



TKR COLLEGE OF ENGINEERING AND TECHNOLOGY

AN AUTONOMOUS INSTITUTION

Accredited by NAAC with 'A+' Grade.

(Sponsored by TKR Educational Society, Approved by AICTE, Affiliated to JNTU H)

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Value Added Courses Syllabus

2022-23

1. Health and Wellness

Course Objectives

- To promote physical, mental, and emotional well-being among engineering students.
- To develop awareness of healthy lifestyle practices and disease prevention.
- To understand nutrition, fitness, stress management, and workplace wellness.
- To encourage lifelong healthy habits for professional and personal success.

UNIT–I: Fundamentals of Health and Wellness

- Concept, dimensions, and determinants of health and wellness
- Physical, mental, emotional, social, and occupational wellness
- Health indicators and quality of life
- Factors affecting health: lifestyle, environment, heredity, and technology usage
- Role of wellness in academic and professional performance

UNIT–II: Nutrition and Healthy Lifestyle

- Principles of balanced diet and nutritional requirements
- Macronutrients and micronutrients
- Healthy eating habits and hydration
- Obesity, malnutrition, and weight management
- Food safety, junk food, and dietary planning for students

UNIT–III: Physical Fitness and Yoga

- Components of physical fitness and exercise principles
- Aerobic and anaerobic exercises
- Fitness assessment and BMI calculation
- Yoga, meditation, and breathing techniques
- Posture correction and ergonomic practices for engineering students

UNIT–IV: Mental Health and Stress Management

- Mental health and emotional intelligence
- Stress, anxiety, depression, and burnout among students
- Time management and work-life balance
- Mindfulness and relaxation techniques
- Substance abuse awareness and prevention strategies

UNIT–V: Preventive Healthcare and Workplace Wellness

Lifestyle diseases: Diabetes, Hypertension, Cardiovascular diseases
Communicable and non-communicable diseases
First aid and emergency response basics
Occupational health and safety in electrical engineering environments
Wellness practices for engineers and sustainable healthy living

After completing the course, students will be able to:

CO1: Explain the concepts and dimensions of health and wellness.

CO2: Apply nutritional principles for healthy living.

CO3: Demonstrate fitness, yoga, and stress management practices.

CO4: Identify lifestyle diseases and preventive healthcare measures.

CO5: Adopt workplace wellness and safety practices in engineering professions.

2. Electrical Safety, Earthing and Maintenance Practices

Course Objectives

To understand electrical hazards and safety regulations.

To learn various earthing systems and grounding practices.

To develop skills in testing, inspection, and maintenance of electrical installations.

To familiarize students with personal protective equipment (PPE) and emergency response procedures.

To promote safe operation and maintenance of electrical equipment in domestic, commercial, and industrial environments.

UNIT–I: Fundamentals of Electrical Safety

Introduction to electrical safety and its importance

Effects of electric shock on the human body

Electrical hazards: shock, arc flash, arc blast, fire, and explosions

Causes of electrical accidents and preventive measures

Safety rules, permits to work, lockout/tagout (LOTO) procedures

UNIT–II: Electrical Safety Standards and Protective Equipment

Indian Electricity Rules and relevant safety regulations

Safety standards: IS, IEC, IEEE, and National Electrical Code (NEC)

Personal Protective Equipment (PPE) for electrical work

Safety signs, symbols, and color codes

First aid for electric shock victims and emergency response procedures

UNIT–III: Earthing and Grounding Systems

Importance and objectives of earthing

Types of earthing: Plate, Pipe, Rod, Strip, and Chemical Earthing

System grounding methods: TN, TT, and IT systems

Earth resistance measurement and testing methods

Design considerations and maintenance of earthing systems

UNIT–IV: Testing, Inspection and Maintenance Practices

Preventive, predictive, corrective, and breakdown maintenance

Inspection and testing of electrical installations

Maintenance of transformers, motors, switchgear, and cables

Use of insulation resistance tester (Megger), earth tester, and clamp meter

Troubleshooting common electrical faults

UNIT–V: Industrial Electrical Safety and Case Studies

Safety practices in substations and industrial plants

Electrical fire hazards and fire-fighting techniques

Maintenance planning and documentation

Accident investigation and safety audit procedures

Case studies on electrical accidents and lessons learned

After successful completion of the course, students will be able to:

CO1: Identify electrical hazards and follow safe work practices.

CO2: Apply electrical safety regulations, standards, and PPE requirements.

CO3: Design, test, and maintain earthing systems.

CO4: Carry out inspection, testing, and maintenance of electrical equipment.

CO5: Analyze electrical accidents and implement industrial safety measures.

3. Microgrid Design and Operation

Course Objectives

To Understand the concepts, architecture, and components of AC, DC, and hybrid microgrids.

To Learn the design and sizing of distributed energy resources (DERs), renewable energy sources, and energy storage systems for microgrids.

To Analyze microgrid operation under grid-connected and islanded modes.

To Study control strategies, energy management systems, and power-sharing techniques in microgrids.

To Understand protection, reliability, and future smart grid applications of microgrids.

UNIT-I : Introduction to Microgrids

Evolution of Power Systems

Concept and Definition of Microgrids

Need and Benefits of Microgrids

Microgrid Architecture

Components of Microgrids

Distributed Energy Resources (DERs)

Types of Microgrids:

- AC Microgrids
- DC Microgrids
- Hybrid Microgrids

Applications of Microgrids

Indian and Global Microgrid Case Studies

UNIT-II: Microgrid Design and Components

Load Assessment and Load Profiling
Design Considerations for Microgrids
Solar PV Integration
Wind Energy Integration
Biomass and Fuel Cell Systems
Energy Storage Systems:

- Batteries
- Supercapacitors
- Flywheels

Power Electronic Interfaces
Microgrid Sizing and Planning

UNIT-III: Microgrid Operation and Control

Modes of Operation:

- Grid Connected Mode
- Islanded Mode

Power Flow in Microgrids
Voltage and Frequency Regulation
Droop Control
Centralized Control
Decentralized Control
Hierarchical Control Architecture
Active and Reactive Power Sharing
Grid Synchronization and Islanding Detection

UNIT-IV: Energy Management and Optimization

Energy Management Systems (EMS)
Demand Side Management
Load Forecasting
Economic Dispatch in Microgrids
Renewable Energy Forecasting
Battery Charging and Discharging Strategies
Optimal Scheduling of Resources
Smart Grid Integration
SCADA and IoT-based Monitoring

UNIT-V: Protection, Reliability and Emerging Trends

Protection Challenges in Microgrids
Fault Detection and Isolation
Relay Coordination
Anti-Islanding Protection
Reliability and Resilience Assessment
Cybersecurity Issues in Microgrids
IEEE Standards and Grid Codes
Peer-to-Peer Energy Trading
Artificial Intelligence Applications
Future Trends in Smart and Sustainable Microgrids

After successful completion of the course, students will be able to:

CO1: Explain the architecture, components, and operational characteristics of microgrids.

CO2: Design and size renewable energy sources and energy storage systems for microgrid applications.

CO3: Analyze the performance of microgrids under grid-connected and islanded operating conditions.

CO4: Apply control and energy management techniques for stable and efficient microgrid operation.

CO5: Evaluate protection schemes, reliability issues, and emerging trends in smart and sustainable microgrids.

4. Embedded Systems for Electrical Applications

Course Objectives

To understand the fundamentals of embedded systems and microcontrollers.

To learn interfacing techniques for sensors, actuators, and electrical devices.

To develop embedded solutions for electrical engineering applications.

To study communication protocols used in automation and smart grids.

To gain exposure to IoT-based monitoring and control systems.

UNIT – I: Fundamentals of Embedded Systems

Introduction to Embedded Systems

Characteristics and Classification of Embedded Systems

Hardware and Software Components of Embedded Systems

Microcontroller's vs Microprocessors

Architecture of Embedded Systems

Overview of ARM, PIC, and AVR Microcontrollers

Embedded System Design Flow

UNIT – II: Microcontroller Programming and Interfacing

Introduction to Arduino and ARM-based Development Boards

GPIO Programming

Timers, Counters, and Interrupts

Analog-to-Digital (ADC) and Digital-to-Analog (DAC) Converters

Interfacing LEDs, Relays, LCDs, and Keypads

Sensor Interfacing (Temperature, Current, Voltage, and Light Sensors)

UNIT – III: Embedded Systems for Electrical Applications

Embedded Control of DC and AC Motors

PWM Techniques for Speed Control

Embedded-Based Battery Monitoring Systems

Smart Energy Metering Systems

Embedded Protection Systems for Electrical Equipment

Data Acquisition Systems in Power Applications

UNIT – IV: Communication Protocols and Industrial Automation

Serial Communication: UART, SPI, and I²C

CAN Protocol Basics

RS-232 and RS-485 Communication
Modbus Communication Protocol
Embedded Systems in Industrial Automation
SCADA and PLC Integration Concepts
Smart Grid Communication Architecture

UNIT – V: IoT and Smart Electrical Systems

Introduction to Internet of Things (IoT)
ESP32 and Wi-Fi Enabled Embedded Systems
Cloud-Based Monitoring and Control
Smart Home Automation
IoT-Based Energy Monitoring Systems
Embedded Systems for Renewable Energy Applications
AI and Edge Computing in Smart Electrical Systems
Future Trends in Embedded Electrical Applications

After successful completion of the course, students will be able to:

CO1: Explain the architecture, components, and operational characteristics of embedded systems used in electrical engineering applications.

CO2: Develop embedded programs using microcontrollers and embedded C for interfacing sensors, actuators, and electrical devices.

CO3: Apply communication protocols and interfacing techniques for data acquisition, monitoring, and control of electrical systems.

CO4: Design embedded solutions for electrical engineering applications such as motor control, smart energy metering, industrial automation, and renewable energy systems.

CO5: Analyze and implement real-time embedded systems using RTOS concepts for reliable and efficient operation of electrical and power system applications.