JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

Course Structure for Electrical and Electronics Engineering

B. Tech Course

IV B. Tech – II Sem

S.No.	Course Code	Subject	Theory	Tu	Lab	Credits
1	13A02801 13A02802	MOOC – I* (i) Instrumentation (ii) Power System dynamics and control	3	1	-	3
2	13A02803 13A02804 13A02805	MOOC – II* (i) HVDC Transmission (ii) Energy Resources & Technology (iii) Design Of Electrical Systems	3	1	-	3
3	13A04703 13A02806	MOOC – III* (i) Embedded Systems (ii) Industrial Automation & Control	3	1	-	3
4	13A02807	Technical Seminar	-	-	4	2
5	13A02808	Project Work	-	-	24	12
		Total	**9**	**03**	**28**	**23**

3 Theory + 1 Technical Seminar + 1 Project work

***Either by MOOCS manner or Self study or Conventional manner**

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	3	**1**	**3**

(13A02801) INSTRUMENTATION

(MOOC-I)

OBJECTIVES : *The objectives of the course are to make the students learn about:*

- Common errors that occur in measurement systems, and their classification
- Characteristics of signals, their representation, and signal modulation techniques
- Methods of Data transmission, telemetry, and Data acquisition.
- Working principles of different signal analyzers and Digital meters.
- Several types of transducers and their use for measurement of non-electrical quantities.

UNIT-I: CHARACTERISTICS OF SIGNALS AND THEIR REPRESENTATION

Measuring Systems, Performance Characteristics, - Static Characteristics, Dynamic Characteristics; Errors in Measurement – Gross Errors, Systematic Errors, Statistical Analysis of Random Errors. Signals and Their Representation: Standard Test, Periodic, Aperiodic, Modulated Signal, Sampled Data, Pulse Modulation and Pulse Code Modulation.

UNIT-II: DATA TRANSMISSION , TELEMETRY AND DAS

Methods of Data Transmission – General Telemetry System. Frequency Modulation (FM), Pulse Modulation (PM), Pulse Amplitude Modulation (PAM), Pulse Code Modulation (PCM) Telemetry. Comparison of FM, PM, PAM and PCM. Analog and Digital Data Acquisition Systems – Components of Analog DAS – Types of Multiplexing Systems: Time Division and Frequency Division Multiplexing – Digital DAS – Block Diagram — Modern Digital DAS (Block Diagram)

UNIT-III: SIGNAL ANALYZERS, DIGITAL METERS

Wave Analysers- Frequency Selective Analyzers, Heterodyne, Application of Wave Analyzers-Harmonic Analyzers, Total Harmonic Distortion, Spectrum Analyzers, Basic Spectrum Analyzers, Spectral Displays, Vector Impedance Meter, Q Meter. Peak Reading and RMS Voltmeters, Digital Voltmeters - Successive Approximation, Ramp and Integrating Type-Digital Frequency Meter-Digital Multimeter-Digital Tachometer

UNIT-IV: TRANSDUCERS

Definition of Transducers, Classification of Transducers, Advantages of Electrical Transducers, Characteristics and Choice of Transducers; Principle of Operation of Resistive, Inductive, Capacitive Transducers, LVDT, Strain Gauge and Its Principle of Operation, Gauge Factor, Thermistors,

Thermocouples, Synchros, Piezoelectric Transducers, Photovoltaic, Photo Conductive Cells, Photo Diodes.

UNIT-V: MEASUREMENT OF NON-ELECTRICAL QUANTITIES

Measurement of strain, Gauge Sensitivity, Measurement of Displacement, Velocity, Angular Velocity, Acceleration, Force, Torque, Temperature, Pressure, Flow, Liquid level.

OUTCOMES: The student should be able to:

- Identify and explain the types of errors occuring in measurement systems
- Differentiate among the types of data transmission and modulation techniques
- Apply digital techniques to measure voltage, frequency and speed
- Choose suitable transducers for the measurement of non-electrical quantities

TEXT BOOKS:

1. A course in Electrical and Electronic Measurements and Instrumentation, A.K. Sawhney, Dhanpat Rai & Co., 2012.
2. Transducers and Instrumentation, D.V.S Murty, Prentice Hall of India, 2nd Edition, 2004.

REFERENCE BOOKS:

1. Modern Electronic Instrumentation and Measurement technique, A.D Helfrick and W.D.Cooper, Pearson/Prentice Hall of India., 1990.
2. Electronic Instrumentation, H.S.Kalsi Tata MCGraw-Hill Edition, 2010.
3. Industrial Instrumentation – Principles and Design, T. R. Padmanabhan, Springer, 3rd re print, 2009.

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(13A02802) Power System dynamics and control

(MOOC-I)

Objectives: The objectives of the course are to make the students learn about:

- The kinds of power stability problems
- The basic concepts of modelling and analysis of dynamical systems.
- Modelling of power system components - generators, transmission lines, excitation and prime mover controllers.
- Stability of single machine and multi-machine systems is analyzed using digital simulation and small-signal analysis techniques.
- The impact of stability problems on power system planning and operation.

Unit – I Introduction to Power System Stability

Power System Operation and Control - Stability Problems faced by Power Systems - Impact on Power System Operation and Control - Analysis of Dynamical Systems - Concept of Equilibria, Small and Large Disturbance Stability - Example: Single Machine Infinite Bus System - Modal Analysis of Linear Systems - Analysis using Numerical Integration Techniques - Issues in Modelling: Slow and Fast Transients, Stiff Systems

Unit – II Modelling of a Synchronous Machine

Physical Characteristics - Rotor Position Dependent model - D-Q Transformation - Model with Standard Parameters - Steady State Analysis of Synchronous Machine - Short Circuit Transient Analysis of a Synchronous Machine - Synchronous Machine Connected to Infinite Bus.

Unit – III Modelling of power system components

Physical Characteristics and Models - Control system components - Excitation System Controllers - Prime Mover Control Systems - Transmission Line Physical Characteristics - Transmission Line Modeling - Load Models - induction machine model - Other Subsystems - HVDC, protection systems.

Unit – IV Stability Issues in Interconnected Power Systems

Single Machine Infinite Bus System - Multi-machine Systems - Stability of Relative Motion - Frequency Stability: Centre of Inertia Motion - Concept of Load Sharing: Governors - Single Machine Load Bus System: Voltage Stability - Torsional Oscillations

Unit – V Enhancing System Stability

Planning Measures - Stabilizing Controllers (Power System Stabilizers) - Operational Measures-Preventive Control - Emergency Control - Power System Stability Analysis Tools: Small Signal Analysis Program - Transient Stability Program - Real-Time Simulators.

Outcomes: After completion of Course, the student should be able to

- Understand the power stability problems
- Understand the basic concepts of modelling of synchronous machine and power system components
- Analyse the stability issues in interconnected systems
- Understand the power system stability analysis tools and enhancement of power system stability

Reference Books:

1. K.R.Padiyar, Power System Dynamics, Stability & Control, 2nd Edition, B.S. Publications, Hyderabad, 2002.

2. P.Kundur, Power System Stability and Control, McGraw Hill Inc, New York, 1995.

3. P.Sauer & M.A.Pai, Power System Dynamics & Stability, Prentice Hall, 1997.

4. Jan Machowski, Janusz Bialek, James Richard Bumby, Power system dynamics and control , John Wiley & Sons, 1997.

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(13A02803) HVDC TRANSMISSION

(MOOC-II)

OBJECTIVES: The objectives of the course are to make the students learn about:

- Technical and economic aspects of HVAC and HVDC transmission and their comparison.
- Static power converters
- Control of HVDC converter systems
- Origin, effects, classification and elimination of harmonics
- The occurrence of faults, and transients in HVDC system and their protection.

UNIT-I: INTRODUCTION TO HVDC TRANSMISSION

HVDC Transmission: Technical And Economical Comparison of HVAC and HVDC Transmission, Types of DC Links, Power Handling Capabilities of HVDC Lines, static Conversion Principles, Static Converter Configuration.

UNIT-II: STATIC POWER CONVERTER ANALYSIS

Static Power Converters: 3-Pulse, 6-Pulse & 12-Pulse Converters, Converter Station and Terminal Equipment, Commutation Process, Rectifier and Inverter Operation, Equivalent Circuit for Rectifier, Inverter and HVDC Link- Special Features of Converters.

UNIT-III: CONTROL OF HVDC CONVERTER SYSTEMS

Control of HVDC Converter Systems: Principle of DC Link Control – Constant Current, Constant Extinction Angle and Constant Ignition Angle Control and Voltage Dependent Current Control. Individual Phase Control and Equidistant Firing Angle Control

UNIT-IV: HARMONICS AND FILTERS

Origin of Harmonics in HVDC Systems, Classification of Harmonics, Elimination of Harmonics, Suppression Methods, Harmonic Instability Problems, Design of HVDC AC & DC Filters.

UNIT-V: TRANSIENTS, FAULTS AND PROTECTION OF HVDC SYSTEMS

Origin of over Voltages in HVDC Systems, Over Voltages due to DC and AC Side Line Faults - Converter Faults, Over Current Protection- Valve Group and DC Line Protection. Over Voltage Protection of Converters, Surge Arresters etc.

OUTCOMES: After Completion of Course, the student should be able to:

- Compare HVDC and HVAC transmission systems
- Understand the operation of various converters used in HVDC transmission systems
- Devise means to suppress / eliminate harmonics.
- Design HVDC and AC Filters

TEXT BOOKS:

1. HVDC Power Transmission Systems, K.R.Padiyar, 3rd Edition, New Age International publishers, 2015.
2. HVDC Transmission, S.Kamakshaiah, V.Kamaraju, Mc Graw Hill Education (India) Pvt. Ltd., 2011.

REFERENCES:

1. Direct Current Transmission, Vol. 1, E. W. Kimbark, Wiley, 1971
2. High Voltage Direct Current Transmission, Jos Arrillaga, IEE Power and Energy series 29, 2nd Edition, 1998
3. EHV-AC, HVDC Transmission & Distribution Engineering, S Rao, Khanna Publishers, 4th Edition, 2008.

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(13A02804) Energy Resources & Technology

(MOOC-II)

Objectives: The objectives of the course are to make the students learn about:

- Production of quality of energy
- Types of generation plants and their principle of operation
- Methods of energy storage
- Economics of generation

Unit – I: Fundamentals principles of energy

Fundamentals of energy- Quality of energy- Complete Cycle Analysis of Fossil Fuels - Other Fossil Fuels - Energy Economics : Input-Output Analysis.

Unit – II: Thermal, Hydro and Nuclear power sources

Thermal Power Plants - Hydroelectric Power plants - Nuclear Power Generation- Nuclear Fusion Reactors - Environmental Effects of Conventional Power

Unit – III: Solar, wind and photo voltaic power sources

Solar Thermal Energy Conversion - Solar Concentrating Collectors - Photovoltaic Power Generation- Wind Energy - Wind Electrical Conversion

Unit – IV: Other sources of energy

Tidal Energy - Ocean Thermal Energy Conversion - Solar Pond and Wave Power - Geothermal Energy - Solar Distillation and Biomass Energy

Unit – V: Energy storage and Economy

Energy Storage - Energy in Transportation - Magneto hydrodynamic Power Generation - Hydrogen Economy.

Outcomes: After completion of Course, the student should be able to:

- Understand different types of sources of energy
- Analyse the generation principles and operation of variety of sources of energy
- Understand energy storage and economy

Reference Books:

1. Renewable energy Resources – Jhon Twidell and tony Weir, Second edition, Taylor and Francis Group, 2006
2. Non- conventional energy sources by G. D. Rai, Khanna Publishers, 2000
3. Electrical power generation, Transmission and distribution by S. N. Singh, PHI, 2003
4. Wind electrical systems by S. N. Bhadra, D. Kastha & S. Banerjee – Oxford University Press, 2013

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(13A02805) Design of Electrical Systems

(MOOC-II)

Course Objective: This course introduces the procedure for basic design of electrical installations for domestic and industrial applications. And also it concentrates on power system earthing for the protection of electrical devices which are generally used for domestic and industries. This will enable the procedure to maintain the protective system. It also learns the power quality issues and power factor improvement for domestic and industrial applications.

UNIT I DESIGN ASPECTS & ELECTRICAL INSTALLATIONS IN DOMESTIC BUILDINGS

Role of Statutes in Electrical System Design, Classification of Building Services, Design Aspects of Lighting, Design Aspects of Ventilation, Design Aspects of Climate Control, Design Aspects of Vertical Transportation, Design Aspects of Minor Building Services- Classification, Estimation of Load Requirements, Selection of Type of Wiring, Special Features Applicable for High-Rise Apartment Buildings, Pre-commissioning Tests.

UNIT II INDUSTRIAL INSTALLATIONS

Classification of Industrial Installation, General Characteristics, Selection of Distribution Architecture, Selection of Transformers and Sub Stations -Short Circuit Studies, Fault Current Calculations, Earthing Design, Selection of Switch Gears: Electrical Protection, Protection of Circuit Elements, Persons & Life stack, Equipment, Electrical Isolation, Switch Gear Control, Switching Devices, Uses, Selective Coordination, Circuit Breakers and Their Selection

UNIT III POWER SYSTEM EARTHING

Introduction, Earthing, Types of System Earthing, Reasons for Grounding/ Earthing, TN System, TT System, IT System, Protective Measures and Protective Devices in IT System, Main Characteristics of Earthing Systems, Selection Criteria for Earthing, Design Considerations of Earting, Measurement of Earth Resistance, Earth Leakage Protection, Neutral Earthing for Generators and Transformers.

UNIT IV LIGITINING PROTECTION SYSTEMS DESIGN

Introduction to Protection Methods and Risks- Risk Management-Lightening Protection Zones-Design Process-Material Requirement-Design Methods-Rolling Sphere-Mesh Method-Protection Angle MethodAir Terminations-Down Conductors

UNIT V ENERGY ECONOMICS IN SYSTEM DESIGN

Introduction, Time Value of Money, Single Payment Compound Amount Model (SPCA), Uniform Series Compound Amount Model (USCA), Uniform Series Present Worth Model (USPW), Depreciation, Tax Considerations, After Tax Analysis.

Text Books:

1. Electrical Systems Design – by M. K. Giridharan, I. K. International Publishing House Pvt. Ltd., 2011. 2. Design of Electrical Installations – by Er. V. K. Jain and Er. Amitabh Bajaj, University Science Press. 3. Lightening protection Hand book –ERITECH:
URL: igs.nigc.ir/STANDS/Book/LIGHTINING-ERITECH.pdf

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(13A04703) EMBEDDED SYSTEMS
(MOOC-III)

Course Outcomes:

- Able to understand the fundamental concepts of embedded systems.
- Able to learn the architecture of Advanced ARM microcontrollers.
- Able to learn the architecture of Advanced MSP430 microcontrollers.
- Able to learn various programming techniques and interfacing using ARM and MSP430.

UNIT I

Embedded system overview, applications, features and architecture considerations - ROM, RAM, timers, data and address bus, I/O interfacing concepts, memory mapped I/O. CISC Vs RISC design philosophy, Von-Neumann Vs Harvard architecture. Low power RISC MSP430 – block diagram, features and architecture, Instruction set, instruction formats, and various addressing modes of 16-bit microcontroller e.g. MSP430, Variants of the MSP430 family viz. MSP430x2x, MSP430x4x, MSP430x5x and their targeted applications, Sample embedded system on MSP430 microcontroller.

UNIT-II

MSP430x5x series block diagram, address space, on-chip peripherals (analog and digital), and Register sets. I/O ports pull up/down registers concepts, Interrupts and interrupt programming. Watchdog timer. System clocks. Low Power aspects of MSP430: low power modes, Active vs Standby current consumption, FRAM vs Flash for low power & reliability.

UNIT-III

Timer & Real Time Clock (RTC), PWM control, timing generation and measurements. Analog interfacing and data acquisition: ADC and Comparator in MSP430, data transfer using DMA.

Case Study: MSP430 based embedded system application using ADC & PWM demonstrating peripheral intelligence. "Remote Controller of Air Conditioner Using MSP430".

UNIT-IV

Serial communication basics, Synchronous/Asynchronous interfaces (like UART, USB, SPI, and I2C). UART protocol, I2C protocol, SPI protocol. Implementing and programming UART, I2C, SPI interface using MSP430, Interfacing external devices.

Case Study: MSP430 based embedded system application using the interface protocols for communication with external devices: "A Low-Power Battery less Wireless Temperature and Humidity Sensor with Passive Low Frequency RFID"

UNIT-V

IoT overview and architecture, Adding Wi-Fi capability to the Microcontroller, Embedded Wi-Fi, User APIs for Wireless and Networking applications, Building IoT applications using CC3100 user API for connecting sensors.

Case Study: MSP430 based Embedded Networking Application: "Implementing Wi-Fi Connectivity in a Smart Electric Meter"

Text Books:

1. MSP430 microcontroller basics 1st Edition by John H. Davies (Author), Newnes Publication ISBN-13: 978-0750682763
2. Gettingstarted with the MSP430 Launchpad by Adrian Fernandez, Dung Dang, Newness publication ISBN-13: 978-0124115880
3. Embedded Systems 2E Raj Kamal, Tata McGraw-Hill Education, 2011 ISBN-0070667640, 9780070667648

References:

1. http://processors.wiki.ti.com/index.php/MSP430_LaunchPad_Low_Power_Mode
2.http://processors.wiki.ti.com/index.php/MSP430_16-Bit_Ultra-Low_Power_MCU_Training
3.CC3100/CC3200 SimpleLink™ Wi-Fi® Internet-on-a-Chip User Guide Texas Instruments Literature Number: SWRU368A April 2014–Revised August 2015

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(13A02806) Industrial Automation & Control

(MOOC-III)

Objectives: The objectives of the course are to make the students learn about

- Sensors and types of measurement systems
- Process control and sequence control of different controllers
- Operation of actuators
- Types of electric drives and their principles

Unit – I Introduction to sensors and measurement systems

Introduction to Industrial Automation and Control - Architecture of Industrial Automation Systems - Introduction to sensors and measurement systems - Temperature measurement - Pressure and Force measurements - Displacement and speed measurement - Flow measurement techniques - Measurement of level, humidity, pH etc - Signal Conditioning and Processing - Estimation of errors and Calibration.

Unit – II Introduction to Process Control

P-- I -- D Control - Controller Tuning - Implementation of PID Controllers - Special Control Structures : Feed forward and Ratio Control - Special Control Structures : Predictive Control, Control of Systems with Inverse Response - Special Control Structures : Cascade Control, Overriding Control, Selective Control, Split Range Control.

Unit – III Introduction to Sequence Control

PLCs and Relay Ladder Logic - Sequence Control: Scan Cycle, RLL Syntax - Sequence Control: Structured Design Approach - Sequence Control: Advanced RLL Programming - Sequence Control: The Hardware environment

Unit – IV Introduction to Actuators

Flow Control Valves - Hydraulic Actuator Systems: Principles, Components and Symbols

- Hydraulic Actuator Systems: Pumps and Motors- Proportional and Servo Valves - Pneumatic Control Systems: System Components - Pneumatic Control Systems: Controllers and Integrated Control Systems - Networking of Sensors, Actuators and Controllers: The Fieldbus - The Field bus Communication Protocol

Unit – V Electric Drives

Introduction, Energy Saving with Adjustable Speed Drives - Step motors: Principles, Construction and Drives - DC Motor Drives: Introduction, DC--DC Converters, Adjustable Speed Drives - Induction Motor Drives: Introduction, Characteristics, Adjustable Speed Drives - Synchronous Motor Drives: Motor Principles, Adjustable Speed and Servo Drives.

Outcomes: After completion of Course, the student should be able to

- Understand the measurement of different quantities
- Apply principles of electric drives for different applications like speed control
- Understand the principles of process control and sequence control in relay ladder logic.
- Understand the operation of controller in integrated control systems

Reference Books:

1. S. Mukhopadhyay, S. Sen & A. K. Deb, Industrial instrumentation, control and automation, Jaico Publishing House, 2012
2. Madhuchhanda Mitra and Samarjit Sen Gupta, Programmable Logic Controllers And Industrial Automation An ntroduction,2008
3. David W. Pessen, Industrial Automation: Circuit Design and Components
4. Wiley India Publication, 2011
5. Rajput R.K, Robotics and Industrial Automation, S. Chand publications, 2008