# SPPU B.E./B.Tech EE Sem 3 syllabus

## Material Science

### Material Science

### Credit - 03

**Unit 01: Dielectric Properties of Insulating Materials**
Static Field, Parameters of Dielectric material [Dielectric constant, Dipole moment, Polarization, Polarizability], Introduction to Polar and Non- Polar dielectric materials. Mechanisms of Polarizations- Electronic, Ionic and Orientation Polarization (descriptive treatment only), Clausius Mossotti Equation, Piezo-Electric, Pyro-Electric & Ferro-Electric Materials, Dielectric loss and loss tangent, Concept of negative tan delta.

**Unit 02: A) Dielectric Breakdown**

Introduction, Concept of Primary and Secondary Ionization of Gases (descriptive treatment only), Breakdown Voltage, Breakdown Strength, Factors affecting Breakdown Strengths of Solid, Liquid and Gaseous dielectric materials.

**Unit 02: B) Testing of Materials**

Explanation of following with objectives, equipment required, circuit diagrams and observations to be taken.
1. Measurement of dielectric loss tangent (tan δ) by Schering Bridge-IS 13585-1994.
2. Measurement of dielectric strength of solid insulating material-IS 2584.
3. Measurement of dielectric strength of liquid insulating material -IS 6798.
4. Measurement of dielectric strength of gaseous insulating material as per IS.

**Unit 03 : Insulating Materials, Properties & Applications**
Introduction, Characteristics of Good Insulating Material, Classification, Solid Insulating Materials-Paper, Press Board, Fibrous Materials, Ceramics, Mica, Asbestos, Resins, Liquid Insulating Materials such as Transformer Oil, Varnish, Askarel. Insulating Gases like Air, SF6. Insulating Materials for Power and Distribution Transformers, Rotating Machines, Capacitors, Cables, Line Insulators and Switchgears.

**Unit 04 : Magnetic Materials**
Introduction, Parameters of Magnetic material [Permeability, Magnetic Susceptibility, Magnetization], Classification of Magnetic Materials, Diamagnetism, Paramagnetism, Ferromagnetism, Ferri-magnetism, Ferro-magnetic behavior below Critical Temperature, Spontaneous Magnetization, Anti-ferromagnetism, Ferrites, Applications of Ferro magnetic Materials, Magnetic materials for Electric Devices such as Transformer Core, Core of Rotating Machines, Soft Magnetic Materials, Hard Magnetic Materials.

**Unit 05 : Conducting Materials**
General Properties of Conductor, Electrical Conducting Materials - Copper, Aluminum and its applications, Materials of High and Low Resistivity-Constantan, Nickel-Chromium Alloy, Tungsten, Kanthal, Silver and Silver alloys, Characteristics of Copper Alloys (Brass & Bronze), Electrical Carbon Materials. Materials used for Lamp Filaments, Solders, Metals and Alloys for different types of Thermal Bimetal and Thermocouples.

**Unit 06 : Nanotechnology**
Introduction, Concepts of Energy bands and various Conducting Mechanism in Nano-structures, Carbon Nano-structures, Carbon Molecules, Carbon Clusters, Carbon Nano-tubes and applications. Special Topics in Nano Technology such as Single Electron Transistor, Molecular Machines, BN Nanotubes, Nano wires. Nano materials used in Batteries, Photovoltaic Cells and in Supercapacitors.

**Text Books:**
[T1] “A Course in Electrical Engineering Materials”, by S.P. Seth, Dhanpat Rai and Sons publication.
[T2] A Textbook of “Electrical Engineering Materials” by R.K.Rajput, Laxmi Publications (P) Ltd.
[T3] “Electrical Engineering Materials”, by T.T.T.I, Madras.
[T4] “Electrical Engineering Materials”, by K. B. Raina and S. K. Bhattacharya, S. K. Kataria Sons.

[T5] “Material Science for Electrical Engineering”, by P.K. Palanisamy, Scitech Pub. Pvt. Ltd., Chennai (India).
[T6] “Introduction to Nanotechnology” by Charles P. Poole, Jr. Frank & J. Ownes (Wiley Student Edition)

**Reference Books:**

[R1] “Electrical Power Capacitors-Design & Manufacture”, by D. M. Tagare, Tata McGraw Hill Publication.
[R2] “Electrical Engineering Materials”, by S. P. Chalotra and B. K. Bhattacharya, Khanna Publishers, Nath Market.
[R3] “Electrical Engineering Materials”, by C. S. Indulkar and S. Thiruvengadam, S. Chand and Company Ltd.
[R4] “High Voltage Engineering” by Kamraju and Naidu, Tata McGraw Hill Publication.
[R5] “Introduction to Material Science for Engineering”, Sixth Edition by James F. Shackelford & M. K. Muralidhara, Pearson Education.
[R6] “Insulation Technology Course Material” of IEEMA Ratner, Pearson Education.
[R7] “Materials Science for Engineering Students”, by Traugott Fischer, Elsevier Publications.
[R8]“Energy Conversion Systems”, by Rakosh Das Begamudre, New Age International Publishers.
[R9] “Advanced Nanomaterials and Their Applications in Renewable Energy”, by Jingbo Louise Liu, Sajid Bashir, ELSEVIER Publications.

# Analog and Digital Electronics

### Analog And Digital Electronics

### CREDIT - 03

### Unit 01 : Design of combinational circuit

Booleans algebra, De-Morgan theory etc, Karnaugh map: structure for two, three and four Variables, SOP and POS form reduction of Boolean expressions by K-map. Design of combinational circuits using Boolean expression and K-map, encoder, decoder, half and full adder.

### Unit 02: Design of sequential circuit

Introduction to sequential circuit. Design of synchronous (K-map) and asynchronous counters. Up down counters, N modulo counters, Shift registers, ring and twisted ring counters.

### Unit 03: Digital memories and logic families

A) Digital memories: SRAM, DRAM, ROM, EPROM
B) Digital logic families: PAL,PLA, CPLD, FPGA

**Unit 04: Operational Amplifier Applications**
Open loop and close loop configuration of Op-Amp. Applications of Op- Amp- zero crossing detectors, Comparator, Schmitt trigger, V-I and I-V converters, Instrumentation amplifier, peak detector, Waveform generation using Op-amp - sine, square, saw tooth and triangular generator

**Unit 05: Other Analog circuits**
Active filters-Its configuration with frequency response, Analysis of first order low pass and high pass filters using OPAMP, IC 555 – construction, working and modes of operation- astable and monostable multi vibrators, Sequence generator, voltage regulators using IC78xx, 79xx, LM 317

**Unit 06: Diode rectifier**
Single phase half wave rectifier with R, RL loads. Single phase full wave rectifier-Center tap and bridge rectifier supplying R and RL load and performance parameters. Three phase full wave bridge rectifier with R load.

**Text Books:**
[T1] Floyd and Jain, “Digital Fundamentals”, Pearson Education.
[T2] R. P. Jain, “Digital Electronics”, Tata McGraw Hill, New Delhi.
[T3] Malvino, “Digital Computer Electronics- An Introduction to Microcomputers,” Tata McGraw Hill.
[T4] Gaikwad R., “Operational Amplifier”, PHI New Delhi.
[T5] Floyd, “Electronics Devices”, Pearson Education.
[T6] Mottershed, “Electronics Devices & Circuits”, PHI New Delhi
[T7] Muhammad H. Rashid, “Power Electronics: Circuits, Devices and Applications”, 3rd edition, Pearsons Education.
[T8] Fundamental of digital circuits, 4th Edition, by A Anand Kumar, PHI learning private limited publication

**Reference Books:**
[R1] Tokheim, “Digital Electronics-Principles and Application”, 6th edition, Tata McGraw Hill, New Delhi.
[R2] A Jaico and Charles H. Roth, “Fundamentals of Logic Design” Jr. Forth Edition.
[R3] K. R. Botkar, “Integrated Circuits”, Khanna Publication, New Delhi.

[R4] James, “Operational Amplifier and Linear Integrated Circuits Theory and Application.”
[R5] P John Paul, “Electronics Devices and circuits”, New Age international Publications.

# Electrical Measurement & Instrumentation

## 203144: Electrical Measurements and Instrumentation

**Credits**
**Th: 03**
**PR:02**

**Unit 01:**
**A. Classification of Measuring Instruments:** Characteristics of measuring instruments: static and dynamic, accuracy, linearity, speed of response, dead zone, repeatability, resolution, span, reproducibility, drifts. Necessity of calibration, standards and their classification, absolute and secondary instruments, types of secondary instruments: indicating, integrating, and recording, analog / digital. Ammeter and Voltmeter Theory: Essentials of indicating instruments deflecting, controlling and damping systems. Construction, working principle, torque equation, advantages and disadvantages of Moving Iron (MI) instruments (attraction and repulsion). block diagram and operation of digital ammeter & voltmeter.
**B. Range Extension:** Instrument Transformers : Construction, connection of CT & PT in the circuit, advantages of CT / PT for range extension of MI Instruments, transformation ratio, turns ratio, nominal ratio, burden, ratio and phase angle error.(descriptive treatment only)

**Unit 02:**
**A. Measurement of Resistance:** Measurement of low, medium and high resistance. Wheatstone bridge, Kelvin’s double bridge, ammeter-voltmeter method, megger. Earth tester for earth resistance measurement.
**B. Measurement of Inductance:** Introduction, sources and

detectors for A.C. bridge, general
equation for bridge at balance. Maxwell's inductance, Maxwell's inductance – Capacitance
Bridge, Anderson's bridge.

**Unit 03:**
**Measurement of Power:** Construction, working principle, torque equation, errors and their
compensation, advantages and disadvantages of dynamometer type wattmeter, low power factor
wattmeter, poly-phase wattmeter. Active & reactive power measurement in three phase system
for balanced and unbalanced load using three wattmeter method, two wattmeter method & one
wattmeter method.

**Unit 04:**
**Measurement of Energy:** Construction, working principle, torque equation of single phase
conventional (induction type) energy meter. Block diagram and operation of single phase and
three phase static energy meter. Calibration of static energy meter. TOD meter.

**Unit 05:**
**A. Oscilloscope:** Introduction, various parts, front panel controls, use of CRO for measurement of
voltage, current, period, frequency. Phase angle & frequency by Lissajous pattern. Introduction to DSO.
**B. Transducers:** Introduction, classification, types: resistive, inductive, capacitive, basic
requirements for transducers.
**C. Pressure Measurement:** Introduction, classification of pressure as low, medium & high,
absolute, gauge, vacuum, static, dynamic & head pressure. High pressure measurement using
electric methods, low pressure measurement by McLeod gauge and pirani gauge, capacitive
pressure transducer.

**Unit 06:**
**A. Level Measurement:** Introduction and importance of level measurement, level measurement
methods: mechanical, hydraulic, pneumatic, electrical, nucleonic and

ultrasonic.
**B. Displacement Measurement:** LVDT & RVDT – construction, working, applications,
specifications, advantages & disadvantages, effect of frequency on performance.
**C. Strain Gauge:** Introduction, definition of strain, types of strain gauge: wire strain gauge, foil
strain gauge, semiconductor strain gauge; their construction, working, advantages and
disadvantages.

**Text Books**
[T1] A. K. Sawhney, “A Course in Electrical and Electronic Measurements & Instrumentation”,
Dhanpat Rai & Co.
[T2] J. B. Gupta, “A Course in Electronics and Electrical Measurements and Instrumentation”, S.
K. Kataria & Sons,
[T3] R. K. Jain, “Mechanical and Industrial Measurements”, Khanna Publishers.
[T4] B. C. Nakra & K. K. Chaudhari, “Instrumentation Measurement and Analysis”, Tata McGraw Hill.

**Reference Books**
[R1] E. W. Golding & F. C. Widdies, “Electrical Measurements & Measuring Instruments”,
Reem Publications.
[R2] Dr. Rajendra Prasad, “Electronic Measurements & Instrumentation”, Khanna Publishers.
[R3] Arun K. Ghosh, “Introduction to Measurements and Instrumentation”, PHI Publication.
[R4] M. M. S. Anand, “Electronics Instruments and Instrumentation Technology”, PHI
Publication.

## Power Generation Technologies

### 203141: Power Generation Technologies

**Credits**
**Th: 03**

### Unit 01: Thermal Power Plant

**Basic thermodynamic cycles:** Carnot cycle, Rankine cycle; Actual Rankine cycle; Reheat cycle (theoretical only); heat rate (Numerical on Heat rate).
**Thermal Power Plants:** Site selection, Main parts and its working. Types of boilers (FBC, Fire tube, and Water tube). Assessment of heat recovery systems Steam turbines Fuel Handling, Ash disposal and dust collection, Draught systems, electrostatic precipitator.

**Unit 02: Nuclear, Diesel, Gas Power Plant**
**A. Nuclear Power Plant:** Introduction, atomic physics, nuclear reaction, materials, site selection, nuclear reactors and working of each part, classification of nuclear reactor, nuclear waste disposal.
**B. Diesel Power Plants:** Main components and its working, Diesel plant efficiency and heat balance (Numerical), Site selection of diesel power plant.
**C. Gas Power Plant:** Introduction to gas cycles. Simple gas turbine power plant, methods to improve thermal efficiency, open loop and closed loop cycle power plants, gas fuels, gas turbine materials, plant layout. Combined cycle power plants, concept of heat to power ratio.

**Unit 03: Hydro Power Plant**
Site selection, Hydrology, storage and pondage, general arrangements and operation of hydro power plant, Hydraulic turbines, turbine size, pelton wheel turbine, Francis and Kaplan turbines, selection of turbines, Dams, Spillways, gates, intake and out take works, canals and layout of penstocks, water hammer and surge tank, simple numerical on hydro graphs and number of turbine required. Small, mini and micro hydro power plant (Introduction only).

**Unit 04: Wind Energy Systems**
Historical Development of Wind Power, Types of wind turbine, Impact of Tower Height, Power in the Wind. Maximum Rotor efficiency, Speed control for Maximum Power, Average Power in

the wind (Numerical). Wind Turbine Generators (WTG) - Synchronous and Asynchronous (block
diagrams only), Wind Turbine Economics, Simple Estimates of Wind Turbine Energy,
Environmental Impacts of Wind Turbines. Change in wind pattern and its effect on power
generation. Control of wind turbine generator.

**Unit 05: Solar Energy**
Principles of solar radiations, solar constant, cloudy index and concentration ratio, measurement
of solar radiation. Solar energy collectors (solar thermal applications), principle of energy
conversion, collection systems and their features, types of collectors with comparison. Solar
thermal power plants. Over view of recent development of PV technologies. A Generic Photovoltaic Cell, The Simplest Equivalent Circuit for a Photovoltaic Cell From Cells to Modules to Arrays, Numerical on number of solar panel selection. The PV I–V Curve under Standard Test Conditions (STC), Impacts of Temperature and Insolation on I–V Curves, Shading Impacts on I– V curves, System: Introduction to the Major Photovoltaic System Types.

**Unit 06: Other Sources and Grid Connection**
Biomass energy, conversion to electricity, municipal solid waste to energy conversion,
geothermal energy and ocean energy and Fuel cell Energy storage requirements and selection
criteria, stand alone, hybrid stand alone and grid connected renewable systems and their
requirements.

**Text Books:**
[T1] P. K. Nag, “Power Plant Engineering”, Tata McGraw Hill Publications.
[T2] Dr. P. C. Sharma, “Power Plant Engineering”, S.K. Kataria Publications.
[T3] R. K. Rajput, “A text book on Power System Engineering”, Laxmi Publications (P) Ltd.
[T4] Chakrabarti, Soni, Gupta, Bhatnagar, “A text book on Power System Engineering”,
DhanpatRai publication.
[T5] R.K. Rajput, “Non-Conventional Energy Sources and Utilization”, S. Chand Publications.

[T6] M.M. Wakil, “Power Plant Engineering”, McGraw Hill, Indian Edition.
[T7] G. D. Rai, “Renewable Energy Sources”, Khanna Publications.
[T8] Chetan singh solanki “ Solar Photovotaics: Fundamentals, Technology and Application”
PHI Publications.

**Reference Books:**

[R1] Arora and Domkundwar, “A Course in Power Plant Engineering”, DhapatRai Publication.
[R2] Dr. S. P. Sukhatme, “Solar Energy”, Tata McGraw Hill Publication.
[R3] Mukund Patel, “Wind and Solar Power Plants”, CRC Press.
[R4] Gilbert Masters John, “Renewable Energy”, Wiley and sons’ publications.
[R5] Robert Foster, Majid Ghassemi, Alma Cota “Solar Energy” CRC Press

## Engineering Mathematics III

### 207006: Engineering Mathematics-III

**Credits**
**Th: 03**

**Unit I: Linear Differential Equations (LDE) and Applications**
LDE of nth order with constant coefficients, Complementary Function, Particular Integral,General
method, Short methods, Method of variation of parameters, Cauchy’s and Legendre’s DE,
Simultaneous and Symmetric simultaneous DE. Modeling of Electrical circuits.

**Unit II:Laplace Transform (LT)**
Definition of LT, Inverse LT, Properties & theorems, LT of standard functions, LT of some
special functions viz. Periodic, Unit Step, Unit Impulse. Applications of LT for solving Linear
differential equations.

**Unit III:Fourier and Z - transforms**
Fourier Transform (FT): Complex exponential form of Fourier series, Fourier integral theorem,
Fourier Sine & Cosine integrals, Fourier transform, Fourier Sine &

Cosine transforms and their
inverses.
Z - Transform (ZT): Introduction, Definition, Standard properties, ZT of standard sequences and
their inverses. Solution of difference equations.

**Unit IV:Statistics and Probability**
Measures of central tendency, Measures of dispersion, Coefficient of variation, Moments,
Skewness and Kurtosis, Correlation and Regression, Reliability of Regression estimates.
Probability, Probability density function, Probability distributions: Binomial, Poisson, Normal,
Test of hypothesis: Chi-square test.

**Unit V: Vector Calculus**
Vector differentiation, Gradient, Divergence and Curl, Directional derivative, Solenoidal and
Irrotational fields, Vector identities. Line, Surface and Volume integrals, Green's Lemma,
Gauss's Divergence theorem and Stoke's theorem.

**Unit VI: Complex Variables**
Functions of a Complex variable, Analytic functions, Cauchy-Riemann equations, Conformal
mapping, Bilinear transformation, Cauchy's integral theorem, Cauchy's integral formula and
Residue theorem.

**Text Books:**
1. Higher Engineering Mathematics by B.V. Ramana (Tata McGraw-Hill).
2. Higher Engineering Mathematics by B. S. Grewal (Khanna Publication, Delhi).

**Reference Books:**
1. Advanced Engineering Mathematics, 10e, by Erwin Kreyszig (Wiley India).
2. Advanced Engineering Mathematics, 2e, by M. D. Greenberg (Pearson Education).
3. Advanced Engineering Mathematics, 7e, by Peter V. O'Neil (Cengage Learning).
4. Differential Equations, 3e by S. L. Ross (Wiley India).
5. Introduction to Probability and Statistics for Engineers and

Scientists, 5e, by Sheldon M. Ross
(Elsevier Academic Press).
6. Complex Variables and Applications, 8e, by J. W. Brown and R. V. Churchill (McGraw-Hill Inc.).