SPPU B.E./B.Tech ENTC Sem 5 syllabus

Mechatronics

304185 Mechatronics
Credits: TH-03

Unit I :Introduction to Mechatronics
Basics of Mechatronics Systems : Definition of Mechatronics, Key elements of Mechatronics Systems, Levels of mechatronics systems,Measurement Characteristics,Examples of Mechatronics systems in daily life as ,washing machines, Digital Cameras,CD Players, camcorders, Mechatronics design process,phases of mechatronics design process, integrated design approach.Mechanical Components and Servo mechanism :Mechanical System and Motion, Mass Inertia and Dashpot, Gears, types of Gears,Servomechanism(Concepts and Theory, Problems).Case study Mechatronics Design of Coin Counter/Coin Separator

Unit II :Overview of Sensors, Transducers and their Characteristics Specifications
Specifications related to selection criterion for force, pressure, temperature and motion (Rotary and Linear).
Classification and selection of transducers:
Force: Load Cell, Cantilever Beam (Design aspect example)
Pressure:Strain Gauge, Piezoelectric
Motion: Rotary and Linear motions, Proximity sensors Inductive, Capacitive and Magnetic, sources detectors in optical proximity sensors.Comparison of Various proximity sensors
Temperature:Optical Fibre and its use in temperature measurement, Fibre Optic Temperature sensors,Ultrasonic Transducers for applications as position, level, flow measurement.
Gas sensors, Wind sensors:Gyroscope, Accelerometer, Magnetometer (As used in smart phones)
Smart Sensors: Concept, Radiation Sensors - Smart Sensors - Film sensor, IR- temperature sensors

Introduction to MEMS& Nano Sensors . Rotary Optical Encoder

Unit III : Hydraulic Systems
Introduction to Hydraulic Actuators
Fluid Power systems:Concept of Actuators, Classification of Actuators: Pneumatic, Hydraulic and Electrical Actuators, Fluid Power systems
Hydraulic Systems: Physical Components of a Hydraulic systems, Hydraulic Pumps (e.g. Gear Pumps, Vane Pumps, Piston Pumps and Axial Piston Pumps) , Filters and Pressure Regulation, Relief Valve, Accumulator.

Unit IV : Pneumatic Systems
Introduction to Pneumatic a Actuators
Physical Components of a Pneumatic Systems, Pneumatic Cylinders, Pneumatic Actuators (e.g. Spring Actuator and Spring Actuator with positioner), Air compressor ,Air Receiver, Air Dryer
Air Service Treatment: Air Filter, air regulator and Gauge, Air Lubricator and Pressure regulation Intake and Air Filter.Case study of Robotic Pick and Place robot

Unit V : Electrical Actuators, Electron-Mechanical Actuators
Electrical-Actuation system: Selection criteria and specifications of stepper motors, solenoid valves,relays (Solid State relays and Electromechanical relays).
Selection Criterionofcontrol valve, Single acting and Double acting Cylinders.
Electro-Pneumatic: Pneumatic Motors, Valves: Electro Hydraulic: 3/2 Valves, 4/2 Valves, 5/3 Valves
Cables: Power cable and Signal cables

Unit VI :Mechatronics Systems in Automobile
(Treatment with Block Diagram Approach)
Boat Autopilot, High-Speed tilting trains, Automatic car parking systems, Engine Management systems, Antilock Brake systems (ABS) ,CNC Machines(Only Black Diagram and explanation)

Text Books:
1) W. Boltan —Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering 6th Edition, Pearson Education, 2016
2)David Alciatore and Maichael B Histand, —Introduction to Mechatronics and Measurement Systems,4th Edition, Tata McGraw Hill 2013.

3) K.P.Ramachandran, G.K.Vijayaraghavan and M.S. Balasundaram, —Mechatronics-Integrated Mechanical Electronic Systems, Willey Publication 2008

Reference Books:

1) Nitaigour P. Mahalik , Mechatronics-Principles, Concepts and Applications‖, Tata McGraw Hill, Eleventh reprint 2011.
2) Devdas Shetty and Richard A.Kolk, —Mechatronics System Design‖, Thomson India Edition 2007.
3) HMT Limited, — Mechatronics‖, Tata McGraw-Hill Publishing House

Microcontroller

Microcontroller

Unit I: Introduction to Microcontroller Architecture

Difference between microprocessor and microcontroller Introduction to the Microcontroller classification, Feature and block diagram of 8051 and explanation, Program Status Word (PSW), 8051. Overview of Instruction set, memory organization, Interrupt structure, timers and its modes, Serial communication: concept of baud rate, Data transmission and reception using Serial port. Sample programs of data transfer, Delay using Timer (0&1) and interrupt, Data transmission and reception using Serial port. I/O Port Programming, All programs in C language.

Unit II: IO Port Interfacing-I

Pin diagram and its functioning Port structure, IO Interfacing Requirements, Interfacing of: LEDS, Keys, 7-segment multiplexed display, DAC 0808, ADC 0809 Stepper motor, Relay, Buzzer, Opto-isolators, \ Design of Data acquisition System (DAS): All programs in C language.

Unit III: PIC 18F XXXX Microcontroller Architecture

Comparison of PIC family, Criteria for Choosing Microcontroller, features, PIC18FXX architecture with generalized block diagram. MCU, Program and Data memory organization, Bank selection using Bank Select Register, Pin out diagram, Reset operations, Watch Dog Timers, Configuration registers and oscillator options (CONFIG), Power down modes , Brief summary of Peripheral support, Overview of instruction set.

Unit IV: Peripheral Support in PIC 18FXXXX
Timers and its Programming (mode 0 &1), Interrupt Structure of PIC18F with SFR, PORTB change Interrupts, use of timers with interrupts, CCP modes: Capture, Compare and PWM generation, DC Motor speed control with CCP, Block diagram of in-built ADC with Control registers, Sensor interfacing using ADC: All programs in embedded C.

Unit V: Real Word Interfacing With 18FXXXX
Port structure with programming, Interfacing of LED, LCD and Key board, Motion Detectors, DAC for generation of waveform, Design of PIC test Board and debugging, Home protection System: All programs in embedded C.

Unit VI: Serial Port Programming interfacing with 18FXXXX

Basics of Serial Communication Protocol: Study of RS232, RS 485, I2C, SPI, MSSP structure (SPI & I2C), USART (Receiver and Transmitter), interfacing of RTC (DS1307) with I2C and EEPROM with SPI. Design of Traffic Light Controller; All programs in embedded C.

Digital Communication

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Unit I: Random Processes & Noise
Random Processes: Introduction, Mathematical definition of a random process, Stationary processes, Mean, Correlation and Covariance function, Ergodic processes, Transmission of a random process through a LTI filter, Power spectral density.
Mathematical Representation of Noise: Some Sources of Noise, Frequency-domain Representation of Noise, Superposition of Noises, Linear Filtering of Noise, Quadrature Components of Noise, Representation of Noise using Orthonormal Coordinates.

Unit II: Digital Modulation-I
Baseband Signal Receiver: Probability of Error, Optimal Receiver Design.
Digital Modulation: Generation, Reception, Signal Space

Representation and Probability of Error Calculation for Binary Phase Shift Keying (BPSK), Binary Frequency Shift Keying (BFSK), Quadrature Phase Shift Keying (QPSK), M-ary Phase Shift Keying (MPSK).

Unit III: Digital Modulation-II

Generation, Reception, Signal Space Representation and Probability of Error Calculation for Quadrature Amplitude Shift Keying (QASK), M-ary FSK (MFSK), Minimum Shift Keying (MSK), Pulse Shaping to reduce Interchannel and Intersymbol Interference, some Issues in transmission and reception, Orthogonal Frequency Division Multiplexing (OFDM), Comparison of digital modulation systems.

Unit IV: Spread Spectrum Modulation

Use of Spread Spectrum , Direct Sequence (DS) Spread Spectrum, Spread Spectrum and Code Division Multiple Access (CDMA), Ranging Using DS Spread Spectrum , Frequency Hopping (FH) Spread Spectrum, Pseudorandom (PN) Sequences: Generation and Characteristics, Synchronization in Spread Spectrum Systems.

Unit V: Information Theoretic Approach to Communication System

Introduction to information theory, Entropy and its properties, Source coding theorem, Huffman coding, Shannon-Fano coding, Discrete memory less channel, Mutual information, Channel capacity, Channel coding theorem, Differential entropy and mutual Information for continuous ensembles, Information Capacity theorem.

Unit VI: Error-Control Coding

Linear Block Codes: Coding, Syndrome and error detection, Error detection and correction capability, Standard array and syndrome decoding. Cyclic Codes: Coding & Decoding, Convolutional Codes: Coding & Decoding, Introduction to Turbo Codes & LDPC Codes.