

**Engineering Science Courses for B.Tech.(AICTE Model Curriculum) 2<sup>nd</sup> Year**  
**(effective from the session 2019-20)**

SEMESTER- III/IV													
Sl.No.	Subject Codes	Subject	Periods	Evaluation Scheme					End Semester			Total	Credit
			L	T	P	CT	TA	Total	PS	TE	PE		
1	KOE031/041	Engineering Mechanics	3	1	0	30	20	50		100		150	4
2	KOE032/042	Material Science	3	1	0	30	20	50		100		150	4
3	KOE033/043	Energy Science & Engineering	3	1	0	30	20	50		100		150	4
4	KOE034/044	Sensor & Instrumentation	3	1	0	30	20	50		100		150	4
5	KOE035/045	Basics Data Structure & Algorithms	3	1	0	30	20	50		100		150	4
6	KOE036/046	Introduction to Soft Computing	3	1	0	30	20	50		100		150	4
7	KOE037/047	Analog Electronics Circuits	3	1	0	30	20	50		100		150	4
8	KOE038/048	Electronics Engineering	3	1	0	30	20	50		100		150	4

Sl.No.	Subject	
1	Engineering Mechanics	To be offered to any Engg. Branch except ME/CE/AG and allied branches
2	Material Science	
3	Energy Science & Engineering	To be offered to any Engg. Branch except EE and allied branches
4	Sensor & Instrumentation	
5	Basics Data Structure & Algorithms	To be offered to any Engg. Branch except CSE and allied branches
6	Introduction to Soft Computing	
7	Analog Electronics Circuits	To be offered to any Engg. Branch except EC and allied branches
8	Electronics Engineering	

**Important Note:** CH/BT/TX Engg. and allied branches can be offered any of the above listed ES.

# ENGINEERING MECHANICS

## UNIT-I:

**Two-dimensional force systems:** Basic concepts, Laws of motion, Principle of transmissibility of forces, transfer of a force to parallel position, resultant of a force system, simplest resultant of two dimensional concurrent and non-concurrent force systems, distribution of force systems, free body diagrams, equilibrium and equations of equilibrium.

**Friction:** Friction force – Laws of sliding friction – equilibrium analysis of simple systems with sliding friction – wedge friction.

## UNIT-II:

**Beam:** Introduction, shear force and bending moment, different equations of equilibrium, shear force and bending moment diagram for statically determined beams.

**Trusses:** Introduction, simple truss and solution of simple truss, methods of F-joint and methods of sections.

## UNIT-III:

**Centroid and moment of inertia:** Centroid of plane, curve, area, volume and composite bodies, moment of inertia of plane area, parallel axis theorem, perpendicular axis theorem, principle moment of inertia, mass moment of inertia of circular ring, disc, cylinder, sphere, and cone about their axis of symmetry.

## UNIT-IV:

**Kinematics of rigid body:** Introduction, plane motion of rigid body, velocity and acceleration under translational and rotational motion, relative velocity.

**Kinetics of rigid body:** Introduction, force, mass and acceleration, work and energy, impulse and momentum, D'Alembert's principle and dynamic equilibrium.

## UNIT-V:

**Simple stress and strain:** Introduction, normal and shear stresses, stress-strain diagrams for ductile and brittle material, elastic constants, one-dimensional loading of members of varying cross sections, strain energy.

**Pure bending of beams:** Introduction, simple bending theory, stress in beams of different cross sections.

**Torsion:** Introduction, torsion of shafts of circular cross sections, torque and twist, shear stress due to torque.

## Books and References:

1. Beer, F.P and Johnston Jr. E.R., "Vector Mechanics for Engineers (In SI Units): Statics and Dynamics", 8th Edition, Tata McGraw-Hill Publishing company, New Delhi (2004).
2. Vela Murali, "Engineering Mechanics", Oxford University Press (2010).
3. A Textbook of Engineering Mechanics, R.K. Bansal, Laxmi Publications.
4. Engineering Mechanics, R.S. Khurmi, S.Chand Publishing.
5. Meriam J.L. and Kraige L.G., "Engineering Mechanics- Statics - Volume 1, Dynamics- Volume 2", Third Edition, John Wiley & Sons (1993).
6. Rajasekaran S and Sankarasubramanian G., "Engineering Mechanics Statics and Dynamics", 3 rd Edition, Vikas Publishing House Pvt. Ltd., (2005).
7. Bhavikatti, S.S and Rajashekarappa, K.G., "Engineering Mechanics", New Age International (P) Limited Publishers, (1998).
8. Engineering mechanics by Irving H. Shames, Prentice-Hall.

# MATERIAL SCIENCE

## UNIT-I:

### Phase Diagrams:

Solid solutions – Hume Rothery's rules – the phase rule – single component system – one-component system of iron – binary phase diagrams – isomorphous systems – the tie-line rule – the lever rule – application to isomorphous system – eutectic phase diagram – peritectic phase diagram – other invariant reactions – free energy composition curves for binary systems – microstructural change during cooling.

## UNIT-II:

### Ferrous Alloys:

The iron-carbon equilibrium diagram – phases, invariant reactions – microstructure of slowly cooled steels – eutectoid steel, hypo and hypereutectoid steels – effect of alloying elements on the Fe-C system – diffusion in solids – Fick's laws – phase transformations – T-T-T-diagram for eutectoid steel – pearlitic, bainitic and martensitic transformations – tempering of martensite – steels – stainless steels – cast irons.

## UNIT-III:

### Mechanical Properties:

Tensile test – plastic deformation mechanisms – slip and twinning – role of dislocations in slip – strengthening methods – strain hardening – refinement of the grain size – solid solution strengthening – precipitation hardening – creep resistance – creep curves – mechanisms of creep – creep-resistant materials – fracture – the Griffith criterion – critical stress intensity factor and its determination – fatigue failure – fatigue tests – methods of increasing fatigue life – hardness – Rockwell and Brinell hardness – Knoop and Vickers microhardness.

## UNIT-IV:

### Magnetic, Dielectric & Superconducting Materials:

Ferromagnetism – domain theory – types of energy – hysteresis – hard and soft magnetic materials – ferrites – dielectric materials – types of polarization – Langevin-Debye equation – frequency effects on polarization – dielectric breakdown – insulating materials – Ferroelectric materials – superconducting materials and their properties.

## UNIT-V:

### New Materials:

Ceramics – types and applications – composites: classification, role of matrix and reinforcement, processing of fiber reinforced plastics – metallic glasses: types, glass forming ability of alloys, melt spinning process, applications – shape memory alloys: phases, shape memory effect, pseudoelastic effect, NiTi alloy, applications – nanomaterials: preparation (bottom up and top down approaches), properties and applications – carbon nanotubes: types.

### Text Books & References:

1. Balasubramanian, R. —Callister's Materials Science and Engineering. Wiley India Pvt. Ltd., 2014.
2. Raghavan, V. —Physical Metallurgy: Principles and Practice. PHI Learning, 2015.
3. Raghavan, V. —Materials Science and Engineering: A First course. PHI Learning, 2015.
4. Askeland, D. —Materials Science and Engineering. Brooks/Cole, 2010.

5. Smith, W.F., Hashemi, J. & Prakash, R. —Materials Science and Engineering. Tata McGraw Hill Education Pvt. Ltd., 2014.
6. Wahab, M.A. —Solid State Physics: Structure and Properties of Materials. Narosa Publishing House, 2009.

## **Energy Science and Engineering**

**Unit-I Energy and its Usage:** Units and scales of energy use, Mechanical energy and transport, Heat energy: Conversion between heat and mechanical energy, Electromagnetic energy: Storage, conversion, transmission and radiation, Introduction to the quantum, energy quantization, Energy in chemical systems and processes, flow of CO<sub>2</sub>, Entropy and temperature, Carnot and Stirling heat engines, Phase change energy conversion, refrigeration and heat pumps, Internal combustion engines, Steam and gas power cycles, the physics of power plants. Solid-state phenomena including photo, thermal and electrical aspects

**Unit-II Nuclear Energy:** Fundamental forces in the universe, Quantum mechanics relevant for nuclear physics, Nuclear forces, energy scales and structure, Nuclear binding energy systematics, reactions and decays, Nuclear fusion, Nuclear fission and fission reactor physics, Nuclear fission reactor design, safety, operation and fuel cycles

**Unit-III Solar Energy:** Introduction to solar energy, fundamentals of solar radiation and its measurement aspects, Basic physics of semiconductors, Carrier transport, generation and recombination in semiconductors, Semiconductor junctions: metal-semiconductor junction & p-n junction, Essential characteristics of solar photovoltaic devices, First Generation Solar Cells, Second Generation Solar Cells, Third Generation Solar Cells

**Unit-IV Conventional & non-conventional energy source:** Biological energy sources and fossil fuels, Fluid dynamics and power in the wind, available resources, fluids, viscosity, types of fluid flow, lift, Wind turbine dynamics and design, wind farms, Geothermal power and ocean thermal energy conversion, Tidal/wave/hydro power

**Unit-V Systems and Synthesis:** Overview of World Energy Scenario, Nuclear radiation, fuel cycles, waste and proliferation, Climate change, Energy storage, Energy conservation. Engineering for Energy conservation: Concept of Green Building and Green Architecture; Green building concepts, LEED ratings; Identification of energy related enterprises that represent the breath of the industry and prioritizing these as candidates; Embodied energy analysis and use as a tool for measuring sustainability. Energy Audit of Facilities and optimization of energy consumption

### **Reference/Text Books**

1. Energy and the Challenge of Sustainability, World Energy Assessment, UNDP, New York, (2000).
2. Perspective of Modern Physics, A. Beiser, McGraw-Hill International Editions (1968).
3. Introduction to Modern Physics, H.S. Mani and G.K.Mehta, East-West Press (1988).
4. Introduction to Electrodynamics, D. J. Griffiths, Fourth Edition, Prentice Hall (2013).
5. Introductory Nuclear Physics, R. K. Puri and V.K. Babbar, Narosa Publishing House (1996).
6. Physics of Solar Cells: From Basic Principles to Advanced Concepts by Peter Würfel, John Wiley & Sons, 2016
7. Principles of Solar Engineering, D.Y. Goswami, F.Kreith and J.F. Kreider, Taylor and Francis, Philadelphia, 2000.

## SENSOR AND INSTRUMENTATION

**Pre-requisites of course:** Basic Electrical Engineering

<b>Course Outcomes:</b>		<b>Knowledge Level, KL</b>
Upon the completion of the course, the student will be able to:		
<b>CO 1</b>	Apply the use of sensors for measurement of displacement, force and pressure.	K <sub>3</sub>
<b>CO2</b>	Employ commonly used sensors in industry for measurement of temperature, position, accelerometer, vibration sensor, flow and level.	K <sub>3</sub>
<b>CO3</b>	Demonstrate the use of virtual instrumentation in automation industries.	K <sub>2</sub>
<b>CO4</b>	Identify and use data acquisition methods.	K <sub>3</sub>
<b>CO5</b>	Comprehend intelligent instrumentation in industrial automation.	K <sub>2</sub>

### **Detailed Syllabus:**

#### **Unit- I:**

Sensors & Transducer: Definition, Classification & selection of sensors, Measurement of displacement using Potentiometer, LVDT & Optical Encoder, Measurement of force using strain gauge, Measurement of pressure using LVDT based diaphragm & piezoelectric sensor.

#### **Unit-II:**

Measurement of temperature using Thermistor, Thermocouple & RTD, Concept of thermal imaging, Measurement of position using Hall effect sensors, Proximity sensors: Inductive & Capacitive, Use of proximity sensor as accelerometer and vibration sensor, Flow Sensors: Ultrasonic & Laser, Level Sensors: Ultrasonic & Capacitive.

#### **Unit -III:**

Virtual Instrumentation: Graphical programming techniques, Data types, Advantage of Virtual Instrumentation techniques, Concept of WHILE & FOR loops, Arrays, Clusters & graphs, Structures: Case, Sequence & Formula nodes, Need of software based instruments for industrial automation.

#### **Unit-IV:**

Data Acquisition Methods: Basic block diagram, Analog and Digital IO, Counters, Timers, Types of ADC: successive approximation and sigma-delta, Types of DAC: Weighted Resistor and R-2R Ladder type, Use of Data Sockets for Networked Communication.

#### **Unit V:**

Intelligent Sensors: General Structure of smart sensors & its components, Characteristic of smart sensors: Self calibration, Self-testing & self-communicating, Application of smart sensors: Automatic robot control & automobile engine control.

**Text Books:**

1. DVS Murthy, Transducers and Instrumentation, PHI 2nd Edition 2013
2. D Patranabis, Sensors and Transducers, PHI 2nd Edition 2013.
3. S. Gupta, J.P. Gupta / PC interfacing for Data Acquisition & Process Control, 2nd ED / Instrument Society of America, 1994.
4. Gary Johnson / Lab VIEW Graphical Programming II Edition / McGraw Hill 1997.

**Reference Books:**

1. Arun K. Ghosh, Introduction to measurements and Instrumentation, PHI, 4th Edition 2012.
2. A.D. Helfrick and W.D. cooper, Modern Electronic Instrumentation & Measurement Techniques, PHI – 2001
3. Hermann K.P. Neubert, “Instrument Transducers” 2nd Edition 2012, Oxford University Press.

## Basics Data Structure and Algorithms

<b>Course Outcome ( CO)</b>		<b>Bloom's Knowledge Level (KL)</b>
<b>At the end of course , the student will be able to understand</b>		
CO 1	Understand and analyze the time and space complexity of an algorithm	K <sub>2</sub> , K <sub>4</sub>
CO 2	Understand and implement fundamental algorithms (including sorting algorithms, graph algorithms, and dynamic programming)	K <sub>2</sub> , K <sub>3</sub>
CO 3	Discuss various algorithm design techniques for developing algorithms	K <sub>1</sub> , K <sub>2</sub>
CO 4	Discuss various searching, sorting and graph traversal algorithms	K <sub>2</sub> , K <sub>3</sub>
CO 5	Understand operation on Queue , Priority Queue , D-Queue.	K <sub>2</sub>

K<sub>1</sub>- Remember, K<sub>2</sub>- Understand, K<sub>3</sub>- Apply, K<sub>4</sub>- Analyze, K<sub>5</sub>- Evaluate, K<sub>6</sub>- Create



## Basics Data Structure and Algorithms

### Detailed Syllabus

Unit	Topic	Proposed Lecture
<b>I</b>	<b>Introduction to data structure and Algorithms:</b> Performance analysis of Algorithm, time complexity, Big-oh notation, Elementary data organization data structure operations, Recurrences, Arrays, Operation on arrays, representation of arrays in memory, single dimensional and multidimensional arrays, sparse matrices, Character storing in C, String operations.	08
<b>II</b>	<b>Stack And Queue and Link List:</b> Stack operation, PUSH and POP, Array representation of stacks, Operation associated with stacks Application of stacks, Recursion, Polish expression, Representation Queue, operation on Queue , Priority Queue , D-Queue , Singly and circularly linked list, List operations Lists implementations	08
<b>III</b>	<b>Trees :</b> Basic terminology, Binary Trees, Binary tree representation, Algebraic/expressions, Complete Binary Trees, Extended binary tree, representing binary trees in memory, linked representation of Binary trees, Traversing binary trees & Searching in binary trees, Inserting in binary search trees, Complexity of searching algorithm, Heaps, general trees, Threaded binary tree.	08
<b>IV</b>	<b>Graphs:</b> Terminology & representations, Graphs & Multigraphs, Directed Graphs, Sequential representation of graphs, adjacency Matrices, Transversal, connected component and spanning trees, Minimum Cost spanning tree, Prims and Kruskal Algorithm, BFS, DFS, Shortest path and transitive closure, Activity networks, topological sort and critical paths.	08
<b>V</b>	<b>Searching and Sorting:</b> Linear search, binary Search, Internal and External sorting, Bubble sorting, selection sort, Insertion sort, quick sort, Two way merge sort, Heap sort, sorting on different keys, practical consideration for internal sorting, External Sorting, Storage Devices : Magnetic tapes, Disk Storage, Sorting with disks and Indexing techniques, introduction to B tree and B+ tree, File organization and storage management, Introduction to hoisting.	08

#### **Text books:**

1. Thomas H. Cormen, Charles E. Leiserson and Ronald L. Rivest, Introduction to Algorithms, PHI.
2. Horowitz and Sahani, "Fundamentals of Data Structures", Galgotia Publication.
3. Weiss, "Data Structure & Algorithm Analysis in C", Addison Wesley.
4. Basse, "computer Algorithms: Introduction to Design & Analysis", Addison Wesley.
5. Lipschutz, "Data structure, "Schaum series.
6. Aho, hopcroft, Ullman, "Data Structure & Algorithm", Addison Wesley.
7. Aho, Hopcraft, Ullman, "The Design and Analysis of Computer Algorithms" Pearson Education, 2008

## Introduction to Soft Computing

Course Outcome ( CO)		Bloom's Knowledge Level (KL)
<b>At the end of course , the student will be able to understand</b>		
CO 1	Comprehend the fuzzy logic and the concept of fuzziness involved in various systems and fuzzy set theory.	K <sub>1</sub> , K <sub>2</sub>
CO 2	Understand the concepts of fuzzy sets, knowledge representation using fuzzy rules, approximate reasoning, fuzzy inference systems, and fuzzy logic	K <sub>2</sub> , K <sub>3</sub>
CO 3	Describe with genetic algorithms and other random search procedures useful while seeking global optimum in self-learning situations.	K <sub>4</sub>
CO 4	Understand appropriate learning rules for each of the architectures and learn several neural network paradigms and its applications.	K <sub>2</sub> , K <sub>3</sub>
CO 5	Develop some familiarity with current research problems and research methods in Soft Computing Techniques.	K <sub>5</sub> , K <sub>6</sub>

K<sub>1</sub>- Remember, K<sub>2</sub>- Understand, K<sub>3</sub>- Apply, K<sub>4</sub>- Analyze, K<sub>5</sub>- Evaluate, K<sub>6</sub>- Create

<b>Introduction to Soft Computing</b>		
<b>Detailed Syllabus</b>		
<b>Unit</b>	<b>Topic</b>	<b>Proposed Lecture</b>
<b>I</b>	Introduction to Soft Computing, <b>ARTIFICIAL NEURAL NETWORKS</b> Basic concepts - Single layer perception - Multilayer Perception - Supervised and Unsupervised learning – Back propagation networks - Kohnen's self-organizing networks - Hopfield network.	08
<b>II</b>	<b>FUZZY SYSTEMS</b> Fuzzy sets, Fuzzy Relations and Fuzzy reasoning, Fuzzy functions - Decomposition - Fuzzy automata and languages - Fuzzy control methods - Fuzzy decision making.	08
<b>III</b>	<b>NEURO - FUZZY MODELING</b> Adaptive networks based Fuzzy interface systems - Classification and Regression Trees - Data clustering algorithms - Rule based structure identification - Neuro-Fuzzy controls - Simulated annealing – Evolutionary computation	08
<b>IV</b>	<b>GENETIC ALGORITHMS</b> Survival of the Fittest - Fitness Computations - Cross over - Mutation - Reproduction - Rank method - Rank space method.	08
<b>V</b>	<b>APPLICATION OF SOFT COMPUTING</b> Optimiation of traveling salesman problem using Genetic Algorithm, Genetic algorithm based Internet Search Techniques, Soft computing based hybrid fuzzy controller, Introduction to MATLAB Environment for Soft computing Techniques.	08
<b>Text books:</b>		
<ol style="list-style-type: none"> <li>1.An Introduction to Genetic Algorithm Melanic Mitchell (MIT Press)</li> <li>2.Evolutionary Algorithm for Solving Multi-objective, Optimization Problems (2nd Edition), Collelo, Lament, Veldhnizer ( Springer)</li> <li>3.Fuzzy Logic with Engineering Applications Timothy J. Ross (Wiley)</li> <li>4.Neural Networks and Learning Machines Simon Haykin (PHI)</li> <li>5.Sivanandam, Deepa, “ Principles of Soft Computing”, Wiley</li> <li>6.Jang J.S.R, Sun C.T. and Mizutani E, "Neuro-Fuzzy and Soft computing", Prentice Hall</li> <li>7.Timothy J. Ross, "Fuzzy Logic with Engineering Applications", McGraw Hill</li> <li>8.Laurene Fausett, "Fundamentals of Neural Networks", Prentice Hall</li> <li>9.D.E. Goldberg, "Genetic Algorithms: Search, Optimization and Machine Learning", Addison Wesley</li> <li>10.Wang, “Fuzzy Logic”, Springer</li> </ol>		

<b>Analog Electronics Circuits</b>	<b>3L:1T:0P</b>	<b>4 Credits</b>
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<b>Unit</b>	<b>Topics</b>	<b>Lectures</b>
<b>I</b>	Diode circuits, amplifier models: Voltage amplifier, current amplifier, trans-conductance amplifier and trans-resistance amplifier. biasing schemes for BJT and FET amplifiers, bias stability, various configurations (such as CE/CS, CB/CG, CC/CD) and their features, small signal analysis, low frequency transistor models, estimation of voltage gain, input resistance, output resistance etc., design procedure for particular specifications, low frequency analysis of multistage amplifiers.	8
<b>II</b>	High frequency transistor models, frequency response of single stage and multistage amplifiers, cascode amplifier, various classes of operation (Class A, B, AB, C etc.), their power efficiency and linearity issues, feedback topologies: Voltage series, current series, voltage shunt, current shunt, effect of feedback on gain, bandwidth etc., calculation with practical circuits, concept of stability, gain margin and phase margin.	8
<b>III</b>	Oscillators: Review of the basic concept, Barkhausen criterion, RC oscillators (phase shift, Wien bridge etc.), LC oscillators (Hartley, Colpitt, Clapp etc.), non-sinusoidal oscillators.	8
<b>IV</b>	Current mirror: Basic topology and its variants, V-I characteristics, output resistance and minimum sustainable voltage (VON), maximum usable load, differential amplifier: Basic structure and principle of operation, calculation of differential gain, common mode gain, CMRR and ICMR, Op-Amp design: Design of differential amplifier for a given specification, design of gain stages and output stages, compensation.	8
<b>V</b>	Op-Amp applications: Review of inverting and non-inverting amplifiers, integrator and differentiator, summing amplifier, precision rectifier, Schmitt trigger and its applications, active filters: Low pass, high pass, band pass and band stop, design guidelines.	8

**Text/Reference Books:**

1. J.V. Wait, L.P. Huelsman and GA Korn, "Introduction to Operational Amplifier theory and applications," McGraw Hill, 1992.
2. J. Millman and A. Grabel, "Microelectronics," 2<sup>nd</sup> edition, McGraw Hill, 1988.
3. P. Horowitz and W. Hill, "The Art of Electronics," 2<sup>nd</sup> edition, Cambridge University Press, 1989.
4. A.S. Sedra and K.C. Smith, "Microelectronic Circuits,"Saunder's College11 Publishing, 4<sup>th</sup> edition.
5. Paul R. Gray and Robert G. Meyer, "Analysis and Design of Analog Integrated Circuits," John Wiley, 3rd edition.
6. Muhammad H. Rashid, "Electronic Devices and Circuits," Cengage publication, 2014.

**Course Outcomes:**

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

1. Understand the characteristics of diodes and transistors.
2. Design and analyze various rectifier and amplifier circuits.
3. Design sinusoidal and non-sinusoidal oscillators.
4. Understand the functioning of OP-AMP and design OP-AMP based circuits.
5. Design LPF, HPF, BPF, BSF.

<b>Electronics Engineering</b>	<b>3L:1T:0P</b>	<b>4 Credits</b>
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<b>Unit</b>	<b>Topics</b>	<b>Lectures</b>
<b>I</b>	PN junction diode: Introduction of semiconductor materials; Semiconductor diode: Depletion layer, V-I characteristics, ideal and practical, diode resistance, capacitance, diode equivalent circuits, transition and diffusion capacitance, Zener diodes breakdown mechanism (Zener and avalanche).	8
<b>II</b>	Diode application: Series, parallel and series, parallel diode configuration, half and full wave rectification, clippers, clampers, Zener diode as shunt regulator, voltage-multiplier circuits special purpose two terminal devices : light-emitting diodes, Varactor (Varicap) diodes, tunnel diodes, liquid-crystal displays.	8
<b>III</b>	Bipolar junction transistors and field effect transistor: Bipolar junction transistor: Transistor construction, operation, amplification action, common base, common emitter, common collector configuration dc biasing BJTs: operating point, fixed-bias, emitter bias, voltage-divider bias configuration. Collector feedback, emitter-follower configuration. Bias stabilization. CE, CB, CC amplifiers and AC analysis of single stage CE amplifier (re Model), Field effect transistor: Construction and characteristic of JFETs. AC analysis of CS amplifier, MOSFET (depletion and enhancement) type, transfer characteristic.	8
<b>IV</b>	Operational amplifiers: Introduction and block diagram of Op-Amp, ideal & practical characteristics of Op-Amp, differential amplifier circuits, practical Op-Amp circuits (inverting amplifier, non-inverting amplifier, unity gain amplifier, summing amplifier, integrator, differentiator), Op-Amp parameters: input offset voltage, output offset voltage, input biased current, input offset current differential and common-mode operation.	8
<b>V</b>	Electronic instrumentation and measurements: Digital voltmeter: Introduction, RAMP techniques digital multimeters: Introduction Oscilloscope: introduction, basic principle, CRT, block diagram of oscilloscope, simple, measurement of voltage, current phase and frequency using CRO, introduction of digital storage oscilloscope and comparison of DSO with analog oscilloscope.	8

**Text /Reference Books:**

1. Robert L. Boylestand / Louis Nashelsky, "Electronic Devices and Circuit Theory," Latest Edition, Pearson Education.
2. H S Kalsi, "Electronic Instrumentation", Latest Edition, TMH Publication.
3. Meetidehran/ A.K. singh "fundamental of electronics Engineering", New age international publisher.

**Course Outcomes:**

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

1. Understand the concept of PN junction and special purpose diodes.
  2. Study the application of conventional diode and semiconductor diode.
  3. Analyse the I-V characteristics of BJT and FET.
  4. Analyzethe of Op-Amp, amplifiers, integrator, and differentiator.
  5. Understand the concept of digital storage oscilloscope and compare of DSO with analog oscilloscope
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