T.E. Sem. VI [INST]
Digital Signal Processing

SYLLABUS

Time : 3 Hrs.
Theory : 100 Marks
Term Work : 25 Marks
Practical & Oral : 25 Marks

1. Brief review :
   Discrete time signals and systems, difference equations, Fourier series and Transform, Z-Transform, theorems, properties etc.

2. Introduction to digital signal processing :
   Block diagram of DSP, Advantages and Sampling Theorem, Classification of Digital Filter (IIR and FIR).

3. Analysis of Digital Filter :
   Classification of filter on the their pole zero diagram. Frequency response of IIR filters frequency response analysis of all types of linear phase system. Difference between IIR and FIR Filters.

4. Realization of systems :
   Realization of IIR systems by Direct form-I, Direct form-II, Cascade and Parallel. Realization of FIR systems by Direct form, cascade and linear phase system.

5. Digital Filter Design Techniques :
   Properties of IIR filter Discritization Methods like IIT and BLT. Design of Butterworth and Chebyshev-I IIR filter.

6. FIR filter Design :

7. Discrete Fourier Transform :
   Introduction to DTFT, Fourier representation of finite duration sequences, the Discrete Fourier Transform, properties of the DFT, Linear convolution using the DFT and IDFT.

8. Computation of the Discrete Fourier Transform :
   Decimation in frequency (DIF) algorithms, Decimation in time (DIT) algorithms for Radix 2, 3 composite. Overlap add and save Methods.

9. Introduction to Digital Hardware and Applications :
   Digital signal processor series Texas 320, Motorola 56000. Applications to speech, Radar, CT scanner and Digital touch tone receiver.

Reference :
2. Introduction to DSP (Johny Johnson) PHI – 1996.
## Embedded Systems for Instrumentation

### SYLLABUS

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1. **Embedded systems**:
   - Definition, embedded system overview, classifications, Design challenges, processor technology, IC technology and Design Technology and trade offs. Examples of embedded system.

2. **MCS-51 microcontroller**:
   - Architecture of MCS 51 family of microcontroller, and its variants and comparison. Comparison of microprocessor and microcontroller. CPU timing and machine cycle. Memory organization, SFRS. Integrated peripherals such as Timers/Counters, Serial port, parallel I/O ports, Interrupt Structure, memory interfacing. Power saving and power down mode.

3. **Development tools**:
   - Simulator, in-circuit debugger, in-circuit emulator, programmers, integrated development environment (IDE), cross compilers, Merits and demerits of above tools.

4. **8051 programming**:

5. **Serial communication protocols**:
   - Operation of serial port. Programming for implementation of asynchronous serial communication. Buses like I²C (RTC/EEPROM Memory Example), SPI (ADC, DAC example), introduction to USB and CAN Bus.

6. **Case studies**:

7. **RISC Microcontroller**:

8. **Real Time Operating System (RTOS)**:
   - Introduction to RTOS concept. RTOS Scheduling models interrupt latency and response times of the tasks as performance metrics. Example of any tiny RTOS.
Reference:
6. Website: www.atmel.com
7. Website: www.microchip.com
8. Website: www.nxp.com
T.E. Sem. VI [INST]

Industrial Data Communications

SYLLABUS

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1. **Introduction**:
   - OSI reference model, Systems engineering approach, State transition structure, Detailed design, Media, Physical connections, Protocols, Noise, Cable spacing, Ingress protection.

2. **Communication and control**:
   - Introduction, Evolution of industrial control process, communication interface – serial and parallel, communication mode-simplex, half duplex and full duplex, synchronization and timing.

3. **Industrial network**:
   - Network requirements, OSI implementation, Enterprise network : types of networks, LAN-architecture, topology, transmission media: Cable characteristics, Cable selection, unshielded twisted-pair cable, shielded twisted-pair cable, Coaxial cables, Fiber optics, wireless media, physical and logical media access and arbitration methods – token passing, ring, bus master-slave, peer-peer, network and transport layer services, real time implications, Session, presentation, and application layers. LAN standards for open LAN, bridges, routers and gateways, Manchester coding.

4. **Open control network**:
   - **Proprietary control network**: MODBUS plus, data highway plus.

5. **Networks at different levels**:
   - Sensor level network : AS-i, CAN, Devicenet, Interbus and LON
   - Device network : Foundation Fieldbus – H1, HART, PROFIBUS-PA
   - Control network : BACnet, ControlNet, FF-HSE, PROFIBUS-DP, Ethernet, TCP/IP

6. **HART**:
   - Architecture – physical, data link, application layer, communication technique, normal and burst mode of communication troubleshooting, benefits of HART.

7. **Foundation fieldbus**:
   - Fieldbus requirement, features, advantages, fieldbus components, types, architecture-physical, data link, application layer, system and network management, wiring, segment functionality checking, installation in safe and hazardous area and troubleshooting, function block application process.

8. **Wireless technologies**:
   - satellite systems, Wireless LANs (WLANs), Radio and wireless communication, WiFi, GSM, GPRS and VSAT – their comparison, limitations and characteristics.
Reference:
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Power Electronics and Drives

SYLLABUS

Time : 3 Hrs.

Theory : 100 Marks
Term Work : 25 Marks
Practical and Oral : 25 Marks

1. Power Semiconductor Devices :
   (a) Introduction to construction, characteristics, ratings, data sheets and applications of power diodes, power BJT, power MOSFET, SIT and IGBT.
   (b) Study of Thyristors : constructions, characteristics, ratings of SCR, TRIAC, MCT, GTO and LASC.
   (c) Comparison and selection criteria for above devices.
   (d) Switching / triggering method : Switching methods / types of triggering, triggering devices DIAC, SUS, 585, UJT and PUT.
   (e) Thyristors Communication Techniques.
   (f) Protection Scheme against over-current, over-voltage, dv/dt and di/dt.

2. Thyristor Application :
   (a) Controlled rectifiers : Principles of operations of phase controlled converters, single phase half bridge, semi converter and bridge converters.
      Design of SCR based DC power circuits including UJT as triggering device and application.
   (b) AC power control using SCR-UJT and TRIAC-DIAC like universal speed controller fan regulator. Design of SCR/TRIAC based AC power control circuits including UJT/DIAC as a triggering device.

3. Inverters :
   Principles of operation of inverters, PWM inverter, series and parallel inverters, bridge inverter, basic circuit scheme of IGBT/Power MOSFET based inverter circuits. Suitability in different applications of different capacities and frequencies operation. Principle of ZVC/ZCS resonant converters.

4. Choppers :
   Basic operation of choppers, study of different types of simple chopper circuits like step up choppers, step down choppers and Jones chopper, DC motor speed control application using chopper.

5. Switch Mode Power Supplies :
   Basic concept schemes, Working principles of Buck, Boost, Buck-Boost converter merits and demerits and applications.

6. Drives :
   (a) AC Motor Drives : Concept and requirement of drives, Current fed and voltage fed drives, PWM technique (using IGBT/BJT) for control.
   (b) DC Motor Drives : DC drives for brushed/brushless motors, methods of motor control using constant voltage and constant current techniques.

7. Industrial Applications :
   (a) Induction and Dielectric heating process, Block diagram, Merits/demerits and applications.
   (b) Temperature controller using thyristor principle and circuit scheme.
Reference:
T.E. Sem. VI [INST]  
Process Instrumentation Systems

SYLLABUS

Time : 3 Hrs.  
Theory : 100 Marks  
Term Work : 25 Marks  
Oral : 25 Marks

1. Process dynamics :  
Dynamic elements in a control loop, Dead time processes and smith predictor compensator. Inverse  
response behavior of processes and compensator. Dynamic behavior of first and second order  
systems. Interacting and non-interacting systems.

2. Process Controllers :  
Elements of process control, Controller Principle, Process characteristics, Control system parameters,  
discontinuous, continuous and composite controller modes/actions (P, I, D, PI, PD and PID).

3. Analog and Digital controllers :  
General features, construction and working of Pneumatic, Hydraulic, Electronic and Digital  
controller.

4. Controller tuning :  
Process reaction curve method, Zigler-Nichols method, Cohen-coon correction for quarter amplitude,  
Frequency response method, Relay based tuning.

5. Control Schemes :  
Feedback, feedforward, cascasde, ratio, split range, selective control, adaptive control, and model  
based control.

6. Multivariable Control :  
Block diagram analysis of multivariable systems, Interaction, Tuning of Multivariable, relative gain  
analysis, Decoupler design.

7. Discrete-State process control :  
Discrete state process control characteristics of the system, variables, process specification and event  
sequence description, Physical ladder diagram-elements and examples.

8. Batch and continuous process control :  
Batch mode, nomenclature, formulation, Batch versus continuous process control. Types of control,  
Classifications, Batch recipe management. Design of control system for a complete plant.

Reference :  
1995.  
6. Process Control System (F.G. Shinsky) TMH.  
T.E. Sem. VI [INST]
Control Systems Design

SYLLABUS

Time : 3 Hrs. Theory : 100 Marks
Term Work : 25 Marks

1. State – Space Analysis of Control System :
   Concept of state-space, and state model for Linear Systems – SISO and MIMO systems,
   Linearization, state model for Linear continuous time system - State-Space representation using phase
   variables, Phase variable formulation for transfer function with poles and zeros, state space
   representation using canonical variables, derivation of transfer function from state model,
   Diagonalization, eigenvalues and eigenvectors, Solution of State equations – properties of state
   transition matrix, computation of state transition matrix using Laplace Transformation, Cayley –
   Hamilton theorem.

2. Controller and Observer Design using State-Space :
   Concept of controllability and observability, definitions, phase variable form, properties, effect of
   pole-zero cancellation in transfer function.
   State Feedback and Pole placement – Stabilizability, choosing pole locations, limitations of state
   feedback.
   Tracking Problems – Integral control.
   Controller design – for phase variable form, by matching coefficients, by transformation.
   Observer design – for observer canonical form, by observability matrix, by transformation, by
   matching coefficients.
   Control using observers, separation property
   Reduced order observer design – separation property, reduced order observer transfer function
   Application of above.

3. Introduction to Compensator :
   Analysis of the basic approaches to compensation, cascade compensation, feedback compensation,
   Effect of measuring elements on system performance, block diagram of automatic control system.
   Derivative and integral error compensation.

4. Compensator Design using Root Locus :
   Improving steady-state error and transient response by feedback compensation, cascade

5. Compensator Design using Frequency Response :
   Steady-state error characteristics of Type 0, 1 and 2 systems, Time delay, transient response through
   gain adjustment, Lag, Lead, Lag-Lead compensation.

6. PID Compensator Design :
   Tuning rules for PID controller, Ziegler-Nichols rules, Designing PID controller using Root-Locus
   technique.
Reference: