SRM
UNIVERSITY
(Under section 3 of UGC Act 1956)

M.Tech. Full Time - ELECTRONICS & CONTROL ENGINEERING
CURRICULUM & SYLLABUS
2015 – 2016

DEPARTMENT OF INSTRUMENTATION AND CONTROL ENGINEERING
FACULTY OF ENGINEERING AND TECHNOLOGY
SRM UNIVERSITY
SRM NAGAR, KATTANKULATHUR – 603 203

DEPARTMENT OF INSTRUMENTATION AND CONTROL ENGINEERING
M.Tech. Full Time - ELECTRONICS & CONTROL ENGINEERING
CURRICULUM- 2 (2015-16)

COURSE CODE	COURSE NAME	L	T	P	C
SEMESTER I					
IC2001	Advanced Process Control and Applications	3	0	2	4
IC2002	Microprocessor Based Instrumentation System	3	0	2	4
IC2003	System Identification and Adaptive Control	3	2	0	4
MA2015	Mathematics Applied to Electronics	3	0	0	3
CAC2001	Career Advancement Course For Engineers - I	1	0	1	1
ICXXXX	Program Elective-I	3	0	0	3
TOTAL		16	2	5	19
Total Contact Hours: 23					
SEMESTER II					
IC2004	Advanced Control System Design	3	0	2	4
IC2005	Advanced Digital Signal Processing	3	0	2	4
ICR2006	VLSI Circuit Design	3	2	0	4
CAC2002	Career Advancement Course For Engineers - II	1	0	1	1
ICXXXX	Program Elective-II	3	0	0	3
ICXXXX	Program Elective-III	3	0	0	3
ICXXXX	Program Elective-IV	3	0	0	3
TOTAL		19	2	5	22
Total Contact Hours: 26					
SEMESTER III					
ICXXXX	Program Elective-V	3	0	0	3
ICXXXX	Program Elective-VI	3	0	0	3
XXXXXX	Interdisciplinary Elective-I	3	0	0	3
IC2047	Seminar	0	0	1	1
IC2048	Industrial Training	0	0	1	1
CAC2003	Career Advancement Course For Engineers - III	1	0	1	1
IC2049	Project work Phase I	0	0	12	6
	TOTAL	10		15	18
Total Contact Hours: 25					
SEMESTER IV					
IC2050	Project work Phase II	0	0	32	16

	TOTAL CREDITS	75

Total credits to be earned for the award of M.Tech degree – 75 credits

LEGAND :

L: Lecture Hours per week T: Tutorial Hours per week

P: Practical Hours per week C: Credit

PROGRAM ELECTIVES

Course Code	Name of the course	L	T	P	C
ICR2101	Automotive Instrumentation	3	0	0	3
IC2102	Linear and Non linear systems	3	0	0	3
IC2103	DCS Networks and Protocols	3	0	0	3
IC2104	Digital Signal and Image processing	3	0	0	3
IC2105	Robotics and automation	3	0	0	3
IC2106	Advanced Digital System Design	3	0	0	3
IC2107	Fundamentals of MEMS	3	0	0	3
IC2108	Robust Control	3	0	0	3
IC2109	Embedded Instrumentation systems	3	0	0	3
IC2110	Advanced soft computing	3	0	0	3
IC2111	Process Modeling and Simulation	3	0	0	3
IC2112	Multivariable control	3	0	0	3
ICR2113	Advanced Instrumentation system	3	0	0	3
IC2114	CAD of Instrumentation Systems	3	0	0	3
IC2115	Advanced Electronic circuits	3	0	0	3
IC2116	Optimal control and filtering	3	0	0	3
IC2117	Fault tolerant control systems	3	0	0	3
IC2118	DSP Integrated circuits	3	0	0	3
IC2119	Transducers and Smart Instruments	3	0	0	3

NOTE:

Students have to register for the courses as per the following guidelines:

Sl. No.	Category	Credits				
		I Semester	II Semester	III Semester	IV Semester	Category total
1.	Core courses	12 (3 courses)	12 (3 courses)	---	---	24
2.	Program Elective courses	18 (in I to III semesters)			---	18
	Interdisciplinary elective courses (any one program elective from other programs)	3 (One course to be taken in Semester I or II or III)				3
3.	Supportive courses - mandatory	3 (One course to be taken in Semester I or II or III)			---	3
4.	Seminar	---	---	1	---	1
5.	Industrial Training	---	---	1	---	1
6	Career Advancement Courses	1	1	1	-	3
7	Project work	---	---	06	16	22
	Total					75

SEMESTER I

IC2001	ADVANCED PROCESS CONTROL AND APPLICATIONS	L	T	P	C
	Total Contact Hrs - 60	3	0	2	4
	Prerequisite				
	Basic Knowledge of Process Control				

PURPOSE	
To understand the necessity of control in process industries and appreciate the importance of controller tuning in real time scenario	
INSTRUCTIONAL OBJECTIVES	
1.	To acquire methods of controller tuning and design
2.	To understand the fundamentals of controller modes
3.	To analyze complex control systems and tuning
4.	To impart practical process control concepts

UNIT I - INTRODUCTION (16 hours)

Introduction -Model-based control MBC-real-time optimization-MPC-IMC base PID Controller-statistical process control-batch process control- state estimation- robust controller design-Problems distributed parameter controllers

UNIT II - MIMO CONTROL SYSTEMS (16 hours)

MIMO control systems- input-output pairing- loop interaction- controllability and observability-transfer function model- open-loop dynamic analysis in state-space-transient response- stability analysis-synthesis of alternative control configurations-RGA analysis and loop pairing- design of non-interacting control loops- centralized MVC systems

UNIT III - CONTROLLER TUNING AND CONTROL STRATEGIES (16 hours)

Optimum controller settings – Tuning of controllers by process reaction curve method – Damped

Oscillation method – Ziegler Nichol's tuning – Pole placement method – Feed forward control –

Ratio control – Cascade control – Split range control – Averaging control – Inferential control

UNIT IV - DESIGN OF CONTROLLERS FOR MULTIVARIABLE SYSTEMS (16 hours)

Introduction to multivariable system – Evolution of loop interaction – Evolution of relative gains – Single loop and overall stability – Model equations for a binary distillation column – Transfer function matrix – Method of inequalities – Decoupling control – Centralized controller

UNIT V - COMPLEX CONTROL TECHNIQUES (11 hours)

Internal model control – Adaptive control – Model predictive control: Dynamic matrix control – model – Generalized predictive control

REFERENCES

1. Stephanopoulos G., "*Chemical Process Control*", Prentice Hall, New Delhi,
2. 2003.
3. Coughanowr D.R., "*Process Systems Analysis and Control*", McGraw – Hill
4. Higher Education, Singapore, 2008.
5. Wayne Bequette, "*Process control: modeling, design, and simulation*" Prentice Hall, New Jersey, 2003.
6. Smith C.L and Corripio.A..B, "*Principles and Practice of Automatic Process*
7. *Control*", John Wiley and Sons, New York, 2006.
8. Dale E. Seborg, Thomas F. Edgar, Duncan A. Mellichamp, "*Process Dynamics and Control*", Willey India, 2006.
9. Marlin. T.E., "*Process Control*", Second Edition McGraw Hill New York, 2000.

IC2002	MICROPROCESSOR BASED INSTRUMENTATION SYSTEM	L	T	P	C
	Total Contact Hrs - 60	3	0	2	4
	Prerequisite				
	Basic Knowledge of Z-Transforms				
PURPOSE					
To understand the programming and applications of microprocessor in designing instrumentation systems for different measurements					
INSTRUCTIONAL OBJECTIVES					
1.	To understand the basic microprocessor operations				
2.	To acquire knowledge on design of instrumentation systems using PIC				
3.	To appreciate digital controller design				
4.	To acquire PIC programming knowledge				

UNIT I - PIC EMBEDDED CONTROLLERS (15 hours)

PIC Microcontroller family – PIC Configuration – PIC16F84 microcontroller – Architecture -features- PIC16F877 microcontroller & hardware details – C-compiler for microcontroller – programming concept – Hardware examples of C programs for PIC

UNIT II - TEMPERATURE AND ITS MEASUREMENT (15 hours)

Introduction to Thermocouple Sensors - Thermocouple types – Insulation – Thermocouple Response times – styles – thermocouple temperature voltage relationship – Theory of cold junction compensation – Microcontroller based practical thermocouple circuit -RTD principles – RTD standard – Microcontroller based RTD temperature measurement – Design a microcontroller based temperature measurement using RTD

UNIT III - PIC BASED TEMPERATURE MEASUREMENT (15 hours)

Microcontroller based temperature measurement using thermistor – Design a PIC based temperature measurement using thermistor – IC temperature sensor principle - voltage output temperature sensor current output temperature sensor- Application of current output temperature sensor - Digital output temperature sensor - Application of digital output temperature- PIC based temperature measurement

UNIT IV - DIGITAL CONTROL SYSTEM (15 hours)

Digital control system – introduction, Sampling – Quantization, using Z transform-inverse transform function –digital control algorithm- control of temperature using PID-Ziegler Nichols algorithm -Open loop and close loop trans function model-I order and II order systems using Z transform- Stability and Introduction- Jury's stability test for a system-Root locus and Bode plot – frequency analysis- Bang control of temperature-Closed loop tuning

UNIT V - DIGITAL CONTROLLER DESIGN (15 hours)

Overview of temperature controller process-Mathematical modeling of tank- heater-RTD - thermistor -thermocouple - Programming and design of PI-PID controller using Assembly language-Assembling and testing of controller board for a temperature controller system

REFERENCES

1. Dogan Ibrahim, "*Microprocessor based temperature monitoring and control*", ISBN: 0750655569, Published by Elsevier Science & Technology Books, 2002.
2. Dogan Ibrahim, "*Microprocessor based applied digital control*", John and Wiley sons, 2007.
3. Gopal M., "*Digital Control Engineering*", New Age international publishers, 2012.

IC2003	SYSTEM IDENTIFICATION AND ADAPTIVE CONTROL	L	T	P	C
	Total Contact Hrs - 60	3	2	0	4
	Prerequisite				
	Nil				

PURPOSE	
To understand the modeling and classifications of control systems and analyze the applications of adaptive control	
INSTRUCTIONAL OBJECTIVES	
1.	To acquire knowledge in modeling and controller design
2.	To appreciate Adaptive control and its applications
3.	To perform analytical procedures and find solutions

UNIT I - MODELING AND SIMULATION OF PROCESSES (12 hours)
Impulse response - Frequency response - Step response methods - Signal modeling - Discretisation techniques- Runge-Kutta method -Z-transform method - Use of Simulation packages - Simulation of 1st order, 2nd order systems with and without dead time

UNIT II - MIMO SYSTEM IDENTIFICATION TECHNIQUES (12 hours)
Off line - On line methods - Recursive least squares - Modified recursive least squares techniques - Fixed memory - RLS algorithm - Maximum likelihood - Instrumental variable stochastic approximation techniques-Problems

UNIT III - CLASSIFICATION OF ADAPTIVE CONTROL (12 hours)
Introduction - Uses - Definitions - Auto tuning - Types of adaptive control- Recent trends in self-tuning – Robustness studies – Multivariable systems - Model updating – General-purpose adaptive regulator

UNIT IV - CONTROL POLICIES (12 hours)
Approaches - The Gradient approach - Lyapunov functions - Passivity theory – Control policies - pole placement control - Minimum variance control - Predictive control-Problems

UNIT V - ISSUES IN ADAPTIVE CONTROL AND APPLICATIONS (12 hours)
Stability-Convergence-Robustness-Application of adaptive control- Power systems – Electric drives – Process control- Distillation Column, Dryers, Pulp Dryer, Chemical Reactor

REFERENCES

1. Simon.S.Haykin, "*Adaptive filter theory*", 4th edition, Pearson Education India, 2002.
2. Isermann R., "*Digital Control Systems*", Vol. I and II, Narosa Publishing House, Reprint 1993.
3. Wellstead P.E. and Zarrop M.B., "*Self tuning systems*", John Wiley and Sons, 1991.
4. Chalam, V.V., "*Adaptive Control Systems, Techniques & Applications*", Marcel Dekker, Inc. NY and Basel, 1987.
5. Eveleigh, V.W., "*Adaptive Control and Optimization Techniques*", McGraw-Hill, 1967.

MA2015	MATHEMATICS APPLIED TO ELECTRONICS	L	T	P	C
	Total Contact Hrs - 45	3	0	0	3
	Prerequisite				
	Nil				

PURPOSE

To develop analytical capability and to impart knowledge in Statistical methods and Random and their applications in Engineering and Technology and to apply these concepts in engineering problems they would come across.

INSTRUCTIONAL OBJECTIVES

1.	Understand Statistical concepts
2.	Logically explain the concepts
3.	Apply the concepts in solving the engineering problems

UNIT I - MATRIX THEORY (9 hours)

QR decomposition – Eigen values using shifted QR algorithm- Singular Value Decomposition - Pseudo inverse-Least square approximations

UNIT II - CALCULUS OF VARIATIONS (9 hours)

Concept of Functionals- Euler's equation – functional dependent on first and higher order derivatives – Functionals on several dependent variables – Isoperimetric problems- Variational problems with moving boundaries

UNIT III - TRANSFORMS METHODS (9 hours)

Laplace transform methods for one dimensional wave equation – Displacements in a string – Longitudinal vibration of a elastic bar – Fourier transform methods for one dimensional heat conduction problems in infinite and semi infinite rod

UNIT IV - ELLIPTIC EQUATION (9 hours)

Laplace equation – Properties of harmonic functions – Fourier transform methods for Laplace equations- Solution for Poisson equation by Fourier transforms method

UNIT V - LINEAR AND NON LINEAR PROGRAMMING (9 hours)

Simplex Algorithm- Two Phase and Big M techniques – Duality theory- Dual Simplex method.

Non Linear Programming –Constrained extremal problems- LaGrange's multiplier method- Kuhn- Tucker conditions and solutions

REFERENCES

1. Richard Bronson, "*Schaum's Outlines of Theory and Problems of Matrix Operations*", McGraw-Hill, 1988.
2. Venkataraman M K, "*Higher Engineering Mathematics*", National Pub. Co, 1992.
3. Elsgolts, L., "*Differential Equations and Calculus of Variations*", Mir, 1977.
4. Sneddon, I.N., "*Elements of Partial differential equations*", Dover Publications, 2006.
5. Sankara Rao, K., "*Introduction to partial differential equations*", Prentice Hall of India, 1995.
6. Taha H A, "*Operations research - An introduction*", McMillan Publishing co, 1982.

		L	T	P	C
ICXXXX	PROGRAM ELECTIVE - I	3	0	0	3
	Total Contact Hours - 45				

SEMESTER II

IC2004	ADVANCED CONTROL SYSTEM DESIGN	L	T	P	C
	Total Contact Hrs - 60	3	0	2	4
	Prerequisite				
	Nil				

PURPOSE	
To understand the basic linear and nonlinear system design for the real time applications and find solutions to problems related to stability of systems	
INSTRUCTIONAL OBJECTIVES	
1.	To develop a model for dynamic system
2.	To analyze the stability of linear and nonlinear system
3.	To analyze the different types of artificial intelligent systems
4.	To acquire knowledge of advanced MATLAB programming

UNIT I - MODELING OF DYNAMIC SYSTEMS (15 hours)

Centrifugal Governor – Ground vehicle- Permanent Magnet stepper motor- Inverted Pendulum – Numerical methods – Linearization of Differential Equation –Describing function method

UNIT II - LINEAR SYSTEM ANALYSIS (15 hours)

Reachability and controllability – Observability and constructability –Companion forms – Controller / Observer form – State feedback control – State estimator – Full order and reduced order Estimator-Problems

UNIT III - STABILITY (15 hours)

Definition of stability – Stability of linear system – Hurwitz and Routh stability criteria – Stability of Nonlinear system – Lyapunov's indirect method- Problems

UNIT IV - OPTIMAL CONTROL (15 hours)

Performance Indices – Calculus of variation – Linear Quadratic Regulator steady state optimal control – Dynamic programming – Pontrgagin's minimum principle- Decoupling - Problems

UNIT V - PHASE PLANE ANALYSIS (15 hours)

Linear and non-linear systems - Common physical non-linearities – Methods of linearising non-linear systems - Concept of phase portraits – Singular points – Limit cycles – Construction of phase portraits – Phase plane analysis of linear and non-linear systems – Isoclines method.

REFERENCES
1. Stanislaw Zak, "*Systems and Control*", ISBN0195150112, Oxford University Press, 2003.
2. Norman S.Nice, "*Control Systems Engineering*", John Wiley and Sons, ISBN0471366013, 2000.
3. Ogata.K, "*Modern Control Engineering*", Prentice-Hall Publication, ISBN0130609072, 1996.
4. Godwin. C, Graebe.F, and Salgado. "*Control System Design*", Prentice Hall, New Jersey, ISBN 0139586539, 2001.
5. William S. Levine, "*The Control Hand Book*", IEEE and CRC Press, USA, ISBN 0849385709, 2000.

IC2005	ADVANCED DIGITAL SIGNAL PROCESSING	L	T	P	C
	Total Contact Hrs - 60	3	0	2	4
	Prerequisite				
	Basic Knowledge of Z-Transforms				
PURPOSE					
To acquire the basic knowledge of different signal processing systems and solve problems related to Z transforms and digital filter design					
INSTRUCTIONAL OBJECTIVES					
1.	To appreciate and analyze Z-Transforms				
2.	To design and implement IIR and FIR Digital filters				
3.	To introduce the advancements in DSP Processor				
4.	To learn programming of DSP processor				

UNIT I - INTRODUCTION TO DSP (15 hours)

Signals and their origin- Noise-Classification of continuous time signals- discrete time signals classification and properties of systems- Sampling Theorem-sampling-digitizing-aliasing- anti-alias filter - Convolution theorem-linear convolution and circular convolution - Applications of filters - Advantages of DSP

UNIT II - Z-TRANSFORMS (15 hours)

Z-Transform and its properties –Inverse Z-transform –Discrete Fourier Transforms DFT and its properties-Radix 2FFT, Computational advantages of FFT over DFT-Decimation in time FFT algorithm-Decimation-in Frequency FFT algorithm –MATLAB exercises.

UNIT III - IIR DIGITAL FILTER DESIGN USING MAT LAB (15 hours)

Block diagram Representation of digital filter-Basic IIR digital filter structures-Structure Realization Using MATLAB-Preliminary consideration in digital filter design – Bilinear Transformation.

UNIT IV - FIR DIGITAL FILTER DESIGN USING MATLAB (15 hours)

Basic FIR Filter Structure, Structure realization using MATLAB- FIR Filter design based on windowed Fourier series-Frequency sampling method, equiripple linear, phase FIR filter design using MATLAB-window based FIR filter design using MATLAB-Least square error- FIR filter design using MATLAB

UNIT V - DSP PROCESSOR- TMS320C5X (15 hours)

Introduction to programmable DSPS- Architecture of TMS 320 C5X, TMS 320C5X Assembly language Instructions-Instruction Pipelining in C5X

Programming using DSP Processor:

Convolution using MAC and MACD Instructions- Square wave generation-Ramp signal generation- Triangular wave generation.

REFERENCES

1. Sanjit .K. Mitra, "*Digital Signal Processing A Computer based approach*", Tata McGraw Hill Edition, ISBN 0-07-044705-5, 2001.
2. B.Venkataramani, M Bhasker, "*Digital Signal Processors*", Tata McGraw-Hill Publishing Company limited, ISBN 0-07-047334-X, 2002.
3. John .G.Proakis, "*Digital Signal Processing Principles, Algorithms and Applications*", Addison – Wesley ISBN-81-203-1129-9, 2002.
4. Emmanuel C.Ifeachor, "*Digital Signal Processing A Practical Approach*", Pearson Education Asia, ISBN 81-7808-609-3, 2002.

ICR2006	VLSI CIRCUIT DESIGN	L	T	P	C
	Total Contact Hrs - 60	3	2	0	4
	Prerequisite				
	Basic Knowledge of VLSI				

PURPOSE	
To acquire the knowledge on digital circuits and programmable arrays	
INSTRUCTIONAL OBJECTIVES	
1.	To acquire knowledge about MOS circuits.
2.	To understand the design of combinational and sequential circuits.
3.	To understand the programming in VHDL
4.	To study about programmable devices, FPGA

UNIT I - MOS CIRCUITS (9 hours)

The MOS transistor-Current Voltage Relations-Threshold Voltage-Second order effects-MOS models-Design of Logic gates-Stick diagrams – DC characteristics – Small signal AC characteristics of CMOS inverter – Dynamic behavior – Power consumption – Scaling of MOS circuits

UNIT II - DESIGN OF COMBINATIONAL AND SEQUENTIAL CIRCUITS (9 hours)

CMOS Inverter – Adders - Flip Flops- State machine design using D Flip Flops – Design with JK Flip Flops and T Flip Flops – Design for PLD – ASM chart – Design from an ASM chart – clock skew – Initialization lockout in state machines

UNIT III - VHDL (9 hours)

Introduction to VHDL – data types – data objects - Operators – data types – data objects – concurrent constructs– sequential constructs. -Behavioral Data Flow and Structural Model – VHDL attributes – Timing related issues –subprogram – Functions – Procedure – Package –Timing Diagrams: Micro and Macro Timing diagrams – Hazards –Timing Simulations

UNIT IV - PROGRAMMABLE DEVICES (9 hours)

Array Multiplier – Multiplier structures- Baugh-Wooly – Booth Multiplier – Barrel shifter – Memory structures– SRAM and DRAM design – Design approach of Programmable logic devices – PLA,PAL and ROMs and EPROMs-Programmable gate arrays and applications – CPLDS

UNIT V - FPGA (9 hours)

FPGAs – Antifuse FPGA – Synthesis methods for FPGA – Electronically programmable functions – Basic components – Arithmetic Logic Unit – Programmable register- Altera FPGA Architectures.

REFERENCES

1. Smith, "*Application Specific Integrated Circuits*", *Pearson, Sixth reprint, 2009*.
2. *Bhasker.J," VHDL synthesis primer" Star Galaxy publishing,second edition,2011*
3. James, Palmer E, David E Perlman, "*Introduction to Digital System*", Tata McGraw Hill, 1996.
4. Kevin Skahill, "*VHDL for Programmable Logic Devices*", Addison Wesley, 1996.
5. Stefan Sjoholm and Lennart Lindh, "*VHDL FOR DESIGNERS*", Prentice Hall, 1997.

		L	T	P	C
ICXXXX	PROGRAM ELECTIVE - II	3	0	0	3
	Total Contact Hours - 45				

		L	T	P	C
ICXXXX	PROGRAM ELECTIVE - III	3	0	0	3
	Total Contact Hours - 45				

		L	T	P	C
ICXXXX	PROGRAM ELECTIVE - IV	3	0	0	3
	Total Contact Hours - 45				

SEMESTER III

		L	T	P	C
ICXXXX	PROGRAM ELECTIVE - V	3	0	0	3
	Total Contact Hours - 45				

		L	T	P	C
ICXXXX	PROGRAM ELECTIVE – VI	3	0	0	3
	Total Contact Hours – 45				

		L	T	P	C
XXXXXX	INTER DISCIPLINARY ELECTIVE - I	3	0	0	3
	Total Contact Hours - 45				

IC2047	SEMINAR	L	T	P	C
		0	0	1	1
PURPOSE					
To train the students in preparing and presenting technical topics.					
INSTRUCTIONAL OBJECTIVE					
The student shall be capable of identifying topics of interest related to the program of study and prepare and make presentation before an enlightened audience.					

The students are expected to give at least two presentations on their topics of interest which will be assessed by a committee constituted for this purpose. This course is mandatory and a student has to pass the course to become eligible for the award of degree. Marks will be awarded out of 100 and appropriate grades assigned as per the regulations

IC2048	INDUSTRIAL TRAINING (Training to be undergone after II semester)	0	0	1	1
	3 week practical training in industry				
	Prerequisite				
	Nil				
PURPOSE					
To provide practical exposure in Civil Engineering related organizations.					
INSTRUCTIONAL OBJECTIVES					
1.	Students have to undergo three – week practical training in Civil Engineering related organizations so that they become aware of the practical applications of theoretical concepts studied in the class rooms.				

Students have to undergo three-week practical training in Civil Engineering related organizations of their choice but with the approval of the department. At the end of the training student will submit a report as per the prescribed format to the department.

Assessment process

This course is mandatory and a student has to pass the course to become eligible for the award of degree. The student shall make a presentation before a committee constituted by the department which will assess the student based on the report submitted and the presentation made. Marks will be awarded out of 100 and appropriate grades assigned as per the regulations.

		L	T	P	C
IC2049 IC2050	PROJECT WORK PHASE I (III semester)	0	0	12	6
	PROJECT WORK PHASE II (IV semester)	0	0	32	16
PURPOSE					
To undertake research in an area related to the program of study					
INSTRUCTIONAL OBJECTIVE					
The student shall be capable of identifying a problem related to the program of study and carry out wholesome research on it leading to findings which will facilitate development of a new/improved product, process for the benefit of the society.					

M.Tech projects should be socially relevant and research oriented ones. Each student is expected to do an individual project. The project work is carried out in two phases – Phase I in III semester and Phase II in IV semester. Phase II of the project work shall be in continuation of Phase I only. At the completion of a project the student will submit a project report, which will be evaluated (end semester assessment) by duly appointed examiner(s). This evaluation will be based on the project report and a viva voce examination on the project. The method of assessment for both Phase I and Phase II is shown in the following table:

Assessment	Tool	Weightage
In- semester	I review	10%
	II review	15%
	III review	35%
End semester	Final viva voce examination	40%

Student will be allowed to appear in the final viva voce examination only if he / she has submitted his / her project work in the form of paper for presentation / publication in a conference / journal and produced the proof of acknowledgement of receipt of paper from the organizers / publishers.

PROGRAM ELECTIVES

ICR2101	AUTOMOTIVE INSTRUMENTATION	L	T	P	C
	Total Contact Hrs - 45	3	0	0	3
	Prerequisite				
	Nil				
PURPOSE					
To understand the applications of instruments in automotives and analyze the importance of indicating and alarm instruments					
INSTRUCTIONAL OBJECTIVES					
1.	To appreciate the operation of various automotive instruments				
2.	To analyze the design issues in instruments				
3.	To apply the knowledge in developing new instruments				

UNIT I - AUTOMOBILE PANEL METERS AND SENSOR DESIGN (9 hours)
Ergonomics- Panel Meters- Controllers- Sensor for Fuel Level in Tank- Engine Cooling Water Temperature Sensors Design- Engine Oil Pressure Sensor Design- Speed Sensor-Vehicle Speed Sensor Design- Air Pressure Sensors-Engine Oil Temperature Sensor

UNIT II - INDICATING INSTRUMENTATION DESIGN (9 hours)
Moving Coil Instrument Design- Moving Iron Instruments- Balancing Coil Indicator Design-Ammeter and voltmeter- Odometer and Taximeter Design- Design of Alphanumeric Display

UNIT III - WARNING AND ALARM INSTRUMENTS (9 hours)
Brake Actuation Warning System- Trafficators- Flash System- Oil Pressure Warning System-Engine Overheat Warning System- Air Pressure Warning System- Speed Warning System-Door Lock Indicators- Gear Neutral Indicator- Horn Design- Permanent Magnet Horn-Air Horn-Music Horns

UNIT IV - DASH BOARD AMENITIES (9 hours)
Car Radio Stereo- Courtesy Lamp- Timepiece- Cigar Lamp-Car Fan- Windshield Wiper-Window Washer- Instrument Wiring System and Electromagnetic Interference Suppression-Wiring Circuits for Instruments- Electronic Instruments-Dash Board Illumination

UNIT V – VEHICLE MOTION CONTROL AND STABILIZATION SYSTEM (9 hours)

Vehicle Motion Control – Adaptive Cruise Control, Electronic Transmission Control. Vehicle Stabilization System – Antilock Braking System, Traction Control System, Electronic Stability Program. Onboard diagnosis System

REFERENCES

1. Tom Denton, "*Automotive Electric and Electronic Systems*", 3rd edition, Elsevier, 2004.
2. Walter E, Billiet and Leslie, Goings, "*Automotive Electric Systems*", American Technical Society, Chicago, 1971.
3. P.L.Kohli, "*Automotive Electrical equipment*" Tata McGraw Hill Ltd., New Delhi, 2006.
4. Sonde.B.S. "*Transducers and Display System*", Tata McGraw Hill Ltd., New Delhi, 1977.
5. Tom Denton, "Automotive Electric and Electronic Systems", 3rd edition, Routledge, 2012.
6. P.L.Kohli, "Automotive Electrical Equipment " Tata McGraw Hill Ltd., New Delhi, 2011

IC2102	LINEAR AND NON LINEAR SYSTEMS	L	T	P	C
	Total Contact Hrs - 45	3	0	0	3
	Prerequisite				
	Basic Knowledge of Modern Control Systems				
PURPOSE					
To understand the dynamics of linear and non linear systems and apply the knowledge in finding the solutions related to system stability					
INSTRUCTIONAL OBJECTIVES					
1.	To impart the knowledge on linear and non linear process dynamics				
2.	To appreciate the methods that analyze the stability of systems				
3.	To apply the knowledge in solving problems related to stability				

UNIT I - INTRODUCTION (9 hours)

Linear time varying systems- Properties of the state transition matrix - ad joint equation -variation equation-Linear time invariant systems – Eigen values left and right eigenvectors-Dyadic expansions

UNIT II - CONTROLLABILITY (9 hours)

Concepts of Controllability-observability-effects of state feedback- output injection-Characterization of controllability and observability for linear systems- Stabilizability – detectability- Duality - Kalman decomposition- internal stability - I/O stability

UNIT III - STABILITY CONCEPTS (9 hours)

Concept of stability- Lyapunov stability and absolute stability-Zero-input and BIBO stability-second 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

UNIT IV - DESCRIBING FUNCTIONS (9 hours)

Linear versus nonlinear systems- Describing function analysis-Fundamentals-common nonlinearities –saturation - dead-zone - on-off non-linearity- backlash-hysteresis - describing functions- Describing function analysis of nonlinear systems-Reliability of describing method analysis-Compensation and design of nonlinear system

UNIT V - DYNAMIC BEHAVIOUR (9 hours)

Full order observers-state estimation-Eigen value assignment-Approximate solution of nonlinear system - perturbation method and averaging method-Review of dynamic behavior of linear systems design- Linear processes with difficult dynamics-Nonlinear process dynamics

REFERENCES

1. *Ogata K, "Modern Control Engineering", Person Education, New Jersey, 5th Edition,2009*.
2. *Gopal M " Digital Control and State variable Methods", Tata McGraw Hill Ltd., New Delhi, 2nd Edition 2003*.
3. *Vidyasagar. M, " Non-Linear System Analysis", Prentice Hall Inc., New Jersey, 2nd Edition 2002*.
4. Singiresu S. Rao, "*Applied Numerical Methods*" Prentice Hall, Upper Saddle River, New Jersey, 2001.
5. Jean-Jacques E. Slotine, Weiping Li, "*Applied nonlinear control*", Prentice Hall Inc., New Jersey, 2004.
6. Ogata K, "Modern Control Engineering", Person Education, New Jersey, 5th Edition,2009.
7. Gopal M " Digital Control and State variable Methods", Tata McGraw Hill Ltd., New Delhi, 2ndEdition2003.
8. Vidyasagar. M, " Non-Linear System Analysis", Prentice Hall Inc., New Jersey, 2nd Edition 2002.

9. Singiresu S. Rao, “Applied Numerical Methods” Prentice Hall, Upper Saddle River, New Jersey, 2001.
10. Jean-Jacques E. Slotine, Weiping Li, “ Applied Non-Linear Control”, Prentice Hall Inc., New Jersey, 2004.

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IC2103	DCS NETWORKS AND PROTOCOLS	L	T	P	C
	Total Contact Hrs - 45	3	0	0	3
	Prerequisite				
	Nil				

PURPOSE	
To understand the importance of data communication and industrial data networks and to obtain in depth knowledge in data compression techniques	
INSTRUCTIONAL OBJECTIVES	
1.	To analyze and compare different types of computer networks
2.	To understand the fundamental need for data networks
3.	To appreciate the importance of DCS and field bus communication

UNIT I - COMPUTER NETWORKS (9 hours)

Common bus topology- Star topology- Ring topology- Fully connected topology- Combined Topologies - Protocols and protocol architecture- Asynchronous- Synchronous Communication USART, UART- Serial data transmission standard – RS232, RS422, RS485 –Multi-drop Communication- Data coding methods- ASCII, EBCDIC, Baudot, Morse and BCD Codes-Digital encoding schemes

UNIT II - DATA COMPRESSION, SECURITY AND INTEGRITY (9 hours)

Data Compression – Huffman - Run length encoding-relative -Lempel- Image compression- JPEG, MPEG- Data Integrating –Error parity checking analysis- Deribie bit error detection- Burst error detection- Cyclic redundancy checks- Polynomial division- Analysis of CRC- CRC implementation - Error correction- Hamming codes- Single error correction- Multi-bit error correction- Comparison of error detection and correction- Data Security- Encryption and decryption- Caesar Cipher Bit level ciphering- Data encryption protection- Public key encryption

UNIT III - DATA NETWORK FUNDAMENTALS (9 hours)

Network hierarchy and switching - Open system interconnection model of OSI - Data link control protocol - BISYNC - SDLC - HDLC - Media Access protocol - Command/response - Token pass- CSMA/ CDMA, TCP/IP- Internetworking- Bridges - Routers - Gateways - Open system with bridge configuration - Open system with

gateway configuration – Standard ETHERNET and ARCNET configuration – Special requirement for networks used for control.

UNIT IV - DISTRIBUTED CONTROL SYSTEMS (9 hours)

Evolution - Different architectures - Local control unit - Operator interface - Displays- Engineering interface-alarms and alarm management-DCS Case study- Study of anyone popular DCS available in market - Factors to be considered in selecting DCS - Case studies in DCS

UNIT V - HART AND FIELD BUS (9 hours)

Introduction - Evolution of signal standard - HART Communication protocol - Communication modes - HART networks -Control system interface - HART commands - HART field controller implementation - HART and the OSI model – Field bus – Introduction - General Field bus architecture - Basic requirements of field bus standard - Field bus topology - Interoperability - Interchangeability

REFERENCES

1. *A.S. Tanenbaum and David J. Wetherall "Computer Networks", Fifth Edition, Dorling Kindersley, ISBN 8130311655,2012*.
2. *Behrooz A.F., " Data Communication and Networking", 4th Edition Tata McGraw Hill Ltd., ISBN 0070435034, 2006*.
3. Romilly Bowden, "*HART application Guide*", HART Communication Foundation, 1999.
4. A.S. Tanenbaum and David J. Wetherall "Computer Networks", Fifth Edition, Dorling Kindersley, ISBN 8130311655,2012.
5. Behrooz A.F., " Data Communication and Networking", 4th Edition Tata McGraw Hill Ltd., ISBN 0070435034, 2006.
6. William A Shay, "Understanding Data Communications and Networks", Cole Publishing Company, A division of Thomson Learning, ISBN 05395954, 3rd edition, 2003.

IC2104	DIGITAL SIGNAL AND IMAGE PROCESSING	L	T	P	C
	Total Contact Hrs - 45	3	0	0	3
	Prerequisite				
	Nil				

PURPOSE	
To acquire in depth knowledge in digital image processing and subsequently apply the knowledge in improving quality of image using different techniques	
INSTRUCTIONAL OBJECTIVES	
1.	To understand the need for image processing techniques
2.	To develop skills needed for design of Digital filters
3.	To appreciate the different data compression techniques

UNIT I - SPECTRUM ESTIMATION & PREDICTIO (9 hours)

Review of FIR, IIR, filters-Signal analysis using Fourier Transform - Periodogram-sample auto correlation- sum decomposition theorem- spectral factorization theorem-non parametric method- correlation method- co variance estimator- unbiased, consistent estimator- periodogram estimator- Bartlett spectrum estimation- Welch estimation- model based approach- ARMA signal modeling- parameter estimation using Yule walker method- least mean square error criterion- Wiener filter-linear prediction- forward backward prediction- levinson recursion algorithm

UNIT II - ADAPTIVE FILTERS (9 hours)

FIR adaptive filter- Newton steepest descent method – Widrow Hoff LMS adaptive algorithm- adaptive channel equalization- adaptive echo cancellor- adaptive noise cancellation- RLS adaptive filter- simplified IIR LMS adaptive filter

UNIT III - MULTI RATE SIGNAL PROCESSING (9 hours)

Mathematical description of change of sampling rate- interpolation- decimation-continuous time model- direct digital domain approach- decimation by an integer factor- interpolation by an integer factor- single and multi stage realization-poly phase realization- filter bank implementation- application to sub band coding

UNIT IV - IMAGE ENHANCEMENT AND RESTORATION (9 hours)

Elements of digital image processing systems- elements of visual perception-structure of human eye-Monochrome vision model- image enhancement and restoration-Spatial domain method- histogram processing- spatial filtering- edge crispening- interpolation- homomorphic filtering – degradation model- diagonalization of Circulant and Block Circulant Matrices-Algebraic Approach to restoration-constrained and unconstrained restoration- inverse filtering and wiener filter-Image morphology

UNIT V - IMAGE DATA COMPRESSION (9 hours)

Fundamentals of coding- image compression model- fundamental coding theorem Shannon's coding, Huffman coding- pixel coding- predictive techniques- lossy and lossless predictive coding- variable length coding- bit plain coding -transform coding, zonal and threshold coding, image compression standard- CCITT and JPEG standards

REFERENCES

1. *John G Proakis, "Digital Signal Processing", Pearson Prentice Hall, 4th Edition, 2012*.
2. *Simon Haykin, "Adaptive Filter Theory", Prentice Hall, 4th Edition, 2002*.
3. *Anil K Jain, " Fundamental Of Digital Image Processing", Prentice Hall, 4th Edition. 2010*.
4. *Gonzalez. R.C, "Digital Image Processing", Pearson Prentice Hall, 3rd edition, 2008*.

IC2105	ROBOTICS & AUTOMATION	L	T	P	C
	Total Contact Hrs - 45	3	0	0	3
	Prerequisite				
	Basic Knowledge of Robotics				

PURPOSE

To understand the operation of robots, calculate their degrees of freedom and analyze criteria involved in designing robots for performing certain functions

INSTRUCTIONAL OBJECTIVES

1.	To understand the basic functions of robot and degrees of freedom
2.	To analyze different types of robot configurations
3.	To emphasize the need for controls related to robots

UNIT I - INTRODUCTION (9 hours)

Geometric configuration of robots – Manipulators – Drive systems – Internal and external sensors – End effectors – Control systems – Robot programming languages and applications – Introduction to robotic vision

UNIT II - ROBOT ARM KINEMATICS (9 hours)

Direct and inverse kinematics – Rotation matrices – Composite rotation matrices – Euler angle representation – Homogenous transformation – Denavit Hattenberg representation and various arm configurations-Problems

UNIT III - ROBOT ARM DYNAMICS (9 hours)

Lagrange – Euler formulation, joint velocities – Kinetic energy – Potential energy and motion equations – Generalized D'Alembert equations of motion

UNIT IV - PLANNING OF MANIPULATOR TRAJECTORIES (9 hours)

General consideration on trajectory planning- joint interpolation -Cartesian path trajectories-Problems

UNIT V - CONTROL OF ROBOT MANIPULATORS (9 hours)

PID control computed, torque technique – Near minimum time control – Variable structure control – Non-linear decoupled feedback control – Resolved motion control and adaptive control.

REFERENCES

1. Groover M. P. Mitchell Weiss., "*Industrial Robotics Technology Programming and Applications*", Pearson education, 2012.
2. Wesley, E. Sryda, "*Industrial Robots: Computer interfacing and Control*" PHI, 1986.
3. Asada and Slotine, "*Robot Analysis and Control*", John Wiley and Sons, 1986.
4. *Saeed b. Niku, "Introduction to Robotics, Analysis, systems and Applications",John Wiley and Sons,2nd edition, 2011..*

IC2106	ADVANCED DIGITAL SYSTEM DESIGN	L	T	P	C
	Total Contact Hrs - 45	3	0	0	3
	Prerequisite				
	Basic Knowledge of Digital Systems				

PURPOSE	
To understand digital logic and its design and thereby develop new digital logic circuitry	
INSTRUCTIONAL OBJECTIVES	
1.	To apply previous knowledge in design of sequential logic circuits
2.	To understand the importance of Programmable logic arrays
3.	To introduce the students to FPGA

UNIT I - SEQUENTIAL LOGIC CIRCUITS (9 hours)

Mealy machine-Moore machine- Trivial/Reversible/Isomorphic sequential machines-State diagrams-State table minimization- Incompletely specified sequential machines-State assignments-Design of synchronous and asynchronous sequential logic circuits

UNIT II - SYNCHRONOUS SEQUENTIAL CIRCUIT DESIGN (9 hours)

Analysis of clocked synchronous sequential Networks CSSN - Modeling of CSSN-State table assignment and reduction - Design of CSSN-Design of iterative circuits-ASM Chart- ASM Realization

UNIT III - ASYNCHRONOUS SEQUENTIAL CIRCUIT DESIGN (9 hours)

Analysis of Asynchronous sequential Circuits ASC-Flow table reduction -Races in ASC State assignment Problem and the Transition table-Design of ASC-Static and Dynamic hazards-Data synchronizers-Designing of Vending machine controller-Mixed operating mode Asynchronous circuits.

UNIT IV - PROGRAMMABLE LOGIC DEVICES (9 hours)

Basic concepts, programming technologies-Programmable Logic elementPLE-Programmable Logic ArrayPLA-Programmable Array LogicPAL-Structure of standard PLD's-Complex PLD'sCPLD-System design using PLD's-Design of combinational and sequential circuits using PLD's-Programmable PAL device using PALASM- Design of state machines

UNIT V - STUDY OF FPGA AND XILINX (9 hours)

Introduction to Field Programmable Gate Arrays-Types of FPGA –Xilinx XC3000 series- Logic Cell ArrayLCA-Configurable Logic BlocksCLB-Input/output BlockIOB-Programmable Interconnect PointPIP-Introduction to ACT2 family and Xilinx XC4000 families- Design examples

REFERENCES

1. *Thomas Floyd, " Digital Fundamentals", Pearson Education, 10th edition,2013*.
2. *Donald G. Givone, " Digital Principles and Design", Tata McGraw Hill,1st edition 2003*.
3. *John M Yarbrough, " Digital Logic Applications and Design", Thomson Learning, 2002*.
4. Nripendra N Biswas, "*Logic Design Theory*", Prentice Hall of India, 2001.
5. *Charles h Roth Jr,Larry.L.Kinney " Fundamentals Of Logic Design", Thomson Learning,7th edition 2004*.

IC2107	FUNDAMENTALS OF MEMS	L	T	P	C
	Total Contact Hrs - 45	3	0	0	3
	Prerequisite				
	Nil				

PURPOSE	
To acquire in depth knowledge in the design, fabrication and application of MEMS devices and understand the concept of microfluidics	
INSTRUCTIONAL OBJECTIVES	
1.	To introduce the students to Microsystems design
2.	To analyze the significance of Microfluidics and dynamics
3.	To educate the significant developments in fabrication techniques

UNIT I - OVERVIEW OF MEMS (9 hours)

MEMs and Microsystems – Typical MEMS and Microsystems Products – Evolution of Micro fabrication - Microsystems and Microelectronics – Multidisciplinary nature of Microsystems Design and Manufacture – Application of Microsystems in Automotive Industry – Application of Microsystems in other Industries

UNIT II - MICROFLUIDIS (9 hours)

Introduction – Micro sensors – Micro actuation – MEMS with Micro actuators – Micro actuators with mechanical Inertia – Microfluidics-Engineering Science for Microsystems Design and Fabrication : Introduction – Atomic structure of Matter – Ions and Ionization – Molecular theory of matter and Intermolecular forces – Doping of Semiconductors – Diffusion Process – Plasma Physics – Electrochemistry

UNIT III - FLUID DYNAMICS AND DESIGN (9 hours)

Introduction – Static Bending of Thin Plates - Thermo fluid Engineering and Microsystems Design: Introduction – Overview of basics of fluid mechanics at macro and Mesoscales – Basic equation in Continuum fluid Dynamics – Laminar Fluid flow in Circular Conduits – Computational Fluid Dynamics – Incompressible Fluid flow - Micro conduits – overview of Heat Conduction in Solids – Heat Conduction in Multilayered Thin Films – Heat Conduction in Solids at Sub micrometer

UNIT IV - MICROFABRICATION (9 hours)

Introduction – Photolithography – Ion Implantation – Diffusion – Oxidation – Chemical Vapor Deposition - Physical Vapor Deposition: Sputtering – Deposition by Epitaxy – Etching – Summary of Micro fabrication

UNIT V - PACKAGING (9 hours)

Introduction – Bulk Micro manufacturing – Surface Micromachining – LIGA process – Summary of Micro manufacturing :Microsystems Design: Introduction – Design Considerations – Process Design – Mechanical Design - Mechanical Design using finite element method – Design of Silicon Die of a Micro pressure sensor – Design of Micro fluidic Network systems – Computer Aided Design

REFERENCES

1. Tai-Ran Hsu, "*MEMS and MICROSYSTEMS*", John Wiley & Sons, New Jersey, 2008.
2. Chang Liu, "*Foundation of MEMS*", Pearson EducationIllinois ECE series, 2006.
3. *M Madou, "Fundamentals of Micro Fabrication", CRC Press, 2nd Edition2011*.
4. Stephen .D. Senturia, "*Microsystems design*", Springer, 2000.
5. *"Principles Of Microelectromechanical Systems" KI Bang Lee Wiley, IEEE press, 2011.*

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IC2108	ROBUST CONTROL	L	T	P	C
	Total Contact Hrs - 45	3	0	0	3
	Prerequisite				
	Nil				

PURPOSE	
To understand the concept of robustness in control systems and help the students in absorbing effective controller design criteria	
INSTRUCTIONAL OBJECTIVES	
1.	To understand the concept of robustness
2.	To educate the design methodologies involved
3.	To analyze the case studies involving robust control

UNIT I - INTRODUCTION (9 hours)

Introduction- measure of robustness –robustness in stability and performance- plant uncertainty model- robustness of sampled data control system

UNIT II - ANALYSIS OF SYSTEMS (9 hours)

Analysis of robustness-stability analysis - gamma stability-testing sets - Kharitonov's theorem –stability radius- Problems

UNIT III - SYSTEM DESIGN (9 hours)

Design of robust control system –root locus method-frequency response method-ITAE method –robust IMC system –Pseudo-quantitative feedback theory based robust controller- Problems

UNIT IV - METHODOLGY (9 hours)

Robust control design using H S methods – HS control for linear and non-linear systems-Problems

UNIT V - APPLICATIONS (9 hours)

Robust control for constrained systems –integral quadratic constraints and weighted quadratic constraints for linear systems – non-linear system with constraints – case study.

REFERENCES

1. R.D.Colgren, "*Applications of Robust Control to Non linear systems*", AIAA, 2004.
2. M.S.Mahmoud, "*Robust control and filtering for time delay systems*", Marcel Dekker, 2000.
3. L.R.Petersen, V.A.Ugrinovskii, A.V.Savkin, "*Robust control design using HS methods*", Springer –London, 1993.
4. C.I.Byrnes, "*Modeling, Identification and Robust control*", Crafts & Habbies, 1986.
5. *Richard C.Dorf,Robert Bishop, "Modern control systems" , Pearson education, 12th Edition,2011.*
6. *Auckerman , "Robust control parameter space approach" Springer 2002.*
7. *R. D. Colgren, "Applications of Robust Control to Nonlinear Systems", AIAA, 2004.*

IC2109	EMBEDDED INSTRUMENTATION SYSTEMS	L	T	P	C
	Total Contact Hrs - 45	3	0	0	3
	Prerequisite				
	Nil				
PURPOSE					
To equip the students with relevant knowledge about Real-Time Operating System RTOS, concepts which is a multitasking operating system intended for real-time applications					
INSTRUCTIONAL OBJECTIVES					
1.	To apply adequate knowledge in Real time systems				

2.	To expose the students to debugging concepts in RTOS
3.	To understand different applications of Real time systems in the navigation, communication purposes

UNIT I - INTRODUCTION (9 hours)

System evolution trends – basic real time concepts – real time design- Microcontrollers Architecture – instruction set – interrupt handling – integrating system – examples – the shared data problem – software architecture.

UNIT II - REAL TIME OPERATING SYSTEMS RTOS (9 hours)

Real time specifications – real time kernels – inter-task communications and synchronizations– real time memory management.

UNIT III - SYSTEM PERFORMANCE, ANALYSIS AND OPTIMIZATION (9 hours)

Response – time calculation – interrupt latency – time loading and its measurement – scheduling – reducing response times and time loading – analysis of memory requirements – reducing memory loading – input – output performance.

UNIT IV - DEBUGGING TECHNIQUES AND DEVELOPMENT TOOLS (9 hours)

Faults- failures- bugs and effects – reliability – testing – fault tolerance – host and target machines – linker - locators for embedded software – getting embedded software into a target system.

UNIT V - REAL TIME APPLICATIONS (9 hours)

Real time system as complex systems – real time databases – real time image processing – real time UNIX – building real time applications with real time programming languages-An example-Tank monitoring system

REFERENCES

1. Philip A. Laplante, "*Real Time Systems Design and Analysis: an Engineer's Handbook*", PHI, New Delhi, Second Edition, 2005.
2. David E. Simon, "*An Embedded Software Primer*", Addison Wesley, New Delhi, 2005.
3. Raj Kamal, "*Embedded Systems*", Tata McGraw Hill, 2nd Edition, 2008.

IC2110	ADVANCED SOFT COMPUTING	L	T	P	C
	Total Contact Hrs - 45	3	0	0	3
	Prerequisite				
	Basic Knowledge of Neural Networks				
PURPOSE					
To acquire basic knowledge of Neural Architectures, Algorithms, fuzzy and genetic controllers as applicable to real time					
INSTRUCTIONAL OBJECTIVES					
1.	To Introduce the students to neural algorithms and BPN problems				
2.	To emphasize the importance and practical applications to fuzzy logic controllers				
3.	To appreciate the importance of genetic algorithms				

UNIT I - INTRODUCTION (9 hours)

Basic concepts – Supervised and Unsupervised learning- Single layer perception – Multilayer Perception — Back Propagation networks – Kohonen self organizing networks – Hopfield network – Radial Basis Function Networks –Adaptive Resonance Theory- Problems

UNIT II - FUZZY CONTROL (9 hours)

Fuzzy sets- Fuzzy reasoning – Fuzzy matrices – Fuzzy functions – Decomposition - Fuzzy automata and languages – Fuzzy control methods – Fuzzy decision making- Fuzzification and defuzzification

UNIT III - NEURO FUZZY MODELLING (9 hours)

Adaptive networks based Fuzzy interface systems – Classification and Regression Trees – Data clustering algorithms – Rule based structure identification – Neuro–Fuzzy Controls – Simulated Annealing – Evolutionary Computation- Problems

UNIT IV - GENETIC ALGORITHM (9 hours)

Derivative-based Optimization – Descent Methods – The Method of steepest Descent – Classical Newton's Method – Step Size Determination – Derivative-free Optimization – Genetic Algorithms – Simulated Annealing – Random Search – Downhill Simplex Search

UNIT V - APPLICATIONS (9 hours)

Printed Character Recognition – Inverse Kinematics Problems – Automobile Fuel Efficiency prediction – Soft Computing for Color Recipe Prediction.

REFERENCES
1. *Jang J.S.R, Sun C.T and Mizutani. E" Neuro-Fuzzy and Soft Computing", Pearson education,2004*.
2. *Timothy J. Ross," Fuzzy Logic with Engineering Applications", Johnwiley and sons, 3rd edition 2010*.
3. *Lauren Fausett, " Fundementals of Neural Networks",Pearson education 2008*.
4. George. J Klir and Bo Yuan, "*Fuzzy Sets and Fuzzy Logic*", Prentice Hall, USA 1995.
5. *D.E. Goldberg, "Genetic Algorithms: In Search, Optimization and Machine Learning", Pearson Education, Fourth Edition,2009*.

IC2111	PROCESS MODELLING AND SIMULATION	L	T	P	C
	Total Contact Hrs - 45	3	0	0	3
	Prerequisite				
	Basic Knowledge of Process Control and MATLAB				
PURPOSE					
To study about the process identification techniques and apply the knowledge in designing control systems					
INSTRUCTIONAL OBJECTIVES					
1.	To understand the dynamics of linear and non linear systems				
2.	To study about process identification and modeling				
3.	To perform the simulation in MATLAB software				

UNIT I - PROCESS MODELLING (9 hours)

Discrete time system models for control- ARX models-ARMAX models- NARMAX models – Hammerstein models-Wiener model- Linear and Non Linear model structure selection - Mathematical modeling of dynamic system – modeling state space – state space models – canonical state space forms- mechanical systems –Electrical systems – Liquid level systems- Thermal systems – input and output models- transfer functions-linear parametric models – bilinear parametric models.

UNIT II - NONLINEAR SYSTEMS (9 hours)

Model for time varying and nonlinear systems – linear time varying models – nonlinear model as linear regressions– nonlinear state space model. Linearization of nonlinear models – single variable –one state variable and one input variable – linearization of multi state models – interpretation of linearization.

UNIT III - PROCESS IDENTIFICATION (9 hours)

Process Identifications – An empirical models building procedure – Process reaction curve –First Order and Second Order Process with and without dead time statistical model identification

UNIT IV - PROCESS IDENTIFICATION METHODS (9 hours)

least square method – recursive least square – extended least square – output error with extended prediction model – generalized least square – selection of pseudo random binary sequence – model order selection – a practical approach for model order selection – direct order estimation from data- process identification by frequency response technique.

UNIT V - MATLAB SIMULATION (9 hours)

MATLAB- numerical solution – Runge-kutta method - Adam Bass worth Technique-solution of ordinary differential equations – simulation of first order, second order and lead – lag transfer functions – MATLAB routine for step and impulse response-Development of dynamic model, state space model, and Laplace domain model of CSTR using MATLAB.

REFERENCES

1. Wayne Becquette, "*Process control modeling and simulation*", Pearson international studies, 2003.
2. Amiya K. Jana, "*Chemical process modeling and computer simulation*", Second edition, PHI, 2011.
3. O.Nelles, "*Non linear system identification*" Springer-Verlag Berlin Heidelberg, 2001.
4. *Fouwad Giri, Way Bai, "Block oriented Non linear system identification", Springer, 2013*
5. *Stephen Billings, "Nonlinear System Identification: NARMAX Methods in the Time, Frequency, and Spatio Temporal domains" Wiley & Sons, 2013*

IC2112	MULTIVARIABLE CONTROL	L	T	P	C
	Total Contact Hrs - 45	3	0	0	3
	Prerequisite				
	Nil				
PURPOSE					
To understand the importance of multivariable control concepts and analyze the non linearity in real time control situations					
INSTRUCTIONAL OBJECTIVES					
1.	To appreciate the analysis of multivariable systems				

2.	To apply the knowledge in control of multivariable systems
3.	To analyze different application and case studies

UNIT I - MULTIVARIABLE SYSTEMS (9 hours)

Multivariable Systems – Transfer Matrix Representation – State Space Representation –Poles and Zeros of MIMO System - Multivariable frequency response analysis -Directions in multivariable systems - Singular value decomposition

UNIT II - MULTI-LOOP REGULATORY CONTROL (9 hours)

Multi-loop Control - Introduction – Process Interaction – Pairing of Inputs and Outputs -The Relative Gain Array RGA – Properties and Application of RGA - Multi-loop PID Controller – Biggest Log Modulus Tuning Method - Decoupling Control – LQG Control –RGA for Non-square Plant

UNIT III - MULTIVARIABLE REGULATORY CONTROL (9 hours)

Introduction to Multivariable control –Multivariable PID Controller -Multivariable IMC– Multivariable Dynamic Matrix Controller -Multivariable Model Predictive Control – Generalized Predictive Controller – Multiple Model based Predictive Controller – Constrained Model Predictive Controller - Implementation Issues

UNIT IV - CONTROL OF TIME-VARYING AND NONLINEAR SYSTEMS (9 hours)

Models for Time-varying and Nonlinear systems – Input signal design for Identification –Real-time parameter estimation - Types of Adaptive Control - Gain scheduling – Adaptive Control - Deterministic Self-tuning Controller and Model Reference Adaptive Controller – Nonlinear PID Controller - Control of Hammerstein and Wiener Systems

UNIT V - CASE STUDIES (9 hours)

Control Schemes for Distillation Column, CSTR and Bioreactor, Three-tank hybrid system, Four-tank system, pH, and polymerization reactor

REFERENCES

1. Bequette B.W., "*Process Control Modeling, Design and Simulation*", PHI, 2004.
2. Stephanopoulos G., "*Chemical Process Control - An Introduction to Theory and Practice*", PHI, 2005.
3. Seborg D.E., Edgar, T.F. and Mellichamp, D.A., "*Process Dynamics and Control*", Wiley John and Sons, 2nd Edition, 2003.
4. Coughanowr D.R., "*Process Systems Analysis and Control*", McGraw Hill International edition, 2004.
5. Ikonen E. and Najim K, "*Advanced Process Identification and Control*", Marcel Dekker, 2002.
6. *Stephen LeBlanc, Coughanowr, D.R., "Process Systems Analysis and Control",*

McGraw Hill International edition, 2008.

7. *Eduardo F. Camacho, Carlos Bordons, Model Predictive Control, Springer, Second edition,2007*

ICR2113	ADVANCED INSTRUMENTATION SYSTEMS	L	T	P	C
	Total Contact Hrs - 45	3	0	0	3
	Prerequisite				
	Basic Knowledge of Industrial Instrumentation				

PURPOSE	
To understand the importance of instrumentation in process industries and to appreciate the functions and applications of smart instruments	
INSTRUCTIONAL OBJECTIVES	
1.	To understand the need for industrial measurements
2.	To emphasize the need for Industrial communication
3.	To appreciate the working of Smart instruments

UNIT I - INDUSTRIAL INSTRUMENTATION (12 hours)

Pressure measurement – Passive and active electrical pressure transducers- Principles of piezo electric manometers-Measurement of low pressure -Ionization gauge-McLeod gauge- radioactive vacuum gauge-High pressure measurement using air-pressure balance method-Dynamic accuracy of pressure measuring systems- Temperature measurement – Thermal expansion methods- thermoelectric sensors- electrical resistance sensors- digital thermometer-radiation thermometer-Dynamic response of temperature sensors

UNIT II - OPTIC AND LASER INSTRUMENTATION (12 hours)

Fiber optic sensors -Intrinsic & extrinsic type -Characteristics and laser generation- Types of lasers- Laser for measurement of distance and length – velocity - acceleration – Calculation of power requirements of laser for material processing

UNIT III - INDUSTRIAL NETWORKS (12 hours)

PROFIBUS PA/DP/FMS and FF – Profibus - Introduction, Profibus protocol stack, Profibus

Communication model- Communication objects- System operation- Troubleshooting – Foundation field bus versus Profibus.

UNIT IV - INDUSTRIAL STANDARDS (12 hours)

RS – 232- RS – 485 - ISO-OSI model – EIA 232 interface standard – EIA 485 interface standard – EIA 422 interface standard - 20mA current loop – Serial interface converters -Modbus- Data Highway - HART Protocols

UNIT V - SMART INSTRUMENTATION (12 hours)

Introduction to Intelligent sensors – smart sensors for temperature and pressure – Smart transmitters for measurement of differential pressure, flow and temperature- self diagnosis and remote calibration features.

REFERENCES

1. Wayne Becquette, "*Process control modeling and simulation*", Pearson international studies, 2003.
2. Amiya K. Jana, "*Chemical process modeling and computer simulation*", Second edition, PHI, 2011.
3. A.S.Morris, R.Lengari, "*Measurement and Instrumentation-Theory & Application"*, Elsevier, 2011.
4. John Park, Steve Mackay, E.Wright, "*Data Communication for Instrumentation and Control*", Elsevier, 2003.

IC2114	CAD OF INSTRUMENTATION SYSTEMS	L	T	P	C
	Total Contact Hrs - 45	3	0	0	3
	Prerequisite				
	Basic Knowledge of Virtual Instrumentation				
PURPOSE					
To acquire the knowledge on architecture and design of Instrumentation systems using a PC					
INSTRUCTIONAL OBJECTIVES					
1.	To develop and design instrumentation systems using VI programming				
2.	To impart the necessity of Communication protocols				
3.	To learn different simulation software like MATHCAD, MATLAB				

UNIT I - DATA ACQUISITION AND INSTRUMENT INTERFACE (9 hours)

Programming and simulation of Building block of instrument Automation system – Signal analysis- I/O port configuration with instrument bus protocols - ADC, DAC, DIO- counters & timers- PC hardware structure- timing- interrupts- DMA- current loop, RS 232/RS485 - GPIB- USB protocols

UNIT II - VIRTUAL INSTRUMENTATION PROGRAMMING (9 hours)

Block diagram and architecture of a virtual instrument- Graphical programming in data flow- comparison with conventional programming- VIs and sub-VIs- loops and charts- arrays-clusters and graphs-case and sequence structures- formula nodes- local and global variables- string and file I/O

UNIT III - DESIGN TEST & ANALYSIS (9 hours)

Spectral estimation using Fourier Transform- power spectrum- correlation methods- Stability analysis- Fault analysis –Sampling- Data Parity and error coding checks- Synchronization testing – Watch dog timer- DMA method – Real-time Clocking -Noise - Gaussian, White analysis

UNIT IV - PC BASED INSTRUMENTATION (9 hours)

Introduction – Evolution of signal standard – HART Communication protocol – Communication modes – HART networks – control system interface – HART commands – HART field controller implementation – HART and the OSI model

UNIT V - SIMULATION OF PHYSICAL SYSTEMS (9 hours)

Simulation of linear & Non-linear models of systems- Hardware in loop simulation of Physical systems using special software-MATHCAD –MATLAB

REFERENCES

1. K. Ogatta, "*Modern control engineering*", Fourth edition, Pearson education, 2002.
2. *Bela G Liptak,"Process software and Digital networks" Instrument Engineer's handbook,Fourth edition,2012, CRC press*
3. Patrick H. Garrett, "*High performance Instrumentation and Automation*", CRC
. Press, Taylor & Francis Group, 2005
4. MATLAB/SIMULINK user manual
5. MATHCAD/VIS SIM user manual.
6. *Surekha, Sumathi, "LabVIEW based advanced Instrumentation Systems" Springer,2007*

7. Peter bloomfield, "Fourier Analysis of time series", Wiley & sons, second edition, 2004

IC2115	ADVANCED ELCTRONIC CIRCUITS	L	T	P	C
	Total Contact Hrs - 45	3	0	0	3
	Prerequisite				
	Basic Knowledge of Electronics Circuits				

PURPOSE	
To acquire in depth knowledge of active devices, op Amps and ICs and to understand the effect of noise on the performance of the amplifiers	
INSTRUCTIONAL OBJECTIVES	
1.	To analyze different transistor configurations and characteristics
2.	To acquire knowledge in MOS technology
3.	To introduce the students to non linear analog circuits

UNIT I - MODELS FOR IC ACTIVE DEVICES (9 hours)

Models for IC Active Devices: Large Signal and Small Signal Models and Behaviors for BJT- JFET and MOS. Bipolar and MOS IC Technology: Fabrication of Bipolar Integrated Circuit and MOSFET- Active Devices in Bipolar and MOS ICs

UNIT II - SINGLE TRANSISTOR AND TWO TRANSISTOR AMPLIFIERS (9 hours)

Device Model Selection for Analog Circuits- Single and Two Stage Transistor Amplifiers- Emitter Coupled Pairs- Source-Coupled JFET Pairs- Device Mismatch Effects in Differential Amplifier

UNIT III - CIRCUIT CONFIGURATION FOR LINEAR IC (9 hours)

Current Mirror- Current Sources - Analysis of Difference Amplifiers with Active Loads- Supply and Temperature Independent Biasing Techniques- Voltage References

UNIT IV - OPERATIONAL AMPLIFIER AND FREQUENCY RESPONSE (9 hours)

Analysis of Operational Amplifier Circuits- Slew Rate- Design of MOS Operational Amplifier- CMOS voltage references- MOS. Frequency Response of ICs- Signal and Multistage Amplifier Frequency Response- Frequency Response of 741 Op Amp

UNIT V - NOISE AND ITS EFFECTS (9 hours)

Analysis of Four Quadrant and Variable Transconductance Multiplier- VCO- Closed Loop Analysis of PLL- Noise in ICs: Sources of Noise- Effects of Noise-Noise Bandwidth- Circuit Noise Calculation

REFERENCES

1. Gray and Meyer, "*Analysis and Design of Analog ICs*", Wiley International, 1996.
2. Gray, Wooley, Brodersen, "*Analog MOS Integrated Circuits*", IEEE Press, 1989.
3. Kenneth R. Laker, William M.C.Sansen, "*Design of Analog Integrated Circuits and Systems*", McGraw Hill, 1994.

4. Behzad Razavi, "*Principles of Data Conversion System Design*", S. Chand Company Ltd, 2000.
5. *Grey and Meyer, "Analysis and Design of Analog ICs", Wiley International, Fourth edition,2008*

IC2116	OPTIMAL CONTROL AND FILTERING	L	T	P	C
	Total Contact Hrs - 45	3	0	0	3
	Prerequisite				
	Nil				

PURPOSE	
To acquire the knowledge about the design of various types of filters by analytical procedures	
INSTRUCTIONAL OBJECTIVES	
1.	To understand the basic concept of optimal control
2.	To analyze LQ control problems and kalman filters
3.	To understand the estimation of linear filters

UNIT I - INTRODUCTION (9 hours)

Statement of optimal control problem – Problem formulation and forms of optimal control – Selection of performance measures - Necessary conditions for optimal control – Pontryagin's minimum principle – State inequality constraints – Minimum time problem

UNIT II - LQC PROBLEMS AND DYNAMIC PROGRAMMING (9 hours)

Linear optimal regulator problem – Matrix Ricatti equation and solution method – Choice of weighting matrices – Steady state properties of optimal regulator – Linear tracking problem – LQC problem – Computational procedure for solving optimal control problems – Characteristics of dynamic programming solution – Dynamic programming application to discrete and continuous systems – Hamilton Jacobi Bellman equation

UNIT III - NUMERICAL TECHNIQUES FOR OPTIMAL CONTROL (9 hours)

Numerical solution of 2-point boundary value problem - steepest descent - Fletcher Powell method solution of Ricatti equation - negative exponential and interactive methods

UNIT IV - FILTERING AND ESTIMATION (9 hours)

Filtering – Linear system and estimation – System noise smoothing and prediction – Gauss Markov discrete time model – Estimation criteria – Minimum variance estimation – Least square estimation – Recursive estimation

UNIT V - KALMAN FILTER AND PROPERTIES (9 hours)

Filter problem and properties – Linear estimator property of Kalman Filter – Time invariance and asymptotic stability of filters – Time filtered estimates and signal to noise ratio improvement – Extended Kalman filter

REFERENCES

1. Sage, A.P., "*Optimum System Control*", Prentice Hall N.H., 1968.
2. Anderson and Moore J.B., "*Optimal Filtering*", prentice hall Inc., N.J., 1980.
3. Bozic, S.M, "*Digital and Kalman Filtering*", Edward Arnold, London, 1994.
4. Astrom, K.J., "*Introduction to Stochastic Control Theory*", Academic Press, Inc, N.Y., 1986
5. *Jason Spayer and Walter Chung, "Stochastic Processes, Estimation & Filtering", society of Industrial and Applied Mathematics, 2008*

IC2117	FAULT TOLERANT CONTROL	L	T	P	C
	Total Contact Hrs - 45	3	0	0	3
	Prerequisite				
	Nil				

PURPOSE

To acquire the basic knowledge about fault identification and educate the students to understand the importance of fault tolerant control systems

INSTRUCTIONAL OBJECTIVES

1.	To understand the basic concepts of Fault identification
2.	To learn about the implementation of FDI
3.	To appreciate different methods of FDI

UNIT I - FAULT IDENTIFICATION (9 hours)

Definition of fault - Classification and types of fault – Fault detection and Identification – Classification of fault detection and identification schemes – Model based and Model free method

UNIT II - IMPLEMENTATION FAULT IDENTIFICATION (9 hours)
Implementation of FDI approach – residual generation – residual evaluation- Problems

UNIT III - FDI METHODS (9 hours)
Quantitative model based FDI- State and parameter estimation based FDI- Parity space approach based FDI - structured residual approach-directive residual approach- statistical approach based FDI-Generalized likelihood ratio - sequential probability ratio test

UNIT IV - FAULT TOLERANT CONTROL (9 hours)
Introduction to fault tolerant control - active Fault tolerant control – passive fault tolerant control approach- Eigen structure assignment- Introduction to Neural Network and Fuzzy based fault tolerant control

UNIT V - FDI MODEL (9 hours)
Introduction to qualitative model based FDI – introduction to neural network and fuzzy based FDI.
Applications

REFERENCES

1. Gertler M., "*Fault detection in dynamic system*", Marcel Decker Inc corp. 1998.
2. Hassan Noura, Didier Thilliol, J.C.Ponsart, "Fault *tolerant control systems*", Springer, 2009.
3. M.Blanke, M.Kinnaert, J.Lunze, "*Diagnosis and Fault tolerant Control*", Springer, 2003.
4. Halim Alwi, C.P.Tan, C.Edwards, "*Fault detection and Fault tolerant control using sliding modes*", Springer, ISBN- 3642116892, 2010.
5. *Magdi S. Mahmoud, Yuanqing Xia," Analysis and Synthesis of Fault-Tolerant Control Systems", Wiley &Sons, 2013*
6. *Guillaume J. J. Ducard,"Fault-tolerant Flight Control and Guidance Systems", Springer,2009*

IC2118	DSP INTEGRATED CIRCUITS	L	T	P	C
	Total Contact Hrs - 45	3	0	0	3
	Prerequisite				
	Basic Knowledge of DSP				
PURPOSE					
To acquire in depth knowledge in DSP integrated circuitry					

INSTRUCTIONAL OBJECTIVES	
1.	To understand the significance of MOS and VLSI technology
2.	To impart knowledge in design of digital filters
3.	To acquire the concept of Integrated circuit design

UNIT I - DSP INTEGARTED CIRCUITS AND VLSI TECHNOLOGIES (9 hours)
Standard digital signal processors-Application specific IC's for DSP- DSP systems-DSP system design-Integrated circuit design-MOS transistors- MOS logic- VLSI process technologies- Trends in CMOS technologies

UNIT II - DIGITAL SIGNAL PROCESSING (9 hours)
Digital signal processing- Sampling of analog signals-Selection of sample frequency-Signal- processing systems- Frequency response- Transfer functions-Signal flow graphs- Filter structures, Adaptive DSP algorithms- DFT- FFT- Image coding-Discrete cosine transforms.

UNIT III - DIGITAL FILTERS AND FINITE WORD LENGTH EFFECTS (9 hours)
FIR filters-FIR filter structures- FIR chips- IIR filters- Specifications of IIR filters-Mapping of analog transfer functions- Mapping of analog filter structures-Multirate systems- Interpolation with an integer factor L-Sampling rate change with a ratio L/M-Multirate filters- Finite word length effects -Parasitic oscillations- Scaling of signal levels

UNIT IV - SYNTHESIS OF DSP ARCHITECTURES (9 hours)
DSP system architectures- Standard DSP architecture-Ideal DSP architectures-Multiprocessors and multicomputer- Systolic and Wave front arrays- Shared memory architectures-Mapping of DSP algorithms onto hardware- Implementation based on complex PEs-Shared memory architecture with Bit – serial PEs.

UNIT V - ARITHMETIC UNITS AND INTEGRATED CIRCUIT DESIGN (9 hours)
Conventional number system- Redundant Number system- Residue Number System-Bit-parallel and Bit-Serial arithmetic-Basic shift accumulator-Reducing the memory size- Complex multipliers, Improved shift-accumulator- Layout of VLSI circuits- FFT processor- DCT processor and Interpolator as case studies- Cordic algorithm.

REFERENCES

1. Lars Wanhammer, "*DSP Integrated Circuits*", Academic press, New York, 1999.
2. A.V.Oppenheim et.al, "*Discrete-time Signal Processing*", Pearson Education, 2000.
3. Emmanuel C. Ifeachor, Barrie W. Jervis, "*Digital signal processing – A practical approach*", Second Edition, Pearson Education, Asia.

4. Keshab K.Parhi, "*VLSI Digital Signal Processing Systems design and Implementation*", John Wiley & Sons, 1999.
5. Marković, Dejan, Brodersen, Robert W," DSP Architectures and Design Essentials", Springer, 2012.

IC2119	TRANSDUCERS AND SMART INSTRUMENTS	L	T	P	C
	Total Contact Hrs - 45	3	0	0	3
	Prerequisite				
	Nil				
PURPOSE					
To acquire the knowledge about the various types transducers and smart instruments					
INSTRUCTIONAL OBJECTIVES					
1.	To understand the basic concept conventional transducers and its characteristics				
2.	To understand the concepts and applications of smart sensors				
3.	To understand the smart instruments in micro scale and its applications				

UNIT I - OVERVIEW OF CONVENTIONAL TRANSDUCERS AND ITS CHARACTERISTICS

Overview of conventional sensors and Transducers – Difference between Sensor and Transducer – Classification of Sensors – Introduction of Resistive, Capacitive , Inductive types of sensors – Static and Dynamic characteristics – Capacitive transducers – LVDT – Strain Gauges

UNIT II – PIEZOELECTRIC AND OPTICAL TRANSDUCER

Piezoelectric transducer – IC sensors – Piezo –resistive sensors, Photoelectric ,Hall effect- Optical transducer- Principles- types and characteristics of fibres – fibre optic transducers for the measurement of force, temperature, flow and Pressure

UNIT III – SMART SENSORS

Definition of Smart Instruments – General block diagram of Smart sensors - Integrated smart sensors - Interface electronics – Self diagnosis and Remote calibration features – Data communication in industries using smart sensors – Temperature and Flow measurement using Smart sensors

UNIT IV – SMART INSTRUMENTS IN MICRO SCALE

Brief introduction to MEMS technology – MEMS for smart measurement systems – MEMS Pressure sensors – Piezo resistive and capacitive sensors – Micro sensors for bio medical applications – Micro Actuators

UNIT V – SENSOR APPLICATIONS

Application of smart sensors for weather monitoring system – Distance measurement using Smart sensors (Ultrasonic and IR) – Practical implementation of above two applications – Smart sensor applications in Robotics

REFERENCES

1. John G Webster , Measurement , Instrumentation and Sensors Handbook , CRC press IEEE press,1998
2. Patranabis D, Sensors and Transducers, PHI Learning,2006
3. A.K. Ghosh , Introduction to Measurement and Instrumentation , PHI Learning,3rd Edition.
4. J.P. Bentley , Principles of Measurement Systems , Pearson Education, 3rd Edition.
5. Gerord C.M. Meijer, Smart Sensor Systems, John Wiley and Sons,2008
6. Tai-Ran Hsu, Mems and Micro Systems: Design and Manufacture, Tata McGraw Hill ,2002
7. Keiser. G , "Optical Fibre Communication" Tata McGraw Hill Education,5 th Edition.2013

SEMESTER I

CAC2001	**Career Advancement Course For Engineers - I**	L	T	P	C
	Total Contact Hours - 30	**1**	**0**	**1**	**1**
	Prerequisite				
	Nil				
PURPOSE					
To enhance holistic development of students and improve their employability skills					

INSTRUCTIONAL OBJECTIVES

1. To improve aptitude, problem solving skills and reasoning ability of the student.
2. To collectively solve problems in teams & group.
3. Understand the importance of verbal and written communication in the workplace

4. Understand the significance of oral presentations, and when they may be used.
5. Practice verbal communication by making a technical presentation to the class
6. Develop time management Skills

UNIT I–BASIC NUMERACY

- Types and Properties of Numbers, LCM, GCD, Fractions and decimals, Surds

UNIT II-ARITHMETIC – I

- Percentages, Profit & Loss, Equations

UNIT III-REASONING - I

- Logical Reasoning

UNIT IV-SOFT SKILLS - I

- Presentation skills, E-mail Etiquette

UNIT V-SOFT SKILLS - II

- Goal Setting and Prioritizing

ASSESSMENT

Soft Skills (Internal)
Assessment of presentation and writing skills.

Quantitative Aptitude (External)
Objective Questions- 60 marks
Descriptive case lets- 40 marks*
Duration: 3 hours
*****Engineering problems will be given as descriptive case lets.

REFERENCE:

1. Quantitative Aptitude by Dinesh Khattar – Pearsons Publicaitons
2. Quantitative Aptitude and Reasoning by RV Praveen – EEE Publications
3. Quantitative Aptitude by Abijith Guha – TATA Mc GRAW Hill Publications

4. Soft Skills for Everyone by Jeff Butterfield – Cengage Learning India Private Limited
5. Six Thinking Hats is a book by Edward de Bono - Little Brown and Company
6. IBPS PO - CWE Success Master by Arihant - Arihant Publications(I) Pvt.Ltd – Meerut

SEMESTER II

CAC2002	**Career Advancement Course For Engineers - II**	L	T	P	C
	Total Contact Hours - 30	**1**	**0**	**1**	**1**
	Prerequisite				
	Nil				
PURPOSE					
To enhance holistic development of students and improve their employability skills					

INSTRUCTIONAL OBJECTIVES

1. To improve aptitude, problem solving skills and reasoning ability of the student.
2. To collectively solve problems in teams & group.
3. Understand the importance of verbal communication in the workplace
4. Understand the significance of oral presentations, and when they may be used.
5. Understand the fundamentals of listening and how one can present in a group discussion
6. Prepare or update resume according to the tips presented in class.

UNIT I-ARITHMETIC – II

- Ratios & Proportions, Mixtures & Solutions

UNIT II - MODERN MATHEMATICS

- Sets & Functions, Data Interpretation, Data Sufficiency

UNIT III – REASONING - II

- Analytical Reasoning

UNIT IV – COMMUNICATION - I

- Group discussion, Personal interview

UNIT V - COMMUNICATION - II

- Verbal Reasoning test papers

ASSESSMENT

Communication (Internal)

- Individuals are put through formal GD and personal interviews.
- Comprehensive assessment of individuals' performance in GD & PI will be carried out.

Quantitative Aptitude (External)

Objective Questions- 60 marks (30 Verbal +30 Quants)
Descriptive case lets- 40 marks*
Duration: 3 hours
*Engineering problems will be given as descriptive case lets.

REFERENCES

1. Quantitative Aptitude by Dinesh Khattar – Pearsons Publicaitons
2. Quantitative Aptitude and Reasoning by RV Praveen – EEE Publications
3. Quantitative Aptitude by Abijith Guha – TATA Mc GRAW Hill Publications
4. General English for Competitive Examination by A.P. Bharadwaj – Pearson Educaiton
5. English for Competitive Examination by Showick Thorpe - Pearson Educaiton
6. IBPS PO - CWE Success Master by Arihant - Arihant Publications(I) Pvt.Ltd - Meerut
7. Verbal Ability for CAT by Sujith Kumar - Pearson India
8. Verbal Ability & Reading Comprehension by Arun Sharma - Tata McGraw - Hill Education

SEMESTER III

CAC2003	**Career Advancement Course For Engineers - III**	L	T	P	C
	Total Contact Hours - 30	**1**	**0**	**1**	**1**
	Prerequisite				

	Nil				
PURPOSE					
To develop professional skills abreast with contemporary teaching learning methodologies					
INSTRUCTIONAL OBJECTIVES **At the end of the course the student will be able to**					
1	acquire knowledge on planning, preparing and designing a learning program				
2	prepare effective learning resources for active practice sessions				
3	facilitate active learning with new methodologies and approaches				
4	create balanced assessment tools				
5	hone teaching skills for further enrichment				

UNIT I- DESIGN **(2 hrs)**

- Planning &Preparing a learning program.
- Planning & Preparing a learning session

UNIT II – PRACTICE **(2 hrs)**

- Facilitating active learning
- Engaging learners

UNIT III – ASSESSMENT **(2 hrs)**

- Assessing learner's progress
- Assessing learner's achievement

UNIT IV – HANDS ON TRAINING **(10 hrs)**

- Group activities – designing learning session
- Designing teaching learning resources
- Designing assessment tools
- Mock teaching session

UNIT V – TEACHING IN ACTION **(14 hrs)**

- Live teaching sessions
- Assessments

ASSESSMENT (Internal)

Weightage:

Design - 40%
Practice – 40%
Quiz – 10%
Assessment – 10%

REFERENCES

Cambridge International Diploma for Teachers and Trainers Text book by Ian Barker - Foundation books
Whitehead, Creating a Living Educational Theory from Questions of the kind: How do I improve my Practice? Cambridge J. of Education