## Engineering Science Courses for B.Tech. (AICTE Model Curriculum) 2\textsuperscript{nd} Year
(effective from the session 2019-20)

<table>
<thead>
<tr>
<th>Sl.No.</th>
<th>Subject Codes</th>
<th>Subject</th>
<th>Periods</th>
<th>Evaluation Scheme</th>
<th>End Semester</th>
<th>Total</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
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<tr>
<td>1</td>
<td>KOE031/041</td>
<td>Engineering Mechanics</td>
<td>3</td>
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<td>3</td>
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<td>4</td>
<td>KOE034/044</td>
<td>Sensor &amp; Instrumentation</td>
<td>3</td>
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<td>20</td>
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<tr>
<td>5</td>
<td>KOE035/045</td>
<td>Basics Data Structure &amp; Algorithms</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>30</td>
<td>20</td>
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<tr>
<td>6</td>
<td>KOE036/046</td>
<td>Introduction to Soft Computing</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>30</td>
<td>20</td>
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<tr>
<td>7</td>
<td>KOE037/047</td>
<td>Analog Electronics Circuits</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>30</td>
<td>20</td>
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<tr>
<td>8</td>
<td>KOE038/048</td>
<td>Electronics Engineering</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>30</td>
<td>20</td>
</tr>
</tbody>
</table>

### Important Notes:

1. **Engineering Mechanics**: To be offered to any Engg. Branch except ME/CE/AG and allied branches
2. **Material Science**: To be offered to any Engg. Branch except EE and allied branches
3. **Energy Science & Engineering**: To be offered to any Engg. Branch except EE and allied branches
4. **Sensor & Instrumentation**: To be offered to any Engg. Branch except CSE and allied branches
5. **Basics Data Structure & Algorithms**: To be offered to any Engg. Branch except CSE and allied branches
6. **Introduction to Soft Computing**: To be offered to any Engg. Branch except EC and allied branches
7. **Analog Electronics Circuits**: To be offered to any Engg. Branch except EC and allied branches
8. **Electronics Engineering**: To be offered to any Engg. Branch except EC and allied branches

**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.


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:

MATERIAL SCIENCE

UNIT-I:
Phase Diagrams:

UNIT-II:
Ferrous Alloys:

UNIT-III:
Mechanical Properties:

UNIT-IV:
Magnetic, Dielectric & Superconducting Materials:

UNIT-V:
New Materials:

Text Books & References:
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 CO2, 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-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
SENSOR AND INSTRUMENTATION

Pre-requisites of course: Basic Electrical Engineering

<table>
<thead>
<tr>
<th>Course Outcomes:</th>
<th>Knowledge Level, KL</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO 1</td>
<td>Apply the use of sensors for measurement of displacement, force and pressure.</td>
</tr>
<tr>
<td>CO2</td>
<td>Employ commonly used sensors in industry for measurement of temperature, position, accelerometer, vibration sensor, flow and level.</td>
</tr>
<tr>
<td>CO3</td>
<td>Demonstrate the use of virtual instrumentation in automation industries.</td>
</tr>
<tr>
<td>CO4</td>
<td>Identify and use data acquisition methods.</td>
</tr>
<tr>
<td>CO5</td>
<td>Comprehend intelligent instrumentation in industrial automation.</td>
</tr>
</tbody>
</table>

Detailed Syllabus:

Unit- I:

Unit-II:

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:
Text Books:
1. DVS Murthy, Transducers and Instrumentation, PHI 2nd Edition 2013

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

$K_1$ - Remember, $K_2$ - Understand, $K_3$ - Apply, $K_4$ - Analyze, $K_5$ - Evaluate, $K_6$ - Create
## Basics Data Structure and Algorithms

### Detailed Syllabus

<table>
<thead>
<tr>
<th>Unit</th>
<th>Topic</th>
<th>Proposed Lecture</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Introduction to data structure and Algorithms: 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, spare matrices, Character storing in C, String operations.</td>
<td>08</td>
</tr>
<tr>
<td>II</td>
<td>Stack And Queue and Link List: 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</td>
<td>08</td>
</tr>
<tr>
<td>III</td>
<td>Trees : Basic terminology, Binary Trees, Binary tree representation, Algebraic(expressions, Complete Binary Trees, Extended binary tree, representing binary tree in memory, linked representation of Binary trees, Traversing binary trees &amp; Searching in binary trees, Inserting in binary search trees, Complexity of searching algorithm, Heaps, general trees, Threaded binary tree.</td>
<td>08</td>
</tr>
<tr>
<td>IV</td>
<td>Graphs: Terminology &amp; representations, Graphs &amp; 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.</td>
<td>08</td>
</tr>
<tr>
<td>V</td>
<td>Searching and Sorting: 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.</td>
<td>08</td>
</tr>
</tbody>
</table>

### Text books:

# Introduction to Soft Computing

<table>
<thead>
<tr>
<th>Course Outcome (CO)</th>
<th>Bloom’s Knowledge Level (KL)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CO 1</strong> Comprehend the fuzzy logic and the concept of fuzziness involved in various systems and fuzzy set theory.</td>
<td>$K_1, K_2$</td>
</tr>
<tr>
<td><strong>CO 2</strong> Understand the concepts of fuzzy sets, knowledge representation using fuzzy rules, approximate reasoning, fuzzy inference systems, and fuzzy logic.</td>
<td>$K_2, K_3$</td>
</tr>
<tr>
<td><strong>CO 3</strong> Describe with genetic algorithms and other random search procedures useful while seeking global optimum in self-learning situations.</td>
<td>$K_4$</td>
</tr>
<tr>
<td><strong>CO 4</strong> Understand appropriate learning rules for each of the architectures and learn several neural network paradigms and its applications.</td>
<td>$K_2, K_3$</td>
</tr>
<tr>
<td><strong>CO 5</strong> Develop some familiarity with current research problems and research methods in Soft Computing Techniques.</td>
<td>$K_5, K_6$</td>
</tr>
</tbody>
</table>

$K_1$- Remember, $K_2$- Understand, $K_3$- Apply, $K_4$- Analyze, $K_5$- Evaluate, $K_6$- Create
<table>
<thead>
<tr>
<th>Unit</th>
<th>Topic</th>
</tr>
</thead>
<tbody>
<tr>
<td>II</td>
<td><strong>FUZZY SYSTEMS</strong>&lt;br&gt;<strong>FUZZY SETS</strong>, <strong>FUZZY RELATIONS AND FUZZY REASONING</strong>, <strong>FUZZY FUNCTIONS</strong> - Decomposition - <strong>FUZZY AUTOMATA AND LANGUAGES</strong> - <strong>FUZZY CONTROL METHODS</strong> - <strong>FUZZY DECISION MAKING</strong>.</td>
</tr>
<tr>
<td>IV</td>
<td><strong>GENETIC ALGORITHMS</strong>&lt;br&gt;Survival of the Fittest - Fitness Computations - Cross Over - Mutation - Reproduction - Rank Method - Rank Space Method.</td>
</tr>
</tbody>
</table>

**Text books:**

1. An Introduction to Genetic Algorithm  Melanie Mitchell (MIT Press)
3. Fuzzy Logic with Engineering Applications Timothy J. Ross (Wiley)
4. Neural Networks and Learning Machines Simon Haykin (PHI)
8. Laurene Fausett, "Fundamentals of Neural Networks", Prentice Hall
## Analog Electronics Circuits

<table>
<thead>
<tr>
<th>Unit</th>
<th>Topics</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>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.</td>
</tr>
<tr>
<td>II</td>
<td>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.</td>
</tr>
<tr>
<td>III</td>
<td>Oscillators: Review of the basic concept, Barkhausen criterion, RC oscillators (phase shift, Wien bridge etc.), LC oscillators (Hartley, Colpitt, Clapp etc.), non-sinusoidal oscillators.</td>
</tr>
<tr>
<td>IV</td>
<td>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.</td>
</tr>
</tbody>
</table>

### Text/Reference Books:

### 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.
<table>
<thead>
<tr>
<th>Unit</th>
<th>Topics</th>
<th>Lectures</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>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).</td>
<td>8</td>
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<tr>
<td>II</td>
<td>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.</td>
<td>8</td>
</tr>
<tr>
<td>III</td>
<td>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.</td>
<td>8</td>
</tr>
<tr>
<td>IV</td>
<td>Operational amplifiers: Introduction and block diagram of Op-Amp, ideal &amp; 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.</td>
<td>8</td>
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</tbody>
</table>

**Text/Reference Books:**

**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.
5. Understand the concept of digital storage oscilloscope and compare of DSO with analog oscilloscope.