# SHRI VENKATESHWARA UNIVERSITY


# Syllabus

## B.Tech

## Electrical Engineering

**VI SEMESTER**

**(THREE Years Programme)**

**(w.e.f. 2019-20)**

## SCHOOL OF ENGINEERING & TECHNOLOGY

| ELECTRICAL ENGINEERING- VI SEMESTER | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Sl. No.** | **Subject Codes** | **Subject** | **Periods** | | | **Evaluation Scheme** | | | | **End Semester** | | **Total** | **Credit** |
| | | | **L** | **T** | **P** | **CT** | **TA** | **Total** | **PS** | **TE** | **PE** | | |
| 1 | **SEE - 601** | Power Systems – II (Operation and Control) | 3 | 0 | 0 | 20 | 10 | 30 | | 70 | | 100 | 3 |
| 2 | **SEE-602** | Measurements and Instrumentation | 2 | 0 | 0 | 20 | 10 | 30 | | 70 | | 100 | 2 |
| **3** | **SEEE-603** | Power System Dynamics and Control | 3 | 0 | 0 | 20 | 10 | 30 | | 70 | | 100 | 3 |
| **4** | SEE-604 | Electrical Energy Conservation and Auditing | 3 | 0 | 0 | 20 | 10 | 30 | | 70 | | 100 | 3 |
| 5 | SEE-605 | Electrical Materials | 3 | 0 | 0 | 20 | 10 | 30 | | 70 | | 100 | 3 |
| 6 | **SOE-061** | Sociology,Society and Culture | 3 | 0 | 0 | 20 | 10 | 30 | | 70 | | 100 | 3 |
| 7 | **SEE -611** | Power Systems Lab - II | 0 | 0 | 2 | | | | 25 | | 25 | 50 | 1 |
| 8 | **SEE-612** | Measurements and Instrumentation Lab | 0 | 0 | 2 | | | | 25 | | 25 | 50 | 1 |
| 8 | **SEE-613** | Electronics Design Lab | 0 | 0 | 4 | | | | 25 | | 25 | 50 | 2 |
| | | | | | | | | | | | | **750** | **21** |

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| **SEE-601** | **Power Systems – II** | **3L:0T:0P** | **3 credits** |

## Course Outcomes:

At the end of this course, students will demonstrate the ability to

- Use numerical methods to analyse a power system in steady state.
- Understand stability constraints in a synchronous grid.
- Understand methods to control the voltage, frequency and power flow.
- Understand the monitoring and control of a power system.
- Understand the basics of power system economics.

*Module 1: Power Flow Analysis (7 hours)*

Review of the structure of a Power System and its components. Analysis of Power Flows: Formation of Bus Admittance Matrix. Real and reactive power balance equations at a node. Load and GeneratorSpecifications. Application of numerical methods for solution of non-linear algebraic equations – Gauss Seidel and Newton-Raphson methods for the solution of the power flow equations. Computational Issues in Large-scale Power Systems.

*Module 2: Stability Constraints in synchronous grids (8 hours)*

Swing Equations of a synchronous machine connected to an infinite bus. Power angle curve. Description of the phenomena of loss of synchronism in a single-machine infinite bus system following a disturbance like a three--phase fault. Analysis using numerical integration of swing equations (using methods like Forward Euler, Runge-Kutta $4^{th}$ order methods), as well as the Equal Area Criterion. Impact of stability constraints on Power System Operation. Effect of generation rescheduling and series compensation of transmission lines on stability.

*Module 3: Control of Frequency and Voltage (7 hours)*

Turbines and Speed-Governors, Frequency dependence of loads, Droop Control and Power Sharing. Automatic Generation Control. Generation and absorption of reactive power by various components of a Power System. Excitation System Control in synchronous generators, Automatic Voltage Regulators. Shunt Compensators, Static VAR compensators and STATCOMs. Tap Changing Transformers.

Power flow control using embedded dc links, phase shifters and

*Module 4: Monitoring and Control (6 hours)*

Overview of Energy Control Centre Functions: SCADA systems. Phasor Measurement Units and Wide-Area Measurement Systems. State-estimation. System Security Assessment. Normal, Alert, Emergency, Extremis states of a Power System. Contingency Analysis. Preventive Control and Emergency Control.

*Module 5: Power System Economics and Management (7 hours)*

Basic Pricing Principles: Generator Cost Curves, Utility Functions, Power Exchanges, Spot Pricing. Electricity Market Models (Vertically Integrated, Purchasing Agency, Whole-sale competition, Retail Competition), Demand Side-management, Transmission and Distributions charges, Ancillary Services. Regulatory framework.

*Text/References:*


1. J. Grainger and W. D. Stevenson, "Power System Analysis", McGraw Hill Education, 1994.
2. O. I. Elgerd, "Electric Energy Systems Theory", McGraw Hill Education, 1995.
3. A. R. Bergen and V. Vittal, "Power System Analysis", Pearson Education Inc., 1999.
4. D. P. Kothari and I. J. Nagrath, "Modern Power System Analysis", McGraw Hill Education, 2003.
5. B. M. Weedy, B. J. Cory, N. Jenkins, J. Ekanayake and G. Strbac, "Electric Power Systems", Wiley, 2012.


PCC-EE21: Power Systems-II Laboratory (0:0:2 – 1 credit)

Hands-on and computational experiments related to the course contents of EE20. This should includeprogramming of numerical methods for solution of the power flow problem and stability analysis. Visit to load dispatch centre is suggested.

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| **SEE-602** | **Measurements and Instrumentation** | **3L:0T:0P** | **3 credits** |

UNIT I

Electrical Measurements: Measurement system, Characteristics of instruments, Methods of measurement, Errors in Measurement & Measurement standards, Review of indicating and integrating instruments: Voltmeter, Ammeter, Three phase Wattmeter, Multimeter and Energy meter. UNIT II Measurement of Resistance, Inductance and Capacitance: Measurement of low, medium and high resistances, insulation resistance measurement, AC bridges for inductance and capacitance measurement.

UNIT III

Instrument Transformers: Current and Potential transformer, ratio and phase angle errors, design considerations and testing. UNIT IV Electronic Measurements: Electronic voltmeter, Multimeter, Wattmeter & energy meter. Time, Frequency and phase angle measurements using CRO; Spectrum & Wave analyzer. Digital counter, frequency meter, voltmeter, multimeter and storage oscilloscope.

UNIT V

Instrumentation: Transducers, classification & selection of transducers, strain gauges, Thermistors, Thermocouples, LVDT, Inductive & capacitive transducers, Piezoelectric and Hall-effect transducers, Measurement of motion, force, pressure, temperature, flow and liquid level, basic concepts of smart sensors and application. Data Acquisition Systems.

Text Book:


1. A K Sawhney, "Electrical & Electronic Measurement & Instrument", Dhanpat Rai & Sons, India

2. BC Nakra & K. Chaudhary, “Instrumentation, Measurement and Analysis,” Tata McGraw Hill 2nd Edition

3. Purkait, “Electrical & Electronics Measurement & Instrumentation”, TMH

Reference Books:

1. Forest K. Harris, “Electrical Measurement”, Willey Eastern Pvt. Ltd. India

2. M. Stout , “Basic Electrical Measurement”, Prentice Hall of India

3. WD Cooper, “Electronic Instrument & Measurement Technique”, Prentice Hall International

4. EW Golding & F.C. Widdis, “Electrical Measurement &Measuring Instrument”, AW Wheeler & Co. Pvt. Ltd.

**SEE 612 Measurements and Instrumentation Experiments**

1. Measurement of a batch of resistors and estimating statistical parameters.
2. Measurement of L using a bridge technique as well as LCR meter.
3. Measurement of C using a bridge technique as well as LCR meter.

4. Measurement of Low Resistance using Kelvin's double bridge.
5. Measurement of High resistance and Insulation resistance using Megger.
6. Usage of DSO for steady state periodic waveforms produced by a function generator. Selection of trigger source and trigger level, selection of time-scale and voltage scale. Bandwidth of measurement and sampling rate.
7. Download of one-cycle data of a periodic waveform from a DSO and use values to compute the RMS values using a C program.
8. Usage of DSO to capture transients like a step change in R-L-C circuit.
9. Current Measurement using Shunt, CT, and Hall Sensor.

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| **SEE-603** | **Power System Dynamics and Control** | **3L:0T:0P** | **3 credits** |

**Course Outcomes:**

At the end of this course, students will demonstrate the ability to

- Understand the problem of power system stability and its impact on the system.
- Analyse linear dynamical systems and use of numerical integration methods.
- Model different power system components for the study of stability.
- Understand the methods to improve stability.

*Module 1: Introduction to Power System Operations (3 hours)*

Introduction to power system stability. Power System Operations and Control. Stability problems inPower System. Impact on Power System Operations and control.

*Module 2 : Analysis of Linear Dynamical System and Numerical Methods (5 hours)*

Analysis of dynamical System, Concept of Equilibrium, Small and Large Disturbance Stability. Modal Analysis of Linear System. Analysisusing Numerical Integration Techniques. Issues in Modeling: Slow and Fast Transients, Stiff System.

**Module 3 : Modeling of Synchronous Machines and Associated Controllers (12 hours)** Modeling of 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. Synchronization of SynchronousMachine to an Infinite Bus. Modeling of Excitation and Prime Mover Systems. Physical Characteristics and Models. Excitation System Control. Automatic Voltage Regulator. Prime Mover Control Systems. Speed Governors.

*Module 4 : Modeling of other Power System Components (10 hours)*

Modeling of Transmission Lines and Loads. Transmission Line Physical Characteristics. Transmission Line Modeling. Load Models - induction machine model. Frequency and Voltage Dependence of Loads. Other Subsystems – HVDC and FACTS controllers, Wind Energy Systems.

*Module 5 : Stability Analysis (11 hours)*

Angular stability analysis in Single Machine Infinite Bus System. Angular Stability in multi-machine systems – Intra-plant, Local and Inter-area modes. Frequency Stability: Centre of Inertia Motion. Load Sharing: Governordroop. Single Machine Load Bus System: Voltage Stability. Introduction to Torsional Oscillations and the SSR phenomenon. Stability Analysis Tools:Transient Stability Programs, Small Signal Analysis Programs.

*Module 6 : Enhancing System Stability (4 hours)*

Planning Measures. Stabilizing Controllers (Power System Stabilizers). Operational Measures-Preventive Control. Emergency Control.

*Text/Reference Books*


1. K.R. Padiyar, "Power System Dynamics, Stability and Control", B. S. Publications, 2002.
2. P. Kundur, "Power System Stability and Control", McGraw Hill, 1995.
3. P. Sauer and M. A. Pai, "Power System Dynamics and Stability", Prentice Hall, 1997.


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| **SEE-604** | **Electrical Energy Conservation andAuditing** | **3L:0T:0P** | **3 credits** |

**Course Outcomes:**

At the end of this course, students will demonstrate the ability to

- Understand the current energy scenario and importance of energy conservation.
- Understand the concepts of energy management.
- Understand the methods of improving energy efficiency in different electrical systems.
- Understand the concepts of different energy efficient devices.

*Module 1: Energy Scenario (6 Hours)*

Commercial and Non-commercial energy, primary energy resources, commercial energy production,final energy consumption, energy needs of growing economy, long term energy scenario, energy pricing, energy sector reforms, energy and environment, energy security, energy conservation and its importance, restructuring of the energy

supply sector, energy strategy for the future, air pollution, climate change. Energy Conservation Act-2001 and its features.

*Module 2: Basics of Energy and its various forms (7 Hours)*

Electricity tariff, load management and maximum demand control, power factor improvement, selection & location of capacitors, Thermal Basics-fuels, thermal energy contents of fuel, temperature & pressure, heat capacity, sensible and latent heat, evaporation, condensation, steam, moist air and humidity & heat transfer, units and conversion.

*Module 3: Energy Management & Audit (6 Hours)*

Definition, energy audit, need, types of energy audit. Energy management (audit) approach- understanding energy costs, bench marking, energy performance, matching energy use to requirement, maximizing system efficiencies, optimizing the input energy requirements, fuel & energy substitution, energy audit instruments. Material and Energy balance: Facility as an energy system, methods for preparing process flow, material and energy balance diagrams.

*Module 4: Energy Efficiency in Electrical Systems (7 Hours)*

Electrical system: Electricity billing, electrical load management and maximum demand control, power factor improvement and its benefit, selection and location of capacitors, performance assessment of PF capacitors, distribution and transformer losses. Electric motors: Types, losses in induction motors, motor efficiency, factors affecting motor performance, rewinding and motor replacement issues, energy saving opportunities with energy efficient motors.

*Module 5: Energy Efficiency in Industrial Systems (8 Hours)*

Compressed Air System: Types of air compressors, compressor efficiency, efficient compressor operation, Compressed air system components, capacity assessment, leakage test, factors affecting the performance and savings opportunities in HVAC, Fans and blowers: Types, performance evaluation, efficient system operation, flow control strategies and energy conservation opportunities. Pumps and Pumping System: Types, performance evaluation, efficient system operation, flow control strategies and energy conservation opportunities. Cooling Tower: Types and performance evaluation, efficient system operation, flow control strategies and energy saving opportunities, assessment of cooling towers.

*Module 6: Energy Efficient Technologies in Electrical Systems (8Hours)*

Maximum demand controllers, automatic power factor controllers, energy efficient motors, soft starters with energy saver, variable speed drives, energy efficient transformers, electronic ballast, occupancy sensors, energy efficient lighting controls, energy saving potential of each technology.

*Text/Reference Books*


1. Guide books for National Certification Examination for Energy Manager / Energy AuditorsBook-1, General Aspects (available online)
2. Guide books for National Certification Examination for Energy Manager / Energy AuditorsBook-3, Electrical Utilities (available online)
3. S. C. Tripathy, "Utilization of Electrical Energy and Conservation", McGraw Hill, 1991.
4. Success stories of Energy Conservation by BEE, New Delhi (www.bee-india.org)


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| **SEE-605** | **Electrical Materials** | **3L:0T:0P** | **3 credits** |

UNIT- I: Dielectric Materials:Dielectric as Electric Field Medium, leakage currents, dielectric loss, dielectric strength, breakdown voltage, breakdown in solid dielectrics, flashover, liquid dielectrics, electric conductivity in solid, liquid and gaseous dielectrics, Ferromagnetic materials, properties of ferromagnetic materials in static fields, spontaneous, polarization, curie point, anti-ferromagnetic materials, piezoelectric materials, pyroelectric materials.

UNIT – II: Magnetic Materials:Classification of magnetic materials, spontaneous magnetization in ferromagnetic materials, magnetic Anisotropy, Magnetostriction, diamagnetism, magnetically soft and hard materials, special purpose materials, feebly magnetic materials, Ferrites, cast and cermet permanent magnets, ageing of magnets. Factors effecting permeability and hysteresis

UNIT – III: Semiconductor Materials:Properties of semiconductors, Silicon wafers, integration techniques, Large and very large scale integration techniques (VLSI)



Text Books:

- "R K Rajput", " A course in Electrical Engineering Materials", Laxmi Publications, 2009
- "T K Basak", " A course in Electrical Engineering Materials", New Age Science Publications 2009

Reference Books:

- TTTI Madras, "Electrical Engineering Materials", McGraw Hill Education, 2004.
- "AdrianusJ.Dekker", Electrical Engineering Materials, PHI Publication, 2006.
- S. P. Seth, P. V. Gupta "A course in Electrical Engineering Materials", Dhanpat Rai & Sons, 201

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| **SEE-613** | **Electronics Design Laboratory** | | **2credits** |

- the state?
- Has globalization led to cultural homogenisation?
- Does globalization lead to a clash of cultures?

**3. READINGS:**

**Reference Books:**

**3.1**

- Gisbert, P. (2011), Fundamental of Sociology, Orient Blackswan Private Ltd.
- Horton, Paul B. and Hunt, Chester L. (Sixth edition), Sociology, Mc Graw Hill Book Company.

Haralambos, M. and Heald, R.M**Course Outcomes:**

At the end of the course, studentswilldemonstrate the ability to

 Understandthe practical issues related to practicalimplementation of applicationsusingele

- Chooseappropriate components, software and hardware platforms.
- Design a Printed Circuit Board, getit made and populate/solder itwith components.
- Work as a team withotherstudents to implement an application.

Basic concepts on measurements; Noise in electronic systems; Sensors and signal conditioning circuits; Introduction to electronic instrumentation and PC based data acquisition; Electronic system design, Analog system design, Interfacing of analog and digital systems, Embedded systems, Electronic system design employing microcontrollers, CPLDs, and FPGAs, PCB design and layout; System assembly considerations. Group projects involving electronic hardware (Analog, Digital, mixed signal) leading to implementation of an application.

*Text/Reference Books*


1. A. S. Sedra and K. C. Smith, "Microelectronic circuits", Oxford University Press, 2007.
2. P. Horowitz and W. Hill, "The Art of Electronics", Cambridge University Press, 1997.
3. H.W.Ott, "Noise Reduction Techniques in Electronic Systems", Wiley, 1989.
4. W.C. Bosshart, "Printed Circuit Boards: Design and Technology", Tata McGraw Hill, 1983.
5. G.L. Ginsberg, "Printed Circuit Design", McGraw Hill, 1991.


## SOE-061 SOCIOLOGY, SOCIETY AND CULTURE

### 2. OBJECTIVE:

This is one of the foundation course of Humanities (in Foundation Area 1). It strengthens the interest of the student in social issues and demonstrate both the process and challenge of scientific observationand analysis of social behaviour and social data. It focuses on the understanding of basic concepts anddescriptive materials of sociology which is considered a tool for identifying the process of idea and a scientific approach for continuing social observation and analysis.

### 3. COUSE TOPICS:

**3.1 Unit I:Sociology as a Science** (7 hours)

1. Sociology and common Sense
2. Sociology and current affairs
3. Sociology as a science
4. Logic in sociological inquiry
5. Sociology of action
6. The field and relevance of sociology
7. Positivism

**3.2 Unit II: Society and Culture** (12 hours)

1. Culture and society

2. The structure of culture

- Cultural Traits and complexes
- Subcultures and counter cultures
- Cultural integration
- Cultural relativism
- Real and Ideal culture
- Ethnocentrism
- Xenocentrism
- Cultural lag

**3.3 Unit III: Social Institutions** (17 hours)

1. The concept of varna.
2. The Caste system:

- Origin and characteristics (of caste) as a system
- Hierarchy based on birth

Religious sanctions on social participation

- Caste and subcaste
- Caste conflicts
- Caste councils
- An appraisal of caste system
- Prospects of caste in modern India

3. The Class system:

- What is social class?
- Development of class
- Self-identification and class consciousness
- Class in itself and class for itself
- Class having blue collar status and white collar status
- Industrial class
- Significance of social class
- The future of social classes: From Proletariat to status seekers

**3.4 Unit IV: Environment and Ecology** (10 hours)

1. Conceptualising environment
2. Forest, ecology and society
3. Common Property Resources and its management
4. Significance of forest and environment in modern life
5. Environmental movement with reference to forest and water management

**3.5 Unit V: Issues of modernity** (14 hours)

1. Concept of modernity
2. Tradition Vs Modernity
3. Globalization

- Is globalization new and real?
- Has globalization weakened. (26th impression, 2004), Sociology: Themes

and Perspectives, Oxford University Press, New Delhi.
- Betteille, Andre (2014), sociology: essays on Approach & Method, Oxford Uninversity Press, New Delhi.