BHARATH UNIVERSITY
DEPARTMENT OF ELECTRONICS & INSTRUMENTATION ENGINEERING
M.Tech-INSTRUMENTATION &CONTROL ENGINEERING (FULL-TIME)
CURRICULUM & SYLLABI-2015
(4 SEMESTER PROGRAMME) w.e.f 2015-2016

SEMESTER -I

Sl. No.	Sub Code	Subject Title	L	T	P	C
1	MMA101	APPLIED MATHEMATICS	3	1	0	4
2	MEI101	TRANSDUCER ENGINEERING	3	0	0	3
3	MEI102	DIGITAL SIGNAL PROCESSING	3	0	0	3
4	MEI103	PROCESS DYNAMICS & CONTROL	3	0	0	3
5	MEI104	INDUSTRIAL INSTRUMENTATION 1	3	0	0	3
6	MEI105	ADVANCED CONTROL THEORY	3	0	0	3
		Total Contact Hours – 19				19

SEMESTER -II

Sl. No.	Sub Code	Subject Title	L	T	P	C
1	MEI201	INDUSTRIAL INSTRUMENTATION II	3	0	0	3
2	MEI202	COMPUTER CONTROL OF PROCESS	3	0	0	3
3	MEI203	NETWORKS AND DISTRIBUTED CONTROL SYSTEM	3	0	0	3
4	MEI2E1	ELECTIVE 1	3	0	0	3
5	MEI2E2	ELECTIVE 2	3	0	0	3
6	MEI2E3	ELECTIVE 3	3	0	0	3
PRACTICAL						
7	MEI2L1	COMPUTER CONTROL PROCESSES LAB	0	0	4	2
		Total Contact Hours – 22				20

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SEMESTER III

Sl.No.	SubCode	Subject name	L	T	P	C
1	MEI301	PERSONAL COMPUTER & INSTRUMENTATION	3	0	0	3
2	MEI302	DIGITAL INSTRUMENTATION	3	0	0	3
3	MEI3E4	ELECTIVE 4	3	0	0	3
4	MEI3P1	PROJECT WORK PHASE I	0	0	12	6
Total Contact Hours – 21						**15**

SEMESTER IV

Sl. No.	Sub Code	Subject Title	L	T	P	C
1	MEI4P2	PROJECT WORK PHASE II	0	0	24	12
		Total Contact Hours – 24				**12**

Total credits for the programme

Semester	Total Contact Hours	Total Credits
I	19	19
II	22	20
III	21	15
IV	24	12

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Credits in I – IV Semesters = 66
Total Contact Hours = 86

LIST OF ELECTIVES

Sub Code	Subject Title	L	T	P	C
MEI001	1. PARAMETER IDENTIFICATION AND ADAPTIVE CONTROL	3	0	0	3
MEI 002	2. NEURAL NETWORK & FUZZY LOGIC CONTROL	3	0	0	3
MEI003	3. BIOMEDICAL INSTRUMENTATION	3	0	0	3
MEI 004	4. ROBOTICS & AUTOMATION	3	0	0	3
MEI005	5. ANALYTICAL INSTRUMENTATION	3	0	0	3
MEI 006	6. INSTRUMENTATION & CONTROL IN PETROCHEMICAL INDUSTRY	3	0	0	3
MEI 007	7. MICROCONTROLLER BASED SYSTEM DESIGN	3	0	0	3
MEI 008	8. FIBEROPTICS & LASER INSTRUMETNATION	3	0	0	3
MEI 009	9. DIGITAL IMAGE PROCESSING	3	0	0	3
MEI 010	10. POWER ELECTRONICS	3	0	0	3
MEI 011	11. POWER PLANT INSTRUMENTATION	3	0	0	3
MEI012	12. ARTIFICIAL AND INTELLIGENCE AND EXPERT SYSTEM	3	0	0	3

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SEMESTER-I

MMA101 APPLIED MATHEMATICS 3 1 0 4

UNIT I
ADVANCED MATRIX THEORY 12
Eigen values using QR transformations genralized eigen vectors – canonical forms, singular valued composition and application – matrix norms and induced norms pseudo inverse – least square approximations.

UNIT II
CALCULUS OF VARIATIONS 12
Variation and its properties – Euler's Equation – Functional dependent on first and higher order derivatives. Functional dependent on functions of several independent variables – constraints in the form of a functional isompetric problems – Direct method – Ritz and Kantorovich methods – Boundary value problems.

UNIT III
SPECIAL FUNCTIONS 12
Series solutions – Bessel's equations – Bessel fuctions – Recurrence relationsa generating functions and orthogonal of Bessel's functions of the first kind Legendary's equations, Legendary polynomials – Rodriguez'sformula applications to boundary value problems

UNIT IV
PROBABILITY 12
Probability concepts- Random variable Discrete andc ontinous dissimulations –Correlations – partial,multiple, rank analysis of variance on way, two way process.

UNIT V
RANDOM PROCESS 12
Poisson process, Gausian Process, Markov Process – Anti Correlations – Cross Correlations – Queuing models – quality control – control charts – tolerance limits.
60

References:

1. Sankar Rao K.,Introduction to Partial Differential Equations, Prentice Hall of

India. New Delhi. 1995

2. Elsgoth, Differential Eqations and Calculus of variations, MIR Publishers, Moscow.
3. Gruwal B.S., Higher Engineering Mathematics ,Khanna Publications, New Delhi. 1989
4. Andrews LA, Special Function of Scientist and Engineers.

MEI 101 TRANSDUCER ENGINEERING 3 0 0 3

UNIT I
SCIENCE OF MEASUREMENT 9

Unit and standards-calibration methods-static calibration-classification of errors-error analysis – statistical methods – odds and uncertainty, problem based on this approach.

UNIT II
CHARACTERISTICS OF TRANSDUCERS 9

Static characteristics – accuracy, precision, sensitivity, linearity etc. – mathematical model of transducers – zero, first – order and second – order transducers – response to impulse step ramp and sinusoidal inputs with simple application.

UNIT III
VARIABLE RESISTANCE TRANSDUCERS 9

Principle of operation, construction details, characteristics and applications of resistance potentiometers, strain gauges, resistance thermometers, thermistors, hot-wire anemometer, piezoresistive sensors and humidity sensors.

UNIT IV 9
VARIABLE INDUCTANCE AND VARIABLE CAPACITANCE TRANSDUCERS

Induction potentiometer-variable reluctance transducers,EI pickup,LVDT,capacitor transducers-variable air gap type-variable area type-variable permittivity type – capacitor microphone-industrial application.

UNIIT V
OTHER TRANSDUCERS 9

Piezotectric transducer – magnetostrictive transducer & magneto resistance transducer – IC. Sensor,Hall effect transducer, digital transducers – smart sensor & its application – fiber optic transducers. Introduction to hart and field bus protocol.

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Text Books:

1. Renganathan.S., Transducer Engineering, Allied Publisheers, Chennai 1999.

References:

1. Doebelin,5.0., Measurement Systems,McGraw Hill Hill Book Co.,1998
2. Neubert, H.K.P. Instrument Transducers, Clarendon Press, Oxford, 1988.
3. Patranabis, D, Sensors and Transducers, Wheeler Publishing Co., Ltd. New Delhi, 1997.
4. A.K.sawhney, A course in Electrical and Electronic measurement & instrumentation,Dhanpatrai & sons 1982.

MEI 102 DIGITAL SIGNAL PROCESSING 3 0 0 3

UNIT I
DISCRETE TIME SIGNALS AND SYSTEMS 9
Periodic and pulse signals - examples of sequences - pulse step, impulse, ramp, sine and exponential - differential equations - linear time invariant - stability, causality - DT systems time domain analysis.

UNIT II
Z-TRANSFORM 9
Z-transform and its properties - convolution - inverse Z-transform - discrete Fourier series - properties - sampling the Z-transform - discrete Fourier transform - properties for frequency domain analysis - linear convolution using discrete Fourier transform - overlap add method, overlap save method.

UNIT III
FAST FOURIER TRANSFORM (FFT) 9
Introduction to Radix 2 FFT's - decimation in time FFT algorithm - decimation in frequency FFT algorithm - computing inverse DFT using FFT –Introduction to Radix 4 FFT algorithm – decimation in time FFT Algorithm-decimation in frequency FFT algorithm.

UNIT IV
IIR AND FIR FILTER DESIGN 9
Classification - reliability constrains - IIR design - bilinear transform method - impulse invariant method - step invariance method - FIR design - Fourier series method - window function method**.**triangular window,rectangular window,hamming window,hanning window,keiser window.

UNIT V
PROGRAMMABLE DSP CHIPS 9
Architecture and features of TMS, 320C, 240 and ADSP 2181 signal processing chips.introduction to stenography- image processing.

Text Books:

1. Oppenheim A.V., and Shaefer R.W., Discrete Time Signal Processing, Prentice Hall, New Delhi , 1980.
2. Proakis J.G. and Manolakis, D.G., Introduction to Digital Signal Processing, Maxwell Macwilliam International Edition, London, 1989.

References:

1.Antonian A., Digital Filters analysis and Design, Tata McGraw Hill Publishing Co., New Delhi, 198.

2. Stanley W.D., Digital Signal Processing, Restion Publishing House, 1989.

MEI103 PROCESS DYNAMICS & CONTROL 3 0 0 3

UNIT I INTRODUCTION 9

Dynamic Response of simple temperature, Pressure, Flow & level process- study of interacting and non interacting systems– continuous and batch process – self-regulation – servo and regulator operation, Degree of freedom and calculation based on simple process.

UNIT II CONTROL ACTIONS AND CONTROLLERS 9

Characteristics of on-off, proportional, single-speed floating, integral and derivative control modes, study of composite control modes-Response of controllers for different types of test inputs- selection of control modes for different applications- Feed forward control – ratio control – cascade control – inferential control – split range control –multivariable control.

UNIT III OPTIMUM CONTROLLER SETTINGS 9

Various controller tuning based on continuous cycling method. process reaction curve method – Ziegler Nichols method & modified tuning method. Introduction to various performance criteria-ISE, IAE, ISTE, IATE etc,. Frequency response & tuning of controllers.

UNIT IV FINAL CONTROL ELEMENT 9

I/P&P/I converters – pneumatic, electric & hydraulic actuators, valve positioners – characteristics of control valves – Different types of valves - control valve sizing – cavitation and flashing in control valves.

UNIT V INSTRUMENTATION IN CONTROL SYSTEM 9

Introduction to adaptive & robust controllers – study of different controller operations in distillation columns, heat exchanger & steam piping instrumentation diagram of various control loops.

Text books

1. Stephanopoulis, G, Chemical Process Control, Prentice Hall of India, New Delhi, 1990
2. Eckman. D.P., Automatic Process Control, Wiley Eastern Ltd., New Delhi, 1993

References:

1. Pollard A. Process Control, Heinemann educational books, London, 1971
2. .Harriott. P., Process Control, Tata McGraw-Hill Publishing Co., New Delhi, 1991

MEI104 INDUSTRIAL INSTRUMENTATION – I 3 0 0 3

UNIT I 12
NON ELECTRICAL METHODS OF TEMPERATURE MEASUREMENT
Primary & Secondary standard for calibration of temperature Measuring devices – Different types of filled system thermometers – Source of error & the compensation Methods – Installation & maintenance of filled system thermometers – Construction & Characteristics of Bimetallic thermometers-overall comparison between the temperature measuring Instruments.

UNIT II 12
ELECTRICAL METHODS OF TEMPERATURE MEASUREMENT
Thermocouple-Indusrial ckts-Isothermal block reference junction compensation technique-RTD 3 lead & 4 lead compensation-thermistors IC-Temperature sensors-rardiation methods-broad band band radiation thermometer-2 color radiation Thermometry-Installation of temperature measuring device special material configuration & techniques.

UNIT III 12
MEASUREMENT OF PRESSURE
Types of pressure measurement-Monmetric and Elastic type of Presure gauges-Motion balance & force balnance design using bellows & diaphragms-Bordon tubes.Bellow type & slack daphragms pressure gauge-pressure gauge using strain gauge-Capacitive,inductive & Piezo electric transducers-Carbon pile-semi conductor gauges-Vaccum pressure measurement-Pirani Gauge-Knudsen gauge anesting Macleod gauge,calibration and Testing of Pressure gauge transmitter.

UNITIV
SPEED,VELOCITY &ACCELERATION MEASUREMENT
Relative velocity-Traslational & rational velocity Measurement-Revolution counters & Timers – Magnetic & Photo electric pulse counting stroboscopic methods-Accelerometers different types-Gyroscopes.

UNIT V **12**
FORCE,TORQUE,FREQUENCY & VIBRATION MEASUREMENT
Force measurement – Different methods. Vibration Measurement – Vibration shapes Piezo electric & variable reluctance picks ups. Torque measurement mechanical, optical & Electrical methods. Frequency Measurement Oscilloscope Methods and Frequency counters.

Text Books: **60**

1. D.P. ECKMAN, Industrial Instrumentaion, Wiley Eastern Ltd., 1980
2. D. Patranabis, Principles of Industrial Instrumentation , Mc Graw Hill Publishing, co., Ltd.

References:

1.E.O. Deobelin, Measurement System & Applications, Mc Graw Hill International, 2001
B.G. Liptak,Industrument Engineering Handbook,(Measurement), Chilton book Co.,

MEI105 ADVANCED CONTROL THEORY 3 0 0 3

UNIT-1 **12**
Properties of transfer function-impulse response matrices-poles & zeroes of transfer function matrices-critical frequencies, resonance-steady state & dynamic response bandwidth-singular value. Analysis-multivariable Nyquist plots.

UNIT-2 **12**
Review to sate model for systems-state transition matrix & its properties-free and forced response-controllability & observability-kalman’s decomposition-minimal realization.

UNIT-3 **12**
State feedback and state estimators,single variable case,compensation design-design concepts-realisation of basic compensation-cascade compensation in time domain and frequency domain.

UNIT-4 **12**
Types of non-linerity-typical examples-phase plane analysis-isocline method-limit cycle-eqn.linearization-describing function-describing function analysis of simple non linear systems.

UNIT-5 **12**
Stability concepts-equilibrium points –BIBO& asymptotic stability-direct method of liapnov-variable gradient method of generating liapnov functions-application to non linear problems-krasakovski’s theorem on globle asymptotic stability of non linear systems.

60

Text Book
1.Gopal M,modern control system theory. New age international pvt.ltd,2002.

References:
1.Nagrath & Gopal, control system engineering,wiley & soms,1982.
2.Ogata K.H.,modern control engineering,pill,1982.
3.Ogata.K.H.,state space analysis of control systems,PHL,1982
4Tou.J.T.,Modern control theory, McGraw hill.

SEMESTER II

MEI201 INDUSTRIAL INTRUMENTATION-II 3 0 0 3

UNIT-1
DIFFERENTIAL PRESSURE FLOWMETER 9
D.P.Flow meter;physical properties of flow-fundamentals of flow measurements- differential pressure low meters-operating principle-different types –orifice,venture meters-installation and maintenance of flow meter.

UNIT-2
MECHANICAL TYPE FLOWMETERS 9
Mechanical type flow meter:principle of operation element of construction and application of positive displacement meters-inferential flow meter-rotameters-turbine flow meters-installation and maintenance.

UNIT-3
ELECTRICAL TYPE AND OPEN CHANNEL FLOWMETERS 9
Electrical type flow meter;principle of operation-construction application sizing-installation and maintenance of electromagnetic flow meters-ultrasonic flow meters-cross correlation flow meter-vortex shedding flow meters. Open channel flow measurement-momentum,weirs,flumes.

UNIT-4
CALIBRATION OF FLOW METERS 9
Guidelines for selection of flow meters-methods of calibration of flow meters with liquids-dynamic weighing,pipe prover method,master meters,combination of master meter and calibrator.indirect methods for calibration at high flow rates-methods of calibrating flow meters for gases-bell prover system.gravimetric system.PVT system.

UNIT-5
LEVEL MEASUREMENT 9
Float actuated device-sight glass-displacer devices-torque tube-purge system-diaphragm box type-manometer type-boiler drum level measurement-differential pressure methods-hydra step method-resistance,capacitive,nucleonic of ultrasonic type level gauges,solid level measurement-gamma ray absorption method.Ponder cone,rotating paddle wheel and slack detector-level switches.
45

Text book
1.Dr.S.Renganathan ,flow metwrs.allied publishers pvt ltd.first edition,2003.

References:
1.Flow measurement,practical guides or measurement and control.ISA Publication.1991
2.cheremixsinsoff N.P.Process flow instrumentation and control,marcal decker inc.1992

MEI 202 COMPUTER CONTROL OF PROCESS 3 0 0 3

UNIT I
COMPUTER AS A CONTROLLER 9

Building blocks of computer control system, hybrid architecture, DDC and DCS – computer based PLC building block, expert control system and heuristic control system.

UNIT II
ANALYSIS OF DISCRETE DATA SYSTEM 9
Mathrematical representation of SDCS- Z- transform and properties, modified z-transform open loop and closed loop response of SDCS- Pulse transfer function. Analysis of stability in z-domain- jury's test, schur cohn test and root locus method.

UNIT III
DESIGN OF DIGITAL CONTROLLER 9

Requirement of digital controller- deadbeat, dahlins- position and velocity form of PID controller, smith predictor algorithm- IMC controller design.

UNIT IV
MULTIVARIABLE CONTROLLER DESIGN 9
Dynamics and mathematical modeling of multivariable controller design- study of interacting effect in control loops- relative array and selection loops- designing of decoupling control-partial decoupling controller.

UNIT V
CASE STUDIES **9**
Computer application of thermal and nuclear power plant, inverted pendulum and distillation column.

45

Text book:
1. Despande P.B and ash R.H., computer process control, ISA publication, USA.1995.

Reference:
1. Frankling. G.F. and power J.D., digital control of dynamo systems, Addison Wesley publishing co., 1992.
2. Kutshiko ogata. Discrete time control system, second edition, university of Minnesota, 2001.

MEI203 NETWORKS AND DISTRIBUTED CONTROL SYSTEMS 3 0 0 3

UNIT I **9**
DATA NETWORK FUNDAMENTALS
Objects of Networks – data communication fundamentals – circuit switched – Message switched, packet switched networks – OSI reference model – ARPA; SNA and other networks

UNIT II
NETWORK STANDARDS **9**
IEEE 802, Standardization in OSI model ,IEEE 802.2 and Ethernet – IEEE Standard 8024 – Token bus – IEEE standard 802.5 – Token ring

UNIT III
DCS **9**
Evolution – Different architectures – Functional elements – Local control unit – Operator station – comparative study of Industrial DCS, Reliability factors – Redundancy – case studies.

UNIT IV
NETWORKS FOR CONTROL **9**
Requirements of communication network for control purpose – communication hierarchy – Networks – Access protocols – Topologies – OSI Layers Data Transmission in OSI layers, Fibre optic LAN – MAP and TOP

UNIT V
FIELD BUS CONTROL SYSTEM **9**

Overview aspects and benefits – smart transmitters – Design and Integration – DCS integration of field bus – foundation field bus – specification – comparisons of field bus – Profit bus .Hart, FIP BUS and MOD BUS

45

References:

1. Lucas M.P.., Distributed control systems. Van Nostrand Reinhold company Neyork,1982.
2. Moore, Digital control Devices, ISA press, 1986.
3. Stallings W. Data and Computer Communication.PIII,1993.
4. Tenanbaum A.S., Computer Network, PHI, Second Edition,1992.
5. http//kernow.cartis.edu.an, www/fieldbus/ fieldbus.htm

B.U.Liptak, process control, Chilton Book co,1972

MEI2E1 ELECTIVE 1 3 0 0 3

MEI2E2 ELECTIVE II 3 0 0 3

MEI2E3 ELECTIVE III 3 0 0 3

MEI2L1 COMPUTER CONTROL LAB 0 0 4 2

1. Design and implementation of smith predictor algorithm
2. Design and implementation of dead beat and dahlins algorithm
3. Design of digital filter(Low pass, High pass,Band pass)
4. Study of any one of popular DCS
5. PC based PLC programming using LADDER building software
6. Study of one SCADA s/w
7. Process identification using least square distingushing algorithm
8. PC based control of thernal process

9. PC based control of Pressure process
10. PC based control of Flow process
11. Study of static and dynamic characteristics of thermocouple
12. Study of characteristics of load cell
13. Study of characteristics of RTD
14. Viscometer
15. Stroboscope

SEMESTER III

MEI301 PERSONALCOMPUTER AND INSTRUMENTATION 3 0 0 3

UNIT I
PC ARCHITECTURE BASICS 9
Architecture of 8088/8086 processor- Memory mapping in PC- Memory organization – PPI, DMA and Interrupt Controllers – I/O interface – PC bus specifications – Architectural features of 8026,386,486 and Pentium processors – Memory protection – Extended and expanded Memory.

UNIT II
BASIC I/O IN PC 9
Video display adapters – Monochrome, color graphics and video graphics adapters – Text and graphic modes – printer – keyboard and serial interface – floppy disk and hard disk controllers – format of floppy and hard disk.

UNIT III
DOS OPERATING SYSTEM 9
Structure of MS DOS – BIOS – DOS Kernel – Command processor – File organization in MS DOS – Boot record – file allocation table and file directory – Boot Process Power – on-self-test and loading of MSDOS program segment prefix – DOS device drivers – mouse drivers – real time operating system.

UNIT IV
WINDOWS BASIC **9**

Windows presentation manager Filer application and managers control panel programming – window manager interface – Graphic device interface- System service interface- Naming conventions – windows calling conventions – real time operating system.

UNIT V **9**
TYPICAL PC BASED INSTRUMENTS

Outline and features of PC based instruments – Virtual of PC based instruments – Functions Generator, waveform and analyzer and digital storage oscilloscope – DAS card for PC – fault diagnosis and analysis

45

References:

1. Hall D. V., Microprocessors and Interfacing, Tata McGraw Hill,1986.
2. Duncan R., Advanced MSDOS programming, Microsoft press, USA,1986
3. Norton P.Inside the PC, Prentice Hall of India Private Ltd., New Delhi,1996

MEI302 DIGITAL INSTRUMENTATION 3 0 0 3

UNIT-I
D/A AND AID CONVERTERS **9**

D/A converters-Accuracy,resolution,setting time and other specification-A/D converters of different types performance specification-Interfacing with microprocessors,Data acquisition systems.

UNIT-II **9**
FREQUENCY & TIME MEASUREMENTS

Frequency counters-Frequency,Period,Frequency ratio & time interval modes of operation Errors.

UNIT-III **9**
TYPICAL DIGITAL INSTRUMENTS

Digital Voltmeters-Dual Slope and other types-source of errors-Automation in DVM multimeter-Digital Q meter –LCR meters & spectrum analysis Digital measurement of non-electrical variables like speed,temperature & displacement.Digital storage oscilloscope.

UNIT-IV **9**
INTELLIGENT INSTRUMENTATION
Microprocessor / PC based digital voltmeter and multimeters with self diagnostic features-Parallel bus standards-GPIB interface-RS232C & serial communication standards.

UNIT-V **9**
DISPLAY AND RECORDING DEVICES
Bar graph display LED,LCD and plasma display of segment & matrix type CRT monitors character generators-static and dynamic display Digital recorders & plotters.

45

References.
1.Sonde B.S,Data converters,Tata McGraw Hill,1993.
2.Sonde B.S,An Introduction to system Design using ICS,Tata McGraw Hill,1993.
3.Bouwens A.J.,Digital Instrumentation,McGraw Hill,1992.
4.Byers T.J.Electronics text equipment principle and applications,McGraw Hill,1987.

MEI3E4	**ELECTIVE 4**	**3**	**0**	**0**	**3**
MEI3P1	**PROJECT PHASE I**	**0**	**0**	**12**	**6**

SEMESTER IV

MEI4P2	**PROJECT PHASE II**	**0**	**0**	**24**	**12**

ELECTIVE

MEI001 PARAMETRIC IDENTIFICATION AND ADAPTIVE CONTROL 3 0 0 3

UNIT-I **9**
CONVENTIONAL METHOD OF SYSTEM MODELLING

Impulse response- Frequency response-step response methods-signal modeling-discretation techniques-Runge kutta methods-Simulation of 1st order systems with and without dead time.

UNIT-II **9**

Least square estimation-Recursive least square-Modified recursive least squares –Fixed memory-R's algorithm-maximum likelyhood-instrumental variable –stochastic approximation techniques.

UNIT-III **9**

NEED AND CLASSIFICATION OF ADAPTIVE CONTROL

Introduction-use-definitions-Auto tuning-Types of adaptive control-Gain Scheduling-MRAC-STC.

UNIT-IV **9**

MODEL REFERENCE ADAPTIVE CONTROL AND SELF TUING CONTROLLER

MRAC-Approaches-The Gradient approach-Liapunov functions-passivity theory.Self tuning controller-control policies-Pole placement control-minimum variance control.

UNIT-V **9**

ADAPTIVE PREDICTIVE CONTROL

Adaptive predictive control systems-Fuzzy logic-inverse mocelling-Neural network methods.Application of Adaptive control.

References:

1.Mendel J.M.Discerete techniques of parameter estimation,Marcal dekkar,Newyorrk,1973.
2.Astrom.K.J.& Willtenmerk B.,Adaptive control,Addison Wesley Publishing Co., USA 1989
3.Sastry S and Bodson M., Adaptive control-stability,convergence & robustness, Prentice Hall Inc., Newjersey,1989.

MEI002 NEURAL NETWORKS AND FUZZY LOGIC CONTROL 3 0 0 3

UNIT I **9**

INTRODUCTION AND DIFFERENT ARCHITECTURES OF NEURAL NETWORKS

Artificial neuron – MLP – Back progagation – Hope field networks – Kohnen Self – organizing maps – adaptive resonance theory

UNIT II **9**
NEURAL NETWORKS FOR CONTROL

Schemes of neuro-control – identification and control of dynamical systems – adaptive neuro controller – case study

UNIT III **9**
INTRODUCITON TO FUZZY LOGIC

Fuzzy sets – fuzzy relation – fuzzy conditional statements – fuzzy rules – fuzzy algorithm

UNIT IV **9**
FUZZY LOGIC CONTROL SYSTEM

Fuzzy logic controller – fuzzification interface – knowledge base – decision making logic – defuzzification interface design of fuzzy logic controller case study.

UNIT V **9**
NEURO – FUZZY LOGIC CONTROL

Optimization of membership function and rules base of fuzzy logic controller using neural networks – genetic algorithm – fuzzy neuron adaptive fuzzy systems – case study

Text Books:

1. Laurance Fausett, Fundamentals of Neural Networks, Prentice Hall, Englewood clifs, N.J. 1992
2. Zimmermann H.J., Fuzzy set theory and its applications. Allied Publication Ltd., 1996

References:

1. Tsoukalas L.H, and Robert E. Uhrigh, Fuzzy and Neural approach in Engineering John Wiley and sons, 1997
2. Jacek M. Zurads, Introduction to artificial Neural System, Jaico Publication House Mumbai, 1997
3. Klir G. J. and Yuan 5.6, Fuzzy Sets and fuzzy logic. Prentice Hall of India, New Delhi.

4. Driankov D., Helendron, H. Rein frank M., An Introduction to Fuzzy control, Narosa publishing House, New Delhi, 1996
5. Million W. T., Sutton R. S. and Webrose P.J., Neural Networds for control, MIT Press, 1992

MEI003 BIOMEDICAL INSTRUMENTATION 3 0 0 3

UNIT-I 9
BIOSIGNALS AND BIOMECHANISM
Orgination of nervous system-CNS-PNS-axons-synapse-action potential-resting potential-resting potential-Bioelectric potentials, bioelectric impedance and conductivity,Total body electrical conductivity (TOBEC).Fluid flow in cardiovascular respiratory and execretary system.Electric signal conduction in CNS.

UNIT-II 9
BIOPOTENTIAL ELECTRODES AND RECORDRES
Half cell potential,Electrode impedance,surface electrodes,micro electrodes and their equivalent circuits ,Polarisable and Non Polarisable electrodes,desirable characteristics of electrodes.Bio potential recorders: ECG,EEG,EMG-instrumentation,Electronic circuits,Calibration and electrical safety aspects.

UNIT-III 9
PHYSIIOLOGICAL ASSIST DEVICES
Pace maker-Synchronous,demand fixed types.Defibrillators-AC andDC –defibrillators: Synchronous and Asynchronous types.Stimulators-stimulator waveforms,peripheral nerve stimulator.Bladder stimulator.Heart lung machines-Normal and Extracorporeal circulation.Various types of orygenerators,Blood pumps.

UNIT-IV 9
DIAGNOSTIC IMAGING INSTRUMENTS(BASIC CONCEPTS ONLY)
General X-ray machines: X-ray tube construction,stationary anode,Rotating anode type.Various controls-mA,KVp and Timer.Fluoroscopy: construction and operation details of image intensifier tube-Digital Subtraction techniques.Computer aided Tomography: X-ray tube,Collimators,Tube rotation,Gantry and couch motion.Various controls,Artifacts.Ultrasound scanner:Transducer construction.Different types of probes.Gray scale imaging,various controls,Doo Gantry movements,Static and dynamic study,Gated Spect and PET ,MRI Scanner –Principles of MRI,Electromanet and Superconducting magnets,RF coils,cooling

mechanism,NMR parameters,larmor frequency,MR sequence,MR spectroscopy,Magnet quench,Helium filling.

UNIT-V 9
THERAPEUTIC INSTRUMENTS (BASIC CONCEPTS ONLY)
Surgical Instruments:Surgical diathermy machines,microwave, diathermy unit,ESWL,Surgical LASER instruments.Teletheraphy Instruments-Telecobalt machine,Linear accelerators,simulators,various shutter systems and controls ,Radio therapy instruments:Branchy therapy instruments-Low dose rate(LDR) branchy therapy machines,High dose rate(HDR) Branchy therapy machines.
Radiation safety regulations.

References:
1.Gadddes and Baker,Principles of Applied Bio-Medical Instrumentation,John Wiley & Sons,1975.
2.Well G, Biomedical Instrumentation & Measurements,Prentice Hall Inc,1980.
3.Khanpur,R.S,Handbook of Biomedical Instrumentation and Measurements,Tata Mc-Graw Hill,1987.
4.Wise D.L,Applied Bio-Sensors,Butterworth,USA,1989.
5.Lesile Cromwell,Fred J Weibell,Erich A Preiffer,Biomedical Instrumentation and measurements.Second Edition,PHI,1997.
6.Christenson's Introduction to Diagnostic Radiology,IV Eidition.

MEI004 ROBOTICS AND AUTOMATION 3 0 0 3

UNIT – I 9
BASIC CONCEPTS

Definition and origin of robotics – different types of robotics – various generations of robots – degrees of freedom – Asimov's laws of robotics – dynamic stabilization of robots.

UNIT – II 9
POWER SOURCES AND SENSORS

Hydaulic, pneumatic and electric drives determination of HP of motor and gearing ratio variable speed arrangements – path determination – micro machines in robotics – machine vision – ranging – laser – acoustic – magnetic, fiber optic and tactile sensors.

UNIT – III 9
MANIPULATORS, ACTUATORS AND GRIPPERS

Construction of manipulators – manipulator dynamics and force control – electronic and pneumatic manipulator control circuits – end effectors – various types of grippers – design considerations.

UNIT – IV **9**
KINEMATICS AND PATH PLANNING

Solution of inverse kinematics problem – multiple solution jacobian work envelop – hilt climbing techniques – robot programming languages.

UNIT – V **9**
CASE STUDIES

Multiple robots – machine interface – robots in manufacturing and non – manufacturing applications – robot cell design – selection of robot.

L = 45

Text Books:

1. Mikell P. Weiss G. M. Nagel R. N, Odraj N. G, Industrial Robotics, McGraw Hill Singapore, 1996.
2. Ghosh. Control in Robotics and Automation: Sensor Based Integration, Allied Publishers, Chennai, 1998

References:

1. Deb. S. R, Robotics technology and flexible Automation, John Wiley. USA 1992.
2. Agahl, C. R, Robots and manufacturing Automation, John Wiley, USA 1992.
3. Klafter P. O., Chimielewski T. A., Negin M, Robotic Engineering – An integrated approach. Prentice Hall of India, New Delhi, 1994

MEI005 ANALYTICAL INSTRUMENTATIONS 3 0 0 3

UNIT 1

PH CONDUCTIVITY & DISSOLVED COMPONENT ANALYSER 9

Sampling systems– ion selective electrodes– conductivity meters- pH meters- dissolved oxygen analyzer– sodium analyser -silica analyzer– moisture measurement

UNIT II

GAS ANALYSER 9

Oxygen analyser– CO monitor – NO, analyzer– H,S analyzer– dust and smoke measurement- thermal conductivity – thermal analyzer– industrial analysers.

UNIT III

CHROMATOGRAPHY 9

Gas chromatography – liquid chromatography ,principles, types and applications – high-pressure liquid chromatography-detectors.

UNIT IV

SPECTRO PHOTOMETERS 9

Spectral methods of analysis– Beer's law UV– visible spectrophotometers – single beam and double beam instruments – source and detectors – IR spectrophotometers – sources and detectors– FTIR spectrometer – atomic absorption spectrophotometer – flame emission spectrophotometers – sources of flame photometry– applications.

UNIT V

NUCLEAR MAGNETIC RESONANCE AND RADIATION TECHNIQUES - 9 NMR basic principle – NMR spectrometers applications– introduction to mass spectrophotometer– nuclear radiation detectors – GM counter – proportional counter – solid state detectors introduction – to x-ray spectroscopy.

45

TEXT BOOKS :

1.Willard, H.H., Merrit L.L., Dean J.A Seattle F.L., 'Instrumental Methods of Analysis', CBS Publishing and Distribution, 1995

2. Robert D.Braun,Introduction to industrial Analysis,McGraw Hill,Singapore 198

3.S.K.Singh., Mechanical &Industrial Measurements,Tata McGraw Hill-New Delhi

REFERENCES:

1. Skoog, D.A. and West D.M., Principles of Instrumental Analysis, Holt Sounder Publication, Philadelphia, 1985

2.Liptak, B.G, Process Measurement and Analysis, Chilton Book Company, 1995 Frank A. Settle, Handbook of Instrumental Techniques for Analytical Chemistry, Prentice Hall, New Jersey, 1997

3.Ewing G.W., Instrumental Methods of Analysis', McGraw Hill, 1992

4.Mann C.K. Vickers, T.J. and Guillick W.H Instrumental Analysis, Harper and Row Publishers, New York, 1974.

5. Robert D.Braun,Introduction to industrial Analysis,McGraw Hill,Singapore 1987

MEI006 INSTRUMENTATION & CONTROL IN PETROCHEMICAL INDUSTRY 3 0 0 3

UNIT I **9**
PETROLEUM PROCESSING

Petroleum exploration, recovery techniques, oil gas separation processing, wet gases refining of crude oil.

UNIT II **9**
OPERATIONS IN PETROLEUM INDUSTRY

Thermal cracking - catalytic cracking - catalytic reforming - polymerization – alkylation-isomerization- production of ethylene, acetylene and propylene from petroleum.

UNIT III **9**
CHEMICALS FROM PETROLEUM PRODUCTS

Chemicals from petroleum - methane derivatives - acetylene derivatives- Ethylene derivatives - propylene derivatives - other products.

UNIT IV **9**
MEASUREMENT IN PETROCHEMICAL INDUSTRY
Parameters to be measured in refinery and petrochemical industry – selection and maintenance of measuring instruments – intrinsic safety of instruments.

UNIT V **9**
CONTROL LOOPS IN PETROCHEMICAL INDUSTRY
Process control of refinery and petrochemical industry – control of distillation column control of catalytic crackers and pyrolysis unit – automatic control of polyethylene production – control of vinyl chloride and PVC production.

Text Books:

1. Waddams A.L. Chemical from petroleum, Butter and Janner Ltd., 1968.
2. Balchand .J.G. and Mumme K. L. , Process control structures and Applications
Van Nostrand Reinhold Company, New York. 1988.

Reference:

1. Austin G.T. Shreeves, Chemical process industries, McGraw Hill International student edition, Singapore ,1985.
2. Uptak B.G. Instrumentation in process industries, Chilton Book Company, 1994.

BEI007 **MICRO – COTROLLER BASED SYSTEM** **3 0 0 3**

UNIT I
THE ROLE OF MO0CRO CONTROLLERS 6

Type and selection - Application example

UNIT II
MICRO – CONROLLER RESOURCES 9

Family members, bus widths program and data memory parallel ports, D/A and A/D converters, reset circuitry, watchdog timers, power - down consideration

UNIT III
REAL TIME CONTROL 9

Interrupt Structures programmable timers, real – time clock, latency, interrupt, density and interval constraints.

UNIT IV
PROGRAMMING FRAMEWORK FOR 8051 AND PIC 16F877 9

CPU register – m Structure - Addressing mode - Instruction sets – Assembly languages – Assemblers

UNIT V
SOFTWARE BUILDING BLOCKS 12

Queues, tables and strings, program organization microcontroller expansion methods, I/O hardware alternatives, development tools, RTOS, Motorola (MC68HC11) and Intel microcontroller *8051)

L = 45

Text Books:

1. John, B. Peatman, 'Design with Microcontroller'. McGraw |Hill International., 1989
2. Michael Slater, 'Microprocessor – Based design : A Comprehensive Guide to Effective Hardware Design', Prentice Hall, 1989

References:

1. S. Yeralsan and A. Ahiuwalia, ' Programming and Interfacing the 8051 Microcontroller', Addison Wesley, 1995
2. Intel Manual on 16 bit – embedded control users, 191
3. Motorola manual on 8 and 16 bit microcontroller
4. Myke Predko, Programming and Customizing the 8051 microcontroller, Tata McGraw Hill , New Delhi.
5. Kenneth J. Ayala, The 8051 Microcontroller Architecture, programming and applications, Pentram International Publishers, Mumbai, 1996
6. Peter Spasoy, Microcontroller Technology: The 68HC11, Prentice Hall.

MEI008 FIBER OPTICS AND LASER INSTRUMENTATIONS 3 0 0 3

UNIT I
OPTICAL FIBERS AND THEIR PROPERTIES 9

Principles of light propagation through a fiber – different types of fibers and their properties transmission characteristics of optical fiber – absorption losses – scattering losses – dispersion – optical fiber measurement – optical sources – optical detectors – LED – LD – PIN and APD

UNIT II
INDUSTRIAL APPLICATION OF OPTICAL FIBERS 9

Fiber optic sensors – fiber optic instrumentation system – different types of modulators – detectors – application in instrumentation – interferometric method of measurement of length – moiré fringes – measurement of pressure, temperature, current, voltage liquid level and strain – fiber optic gyroscope – polarization maintaining fibers.

UNIT III
LASER FUNDAMENTALS 9
Fundamental characteristics of lasers – three level and four level lasers – properties of laser – laser modes – resonator configuration – Q-switching and mode locking – cavity dumping – types of lasers: gas lasers, solid lasers, liquid lasers and semi conductor lasers

UNIT IV
INDUSTRIAL APPLICATION OF LASERS 9
Laser for measurement of distance, length velocity, acceleration, current, voltage and atmospheric effect – material processing – laser heating, welding melting and trimming of materials – removal and vaporization.

UNIT V
HOLOGRAM AND MEDICAL APPLICATION 9
Holography – basic principle; methods; holographic interferometry and applications, holography for non – destructive testing – holographic components – medical applications of lasers; laser and tissue interaction – laser instruments for surgery, removal of tumors of vocal cords, brain surgery, plastic surgery, gynecology and oncology

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TEXT BOOKS

1. John and Harry, Industrial lasers and their applications, McGraw-ill, 1974
2. **Senior J.M., Optical Fiber Communication Principles and Practice, Prentice Hall, 1985**

REFERENCES

1. John F Read, Industrial applications of lasers, Academic Press, 1978
2. MonteRoss, Laser applications, McGraw-Hill, 1968
3. Keiser G., Optical Fiber Communication, McGraw-Hill, 1991
4. Jasprit Singh, Semi conductor optoelectronics, McGraw-Hill, 1995

Ghatak A.K and Thiagarajar K, Optical electronics foundation book, TMH, New Delhi, 1991.

MEI009 DIGITAL IMAGE PROCESSING 3 0 0 3

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UNIT I
DIGITAL IMAGE FUNDAMENTALS AND TRANSFORMS 9
Elements of visual perception – Image sampling and quantization Basic relationship between pixels – Basic geometric transformations-Introduction to Fourier Transform and DFT – Properties of 2D Fourier Transform – FFT – Separable Image Transforms -Walsh – Hadamard – Discrete Cosine Transform, Haar, Slant – Karhunen – Loeve transforms.

UNIT II
IMAGE ENHANCEMENT TECHNIQUES: 9
Spatial Domain methods: Basic grey level transformation – Histogram equalization – Image subtraction – Image averaging –Spatial filtering: Smoothing, sharpening filters – Laplacian filters – Frequency domain filters : Smoothing – Sharpening filters – Homomorphic filtering.

UNIT III
IMAGE RESTORATION: 9
Model of Image Degradation/restoration process – Noise models – Inverse filtering -Least mean square filtering – Constrained least mean square filtering – Blind image restoration – Pseudo inverse – Singular value decomposition.

UNIT IV
IMAGE COMPRESSION 9
Lossless compression: Variable length coding – LZW coding – Bit plane coding- predictive coding-DPCM.
Lossy Compression: Transform coding – Wavelet coding – Basics of Image compression standards: JPEG, MPEG,Basics of Vector quantization.

UNIT V
IMAGE SEGMENTATION AND REPRESENTATION 9
Edge detection – Thresholding - Region Based segmentation – Boundary representation: chair codes- Polygonal approximation – Boundary segments – boundary descriptors: Simple descriptors-Fourier descriptors - Regional descriptors –Simple descriptors- Texture

TOTAL : 45

TEXT BOOKS
1. Rafael C Gonzalez, Richard E Woods 2nd Edition, Digital Image Processing - Pearson Education 2003.

REFERENCES
1. William K Pratt, Digital Image Processing John Willey (2001)
2. Image Processing Analysis and Machine Vision – Millman Sonka, Vaclav hlavac, Roger Boyle, Broos/colic, Thompson Learniy (1999).

3. A.K. Jain, PHI, New Delhi (1995)-Fundamentals of Digital Image Processing.
4. Chanda Dutta Magundar – Digital Image Processing and Applications, Prentice Hall of India, 2000

MEI010 POWER ELECTRONICS 3 0 0 3

UNIT-1

POWER SEMICONDUCTOR DEVICES 9

Power diode-power transistor,SCR.Triac,GTO,MOSFET AND IGBT,Driver circuits,turns-on methods-commulation and various commulations circuits.

UNIT-2

PHASE CONTROLLED CONVERTERS 9

2pulse,3pulse,6pulse converters-inverter operation-comparison ofsymmertic and asymmetric semiconverters-effect of some inductance and firing circuits-application of drive control-dual converters-HVDC transmission.

UNIT-3

DC TO D CHOPPERS 9

Voltage,current & load commulated choppers,step up chopper and firing circuits,one,two and four quadrant chopper application of DC driving control.

UNIT-4

INVERTERS 9

Series inverter-parallel inverter Mc-Murray inverter-McMurray-Bedford inverters,current source inverter,voltage control and waveform control-PWM inverters-UPS.

UNIT-5

AC CHOPPERS,CYCLOCONVERTERS AND VOLTAGE CONTROLLERS 9

Single phase AC choppers,multistage sequence control, step and step down cycloconverters.three phase to single phase converters-triggerting circuit based on microprocessors.single phase AC voltage controller with R.RL.RLE Load.

References

1.Rashid M.H. power electronics circuits devices and application-prentice hall international 1995
2.Sen.P.C.power electronics-tata Mc-Graw hill,new delhi.
3.Sing,power electronics--tata Mc-Graw hill,new delhi.
4.Dubey G.k.Duradla.S.R.joshi.A and sinha.R.M..,Thyristorised power controller,wiley eastern limited,1986.
5.lander.W.power electronics,Mcgraw hill & co,Third edition ,1993.

BHARATH UNIVERSITY
DEPARTMENT OF ELECTRONICS & INSTRUMENTATION ENGINEERING
M.Tech-INSTRUMENTATION &CONTROL ENGINEERING (FULL-TIME)
CURRICULUM & SYLLABI-2015
(4 SEMESTER PROGRAMME) w.e.f 2015-2016

MEI011 POWER PLANT INSTRUMENTATION 3 0 0 3

UNIT-1

SAFETY STANDARDS 9

Electrical safety standards-Requirements for Instruments in Hazardous localities-determination and classification of area in instrument systems-Group of metirials.

UNIT-II

EXPLOSION FUNDAMENTALS 9

Ignition energy and flame velocity-Lower and upper explosion limits-Precaution in testing-Opening contacts in inductive,capacitive and resistive circuits-Principle of hazardous reduction and approach to safety-Explosion proof housig-Reduction of hazard by purging-Intrinsic safety code and safe systems-Flame ancestors-kind of arresters safe level of circuit voltage-Cenelle standards.

UNIT-III

POWER PLANTS 9

Plant layout as process descriptions-Structure of power plants-Nuclear and thermal power station-Hydroelectric-Non conventional energy sources

UNIT-IV

INSTRUMENTS AND CONTROL SYSTEMS IN POWER PLANTS 9

Boiler instruments and control-Turbine instruments and controls-Power house instruments and controls.

UNIT-V 9

INSTRUMENTS AND CONTROL SYSTEMS IN NUCLEAR POWER PLANTS

Control loop in nuclear plants-heat exchangers,moderators-speed control vibration control.

References:

1.Liptak.B.G.,Instrumentation in processing industries 1st editon ,Chiton book co.Philadelphia 1973.

2.Wakil E.I.,Power Plant tecnology.Mc-graw Hill,1984.

3. Magison E.G.,Electrical Instrument in hazardous locations,ISA,USA 1980

MEI012 ARTIFICIAL INTELLIGENCE AND EXPERT SYSTEMS 3 0 0 3

UNIT I

INTRODUCTION TO ARTIFICIAL INTELLIGENCE 9

Overview of AI-general concepts-problem spaces and search-search techniques-BFS,DFS-Heuristic search techniques.

UNIT II

KNOWLEDGE REPRESENTATION **9**

Knowledge – general concepts-predicate logic-representing simple fact-instance and ISA relationships-resolution-natural deduction.

UNIT III

KNOWLEDGE EDGE ORGANISATION AND MANIPULATION **9**

Procedural Vs declaration knowledge-forward Vs backward reasoning- matching techniques-control knowledge/strategies-symbol reasoning under uncertainity-introduction to non-monotonic reasoning-logic for monotonic reasoning.

UNIT IV

PERCEPTION – COMMUNICATION AND EXPERT SYSTEMS **9**

Natural language processing pattern recognition- visual image understanding expert system architecture.

UNIT V

KNOWLEDGE ACQUISITION **9**

Knowledge acquisition-general concepts-leatrning-learning byu induction-explanation based learning.

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Text Books:

1. Elaine Rich and Kelvin knight,Artificial Intelligence,Tata McGraw Hill, New Delhi, 1991.
2. Stuart Russell and Peter Norving. Artificial Intelligence : A Modern approach. Prentice hal,1995.

References:

1. Nilson N.I. Principles of Artificial Intelligence,Springer Variage, Berlin,1980.

Patterson,Introduction to Artificial Intelligence and Expert Systems. Prentice Hall of India, New Delhi,1990.