JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

B.Tech (EEE)– III-II Sem

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(19A02603a) POWER QUALITY

PROFESSIONAL ELECTIVE -II

Unit 1 :

Power quality: An Introduction, Power quality standards and monitoring, Passive Shunt and Series Compensation.

Unit 2 :

Active Shunt Compensation: DSTATCOM, Active Series Compensation: DVR.

Unit 3 :

Unified Power Quality Compensators, Loads That Cause Power Quality Problems.

Unit 4 :

Passive Power Filters, Shunt Active Power Filters, Series Active Power Filters, Hybrid Active Power Filters

Unit 5:

AC-DC Converters That Cause Power Quality Problems; Improved Power, Quality Converters: AC-DC Converters; Improved Power Quality Converters; Power quality improvement in electrical system applications

Books and references:

1. M. H. J. Bollen, Understanding Power Quality Problems: Voltage Sags and Interruptions, IEEE Press Series on Power Engineering, New York, 2000.

2. C. Sankaran, Power Quality, CRC Press, New York, 2001.

3. Bhim Singh, Ambrish Chandra and Kamal Al-Haddad, Power Quality: Problems and Mitigation Techniques, John Wiley & Sons Ltd., U.K, 2015

4. R.M. Mathur, Static Compensators for Reactive Power Control, Contexts Publications, Winnipeg, Canada, 1984.

5. G. Seguier, “Power Electronic Converters-AC/DC Conversion,” McGraw-Hill, 1986.

6. T.J.E. Miller, Reactive Power Control in Electric Systems, John Wiley Sons, Toronto, 1982.

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(19A02603b) FUNDAMENTALS OF SEMICONDUCTOR DEVICES (PROFESSIONAL ELECTIVE-II)

Unit 1: Importance of semiconductor devices and their diverse applications. Introduction to semiconductors, concept of energy bands and how bands form. Effective mass of electrons, E-k diagram. Concept of holes. Concept of Fermi level, Fermi-Dirac distribution. Doping (extrinsic & intrinsic semiconductor), density of states. Equilibrium electron-hole concentration, temperature-dependence. Carrier scattering and mobility, velocity saturation, Drift-diffusion transport, Excess carrier decay & recombination, charge injection, continuity equation, quasi-Fermi level.

Unit 2: p-n junction: static behaviour (depletion width, field profile), p-n junction under forward & reverse bias, current equations, generation-recombination current and reference to typical devices. Zener and avalanche breakdown, Capacitance-voltage profiling, metal/semiconductor junction – Ohmic and Schottky contacts, reference to device applications.

Unit 3: MOS capacitor, charge/field/energy bands, accumulation, inversion, C-V (high and low frequencies), deep depletion, Real MOS cap: Flat-band & threshold voltage, Si/SiO2 system. MOSFET: structure and operating principle, derivation of I-V, gradual channel approximation, substrate bias effects, sub-threshold current and gate oxide breakdown. Control of threshold voltage, short channel effects. Moore's Law and CMOS scaling

Unit 4: Introduction to compound semiconductors & alloys, commonly used compound semiconductors, heterostructure band diagrams and basics of MODFET & HEMT, introduction to quantum well, applications of heterostructure device technologies. BJT: working principle, DC parameters and current components, base transport factor, Early Effect, charge control equation & current gain, need for HBT. Applications of BJTs/HBTs in real-life. (Basics of) - transistors for high-speed logic, transistors for high frequency (RF), transistors for high power switching, transistors for memories, transistors for low noise, transistors for the future.

Unit 5: Solar cells: principle, efficiency, Fill factor, Shockley-Quiesser limit, silicon solar cells, multi-junction solar cell, Photodetectors: operation, figures of merit (responsivity, QE, bandwidth, noise, Detectivity), examples from IR to UV detectors. LEDs: working principle, radiative/non-radiative recombination, various types of efficiencies (EQE, WPE, IQE), light extraction and escape cone. Blue LED and the Nobel Prize, visible LEDs and chromaticity.

Books and references:

1. Solid State Electronic Devices, by Ben Streetman and Sanjay Banerjee, Prentice Hall.
2. Introduction to Semiconductor Materials and Devices, by M. S. Tyagi, Wiley Publications.

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(10A02603c) NONLINEAR SYSTEM ANALYSIS
(PROFESSIONAL ELECTIVE -II)

Unit 1 : Why nonlinear systems? - Non-linear Models of Physical Systems, Mathematical Preliminaries: Finite dimensional normed spaces, Euclidean space and its topology, Infinite dimensional Banach spaces - Contraction mapping theorem

Unit 2 : Existence and Uniqueness results for solutions to non linear ODEs, ODEs as vector fields - One dimensional systems - Phase portrait of second order linear systems - Equilibrium points, linearization and their classification

Unit 3 : Examples: Simple pendulum, Bead on a hoop, Lotka-Volterra models for predation and competition, biological transcriptional system, van der Pol oscillator and conservative systems, non linear circuits - Limit cycles, Bifurcations of two dimensional flows: Saddle-node, pitchfork, transcritical and Hopf - their normal forms

Unit 4 : Notions of stability - Lyapunov and LaSalle's theorems, Finding Lyapunov functions: Linear systems, variable gradient method - Center Manifold Theorem

Unit 5 : Physical Non-linearities - Interconnections and feedback - Aizermann's conjecture – Passivity, PR systems - Dissipation equality - Passive filters, KYP Lemma - Popov and circle criterion

Books and references:

1.Nonlinear Systems - Hassan Khalil

2.Nonlinear dynamics and chaos: with applications to physics, biology, chemistry, and engineering - Steven Strogatz

3.Nonlinear systems: analysis, stability, and control - S.S.Sastry

4.Nonlinear Systems Analysis - Vidyasagar

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(19A04703c) INTRODUCTION TO EMBEDDED SYSTEM DESIGN

(Professional Elective II)

Unit 1: Introduction to Embedded Systems and Computer Systems Terminology. Modular approach to Embedded System Design using Six-Box model: Input devices, output devices, embedded computer, communication block, host and storage elements and power supply. Microcontroller Based Embedded System Design. Salient Features of Modern Microcontrollers. Elements of Microcontroller Ecosystem and their significance. Design of Power Supply for Embedded Systems. Linear Regulator Topologies. Switching Power Supply Topologies. Power Supply Design Considerations for Embedded Systems.

Unit 2: Introduction to MSP430 Microcontroller. MSP430 CPU Architecture. Programming Methods for MSP430. Introduction to Lunchbox Platform. Fundamentals of Physical Interfacing: Connecting Input Devices:Switches, Keyboard and Output devices: LEDs, Seven Segment Displays(SSD). Assignment: MCQ/MSQ. Advanced Physical Interfacing: Driving load - high side, low side and H-bridge. Multiplexing displays including Charlieplexing. Shaft encoder.

Unit 3: Programming the MSP430. Basics of version control system - Git. Installing and using Code Composer Studio(CCS). Introduction to Embedded C. Interfacing LEDs and Switches with MSP430 using Digital Input and Output. MSP430 Clock and Reset System. MSP430 Clock sources and distribution. Types of Reset sources. Handling Interrupts in MSP430. Writing efficient Interrupt Service Routine (ISR).

Unit 4: Interfacing Seven Segment Displays and Liquid Crystal Displays with MSP430. Low Power Modes in MSP430. Introduction to MSP430 Timer Module and it's Modes of Operation.Generating Pulse Width Modulation (PWM) using Timer Capture Mode. ADC operation in MSP430. Interfacing analog inputs. Generating random numbers using LFSR and other methods. Adding DAC to MSP430. Custom Waveform generation using MSP430.

Unit 5: Timer Capture Modes. Measuring frequency and time period of external signals and events. Serial Communication Protocols: UART, SPI, I2C. Interfacing Universal Serial Communication Interface (USCI) Module of the MSP430 for UART Communication. Advanced Coding Exercises based on Interrupt driven Programming. Building an Electronics Project. Circuit Prototyping techniques. Designing Single Purpose Computers using Finite State Machine with Datapath (FSMD) approach. MSP430 Based Project Design and Implementation. Recap of Course Coverage.

Books and references:

1. Designing Embedded Hardware, John Catsoulis. 2nd edition. Shroff Publishers and Distributors. ISBN-10: 9788184042597

2. Embedded System Design: A Unified Hardware / Software Introduction. Tony Givargis and Frank Vahid. Wiley. ISBN-10: 812650837X
3. MSP430 Microcontroller Basics. John H. Davies. Elsevier. ISBN-10: 9789380501857. Programming Embedded Systems in C and C++. Micheal Barr. Shroff Publishers and Distributors. ISBN-10: 817366076X

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(19A02603d) DESIGN OF PHOTOVOLTAIC SYSTEMS (PROFESSIONAL ELECTIVE-II)

Unit 1 : The PV cell, Series and Parallel interconnection

Unit2 : Energy from sun, incident energy estimation, sizing PV

Unit3 : Maximum Power Point Tracking, MPPT algorithms

Unit4 : PV-Battery interfaces, Peltier cooling, PV and water pumping

Unit 5 : PV-grid interface-I, PV-grid interface-II and life cycle costing

Books and References:

1. Chenming, H. and White, R.M., Solar Cells from B to Advanced Systems, McGraw Hill Book Co, 1983
2. Ruschenbach, HS, Solar Cell Array Design Hand Varmostrand, Reinhold, NY, 1980
3. Proceedings of IEEE Photovoltaics Specialists Conferences, Solar Energy Journal.