B.Tech IV-II Semester (EEE)

S. No.	Course Code	Subject	L	T	P	C
1.	15A02801 15A02802 15A02803	**MOOCS – II** 1. Instrumentation 2.Power System Dynamics and Control 3. Industrial Automation & Control	3	1	-	3
2.	15A02804 15A04702 15A02805	**MOOCS – III** 1. HVDC Transmission 2. Embedded Systems 3. Energy Resources & Technology	3	1	-	3
3.	15A02806	Comprehensive Viva Voce	-	-	4	2
4.	15A02807	Technical Seminar	-	-	4	2
5.	15A02808	Project Work	-		24	12
		Total:	**6**	**2**	**32**	**22**

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15A02801 INSTRUMENTATION
(MOOCS-II)

Course 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.

Course 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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15A02802 POWER SYSTEM DYNAMICS AND CONTROL (MOOCS-II)

Course 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.

Course 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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15A02803 INDUSTRIAL AUTOMATION & CONTROL (MOOCS-II)

Course 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.

Course 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

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15A02804 HVDC TRANSMISSION
(MOOCS-III)

Course 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.

Course 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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15A04702 EMBEDDED SYSTEMS
(MOOCS-III)

Course Outcomes:

After completion the students will be able to

- Design of embedded systems leading to 32-bit application development.
- Understand hardware-interfacing concepts to connect digital as well as analog sensors while ensuring low power considerations.
- Review and implement the protocols used by microcontroller to communicate with external sensors and actuators in real world.
- Understand Embedded Networking and IoT concepts based upon connected MCUs

UNIT-I

Introduction to Embedded Systems

Embedded system introduction, host and target concept, embedded applications, features and architecture considerations for embedded systems- ROM, RAM, timers; data and address bus concept, Embedded Processor and their types, Memory types, overview of design process of embedded systems, programming languages and tools for embedded design

UNIT-II

Embedded processor architecture

CISC Vs RISC design philosophy, Von-Neumann Vs Harvard architecture. Introduction to ARM architecture and Cortex – M series, Introduction to the TM4C family viz. TM4C123x & TM4C129x and its targeted applications. TM4C block diagram, address space, on-chip peripherals (analog and digital) Register sets, Addressing modes and instruction set basics.

UNIT- III

Overview of Microcontroller and Embedded Systems

Embedded hardware and various building blocks, Processor Selection for an Embedded System , Interfacing Processor, Memories and I/O Devices, I/O Devices and I/O interfacing concepts, Timer and Counting Devices, Serial Communication and Advanced I/O, Buses between the Networked Multiple Devices.

Embedded System Design and Co-design Issues in System Development Process, Design Cycle in the Development Phase for an Embedded System, Uses of Target System or its Emulator and In-Circuit Emulator (ICE), Use of Software Tools for Development of an Embedded System

Design metrics of embedded systems - low power, high performance, engineering cost, time-to-market.

UNIT-IV

Microcontroller fundamentals for basic programming

I/O pin multiplexing, pull up/down registers, GPIO control, Memory Mapped Peripherals, programming System registers, Watchdog Timer, need of low power for embedded systems, System Clocks and control, Hibernation Module on TM4C, Active vs Standby current consumption. Introduction to Interrupts, Interrupt vector table, interrupt programming. Basic Timer, Real Time Clock (RTC), Motion Control Peripherals: PWM Module & Quadrature Encoder Interface (QEI).

Unit-V

Embedded communications protocols and Internet of things

Synchronous/Asynchronous interfaces (like UART, SPI, I2C, USB), serial communication basics, baud rate concepts, Interfacing digital and analog external device, Implementing and programming UART, SPI and I2C, SPI interface using TM4C. Case Study: Tiva based embedded system application using the interface protocols for communication with external devices “Sensor Hub BoosterPack”

Embedded Networking fundamentals, IoT overview and architecture, Overview of wireless sensor networks and design examples. Adding Wi-Fi capability to the Microcontroller, Embedded Wi-Fi, User APIs for Wireless and Networking applications Building IoT applications using CC3100 user API.

Case Study: Tiva based Embedded Networking Application: “Smart Plug with Remote Disconnect and Wi-Fi Connectivity”

Text Books:

1. Embedded Systems: Real-Time Interfacing to ARM Cortex-M Microcontrollers, 2014, Create space publications ISBN: 978-1463590154.
2. Embedded Systems: Introduction to ARM Cortex - M Microcontrollers, 5th edition
   Jonathan W Valvano, Createspace publications ISBN-13: 978-1477508992
3. Embedded Systems 2E Raj Kamal, Tata McGraw-Hill Education, 2011 ISBN-
4. 0070667640, 9780070667648

References:

1. http://processors.wiki.ti.com/index.php/Hands-On_Training_for_TI_Embedded_Processors
2. http://processors.wiki.ti.com/index.php/MCU_Day_Internet_of_Things_2013_Workshop
3. http://www.ti.com/ww/en/simplelink_embedded_wi-fi/home.html
4. 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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15A02805 ENERGY RESOURCES & TECHNOLOGY
(MOOCS-III)

Course 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.

Course 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