1	31	48	76	76	300	250	0	750	23

SEM II

Course Code	Name of the Course	Teaching Scheme				Evaluation Scheme							Credits
						Theory				Practical		Total	
		Theory Hrs/week	Tutorial Hrs/week	Practical Hrs/week	Total	TA	CT1	CT2	ESE	ICA	ESE		
SHU201	Engineering Mathematics-II	3	1	-	4	10	15	15	60	---	---	100	4
SHU202	Applied Chemistry	4	-	-	4	10	15	15	60	---	---	100	4
MEU201	Engineering Graphics	3	-	-	3	10	15	15	60	---	---	100	3
EEU201	Basic Electrical Engineering	2	-	-	2	4	8	8	30	---	---	50	2
SHU203	Environmental Studies	3	-	-	3	10	15	15	60	---	---	100	3
MEU202	Workshop Practice-II	---	-	2	2	---	---	---	---	50	---	50	1
SHU204	Applied Chemistry LAB	---	-	2	2	---	---	---	---	50	---	50	1
MEU203	Engineering Graphics LAB	---	-	4	4	---	---	---	---	50	---	50	2
EEU202	Basic Electrical Engineering LAB	---	-	2	2	---	---	---	---	50	---	50	1
SHU205	General Proficiency-I	1	-	2	3	---	---	---	---	50	---	50	2
Total		16	1	1	29	44	68	68	270	250	0	700	23

TA: Teacher Assessment CT: Class Tests ESE: End Semester Examination ICA: Internal Continuous Assessment

ESE Duration: 2.00hrs for ETU101, EEU201 and SHU104, 3.00 hrs for MEU201 and 2.30 hrs for the remaining courses.

Note: 50% students shall be offered group **A** courses and remaining 50% shall be offered group **B** courses in a semester. In the next semester, the students who registered for group **A** courses in previous semester shall register for group **B** courses and vice versa. There should be direct correspondence of group **A** and group **B** courses.

Sr. No.	Group A Courses		Group B Courses	
	Course Code	**Title of Course**	**Course Code**	**Title of Course**
1	SHU102	Applied Physics	SHU202	Applied Chemistry
2	CEU101	Engineering Mechanics	MEU201	Engineering Graphics
3	SHU103	Applied Physics LAB	SHU204	Applied Chemistry LAB
4	CEU102	Engineering Mechanics LAB	MEU203	Engineering Graphics LAB

GOVERNMENT COLLEGE OF ENGINEERING AMRAVATI
DEPARTMENT OF INSTRUMENTATION ENGINEERING
SCHEME FOR B.Tech.(Instrumentation Engineering)

Course Code	Name of the course	Teaching Scheme				Evaluation Scheme							Credits
						Theory				Practical		Total	
		Theory Hrs /week	Tutorial Hrs/week	Practical Hrs/week	Total	TA	CT1	CT2	ESE	ICA	ESE		
Sem III													
SHU303	Engineering Mathematics III	3	0	---	3	10	15	15	60	---	---	100	3
INU 302	Electronic Devices and Circuits	3	1	---	4	10	15	15	60	---	---	100	4
INU303	Numerical Methods	3	1	---	4	10	15	15	60	---	---	100	4
INU304	Circuit Theory	3	---	---	3	10	15	15	60	---	---	100	3
INU305	Digital Electronics	3	---	---	3	10	15	15	60	---	---	100	3
INU306	Electronic Devices and Circuits LAB	---	---	2	2	---	---	---	---	25	25	50	1
INU307	Circuit Theory LAB	---	---	2	2	---	---	---	---	25	25	50	1
INU308	Digital Electronics LAB	---	---	2	2	---	---	---	---	25	25	50	1
INU309	Computational Method LAB -I	---	---	2	2	---	---	---	---	50	--	50	1
SHU305	General Proficiency II	1		2	3	--	--	--	--	25	25	50	2
Total		**16**	**2**	**10**	**28**	**50**	**75**	**75**	**300**	**150**	**100**	**750**	**23**
Sem IV													
SHU401	Engineering Mathematics IV	3	-	---	3	10	15	15	60	---	---	100	3
INU402	Sensors and Transducer	3	1	---	4	10	15	15	60	---	---	100	4
INU403	Control System Component	3	1	---	4	10	15	15	60	---	---	100	4
INU404	Linear Integrated Circuits	3	--	---	3	10	15	15	60	---	---	100	3
EEU411	Signals and Systems	3	1	---	4	10	15	15	60	---	---	100	4
INU406	Sensors and Transducer LAB	---	---	2	2	---	---	---	---	25	25	50	1
INU407	Control System Component LAB	---	---	2	2	---	---	---	---	25	25	50	1
INU408	Linear Integrated Circuits LAB	---	---	2	2	---	---	---	---	25	25	50	1
INU 409	Computational Method LAB -II	--	--	2	2	---	--	--	--	25	25	50	1
SHU403	Engineering Mathematics LAB	---	---	2	2	---	---	---	---	50	--	50	1
	Total	**15**	**3**	**10**	**28**	**50**	**75**	**75**	**300**	**150**	**100**	**750**	**23**

GOVERNMENT COLLEGE OF ENGINEERING AMRAVATI
DEPARTMENT OF INSTRUMENTATION ENGINEERING
PROPOSED SCHEME FOR B.Tech.(Instrumentation Engineering)

Course Code	Name of the course	Teaching Scheme				Evaluation Scheme							Credits
						Theory				Practical		Total	
		Theory Hrs /week	Tutorial Hrs/week	Practical Hrs/week	Total	TA	CT1	CT2	ESE	ICA	ESE		
Sem V													
INU501	Microprocessor and Interfacing	3	1	---	4	10	15	15	60	---	---	100	4
INU502	Instrumental Methods of Analysis	3	---	---	3	10	15	15	60	---	---	100	3
INU503	Digital Signal Processing	3	---	---	3	10	15	15	60	---	---	100	3
INU504	Electronic Instrumentation	3	---	---	3	10	15	15	60	---	---	100	3
INU505	Control System Engineering	3	---	---	3	10	15	15	60	---	---	100	3
INU506	Microprocessor and Interfacing LAB	---	---	2	2	---	---	---	---	25	25	50	1
INU507	Instrumental Methods of Analysis LAB	---	---	2	2	---	---	---	---	25	25	50	1
INU508	Electronic Instrumentation LAB	---	---	2	2	---	---	---	---	25	25	50	1
INU509	Digital Signal Processing LAB	---	---	2	2	---	---	---	---	25	25	50	1
INU510	Control System Engineering LAB			2	2	---	---	---	---	25	25	50	1
INU511	Self Study-I	---	---	---	---	---	---	---	---	25	---	25	2
Total		**15**	**1**	**10**	**26**	**50**	**75**	**75**	**300**	**150**	**125**	**775**	**23**
•The self study I is based on INU501,INU502,INU503,INU504 class test each on the basis of 20% curriculum of the courses declared by the course coordinator at the beginning of semester **• One faculty member should be appointed as course coordinator for self study I and his/her teaching work load shall be considered one hour per week**													
Sem VI													
INU601	Microcontroller and It's Application	3	---	---	3	10	15	15	60	---	---	100	3
INU602	Power Electronics	3	---	---	3	10	15	15	60	---	---	100	3
INU603	Material Science and Process	3	---	---	3	10	15	15	60	---	---	100	3
INU604	Process Control	3	1	---	4	10	15	15	60	---	---	100	4
INU605	Project Engineering and Management	3	--	---	3	10	15	15	60	---	---	100	3
INU606	Microcontroller and It's Application LAB	---	---	2	2	---	---	---	---	25	25	50	1
INU607	Power Electronics LAB	---	---	2	2	---	---	---	---	25	25	50	1
INU608	Process Control LAB	---	---	2	2	---	---	---	---	25	25	50	1
INU609	Minor Project	---	---	2	2	---	---	---	---	25	25	50	2
INU610	Self Study-II	---	---	---	---	---	---	---	---	25		25	2
INU611	Industrial Lecture -I	1	---	---	1	---	---	---	---	---	---	---	---
Total		**16**	**1**	**8**	**25**	**50**	**75**	**75**	**300**	**125**	**100**	**725**	**23**
• The self study II is based on INU601,INU602,INU604,INU605 class test each on the basis of 20% curriculum of the courses declared by the course coordinator at the beginning of semester **• One faculty member should be appointed as course coordinator for self study II and his/her teaching work load shall be considered one hour per week** **• Credit shall be awarded on the basis of combined assessment of Industrial Lectures-I and Industrial Lectures-II**													

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PROPOSED SCHEME FOR B.Tech.(Instrumentation Engineering)

Course Code	Name of the course	Teaching Scheme				Evaluation Scheme							Credits
						Theory				Practical		Total	
		Theory Hrs /week	Tutorial Hrs/week	Practical Hrs/week	Total	TA	CT1	CT2	ESE	ICA	ESE		
Sem VII													
INU701	Industrial Automation	3	---	---	3	10	15	15	60	---	---	100	3
INU702	Biomedical Engineering	3	---	---	3	10	15	15	60	---	---	100	3
INU703	Elective-I	3	---	---	3	10	15	15	60	---	---	100	3
INU704	Interdisciplinary Elective	3	---	---	3	10	15	15	60	---	---	100	3
INU705	Industrial Automation Lab	---	---	2	2					25	25	50	1
INU706	Biomedical Engineering Lab	---	---	2	2	---	---	---	---	25	25	50	1
INU707	Elective-I Lab	---	---	2	2	---	---	---	---	25	25	50	1
INU708	Project Phase- I	---	---	4	4	---	---	---	---	50	---	50	2
INU709	Seminar	---	---	2	2	---	---	---	---	50	---	50	2
INU710	Industrial Training/ Visit	---	---	---	0	---	---	---	---	50	---	50	1
INU711	Industrial Lecture II	1	---	---	1	---	---	---	---	25	---	25	1
INU712	Self Study-III	---	---	---	0	---	---	---	---	25	---	25	2
Total		**13**	**0**	**12**	**25**	**40**	**60**	**60**	**240**	**275**	**75**	**750**	**23**

• Interdisciplinary electives will be offered to students other than this department
• The self study III is based on INU701, INU702 and INU703(A-E) class test each on the basis of 20% curriculum of the courses declared by the course coordinator
• One faculty member should be appointed as course coordinator for self study III and his/her teaching work load shall be considered one hour per week
• Credit shall be awarded on the basis of combined assessment of Industrial Lectures I and Industrial Lectures II

Sem VIII													
INU801	Instrumentation System Design	3	---	---	3	10	15	15	60	---	---	100	3
INU802	Modern Control Theory	3	1	---	4	10	15	15	60	---	---	100	4
INU803	Elective -II	3	---	---	3	10	15	15	60	---	---	100	3
INU804	Elective-III	3	---	---	3	10	15	15	60	---	---	100	3
INU805	Instrumentation System Design Lab	---	---	2	2	---	---	---	---	25	25	50	1
INU806	Elective-II Lab	---	---	2	2	---	---	---	---	25	25	50	1
INU807	Project Phase -II	---	---	6	6	---	---	---	---	75	100	175	6
INU808	Self Study-IV	---	---	---	---	---	---	---	---	25	---	25	2
	Total	**12**	**1**	**10**	**23**	**40**	**60**	**60**	**240**	**150**	**150**	**700**	**23**

The self study IV is based on INU801,INU802,INU803(A-E),INU804(A-D) class test each on the basis of 20% curriculum of the courses declared by the course coordinator at the beginning of semester
One faculty member should be appointed as course coordinator for self study IV and his/her teaching work load shall be considered one hour per week

IN703	IN704	IN803	IN804
A) Building Automation	A) Industrial Automation	A) Opto- Electronics Instrumentation	A) Image processing
B) Instrumentation for Agriculture and Food processing	B) Sensors and Transducer	B) Neural network and Fuzzy logic control	B) Optimal & Robust Control
C) System Identification	C) Biomedical Engineering	C) Advance Sensors	C) Biomedical Signal and Processing
D) Embedded Systems	D) Process Instrumentation	D) Digital Control System	D) Nonlinear Control System
E) Power Plant Instrumentation		E) Virtual Instrumentation	

INU701 INDUSTRIAL AUTOMATION

Teaching Scheme : 03 L+00 T Total: 03 Credit: 03
Evaluation Scheme: 15 CT1 + 15 CT2 +10 TA+ 60 ESE Total Marks: 100
Duration of ESE : 2hrs 30min.

Introduction to Programmable logic controllers: PLC architecture, operation, definition of discrete process control, ladder diagrams, ladder diagram elements, ladder programming and its features, programming examples of typical processes.

Hierarchical control: Hierarchical control, overall tasks of the system, task listing, lower and higher level computer tasks. The centralized control and its features Personal computers in process control, direct digital control, distributed process control

Introduction to Supervisory control and data acquisition (SCADA): applications to process control systems.

DCS Configurations: Functional block diagram of DCS, supervisory computer displays, Software configurations in DCS, control technique, Communication between components of DCS, DCS algorithm, attributes. Study of any one DCS such as TDC-3000.

Introduction to Data highways: Field buses, Multiplexers and remote sensing terminal units.

System integration: With PLC and computer (Hybrid control system), I/O hardware, set point stations, Network protocols, MAP/TOP.

Computer integrating process: communication hierarchy, ISO/OSI reference model, MAP, TOP application. Study of YOKOGAWA, Rosemount Distributed Control Systems.

Text Books:

1. Process Control Instrument Engineers Handbook, Bela G. Liptak, 3rd edition, Butterworth Heinemann Company, 1999
2. Introduction to Programmable Logic Controllers, Gary Dunning, 2nd edition, Thomson Delmar learning, 2002.

Reference Books:

1. Process Control Instrumentation Technology, Johnson C. D., 7th edition, Pearson Education, New Delhi, 2003.
2. Programmable Controllers: Principles and Applications, Webb J. W. Mergy/publishing co. 1988
3. Computer Based Industrial Control, Krishankant, 7th edition, PHI, 2005,
4. Programmable logic controllers and Industrial Automation An introduction ,Madhuchandra Mitra,Samarjit Sen Gupta ,Penram publishing (India) Pvt Ltd,2009
5. http://www.nptel.iitm.ac.in

INU702 BIOMEDICAL ENGINEERING

Teaching Scheme : 03 L+00 T Total: 03 Credit: 03
Evaluation Scheme: 15 CT1 + 15 CT2 +10 TA+ 60 ESE Total Marks: 100
Duration of ESE : 2hrs 30min.

Introduction: Biomedical Instrumentation, classification of biomedical Instruments, Scope for Biomedical Engineers.

Physiology and Biopotential Electrodes: Physiology of cardiovascular system, respiratory system, nervous system, Resting and Action Potential, Electrode electrolyte interface, half-cell potential, Electrodes Limb electrodes, floating electrodes, pregelled disposable electrodes, needle and surface electrodes

Cardio Vascular system Heart electro cardiogram, Measurement and analysis of EGG waveform, ECG recorder principles, block schematic of ECG recorder. Introduction of defibrillators.

Electrical activity of the brain: Sources of brain potential, generation of signals, component waves, EEG recording electrodes, 10-20 electrode system, epilepsy and seizures.

Electrical activity of neuromuscular system: muscular system, electrical signals of motor unit and gross muscle, human motor coordination system, EMG and its waveforms.

Introduction to Non-Electrical Parameter Measurements: Measurement of blood pressure, Phonocardiograph, pulmonary function measurements, Body Plethysmography Blood Gas analyzers: measurement of blood pCO2, pO2, finger-tip oxymeter.

Modern imaging systems – Concepts of X ray machine, Computer tomography, Magnetic resonance imaging system, ultrasonic imaging systems

Text Books:

1. Hand book of Biomedical Instrumentation, Khandpur R. S., 2nd edition, Prentice Hall of India Pvt. Ltd, New Delhi, India, 2003.
2. Biomedical Instrumentation and measurement, Leslie Cromwell, 3rd edition, Prentice Hall of India, New Delhi, 1997.

Reference Books:

1. Biomedical Instrumentation, Webster J. G., 4th edition, John Wiley and Sons, Hoboken, NJ, 2004.
2. Introduction to Biomedical Equipment Technology, Carr J., and Brown J., 4th edition, Pearson Education, 2000.
3. Biomedical Digital Signal Processing, Willis J. Tompkins, Prentice Hall of India publications/ Eastern Economy Edition, 2nd Print, 2000.
4. Biomedical Instruments, D. S. Chaudhari, 1999.

INU703 Elective - I

(A) BUILDING AUTOMATION

Teaching Scheme : 03 L+00 T Total: 03 Credit: 03
Evaluation Scheme: 15 CT1 + 15 CT2 +10 TA+ 60 ESE Total Marks: 100
Duration of ESE : 2hrs 30min.

Introduction: Introduction to Building Automation System, Features, Characteristics, need of Building Automation system. Various Systems of Building Automation – Building Management System, Energy Management System, Security System, Safety System, Video Management System. Use of renewable energy sources in building automation. Drawbacks of Building Automation system.

Fire Alarm System (FAS)

Fundamentals: Fire, Fire modes, History, Components, and Principles of Operation
FAS Components: Field Components, Panel Components, Applications. FAS Architectures: Types of Architectures, Examples
FAS loops: Classification of loops, Examples. Power Supply design for FAS. Cause & effect matrix: Examples

Security Systems
Fundamentals: Introduction to Security Systems, Concepts Access Control System: Access Components, Access control system Design.

CCTV: Camera: Operation & types, Camera Selection Criteria, Camera Applications, DVR Based system, DVM, Network design, Storage design. CCTV Applications: CCTV Applications

HVAC (Heating ventilation and air conditioning) system

Fundamentals: Introduction to HVAC, HVAC Fundamentals, Basic Processes (Heating, Cooling etc)
Basic Science: Air Properties, Psychometric Chart, Heat Transfer mechanisms, Examples.
Human Comfort: Human comfort zones, Effect of Heat, Humidity, Heat loss

Processes: Heating Process & Applications (i.e. Boiler, Heater), Cooling Process & Applications (i.e. Chiller), Ventilation Process & Applications (i.e. Central Fan System, AHU, Exhaust Fans), Unitary Systems (VAV, FCU etc).

Control Theory: Instrumentation Basics, Field components & use, DDC & applications
Architecture: Honeywell Architecture, BMS Components

Control Panel: HVAC Control Panel, MCC Basics, Panel Components Communication: Communication Basics, Networks, BACNet, Modbus,

Text Books:

1. Building Control Systems, Applications Guide (CIBSE Guide) by The CIBSE (2000)
2. Security/Fire Alarm Systems: Design, Installation, and Maintenance, John E. Traister, 1995
3. Security, ID Systems and Locks: The Book on Electronic Access Control (Newnes), Joel Konicek and Karen Little, 1997

Reference Books:

1. Access Control Systems: Security, Identity Management and Trust Models, Benantar, Messaoud, ISBN: 0387004459 EAN: 9780387004457 Publisher: Springer (Published: 12/2005)
2. Building Automation Online by McGowan; McGowan, John J.; ISBN: 0824746155
3. CCTV by Damjanovski, Vlado; ISBN: 0750671963 , 3rd edition, Publisher: Butterworth- Heinemann
4. HVAC Control in the New Millennium, Hordeski; Hordeski, Michael F.; Marcel Dekker; ISBN: 0824709152 EAN: 9780824709150 Publisher: Fairmont Press, 2001
5. HVAC Controls and Systems, Levenhagen, John I.Spethmann, Donald H. ISBN: 0070375097 EAN: 9780070375093 Publisher: McGraw-Hill Professional Publishing
4. Integrated Security Systems Design: Concepts, Specifications, and Implementation (Vol. 1), Thomas L. Norman CPP PSP CSC, 2007

INU703 Elective - I

(B) INSTRUMENTATION FOR AGRICULTURE AND FOOD PROCESSING

Teaching Scheme : 03 L+00 T Total: 03 Credit: 03
Evaluation Scheme: 15 CT1 + 15 CT2 +10 TA+ 60 ESE Total Marks: 100
Duration of ESE : 2hrs 30min.

Introduction: Necessity of instrumentation and control for food processing and agriculture sensor requirement, remote sensing, biosensors in Agriculture, standards for food quality.

Instrumentation for Food Processing:

Instrumentation for food quality assurance: Instrumental measurements and sensory parameters. Inline measurement for the control of food processing operations: color measurements of food; food composition analysis using infrared; microwave measurements of product variables; pressure and temperature measurement in food process control; level and flow measurement in food process control; ultrasonic instrumentation in food industry. Instrumental techniques in the quality control

Major Processes:

A) Flow diagram of sugar plant, sensors and instrumentation set-up for it.
B) Oil extraction plant and instrumentation set-up
C) Juice extraction control set-up

Instrumentation for Agriculture:

Major Processes:

A) Application of SCADA for DAM parameters and control
B) Water distribution and management control, Auto-Drip irrigation systems
C) Irrigation Canal management, upstream and downstream control concepts, supervisory control.

Green houses and Instrumentation; ventilation, cooling and heating wind speed, temperature and humidity, rain gauge, carbon dioxide enrichment measurement and control.

Design considerations of agricultural and food Processing Equipments: Design of Food Processing equipments, dryers, design of dryers PHTC, RPEC, LSU and Drum Dryer, determination of heat and air requirement for drying grains.

Text Books:

1. Process Control Instrumentation Technology, Johnson C. D., 7th Edition, Pearson Education, New Delhi, 2003
2. Industrial Instrumentation, D. Patranabis, 3rd edition, Tata McGraw Hill publications, New Delhi

Reference Books:

1. Process Instrumentation, and Control Handbook, Considine D. M ., 3rd edition, McGraw Hill International
2. Instrument Engineers Handbook, Process Measurement Volume I and Process Control Volume II, Liptak B. G., 3rd edition, Chilton Book Company, 2001
3. The literature of Agriculture Engineering, Hall C. W., Olsen W. C., Cornell University Press, 1992
4. Fundamentals of Food Process Engineering**,** Sahu J. K., Narosa Publication, 2013

INU703 Elective - I

(C) SYSTEM IDENTIFICATION

Teaching Scheme : 03 L+00 T Total: 03 Credit: 03
Evaluation Scheme: 15 CT1 + 15 CT2 +10 TA+ 60 ESE Total Marks: 100
Duration of ESE : 2hrs 30min.

Introduction: Dynamical Models, types and their use, procedure for system identification.

Models:
Linear Time invariant system: Impulse responses, disturbance and transfer functions, Frequency domain expression, signal spectra, signal realization behavior and ergodicity results, multivariable systems.

Models for Time invariant Linear Systems: Linear model and set of linear models, Family of transfer function models, Linear regression, ARMAX model structure, pseudo linear regression, output error model structure, general family of model structure, continuous time black box model.

State Space Model: Continuous time models based on physical insight, sampling the transfer function, noise representation and the time invariant Kalman filter, time varying predictors, sampling continuous time process noise.

Distributed parameter models: Model sets and its parameterization, model sets as range of model structures and union of range of model structures, Concept of identifibiality, it's properties and use. **Models for time varying and Nonlinear system:** Linear time varying models, nonlinear models as linear regression, nonlinear state space model, formal characterization of models.

Methods:
Nonparametric Time and frequency Domain Methods: Transient response analysis and correlation analysis, frequency response analysis, Fourier analysis, spectral analysis, estimating the disturbance spectrum.

Parametric Estimation Methods: Guiding principle behind parametric estimation methods, minimizing prediction errors, linear regression and the least square methods, statistical framework, correlating prediction errors with past data, instrumental variable methods.

Choice of identification criteria: General aspects choice of norms: robustness, variance: optimal instruments.

Text Books:

1. System Identification: Theory for the user, Ljung .L, 3rd edition, Prentice Hall, Englewood Cliffs
2. Theory and Practice of Recursive Identification, Ljung, L. and Soderstorm, T., 5th edition, MIT Press, Cambridge, 1987.

Reference Books:

1. Nonlinear System Identification, Nelles, 2nd edition, 2001
2. Applied System Identification, Jer-Nan Juang, Prentice Hall, 1994
3. System Identification: Advances and Case Studies, Mehra R. K., D. G. Lainion, Academic Press, 1976

INU703 Elective - I

(D) EMBEDDED SYSTEM

Teaching Scheme : 03 L+00 T Total: 03 Credit: 03
Evaluation Scheme: 15 CT1 + 15 CT2 +10 TA+ 60 ESE Total Marks: 100
Duration of ESE : 2hrs 30min.

Introduction: Definition of embedded systems, characteristics of embedded systems, design metrics, applications, embedded system operations, Software development, software architectures, IDE, Communication protocols: Blue tooth, Zig- bee, etc.

Embedded Processor: Processor internal architecture, processor technology, processor types, embedded processor, RISC design philosophy, specifications of processor/s, memory organization, memory interfacing aspects, processor and memory selection for different applications, Interrupts.

Arm Processor: ARM-7 processor LPC 2148 architecture, data flow model, memory organization, programming model, ISP and IAP, register banking, operating modes: ARM mode and Thumb mode, I/O port read/write operations, Status registers

Programming: On chip communication protocols of LPC 2148, Programming concepts using embedded C, Programming ARM processor for implementing various communication protocols, keyboard Interface, LCD interface, on chip ADC/DAC interface.

Real Time Operating Systems Concept: Real Time Operating Systems µCOS-II, Features, State diagram, comparison with traditional OS, Semaphore, shared data problem, scheduling algorithms, dead lock.

Case Study: Priority inversion problem, priority inheritance, interrupts management; inter task communication, memory management, Time delays. Case studies: Cruise control, digital Camera.

Text Books:

1. Embedded Systems, Rajkamal, 2nd edition, TMH, 2006
2. Embedded systems software primer, David Simon, 2nd edition, Pearson, 2008.

Reference Books:

1. Embedded System design, Frank Vahid, 3rd edition, Wiley Publications, 2002.
2. Arm System on chip architecture, Steve Furber , Addison Wesely, 2nd edition, Pearson Publications, 2000
3. Linux Device Drivers, Alessandro Rubini and Jonathan Corbet, 3rd edition, O_Reilly Publication.
4. Arm System Developer guide, Andrew Sloss, ELSEVIER publication, 2004.
5. Embedded Linux primer, Christopher Hallinan, 2nd edition, Prentice Hall, 2011.
6. http://www.nptel.iitm.ac.in

INU703 Elective - I

(E) POWER PLANT INSTRUMENTATION

Teaching Scheme : 03 L+00 T Total: 03 Credit: 03
Evaluation Scheme: 15 CT1 + 15 CT2 +10 TA+ 60 ESE Total Marks: 100
Duration of ESE : 2hrs 30min.

Introduction: Energy sources, their availabity, worldwide energy production, energy scenario of India. Introduction to Power generation- Classification: Renewable and nonrenewable energy generation resources. Renewable: small hydro; modern biomass; wind power; solar; geothermal and bio-fuels. Nonrenewable: fossil fuels (coal, oil and natural gas) and nuclear power.

Thermal Power Plant- Method of power generation, layout and energy conversion process, Types of Turbines and control, Types of Generators, condensers. Types of pumps and Fans, variable speed pumps and Fans, Material handling system, study of all loops-water, steam, fuel etc.

Boiler: Types of boilers, boiler safety standards. Boiler instrumentation, control and optimization, combustion control, air to fuel ratio control, three element drum level control, steam temperature and pressure control, boiler interlocks, sequence event recorder, data acquisition systems.

Hydroelectric Power Plant- Site selection, classification of Hydropower plants, Types of Turbines for hydroelectric power plant, Hydrology Estimation electric power to be developed, pumped storage plants, storage reservoir plants, instrumentation used in hydroelectric power plant.

Wind Energy: Power in wind, Conversion of wind power, Aerodynamics of wind turbine, types of wind turbine and modes of operation, power control of wind turbines, different generator protections, data recording, trend analysis, troubleshooting and safety.

Solar Energy: solar resource, solar energy conversion systems: Solar PV technology: Block diagram of PV system, advantages and limitations. Solar thermal energy system: Principle, solar collector and its types, solar concentrator and its types, safety.

Nuclear Power Plant: Nuclear power generation, control station and reactor control.

Comparison of thermal power plant, hydro electric power plant, wind, solar, nuclear power plant on the basis of: Performance, efficiency, site selection, Economics-capital and running, safety standards, pollution, effluent management and handling. Power plant safety, Pollution monitoring, control Sound, Air, smoke, dust, study of Electrostatic precipitator.

Text Books:

1. Boiler Control Systems Engineering., G.F. Gilman, 2nd edition, ISA Publication, 2005.
2. Power plant engineering. P. K. Nag, 3rd edition, McGraw Hill, 2010.

Reference Books:

1. Power Plant Engg., Domkundwar, 2nd edition, Dhanpat Rai and Sons. *New* Delhi. 96
2. Non-conventional energy resources., B. H. Khan, 2nd edition, McGraw Hill, New Delhi, 2006
3. Renewable energy Technology., 2nd edition, Chetan Singh Solanki, Prentice Hall Publication,
4. Solar Energy., S. P. Sukhatme, 3rd edition, Tata McGraw Hill, New Delhi, 2008
5. http://www.nptel.iitm.ac.in

INU704 Interdisciplinary Elective
(A) INDUSTRIAL AUTOMATION

Teaching Scheme : 03 L+00 T Total: 03 Credit: 03
Evaluation Scheme: 15 CT1 + 15 CT2 +10 TA+ 60 ESE Total Marks: 100
Duration of ESE : 2hrs 30min.

Introduction to Programmable logic controllers, PLC architecture, operation, definition of discrete process control, ladder diagrams, ladder diagram elements, ladder programming and its features, programming examples of typical processes.

Hierarchical control: Hierarchical control, overall tasks of the system, task listing, lower and higher level computer tasks. The centralized control and its features Personal computers in process control, direct digital control, distributed process control

Introduction to Supervisory control and data acquisition (SCADA) as applied to process control systems.

DCS Configurations: Functional block diagram of DCS, supervisory computer displays, Software configurations in DCS, control technique, Communication between components of DCS, DCS algorithm, attributes. Study of any one DCS such as TDC-3000.

Introduction to Data highways, Field buses, Multiplexers and remote sensing terminal units.

System integration: With PLC and computer (Hybrid control system), I/O hardware, set point stations, Network protocols, MAP/TOP.

Computer integrating process, communication hierarchy, ISO/OSI reference model, MAP, TOP application. Study of YOKOGAWA, Rosemount Distributed Control Systems.

Text Books:

1. Process Control Instrument Engineers Handbook, Bela G. Liptak, 3rd edition, Butterworth Heinemann Company, 1999
2. Introduction to Programmable Logic Controllers, Gary Dunning, 2nd Edition, Thomson Delmar learning, 2002.

Reference Books:

1. Process Control Instrumentation Technology, Johnson C. D., 7th Edition, Pearson Education, New Delhi, 2003.
2. Programmable Controllers: Principles and Applications, Webb J. W. Mergy/publishing co. 1988
3. Computer Based Industrial Control, Krishankant, 7th Edition, PHI, 2005,
4. Programmable logic controllers and Industrial Automation an introduction, Madhuchandra Mitra,Samarjit Sen Gupta ,Penram publishing (India) Pvt Ltd,2009
5. http://www.nptel.iitm.ac.in

INU704 Interdisciplinary Elective
(B) SENSORS AND TRANSDUCERS

Teaching Scheme : 03 L+00 T Total: 03 Credit: 03
Evaluation Scheme: 15 CT1 + 15 CT2 +10 TA+ 60 ESE Total Marks: 100
Duration of ESE : 2hrs 30min.

Mechanical Measurement:
Definition and Concept: Transducer, Sensor, Calibration, Classification: Active, passive, primary, secondary, mechanical, electrical, electronic, analog and digital transducers. Selection criteria, Static and Dynamic characteristics

Displacement Measurement - Working principles, types, measuring circuits and applications of: Resistive transducers, Inductive transducers, Capacitive transducers, Piezoelectric transducers, Ultrasonic transducers and Hall effect transducers, Optical transducers, Encoders, Photoelectric pickups, stroboscope. Accelerometers -Eddy current type, piezoelectric type,
Process measurement:

Temperature Measurement - Working principles, types, measuring circuits, compensation circuits and applications of : Thermometers, RTD, Thermistors, Thermocouples

Semiconductor temperature sensors: Diode and IC temp sensors. Ultrasonic temp detector, quartz crystal temp, detector. Radiation: Pyrometers (Total and Radiation), Infrared sensors. Fiber optic thermometer.

Flow Measurement: Bernoulli's theorem, Reynolds Number. Differential pressure type flow sensors: Orifice and their types, Venturi and Nozzle. Pressure taps Pitot tube, annubar. Variable area meter (Rotameter). Turbine type flow meter, Electromagnetic flow type, ultrasonic flow meter, Vortex shedding type, mass flow meters, anemometers, flow tantalizers and solid flow measurement.

Pressure Measurement - Working principles, types, measuring circuits and applications of: Pressure scale, Manometers, Elastic pressure sensors, Secondary pressure sensors. Differential pressure measurements. High-pressure sensors: Dead weight tester, Bulk modulus cell, Vacuum sensors: McLeod gauge, thermal conductivity (Pirani, Thermocouple gage) ionization types,

Level Measurement: Float displacers, bubbler, and DP- cell Ultrasonic, capacitive, radar, resistance, Solid level detectors, and fiber optic level detectors. Miscellaneous Measurements: pH, Conductivity, Humidity, moisture and sound measurement.

Text Books:

1. Instrumentation Devices and Systems, Rangan, Mani, Sharma, 9th edition, Tata McGraw Hill, Delhi, 1997
2. Sensors and Transducer, Patranabis , 2nd Edition, Prentice Hall India Pvt. Ltd., 2004

Reference Books:

1. Principle of industrial Instrumentation, Patranabis D., 2nd Edition, Tata McGraw Hill, Delhi, 1997
2. Instrumentation and Measurement Principles, Murthi D.V.S, 3rd Edition, Prentice Hall of India, New Delhi, 1995
3. Instrumentation Measurements and Analysis, Nakra B.C. and Choudhari K.K., 6th edition, Tata McGraw Hill Co Ltd. New Delhi,2001

4. Process Measurement and Analysis, Liptak Volume-I Chilton Book Co. 2001
5. Principles of measurement systems, Bentley J.P., 3rd Edition, Pearson education Asia pvt.ltd, 2000.
6. Measurement Systems, Doebelin, E.O., 6th edition, McGraw Hill Book Co., 1998
7. http://www.nptel.iitm.ac.in

INU704 Interdisciplinary Elective

(C) BIOMEDICAL ENGINEERING

Teaching Scheme : 03 L+00 T Total: 03 Credit: 03
Evaluation Scheme: 15 CT1 + 15 CT2 +10 TA+ 60 ESE Total Marks: 100
Duration of ESE : 2hrs 30min.

Introduction: Biomedical Instrumentation, classification of biomedical Instruments, Scope for Biomedical Engineers.

Physiology and Biopotential Electrodes: Physiology of cardiovascular system, respiratory system, nervous system, Resting and Action Potential, Electrode electrolyte interface, half-cell potential, Electrodes Limb electrodes, floating electrodes, pregelled disposable electrodes, needle and surface electrodes.

Cardio Vascular system Heart, electro cardiogram, Measurement and analysis of EGG waveform, ECG recorder principles, block schematic of ECG recorder. Introduction of defibrillators.

Electrical activity of the brain: Sources of brain potential, generation of signals, component waves, EEG recording electrodes, 10-20 electrode system, epilepsy and seizures.

Electrical activity of neuromuscular system: muscular system, electrical signals of motor unit and gross muscle, human motor coordination system, EMG and its waveforms.

Introduction to Non-Electrical Parameter Measurements: Measurement of blood pressure, Phonocardiograph, pulmonary function measurements, Body Plethysmography Blood Gas analyzers: measurement of blood pCO2, pO2, finger-tip oxymeter.

Modern imaging systems – Concepts of X ray machine, Computer tomography, Magnetic resonance imaging system, ultrasonic imaging systems

Text Book:

1. Hand book of Biomedical Instrumentation, Khandpur R. S., 2nd edition, Prentice Hall of India Pvt. Ltd, New Delhi, India, 1996.
2. Biomedical Instrumentation and measurement, Leslie Cromwell, Prentice hall of India, New Delhi, 1997.

Reference Books:

1. Biomedical Instrumentation, Webster J. G., John Wiley and Sons, Hoboken, NJ, 2004.
2. Introduction to Biomedical Equipment Technology, Carr J., and Brown J., Pearson Education, 2000.
3. Medical Instrumentation Application and Design, John G. Webster, John Wiley and sons, New York, 2004.
4. Biomedical Digital Signal Processing, Willis J. Tompkins, Prentice Hall of India publications/ Eastern Economy Edition, 2nd Print, 2000.
5. Bio Medical Instruments, D.S.Chaudhary, 1999.

INU704 Interdisciplinary Elective

(D) PROCESS INSTRUMENTATION

Teaching Scheme : 03 L+00 T Total: 03 Credit: 03
Evaluation Scheme: 15 CT1 + 15 CT2 +10 TA+ 60 ESE Total Marks: 100
Duration of ESE : 2hrs 30min.

Introduction to Process control: Process characteristics, Types of processes, process characteristics and controllability, self regulating and non self regulating. Processes, interacting and non-interacting processes. Relative gain array and it's analysis.

Dynamic Behavior of systems: Dynamic Behavior of First Order, second order and higher order systems, Dynamic systems with Dead Time/Inverse Response, Computer simulation of process dynamics, linearization of nonlinear systems

Controllers: Open Loop and Closed Loop Control System, .Multi-loop and Multivariable Process control system, Design consideration for P, PI, PID, ON OFF Controller, Tuning of PID controller, Electronic PID controller, pneumatic controllers,

Introduction to Safety Instrumented System: Hazardous Area Classification**:** Intrinsic Safety, Safety Integrity Level. Hazardous Area Safety: Zener Barrier Introduction and Classification of hazardous Area. Protection Principle, Explosion and Flame proof Protection, Type of Protection-Oil or Liquid Emersion, Increase Safety.

Advanced Control systems: Feedback control systems with large dead time or inverse response, feed forward control, Cascade control, ratio control, auto selective control, Split range Control, adaptive control system, inferential control system.

Industrial Process Control: Process control for power plant, cement industry, paper pulp industry, petroleum industry.

Text Books:

1. Process Control System, F. G. Shinskey, 2nd Edition, McGraw Hill, 1979.
2. Chemical process control, George Stephanopoulos, Prentice-Hall of India, 2003.

Reference Books:

1. Process Control Handbook, Bela G. Liptak., 3rd edition, Chilton Book Company, 2001.
2. Computer Based Industrial Control, Krishnakant, 7th edition, Prentice-Hall of India, 1997
3. Process Instrumentation and Control Handbook, Considine, 5th Edition, McGraw Hill, 1995.
4. Instrumentation for Process Measurement and Control, Norman A. Anderson, 3rd edition, CRC Press INC, 1998
5. Process Systems analysis and Control, D.R. Coughanour, 2nd edition, McGraw Hill publications.
6. Process Dynamics and Control, D. E. Seborg, T. F. Edger, and D. A. Millichamp, 2nd Edition, John Wiley and Sons, 2004.
7. Shreve's Chemical Process Industries by George Austin, 5th edition, McGraw hill Publication 1990.
8. Automatic Process Control, D. Eckman, 1st edition, Wiley Eastern Publication, 1988
9. http://www.nptel.iitm.ac.in

INU705 INDUSTRIAL AUTOMATION LAB

Teaching Scheme : 02 P **Total: 02** **Credit: 01**
Evaluation Scheme: 25 ICA + 25 ESE **Total Marks: 50**
Duration of ESE : 3 Hrs

Minimum 8 Experiments should be conducted from the sample list given below.

1. Architectural study of Allen Bradly PLC.
2. Study of any one PLC software package.
3. Developments of Ladder diagram for the controlling motor operation
4. Development of ladder diagram for temperature control system.
5. Development of Ladder diagram for bottling plant.
6. Study of Software package for SCADA
7. Development of mimic diagram for a particular process using SCADA software
8. Comparative Study of SIMATIC range of products(S7-200,300,400 PLC)
9. Study of any one DCS software package.
10. Comparative study of DCS systems.

ICA- The Internal Continuous Assessment shall be based on the practical record and Knowledge/skill acquired. The performance shall be assessed experiment wise by using continuous assessment formats A and B.

ESE- The End Semester Exam shall be based on performance of experiments based on file/journal submitted by students and /or viva.

INU706 BIOMEDICAL ENGINEERING LAB

Teaching Scheme : 02 Total: 02 **Credit: 01**
Evaluation Scheme: 25 ICA +25 ESE **Total Marks: 50**
Duration of ESE : 3 hrs

Minimum Eight Experiments should be conducted from the sample list given below.

1 To Study, Observe and categorize different types of ECG, EMG, EEG electrodes
2 Measurement of Heart Rate by using Stethoscope
3 Measurement and Monitoring of Blood Pressure by using Digital Blood Pressure Meter
4 Measurement and Monitoring of Non Invasive Blood pressure (NIBP), SPO2 and ECG by using multiparameter monitoring device.
5 Measurement and analysis of Real Time ECG by using ECG Machine.
6 Monitoring of Normal ECG and Heart rate signals by using Normal biomedical signal simulator
7 Monitoring of Normal EEG signals (Alpha, Beta, Delta, Theta) by using Normal biomedical signal simulator
8 Monitoring of Various Abnormal Heart signals by using abnormal biomedical signal simulator
9 Monitoring of Cardiac Audio signals of Fetal and Adult by using Ultrasound Doppler technique.
10 Monitoring of Phonocardiograph signals by using Phonocardiograph simulator and digital CRO.
11 Measurement of Safety electrical parameters by using electrical safety analyzer.
12 To study and measure electrical energy in DC Defibrillator

ICA- The Internal Continuous Assessment shall be based on the practical record and Knowledge/skill acquired. The performance shall be assessed experiment wise by using continuous assessment formats A and B.

ESE- The End Semester Exam shall be based on performance of experiments based on file/journal submitted by students and /or viva.

INU707 Elective-I Lab
(A) BUILDING AUTOMATION LAB

Teaching Scheme : 02 P **Total: 02** **Credit: 01**
Evaluation Scheme : 25 ICA + 25 ESE **Total Marks: 50**
Duration of ESE : 3 Hrs

Minimum Eight Experiments should be conducted from the sample list given below

A) Study of FAS components:

1. Study of fire protection in institute (Case Study)
2. Power Supply of FAS
3. Smart door lock system for home automation. (Card reader, smoke detector, SMS alert)
4. Fire alarm system by variation in temperature.
5. Study of security system (IR Sensors)
6. Security wiring web camera. (Image capturing)
7. Access control System Components.
8. CCTV camera selection criteria.
9. Internet based automation. (manual control of remote control)

B) Study of HVAC System(Heating ventilation & air Conditioners)

1. Heating processes & applications.
2. Cooling system & applications.
3. Unitary equipments.
4. DDC & building management system.
5. Energy management & green building automation.
6. Integrated building management system.

ICA- The Internal Continuous Assessment shall be based on the practical record and Knowledge/skill acquired. The performance shall be assessed experiment wise by using continuous assessment formats A and B.

ESE- The End Semester Exam shall be based on performance of experiments based on file/journal submitted by students and /or viva.

INU707 Elective-I Lab
(B) INSTRUMENTATION FOR AGRICULTURE AND FOOD PROCESSING LAB

Teaching Scheme : 02 P **Total: 02** **Credit: 01**
Evaluation Scheme : 25 ICA + 25 ESE **Total Marks: 50**
Duration of ESE : 3 Hrs

Minimum Eight Experiments should be conducted from the sample list given below.

Experiments for Instrumentation for Food Processing

1. To study instrumentation set-up for Sugar plant.
2. To study flow diagram of fermenter and control (Batch process).
3. To study oil extraction process and control.
4. To study juice extraction control set-up.
5. Draw the P&ID for different plants.

Experiments for Instrumentation for Agriculture

6. To study application of SCADA for DAM and irrigation systems..
7. To study Instrumentation and Control in Green house.
8. To study different bio-sensors methods in agriculture.
9. To test soil $_{P}$H, conductivity, resistivity, temperature, moisture and salinity.
10. Draw the P&ID for green house.

ICA- The Internal Continuous Assessment shall be based on the practical record and Knowledge/skill acquired. The performance shall be assessed experiment wise by using continuous assessment formats A and B.

ESE- - The End Semester Exam shall be based on performance of experiments based on file/journal submitted by students and /or viva.

INU707 Elective-I Lab
(C) SYSTEM IDENTIFICATION LAB

Teaching Scheme : 02 P **Total: 02** **Credit: 01**
Evaluation Scheme : 25 ICA + 25 ESE **Total Marks: 50**
Duration of ESE : 3 Hrs

Minimum Eight Experiments should be conducted from the sample list given below.

All practical must be performed on MatLAB

1. Estimation of covariance function.
2. Designing butterworth filters of band pass type.
3. Find the largest root of the estimated model
4. Noise : Module illustrating stochastic processes
5. Time Series Modeling and Prediction to prepare real temperature data for processing
6. Time Series Modeling and Prediction to generates the data from the fictitious data model
7. Estimation of physical parameters
8. Model approximation for frequency domain effects
9. Study the effect of the forgetting factor
10. Study the effect of the initial values.
11. General comparison of samples
12. Study of least squares method
13. Spectral analysis of different samples.
14. Study of correlation analysis low frequency input
15. Transient analysis of step response.
16. Measurement of white noise.

ICA- The Internal Continuous Assessment shall be based on the practical record and Knowledge/skill acquired. The performance shall be assessed experiment wise by using continuous assessment formats A and B.

ESE- The End Semester Exam shall be based on performance of experiments based on file/journal submitted by students and /or viva.

INU707 Elective-I Lab
(D) EMBEDDED SYSTEM LAB

Teaching Scheme : 02 P **Total: 02** **Credit: 01**
Evaluation Scheme : 25 ICA + 25 ESE **Total Marks: 50**
Duration of ESE : 3 Hrs

Minimum Eight Experiments should be conducted from the sample list given below.

1. Write a Simple Assembly Program for
   a. Addition b. Subtraction b. Multiplication d. Division.
2. Write a Program for
   a. 8-Bit Digital Output (LED Interface).
   b. 8-Bit Digital Inputs (Switch Interface).
3. Write a Program for
   a. 4 x 4 Matrix Keypad Interface.
   b. Buzzer Interface.
   c. Relay Interface.
4. Write a Program for character based LCD Interface.
5. Write a Program for Analog to Digital Conversion (On chip ADC)
6. Write a Program for I2-C Device Interface
   a. Serial EEPROM
   b. Seven Segment LED Display Interface
   c. Real Time Clock
7. Interfacing with Temperature Sensor
8. Stepper Motor Interface

Hands on Exercise Based on RTOS:

9. (a) Study and Implement Multitasking.
   (b) Write a Simple Program with Two Separate LED Blinking Tasks.
10. Study and Implement Priority Scheduling and OS TimeDelay Functions by writing 3 different UART Transmitting Tasks.
11. Implement OS Real Time Multitasking by writing a multitasking program with the tasks
    a. Interface RTC and Display on LCD First Line Continuously
    b. Interface ADC and Display on LCD second line continuously
12. Implement OS Real Time Multitasking by implementing the tasks.
    a. Read the Key input and display on seven segments LED.
    b. Read the ADC Analog input and Plot the Corresponding signal on a LCD

ICA- The Internal Continuous Assessment shall be based on the practical record and Knowledge/skill acquired. The performance shall be assessed experiment wise by using continuous assessment formats A and B.

ESE- The End Semester Exam shall be based on performance of experiments based on file/journal submitted by students and /or viva.

INU707 Elective-I Lab
(E) POWER PLANT INSTRUMENTATION LAB

Teaching Scheme : 02 P **Total: 02** **Credit: 01**
Evaluation Scheme : 25 ICA + 25 ESE **Total Marks: 50**
Duration of ESE : 3 Hrs

Minimum Eight Experiments should be conducted from the sample list given below.

1. Study of different types of energy sources & their Classification.
2. Study of different turbines & control actions used in thermal power plant.
3. Study of different boilers & their safety standards.
4. Study of different turbines & control actions used in hydroelectric power plant.
5. Study of different turbines & control actions used in wind power plant.
6. Study of solar thermal energy system.
7. Study of reactor control used in nuclear power plant.
8. Comparison of thermal, hydroelectric, wind, solar & nuclear power plant

ICA- The Internal Continuous Assessment shall be based on the practical record and Knowledge/skill acquired. The performance shall be assessed experiment wise by using continuous assessment formats A and B.

ESE- The End Semester Exam shall be based on performance of experiments based on file/journal submitted by students and /or viva.

INU708 PROJECT PHASE I

Teaching Scheme : 04 P **Total: 04** **Credit: 02**
Evaluation Scheme: ICA 50 **Total Marks: 50**
Duration of ESE : 3 Hrs

1. In general, a group of 3-6 students should be allowed to complete the project on Approved topic.
2. Preferably more than 25 % projects shall be Industry / Research based / oriented.
3. Exhaustive survey of literature based on a clear definition of the scope and focus of the topic should be carried out by the students.
4. Students should finalize the topic for the project after literature survey in consultation with the Guide.
5. The **Synopsis/Abstract** on the selected topic should be submitted to the Program Head for approval.
6. On approval of the topic, students should initiate the topic based work.
7. Approximately more than 30% work(of the total quantum) should be completed by the end of VII semester.
8. At the end of semester, each batch should submit the progress report in following format:
   Title
   Introduction
   Concept
   Work completed
   Work to be completed
   References
9. For uniform and continuous evaluation, the Evaluation Committee comprising of the Guide, Project Course Coordinator and Expert appointed by the Program Head will award the marks based on the work completed by the end of semester and the presentation based on the project work.

Note:

ICA: The Internal Continuous Assessment shall be based on the active participation of the students in the Project work and knowledge / skill acquired. Oral examination shall be conducted by the panel of examiners.

INU709 SEMINAR

Teaching Scheme : 02 P **Total: 02** **Credit: 02**
Evaluation Scheme: 50 ICA **Total Marks: 50**
Duration of ESE :

1. Student shall select a topic for seminar which is **not covered in curriculum**.
2. Topics shall be registered within a month after beginning of VII Semester and shall be approved by the concerned guide and Program Head.
3. Students should know the functional and technical details of selected topic after carrying out the conceptual study.
4. Before the end of semester, student shall deliver a seminar and submit the seminar report in following format:
   Introduction
   Literature Survey
   Concept
   Functional and Technical Details
   Future scope
   Applications
   Comparison with similar topics / methods
   References
5. Student shall deliver a seminar based on submitted report. The presentation and oral examination on selected seminar topic shall be assessed by panel of examiners

Note:

ICA: The Internal Continuous Assessment shall be based on the active participation of the students in the Seminar Topic and the knowledge acquired. The seminar shall be assessed by the examiner panel consisting of Project Guide, Course Coordinator Seminar and Expert appointed by Program Head.

INU710 INDUSTRIAL TRAINING / VISIT

Teaching Scheme : 00 P **Total: 00** **Credit: 01**
Evaluation Scheme: 50 ICA **Total Marks: 50**
Duration of ESE :

Industrial Training shall have an option of Industrial Visit.

Industrial Training: List of renowned industries shall be prepared by the Departmental Coordinator of T & P Cell for the course. After approval from the Principal and with the consultation of Industry personnel, 02 weeks trainings shall be arranged during the vacations (after the VI semester). The students may be permitted to undergo the trainings of 02 weeks as per their choices for which all the official formalities will be completed by the students under the guidance of course coordinator. The students shall submit the report based on the Industrial training to the course coordinator which will be evaluated during the VII semester

Industrial Visit: An Industry Visits to minimum three industries shall be arranged for the students unable to complete the Industrial Training. The visit shall be arranged preferably during the vacation period. However in non-availability of permission for the visit during vacation period, same may be arranged during the regular VII semester. The students will be required to submit the report based on the Industrial Visit which will be evaluated by the course coordinator

Note:

ICA: The Internal Continuous Assessment shall be based on the active participation of the students in the training/visits and knowledge / skill acquired. The technical report submitted by the students shall be assessed, by the panel of examiners consisting of Project Guide, Course Coordinator and Expert appointed by the Program Head.

INU711 INDUSTRIAL LECTURE II

Teaching Scheme: 01L + 00 T Total: 01 Credits:01
(* Credits shall be awarded on the basis of combined assessment of INU611 and INU711.)
Evaluation Scheme: 25 ICA + 00 ESE Total Marks: 25
Duration of ESE: 00hrs.

List of renowned persons from industry shall be prepared by the Departmental Coordinator of T & P Cell for the course. After approval from the Principal, Minimum twelve Industrial lectures shall be arranged, preferably once a week, which shall be delivered by the experts/Officials from Industries/Govt. organizations/ Private Sectors/Public Sectors covering the various aspects.
The assignments based on the Industry Lecture-I and Industry Lecture-II will be evaluated during VII semester

Topics of Industrial Lectures shall be Technical in nature and should not be the specific contents from the curriculum.

Students shall submit the report based on lectures.

Note:

ICA: The Internal Continuous Assessment shall be based on the active participation of the students in the lectures and knowledge acquired. The technical report submitted by the students shall be assessed, by the panel of examiners consisting of Project Guide, Course Coordinator and Expert appointed by the Program Head.

INU712 SELF STUDY-III

Teaching Scheme: 00L + 00 T Total: 00 Credits: 02
Evaluation Scheme: 25 TA Total Marks: 25

Self study-III is based on one class test each, on the basis of 20% curriculum of the courses INU701, INU702 and INU703 (A-E) to be declared by respective course coordinator at the beginning of the semester. These class tests should be conducted separately for each course and after CT-II. The marks of all such class tests then shall be converted to out of 25. One faculty member shall be appointed as course coordinator for Self Study-III and his/ her teaching work load shall be considered as one hr/week.

INU801 INSTRUMENTATION SYSTEM DESIGN

Teaching Scheme : 03 L+00 T Total: 03 Credit: 03
Evaluation Scheme: 15 CT1 + 15 CT2 +10 TA+ 60 ESE Total Marks: 100
Duration of ESE : 2hrs 30min.

Basic concepts of design: Design procedure, Basic concepts of instrument design, Functional requirements and specifications of instrumentation component.

Electronic design guidelines: Noise in electronic circuit, the design of low noise Circuits, Component limits for intrinsic safe design, Electrical safety classification as per standards NEC, NFPA, ISA, Input filters and clamping, suppressors, intrinsically safe electronic systems, The Zener Barrier, Energy Storage calculations.

Enclosure Design guidelines: Grounding and shielding techniques, protection against electromagnetic interference and electrostatic discharge, Packaging for various operational environment including IP-51, IP-54, IP65, IP67 and IP68.

Hazardous Area Classification: Classification of hazardous Area. Protection Principle, Explosion and Flame proof Protection, Type of Protection-Oil or Liquid Emersion, Increase Safety. Intrinsic Safety, Safety Integrity Level.

Design of temperature instrumentation system using RTD, thermocouple, thermistor, Selection criteria, Self heating effects in resistive temperature transducers, Power-dissipation constant and it's calculations, Thermocouple with thermowell assembly, time-constant calculation, Protection-tubes, types, materials, Design considerations for thermowell, types, Manufacturing process of T/C, RTD, Thermistor, Testing of RTD as per the Standard.

Design of flow instrumentation using orifice, rotameter, venturimeter, different flow coefficient like Cd, Cc, and Cv and their calculation. Types of orifice designs, Types of pressure taps to measure Δp, Design of orifice used in tank outflow and pipe-flow measurements, Different design considerations in orifice, venturimeter and rotameter design.

Design considerations for controllers, Pneumatic controllers using flapper-nozzle mechanism, Electronics controller using op-amps, considerations in design of data presentation elements, recorders, and monitors.

Design of a control valve: Control Valve Definition, Control valve coefficient Characteristics of control valve, Selection of characteristics to suit the process for gas, vapor and liquid, Control valve sizing calculations for liquid and gas service, Cavitations, flashing, Control valve noise and its remedies, types of control valve.

Text Books:

1. Process Control Instrument Engineers Handbook, Bela G. Liptak, 3rd edition,Butterworth Heinemann Company, 1999
2. Noise Reduction Techniques, Ott, 2nd edition, A Wiley-Interscience publication

Reference Books:

1. Process Instrumentation, and Control Handbook, Considine D. M., 3rd edition, McGraw Hill International
2. Principles of Measurement Systems, Bentley J. P., 3rd edition, Pearson Education, New Delhi, 2000.

3. Measurement Systems, Doeblin E. O. and D. Mannik, 5th Edition, Application and Design, McGraw Hill International Edition, 2006.
4. Warren Boxleitner, IEEE press: Electrostatic Discharge and Electronic Equipment
5. Printed Circuit Boards, Walter C Bosshart, 31st reprint, CEDT Series-Tata McGraw Hill publications, 2001
6. Applications of Analog Integrated Circuit, S. Soclop, Prentice Hall of India.
7. Applied Instrumentation in the Process Industries, Andrew Williams, 2nd edition, Vol. I and Vol. II, GWF Publishing Company, 2002
8. Process Control Instrumentation Technology, Johnson C. D., 7th Edition, Pearson Education, New Delhi, 2003.
9. Instrumentation, Nakra Chowdhari, 3rd edition, Prentice Hall of India, New Delhi
10. A Course in Mechanical Measurements and Instrumentation, Sawhney A. K. and Puneet Sawhney, 26th edition, Dhanpat Rai and Co. (P) Ltd., New Delhi, 1998

INU802 MODERN CONTROLTHEORY

Teaching Scheme : 03 L+01 T Total: 04 Credit: 04
Evaluation Scheme: 15 CT1 + 15 CT2 +10 TA+ 60 ESE Total Marks: 100
Duration of ESE : 2hrs 30min.

State space analysis : Modeling and Analysis Concept of state, state variable, and state model, state space representation using physical, phase and canonical variables and their block diagram representation, state model and transfer function, diagonalization, solution of state equation, state transition matrix its properties and computation, concept of controllability and observability and their test criterion.

State Variable Design: Design pole placement design using state feedback, state observer, reduced order and full-order observer design, Design of control systems with observers, Design of servo system, Study of some physical plant like inverted pendulum for analysis and design.

Introduction to Optimal Control systems, Linear Quadratic regulator (LQR): Theory and Design: LQR solution using the minimum principle, Generalization of LQR; LQR properties with classical interpretations; Optimal observer design- Kalman-Bucy filter: Problem formulation and Solution, The Linear Quadratic Gaussian (LQG) problem: Introduction, LQG problem formulation and solution, Performance and Robustness of optimal state feedback.

Non-linear system analysis: Behavior of non linear systems, common physical non linearities, describing function method, Concept and derivation of describing function methods, phase plane method, singular points, stability of non linear system.

Fundamentals of Lyapunov Theory: Equilibrium points, concept of stability, linearization and local stability, Lyapunov's Direct method: positive definite functions and Lyapunov functions, equilibrium point theorems, System Analysis based on Lyapunov's Direct Method: Lyapunov analysis of LTI systems, Krasovski's method, physically motivated Lyapunov functions.

Text Books:

1. Modern Control Engineering, K. Ogata, 4th edition, Prentice Hall of India, 2002.
2. Control Systems, Principles and Design, M. Gopal, 2nd edition, TMH, New Delhi, 2002.

Reference Books:

1. Feedback Control of Dynamic Systems, G. Franklin, J. D. Powell and A. E. Naeini, 4th edition, Pearson Education, 2002.
2. Control System Engineering, J. Nagrath and M. Gopal, 2nd edition, Wiley Eastern Limited, Sixteenth reprint 1990.
3. Automatic Control Systems, B. C. Kuo, 7th edition, Prentice Hall of India, New Delhi, 2002.
4. Applied Nonlinear Control, J. E. Slotine and W. Li, Prentice Hall International, 1991.
5. Modern Control Design with MATLAB and SIMULINK, A. Tewari, John Wiley and Sons, Ltd., 2002.
6. Control System Design: An Introduction to State-space Methods, B. Friedland, McGraw Hill International Edition, Singapore, 1987.
7. http://www.nptel.iitm.ac.in

INU803 Elective - II

(A) OPTOELECTRONICS INSTRUMENTATION

Teaching Scheme : 03 L+00 T Total: 03 Credit: 03
Evaluation Scheme: 15 CT1 + 15 CT2 +10 TA+ 60 ESE Total Marks: 100
Duration of ESE : 2hrs 30min.

Photo diode: PIN photodiode, hetero junction diode, Avalanche Photo diode, Phototransistor. LDR, photovoltaic cells, photo emissive cells - types, materials, construction, response, opto-couplers – characteristics, noise figures, applications in analogue and digital devices.

Fiber optics: Optical fiber materials, construction, step index and graded index fibers, ray propagation, attenuation. Modes in optical fibers, intermodal dispersion. Laser configuration – Q-Switching – Mode locking – Different types of Lasers – Ruby, Nd-Yag, He-Ne, CO_2, Organ ion

Properties of Optical Fibers Introduction to optical fibers, Light guidance , Numerical aperture , Dispersion , Laser: semiconductor based lasers - double heterojunction broad area laser, stripe geometry DH laser.

Single mode fiber- working principle, attenuation, dispersion and bandwidth. Multimode fiber-attenuation, dispersion. propagation of EM waves, fibre coupling.

Fiber-optic sensors: classification. Intensity modulated sensors, phase modulated sensors, spectrally modulated sensors, Temperature, displacement, pressure and liquid-level sensors.

Laser Instrumentation: Industrial applications of lasers, Bio-medical application Laser, Doppler velocity meter – Laser heating. Holography: Principle, Methods, Holographic Interferometers and applications

Text Books:

1. Semiconductor Optoelectronic Devices, P. Bhattacharjee, 1st edition, Prentice Hall International, 2006
2. Optoelectronics - An Introduction, W. Hawkes, 2nd edition, Prentice Hall International, 1998

Reference Books:

1. Optoelectronics and Fiber optics communication, Sarkar C. K., 2nd edition, New Age International, 2004
2. Optical Fiber Communications, Senior J. M., 2nd edition, Prentice Hall International, 1992.
3. Optical Fiber Sensors, Culshaw B. and Dakin J(Ed) - Vol.1.2 Artech House, 1989.
4. Elements of Optoelectronic and Fiber Option, Chin-Lin-Chon, McGraw Hill publications.
5. http://www.nptel.iitm.ac.in

INU803 Elective - II

(B) NEURAL NETWORKS AND FUZZY LOGIC CONTROL

Teaching Scheme : 03 L+00 T Total: 03 Credit: 03
Evaluation Scheme: 15 CT1 + 15 CT2 +10 TA+ 60 ESE Total Marks: 100
Duration of ESE : 2hrs 30min.

Introduction and Fundamentals: Artificial Neural Networks. Biological prototype. Artificial Neuron Single Layer ANN, Multi layer ANN, training of Artificial NN.

Perceptrons: Perceptron representation, perceptron learning, perceptron training algorithm. Back Propagation: Introduction to back propagation and back propagation training algorithm, counter propagation networks.

Process modeling and control: Introduction; Overview of process control applications; need of neural networks in process control, Process Modeling by neural network; Direct Adaptive Control; Self Tuning Controller; Indirect Adaptive Control; Model Reference Adaptive Control; Internal Model Control; Model Predictive Control; Cascade Control.

Introduction-Fuzzy Systems: Fuzzy control from an industrial perspective, Uncertainty and Imprecision, Uncertainty in information, Chance Versus Ambiguity, The mathematics of fuzzy control. Classical sets and fuzzy sets: Vagueness, Fuzzy set theory versus Probability theory, Operation and properties of classical and fuzzy sets.

Classical relations and fuzzy relations: Cartesian Product, Crisp relations, Fuzzy relations, Operations on fuzzy relations, Various types of binary fuzzy relations, Fuzzy relation equations, The extension principle and its applications, Tolerance and equivalence relations, Crisp equivalence relation, Crisp tolerance relation, Fuzzy tolerance and equivalence relation, Value assignments.

Fuzzy knowledge based controllers (FKBC) design parameters: Introduction, Structure of a FKBC, Fuzzification and defuzzification module, Rule base, Choice of variable and contents of rules, derivation of rules, data base, choice of membership function and scaling factors, choice of fuzzification and defuzzification procedure, various methods.

Neuro-fuzzy and fuzzy-neural control systems: Adaptive fuzzy systems, optimizing the membership functions and the rule base of fuzzy logic controllers using neural networks, fuzzy transfer functions in neural networks, elements of evolutionary computation, case studies.

Text Books:

1. Fuzzy Logic with Engineering Applications, T. J. Ross, McGraw Hill, 2nd edition, Inc 1995.
2. An introduction to neural networks, James A. Anderson, Prentice Hall of India, Private limited, New Delhi, 1999.

Reference Books:

1. An Introduction to Fuzzy Control, D. Drainkov, H. Hellendoorn and M. Reinfrank, Narosa Publishing House, 1993.
2. Fuzzy set theory and its applications, H. J. Zimmermann, 2nd edition, Allied Publishers limited, New Delhi, 1996.

3. Fuzzy systems theory and its application, T. Terano, K. Asai and M. Sugeno, Academic Press, 1992
4. Fuzzy Sets and Fuzzy Logic: Theory and Applications, G. J. Klir and B. Yuan, 3rd edition Prentice Hall of India, New Delhi, 1997.
5. Neural Networks: A Comprehensive Foundation, S. Haykin, 2nd edition, Macmillan College Publishing Company, 1994.
6. Saxena S.C., Vinod Kumar, Waghmare L.M., Neural network approach for the cascade control of interconnected system, published in the journal of Research of Institution of Electronics and Telecommunication Engineering (IETE) in Vol.48 No.6, pp. 461-469, Nov. Dec. 2002.
7. Introduction to Artificial Systems, Singapore: Info Access and distribution, J.M. Zurada, 1992
8. http://www.nptel.iitm.ac.in

INU803 Elective - II

(C) ADVANCED SENSORS

Teaching Scheme : 03 L+00 T Total: 03 Credit: 03
Evaluation Scheme: 15 CT1 + 15 CT2 +10 TA+ 60 ESE Total Marks: 100
Duration of ESE : 2hrs 30min.

IC technology used in micro sensor system: Crystal growth and wafer making, oxidation lithography, masking, pattern generation and transfer, different types of etching, ion implantation and diffusion, and vacuum evaporation, assembling, packaging, micromachining, epitaxy, use of polysilicon materials, bonding of different types etc.

Smart Sensors: Introduction, 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.

Chemical Sensors: Blood –Gas and Acid –base physiology Electrochemical sensors, Chemical Fibro sensors, Iron-Selective Field-Effect Transistor (ISFET),Immunologically Sensitive Field Effect Transistor (IMFET) , Integrated flow sensor and Blood Glucose sensors.

Optical Sensors: Fiber optic light propagation, Graded index fibers, Fiber optic communication driver circuits, Laser classifications, Driver circuits for solid –state laser diodes, Radiation sensors and Optical combinations.

MEMS and Nanotechnology: Microelectromechanical systems (MEMS), Micromachining, Biomedical applications, Nano-sensors, Carbon Nanotubes.

Advanced Sensor Design: Fluoroscopic machines design, Nuclear medical systems, EMI to biomedical sensors, types and sources of EMI, Fields, EMI effects. Computer systems used in X-ray and Nuclear Medical equipments. Calibration, Typical faults, Trouble shooting, Maintenance procedure for medical equipments and Design of 2 and 4 wire transmitters with 4 – 20 mA output.

Aerospace Sensor: Gyroscope laser and accelerometers. Sensors used in space and environmental applications.

Text Books:

1. Sensors Hand Book Sabaree Soloman - Sensors Hand Book, McGraw Hill,**1998**
2. Principles of Holography, Smith H.M., 2nd edition, John Wiley and Sons, New York, 1975

Reference Books:

1. Medical instrumentation Application and Design, J.G. Webster, 3rd edition, Houghton Mifilin Co. 2004
2. Introduction to Medical Equipment Technology, Carr and Brown, 4th edition, Addison Wesley. 1999
3. Optical Fibre Sensors, Culshaw B and Dakin J (Eds), Vol. 1 and 2 Artech House, Norwood.(1989)
4. Guided Weapon Control Systems, P. Garnell, 2nd edition, Pergamon Press. 1980
5. http://www.nptel.iitm.ac.in

INU 803 Elective - II

(D) DIGITAL CONTROL SYSTEMS

Teaching Scheme : 03 L+00 T Total: 03 Credit: 03
Evaluation Scheme: 15 CT1 + 15 CT2 +10 TA+ 60 ESE Total Marks: 100
Duration of ESE : 2hrs 30min.

Introduction to Discrete Time Control System: Basic building blocks of Discrete time Control system, Sampling Theorem, Z transform and Inverse Z transform for applications for solving differential equations, Mapping between the S-plane and the Z-plane, Impulse sampling and Data Hold.

Pulse Transfer Function and Digital PID Controllers: The pulse transfer function, pulse transfer function of Closed Loop systems, Pulse transfer function of Digital PID controller, Velocity and Position forms of Digital PID Controller, Realization of Digital Controllers, Deadbeat response and ringing of poles.

Design of Discrete Time Control System: by conventional methods Stability analysis in Z-plane, Jury stability criterion, Bi linear transformations, Design based on the root locus method, Digital Controller Design using Analytical Design Method.

State Space Analysis of Discrete Time Control System: State space representation of discrete time systems, Solution of discrete time state space equations, Pulse transfer function matrix, Eigen Values, Eigen Vectors and Matrix Diagonalization, Discretization of continuous time state space equations, Similarity transformations.

Pole Placement and Observer Design: Concept of controllability and Observability, Useful transformations in state space analysis and design, Stability improvement by state feedback, Design via pole placement, State observers.

Optimal Control : Quadratic Optimal Control and Quadratic performance index, Optimal state regulator through the matrix Riccati equations, Steady State Quadratic Optimal Control.

Text Books:

1. Discrete Time Control systems, K. Ogata, 2nd edition, Prentice Hall, 2003.
2. Digital Control and State Variable Methods, M. Gopal, Tata McGraw Hill, 2003

Reference Books:

1. Digital control of Dynamic Systems, G. F. Franklin, J. David Powell, Michael Workman, 3rd Edition, Addison Wesley, 2000.
2. Digital Control Engineering, M. Gopal, 3rd edition, Wiley Eastern Ltd, 1989.
3. Digital Control, Kannan Moudgalya, 2nd edition, John Wiley and Sons, 2007.
4. Digital Control, Forsytheand W. and Goodall R.N McMillan,1991.
5. Digital Control Systems, Contantine H. Houpis and Gary B. Lamont, 2nd edition, McGraw-Hill, 1992.
6. http://www.nptel.iitm.ac.in

INU803 Elective - II

(E) VIRTUAL INSTRUMENTATION

Teaching Scheme : 03 L+00 T Total: 03 Credit: 03
Evaluation Scheme: 15 CT1 + 15 CT2 +10 TA+ 60 ESE Total Marks: 100
Duration of ESE : 2hrs 30min.

Introduction to Virtual Instrumentation: Historical perspective, advantages, blocks diagram and architecture of a virtual instrument, data-flow techniques, graphical programming in data flow, comparison with conventional programming. development of Virtual Instrument using GUI, Real-time systems

VI Programming techniques: VIS and sub-VIS, for and while loops, graphs and charts, arrays, clusters ,case and sequence structures, local and global variables, string Handling and file Input/output.

Basics of Data Acquisition system: Classification of signals, real world signals, analog interfacing, connecting the signals to the board, practical versus ideal interfacing, bridge signal sources.

Data acquisition with LabView DAQmx and DAQ VIs: Measurement and automation explorer, waveform data type, working in DAQmx, use of simple VIs, Interfacing instruments-GPIB and RS 232.

Industrial Applications of VI: Simple temperature indicator – ON/OFF controller, Simulation of a simple second order system, simple industrial application by using LAB View.

Text Books:

1 Virtual Instrumentation using LAB VIEW, Sanjay Gupta and Joseph John ,2nd edition, TMH Publication, New Delhi, 2011
2 Introduction to LAB View Graphical programming for engineers and Scientists-LAB View Tutorial Manual, National Instruments.

References Books:

1 LAB VIEW for Everyone: Graphical Programming Made Easy and Fun", Jeffrey Travis, Jim Kring, 3rd edition, PHI publication, 2006
2 Web Resources: www.ni.com

INU804 Elective - III

(A) IMAGE PROCESSING

Teaching Scheme : 03 L+00 T Total: 03 Credit: 03
Evaluation Scheme: 15 CT1 + 15 CT2 +10 TA+ 60 ESE Total Marks: 100
Duration of ESE : 2hrs 30min.

Introduction: Origin and examples of fields using DIP, fundamentals steps and component of an Image Processing system.

Digital Image Fundamentals: Element of visual perception with respect to image processing, image sensing and acquisition, sampling and quantization. basic relationship between pixels.

Image enhancement in the spatial domain: Basic Gray level transformation, Histogram processing, enhancement using arithmetic/logic operation, Basics of spatial filtering, smoothing spatial filters, Sharpening spatial filters.

Image enhancement in Frequency Domain: Review of Fourier transform and frequency domain, Smoothing frequency domain filters. Sharpening frequency domain filters. Homomorphic filtering.

Image restoration: Model of the image degradation /Restoration process, Noise models, Restoration in presence of noise –only-spatial filtering. Periodic noise reduction by frequency domain filtering..Estimation of degradation function .Inverse filtering. Wiener filtering, Geometric transformations: Spatial and gray level interpolation

Image Segmentation: Detection of discontinuities, edge linking and boundry detection, thresholding, region based segmentation

Introduction to image compression, compression models, image compression standards, introduction to color image processing

Text Books:

1. Digital Image Processing, Gonzalez R.C. and Woods R.E, 2nd edition, Pearson education,2002
2. Digital Image Processing and Analysis, Chanda B. and Majumdar D. 2nd edition, (PHI) edition 2000.

Reference Books:

1. Digital Image Processing, A K Jain 3rd edition, John Wiley Eastern publication 1998
2. Digital Image Processing and Computer Vision, Schalkoff R.J. John Wiley and sons, 1989.
3. Computer Vision and Image Processing, 2nd edition, Umbaugh CRC Press, 2011.

INU804 Elective - III

(B) OPTIMAL AND ROBUST CONTROL

Teaching Scheme : 03 L+00 T Total: 03 Credit: 03
Evaluation Scheme: 15 CT1 + 15 CT2 +10 TA+ 60 ESE Total Marks: 100
Duration of ESE : 2hrs 30min.

Linear Quadratic Control: The Linear Quadratic Regulator (LQR) problem: LQR solution using the minimum principle, Generalization of LQR; LQR properties with classical interpretations; Optimal observer design- Kalman-Bucy filter: Problem formulation and Solution, The Linear Quadratic Gaussian (LQG) problem: Introduction, LQG problem formulation and solution, Performance and Robustness of optimal state feedback, Loop Transfer Recovery (LTR).

Robust/H∞ Control: Introduction, Critique of LQG, Performance specification and robustness: Nominal performance of feedback system; Nominal performance: Multivariable case, Novel problem formulation of classical problem, Modeling uncertainty, Robust stability, Mathematical background: Singular Value Decomposition (SVD); Singular values and matrix norms; The supremum of functions, Norms and spaces, H_2Optimization and Loop Transfer Recovery (LTR), H∞ Control: A brief history, Notation and terminology, The two-port formulation of control problems; H∞ control problem formulation and assumptions; Problem solution, Weights in H∞ control problems, Design example.

Robust Control: The Parametric Approach: Stability theory via the boundary crossing theorem, the stability of a line segment, Interval polynomials: Kharitonov's theorem for real and complex polynomials, Interlacing and Imageset interpretations, External properties of the Kharitonov polynomial, Robust-state feedback stabilization, Schur stability of interval polynomials, The Edge theorem, The Generalized Kharitonov theorem, State space parameter perturbations, Robust stability of Interval matrices, Robustness using the Lyapunov approach, Robust parametric stabilization.

Text Books:

1. Multivariable Feedback Design, J. M. Maciejowski, Addison-Wesley Publishing Company, 1989.
2. Linear Optimal Control Systems, H. Kwakernaak and R. Sivan, Wiley-Interscience, 1972.

Reference Books:

1. Linear Optimal Control, B. D. O. Anderson and J. B. Moore, Prentice-Hall, 1990.
2. Robust Control: The Parametric Approach, S. P. Bhattacharya, H. Chapellat and L. H. Keel, Prentice-Hall, PTR, NJ07458, 1995.
3. Robust and Optimal Control, K. Zhou, J. C. Doyle and K. Glover, Prentice-Hall, NJ07458, 1996.
4. Robust Control: Systems with Uncertain Physical Parameters, J. Ackermann, Springer-Verlag, London, 1993.
5. Optimal Control, F. L. Lewis and V. L. Syrmos, 2nd edition, John Wiley and Sons, Inc. 1995.

INU804 Elective - III

(C) BIOMEDICAL SIGNAL PROCESSING

Teaching Scheme : 03 L+00 T Total: 03 Credit: 03
Evaluation Scheme: 15 CT1 + 15 CT2 +10 TA+ 60 ESE Total Marks: 100
Duration of ESE : 2hrs 30min.

Introduction to biomedical signals: The nature of biomedical signals, Examples of Biomedical signals, The action potential, objectives of biomedical signal analysis, Sources of noise in biomedical signal recordings, Difficulties in biomedical signal analysis, computer aided diagnosis.

Cardiological signal processing: Basic electrocardiography, ECG signal characteristics, Power spectrum of ECG, Band pass filtering technique, Differentiation technique, Template matching, A QRS Detection algorithm.

Data Reduction Techniques: Lossy and Lossless data reduction Algorithms, Direct ECG data compression techniques, Turning point algorithm, AZTEC Algorithm, Fan algorithm, Huffman coding.

Neurological Signal Processing: The brain and its potentials, The electrophysiological origin of brain waves, The EEG signal and its characteristics, EEG analysis Auto Regressive(A.R.) modeling of seizure EEG. Sleep Stage analysis Modeling EEG- linear, stochastic models

Signal Averaging: Basics of signal averaging, signal averaging as a digital filter, software for signal averaging, limitation of signal averaging.

Adaptive Filters: Principal noise canceller model, 60 Hz adaptive cancelling using sine wave model, applications of adaptive filtering removal of artifacts of one signal embedded in another - Maternal-Fetal ECG.

Text Books:

1. Biomedical Signal Processing Principles and Techniques, D. C. Reddy, Tata McGraw-Hill, 2005.
2. Biomedical Signal Analysis A case study approach, Rangaraj M. Rangayyan, John Wiley, 2002.

Reference Book:

1. Biomedical Digital Signal Processing, Willis J. Tompkins, Prentice Hall of India publications/ Eastern Economy Edition, 2nd Print, 2000.
2. Biomedical Instrumentation and Measurements, L.Cromwell, F.Weibell Prentice Hall of India Pvt. Ltd publication, 1979.
3. Hand book of Biomedical Instrumentation, Khandpur R. S., 2nd edition, Prentice Hall of India Pvt. Ltd, New Delhi, India, 1996.

INU804 Elective - III

(D) NONLINEAR CONTROL SYSTEMS

Teaching Scheme : 03 L+00 T Total: 03 Credit: 03
Evaluation Scheme: 15 CT1 + 15 CT2 +10 TA+ 60 ESE Total Marks: 100
Duration of ESE : 2hrs 30min.

Linear versus nonlinear systems: Describing function analysis: Fundamentals, common nonlinearities (saturation, dead-zone, on-off non-linearity, backlash, hysteresis) and their describing functions, describing function analysis of nonlinear systems, reliability of describing method analysis, compensation and design of nonlinear system using describing function method.

Phase plane analysis: Phase portraits, Singular points characterization, analysis of non-linear systems using phase plane technique, Existence of limit cycles. Linearization: Exact linearization, input-state linearization, input-output linearization.

Concept of stability: Stability in the sense of Lyapunov and absolute stability, Zero-input and BIBO stability, Second (or direct) method of Lyapunov stability theory for continuous and discrete time systems, Aizerman's and Kalman's conjecture, Construction of Lyapunov function-Methods of Aizerman, Zubov; variable gradient method, Lure problem.

Popov's stability criterion: generalized circle criterion, Kalman-Yakubovich-Popov Lemma. Popov's hyperstability theorem, Disturbance issues in nonlinear control, non-linear control system design problem.

Concept of variable-structure controller and sliding control: reaching condition and reaching mode, implementation of switching control laws, Reduction of chattering in sliding and steady state mode. Some design examples of nonlinear systems such as the ball and beam, flight control, magnetic levitation and robotic manipulator etc.

Approximate solution of nonlinear system using the perturbation method and averaging method.

Text Books:

1. Nonlinear System Analysis, M. Vidyasagar, 2nd edition, Prentice-Hall Inc, 1978
2. Nonlinear Systems, H. K. Khalil, 3rd edition, Prentice-Hall Inc, 2002

Reference Books:

1. Applied Nonlinear Control., J. E. Slotine and w. Li, Prentice Hall Inc. Englewood cliffs, New Jersey 1995.
2. Multiple Input describing Function and Nonlinear System Design, Gelb A. and Vander Velde W. E., 2nd edition, Machrao-Hill (1968).
3. Nonlinear Control System: An Introduction, Isidori A., 3rd edition, Springer Yerlag, 1995.
4. Nonlinear Automatic Control, Gibson, 8th edition, Tata Ma-Graw Hill, 2008.
5. http://www.nptel.iitm.ac.in

INU805 INSTRUMENTATION SYSTEM DESIGN LAB

Teaching Scheme : 02 P **Total: 02** **Credit: 01**
Evaluation Scheme : 25 ICA + 25 ESE **Total Marks: 50**
Duration of ESE : 3 Hrs

Minimum Eight Experiments should be conducted from the sample list given below.

1. Case study: One LAB instrument/field instrument and its detailed engineering drawings, circuit diagrams on a drawing sheet.
2. Design of any mini project like design of instrument/electronic device/ transducer/ Instrumentation component/ system, its procedure starting from preparation of specifications, designing, testing, and erection. [Drawings dimensional sketches, circuit diagram, details of different component on drawing sheet, testing its specifications, determining practical static and dynamic characteristics]
3. Designing and preparing a PCB layout for electronic circuit and drawing it on drawing sheet.
4. Design of a filter for typical noise problem
5. Design of any electronic intrinsically safe circuit.
6. Designing a control valve for given specifications and detailing it with engineering drawings.
7. Designing any transmitter and drawing its details.
8. Design of any sensor/transducer for particular process variables like flow/temp/Pressure and drawing its dimensional details on a sheet.

ICA- The Internal Continuous Assessment shall be based on the practical record and Knowledge/skill acquired. The performance shall be assessed experiment wise by using continuous assessment formats A and B.

ESE- The End Semester Exam shall be based on performance of experiments based on file/journal submitted by students and /or viva.

INU806 Elective – II Lab
(A) OPTOELECTRONICS INSTRUMENTATION LAB

Teaching Scheme : 02 P **Total: 02** **Credit: 01**
Evaluation Scheme : 25 ICA + 25 ESE **Total Marks: 50**
Duration of ESE : 3 Hrs

Minimum Eight Experiments should be conducted from the sample list given below.

1. Study of setting up a fiber Optic Analog Link.
2. Study of setting up a fiber Optic Digital Link.
3. Study of Losses in Optical Fiber.
4. Measurement of Numerical aperture of a optical fiber.
5. Study of Manchester Coding and Decoding of optical signal.
6. Study of Time Division Demultiplexing through fiber optic link-B
7. Measurement of Bit Error Rate of an optic signal through fiber optic link-B.
8. Study of Eye Pattern of fiber through fiber optic ling–B.
9. Forming PC to PC Communication Link using Optical Fiber and RS-232 Interface.
10. Study of Beam parameters of a laser
11. Study of Michelson interferometer
12. Study of Fabry-Perot interferometer
13. Study of Polarization,
14. Study of Birefringence of materials
15. Study of Optical Isolator - Coherence and lasers
16. Study of Frequency separation between the axial modes
17. Study of Thickness of cladding on an optical fiber by diffraction.

ICA- The Internal Continuous Assessment shall be based on the practical record and Knowledge/skill acquired. The performance shall be assessed experiment wise by using continuous assessment formats A and B.

ESE- The End Semester Exam shall be based on performance of experiments based on file/journal submitted by students and /or viva..

INU806 Elective – II Lab

(B) NEURAL NETWORK AND FUZZY LOGIC CONTROL LAB

Teaching Scheme : 02 P **Total: 02** **Credit: 01**
Evaluation Scheme : 25 ICA + 25 ESE **Total Marks: 50**
Duration of ESE : 3 Hrs

Minimum Eight Experiments should be conducted from the sample list given below.

1. Write a program to create neural network models for illustration of different operations like Union, Intersection and Difference
2. Write a program to generate activation functions used in neural networks
3. Write a program to illustrate different generalized bell functions
4. Write a program to illustrate different membership functions
5. Write a program to illustrate linguistic variables and their values
6. Write a program to create neural network models of different logic gates
7. Write a program to illustrate different fuzzy operations like AND, OR and NOR
8. Write a program to illustrate different operations like union intersection and difference on fuzzy variables
9. Write a program to realize defuzzification to scalars

ICA- The Internal Continuous Assessment shall be based on the practical record and Knowledge/skill acquired. The performance shall be assessed experiment wise by using continuous assessment formats A and B

ESE- The End Semester Exam shall be based on performance of experiments based on file/journal submitted by students and /or viva.

INU806 Elective – II Lab
(C) ADVANCED SENSORS LAB

Teaching Scheme : 02 P **Total: 02** **Credit: 01**
Evaluation Scheme : 25 ICA + 25 ESE **Total Marks: 50**
Duration of ESE : 3 Hrs

Minimum Eight Experiments should be conducted from the sample list given below.

A) **Biomedical projects**

1. Development of Ultra-Small Muscle Force Sensors for Neuromuscular Diseases
2. Tactile MEMS Sensors for Minimally Invasive Medical Applications
3. Wireless Sensors for Orthopaedic Applications
4. Carbon Nanotube Based Breath Sensors for Respiratory Gas Exchange Analysis
5. Development of Battery-Less Wireless Biomedical Sensors for In-Vivo Applications

B) **Automotive Projects**

1. Battery-Less Wireless Traffic Sensors
2. Traffic Friendly Novel Narrow Commuter Vehicle
3. Technologies for Tire-Road Friction Coefficient Measurement
4. Electronic Stability Control Systems
5. Tire Sensors for Measurement of Slip Variables and Tire-Road Friction Coefficient
6. Development of a MEMS Absolute Angle Sensor
7. Development of Carbon Nanotube Transparent Thin Film Acoustic Transducers

ICA- The Internal Continuous Assessment shall be based on the practical record and Knowledge/skill acquired. The performance shall be assessed experiment wise by using continuous assessment formats A and B

ESE- The End Semester Exam shall be based on performance of experiments based on file/journal submitted by students and /or viva.

INU806 Elective – II Lab
(D) DIGITAL CONTROL SYSTEM LAB

Teaching Scheme : 02 P **Total: 02** **Credit: 01**
Evaluation Scheme : 25 ICA + 25 ESE **Total Marks: 50**
Duration of ESE : 3 Hrs

Minimum Eight Experiments should be conducted from the sample list given below.

1. Find the Response of the Discrete Time Control System for any two standard inputs.
2. Unit step Response of Discrete Time Control System using Digital PID controller.
3. Design of deadbeat controller for Discrete Time Control System.
4. Determine effect of sampling period on stability of Discrete Time Control System.
5. Discretization of continuous time state equation.
6. Investigation of the control availability and Observability of a system.
7. Design of control system using pole placement technique.
8. Design of State observer.
9. Design of Discrete Time Control System based on minimization of quadratic performance index.
10. The solution of steady state quadratic optical control using riccati equation.

ICA- The Internal Continuous Assessment shall be based on the practical record and Knowledge/skill acquired. The performance shall be assessed experiment wise by using continuous assessment formats A and B.

ESE- The End Semester Exam shall be based on performance of experiments based on file/journal submitted by students and /or viva.

INU 806 Elective - II LAB
(E) VIRTUAL INSTRUMENTATION LAB

Teaching Scheme : 02 P **Total: 02** **Credit: 01**
Evaluation Scheme : 25 ICA + 25 ESE **Total Marks: 50**
Duration of ESE : 3 Hrs

Minimum Eight Experiments should be conducted from the sample list given below.

1. Basic LAB View programming
2. Simulation of a level measurement process system.
3. Log File writing and reading on TDMS and LVM files.
4. Creating S-transfer functions and observes its Frequency response using control design toolkit.
5. Creating Discrete-time Z- Transfer Functions and state space models.
6. Series and feedback connections using control design toolkit.
7. Calculating Transfer Functions.
8. Discretizing Continuous time models.
9. A complete control system simulation and analysis using PID Controller.
10. Temperature alarm system
11. Designing Filters using NI ELVIS.
12. Manual Testing and Control of Two- Way Stoplight intersection with NI ELVIS.
13. RF wireless Communication using NI ELVIS.
14. Signal Processing with Speedy 33(speech recording and analysis).
15. Image processing techniques and applications using vision assistant.
16. Filtered response of images, corrupted with salt and pepper noise.
17. Temperature control.
18. Application based on ECG biomedical signal analysis.

ICA- The Internal Continuous Assessment shall be based on the practical record and Knowledge/skill acquired. The performance shall be assessed experiment wise by using continuous assessment formats A and B.

ESE- The End Semester Exam shall be based on performance of experiments based on file/journal submitted by students and /or viva.

INU807 PROJECT PHASE-II

Teaching Scheme: 06L **Total: 06** **Credits: 06**
Evaluation Scheme: 75 ICA+ 100 ESE **Total Marks: 175**
Duration of ESE: 3hrs.

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1. Project work decided in VII semester shall be continued.
2. Students should complete implementation of ideas given in synopsis, so that project work should be completed before end of semester.
3. Students shall submit the final project report in proper format as per guidelines given on the college website which shall include the work of both semesters.
4. For uniform and continuous evaluation, evaluation committee for each group shall be formed by Program Head in which guide must be a member. Internal marks should be awarded by committee at the end of semester based on continuous evaluation.
5. Final examination of project shall include demonstration, presentation of complete work and oral examination based on the project work.

Note:

ICA: The Internal Continuous Assessment shall be based on the active participation of the students in the Project work and knowledge / skill acquired. Oral examination shall be conducted on the Project report, by the panel of examiners consisting of Project Guide, Course Coordinator and Expert appointed by Program Head.

ESE: The End Semester Examination for Project shall consist of Demonstration if any, presentation and oral examinations based on the project report.

INU808 SELF STUDY-IV

Teaching Scheme: 00L + 00 T Total: 00 **Credits: 02**
Evaluation Scheme: 25ICA **Total Marks: 25**

Self study-IV is based on one class test each, on the basis of 20% curriculum of the courses INU801, INU802, INU803(A-E), INU804(A-D) to be declared by respective course coordinator at the beginning of the semester. These class tests should be conducted separately for each course and after CT-II. The marks of all such class tests then shall be converted to out of 25. One faculty member shall be appointed as course coordinator for Self Study IV and his/ her teaching work load shall be considered as one hr/week.