



# K. S. INSTITUTE OF TECHNOLOGY

An Autonomous Institution under VTU, Approved by AICTE

Department of Mechanical Engineering

## FIRST / SECOND SEMESTER SYLLABUS

<b>Course : Elements of Mechanical Engineering</b>	Semester	I/II	
<b>Course Code</b>	<b>25BPSC105B /205B</b>	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3-0-0-0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03
Examination type (SEE)	Theory		

### Course Objectives (Course Skill Set)

1. To introduce students to various **engineering materials** and their properties, applications, advantages, and limitations.
2. To develop an understanding of **thermodynamics**, steam properties, IC engines, and **hybrid/electric vehicles**.
3. To familiarize students with **machine tools** and **metal joining processes** and their industrial significance.
4. To provide insights into **power transmission systems** and **robotics** with their applications in automation.
5. To introduce **CNC, CAD/CAM, automation, additive manufacturing, and AI applications** in mechanical engineering.

### Module-1

**Engineering materials:** Introduction, Classification, Ferrous and Non-Ferrous metals: Types, Properties and their applications. **Composite materials:** Introduction, Constituents of a composite, Classification, Types of Matrix and Reinforcement materials, Advantages, Disadvantages and Applications of composite materials in Aerospace and Automobile industries. **Smart materials:** Introduction, Types - Piezoelectric materials, MR fluids, Shape memory alloys and Advantages, Disadvantages and Applications. **Nano materials:** Introduction, Types of nano materials, Advantages, Disadvantages and Applications. **Number of Hours:8**

### Module-2

**Concepts of Thermodynamics:** Work, Energy, Heat, Modes of Heat transfer: Conduction, Convection and Radiation. Steam: Formation of steam, Properties of Steam, Numerical related to the properties of steam. Introduction to Heat engines and Heat pumps.

**Introduction to Internal Combustion engines:** Working principle of Two stroke and Four stroke engines (SI & CI Engines), Simple Numerical involving BP, IP and Mechanical efficiency only.

**Electric vehicles and Hybrid vehicles:** Electric and Hybrid vehicle components, power trains & comparison, Brief introduction to energy storage in Electric vehicles.

Principles of renewable energy sources, energy & sustainable developments.

**Number of Hours:8**

### Module-3

#### Machine Tools:

**Lathe:** Working principle, Specifications, Operations performed – Turning, Facing, Taper turning by swiveling the compound rest, Thread cutting and Knurling.

**Drilling Machine:** Working principle, Specifications, Operations performed – Drilling, Reaming, Boring, Counter boring, Countersinking, Tapping.

**Milling machine:** Working principle, Specifications, Operations performed – Plane milling, End milling, Slot milling, Angular milling. (Sketches of machine tools not required. Sketches to be used only for explaining the operations).

<p><b>Joining Processes:</b> Introduction, Temporary and Permanent joining methods: Working principle of Soldering, Brazing and Electric Arc welding, Advantages, Limitations and Applications.</p> <p><b>Finishing Processes:</b> Grinding, Lapping, Honing</p> <p style="text-align: right;"><b>Number of Hours:8</b></p>
<b>Module-4</b>
<p><b>Belt drives:</b> Introduction, Open and Cross belt drives. (No derivations and numericals), Flat belts and V belts.</p> <p><b>Gear Drives:</b> Types of Gears, Velocity ratio, Gear Trains - Simple and Compound gear trains and Numericals.</p> <p>Chain Drive and Rope Drives: Principle of operation</p> <p><b>Robotics:</b> Introduction, Generation of Robots, Asimov's laws of Robots, Robot anatomy - Links and Joints, Types of Robots, Configurations of Robots, Robot motion - Degrees of Freedom, Robot sensors: Tactile, Force, Proximity and Vision sensors, Definition of Work volume, Accuracy, Precision, Repeatability and Payloads. <b>Introduction to cognitive robotics.</b> <b>Number of Hours:8</b></p>
<b>Module-5</b>
<p><b>Computer Numerical Control (CNC):</b> Introduction, Definition of NC and CNC Components of CNC. Definition of CAD, CAM, CAE and CIM.</p> <p><b>Automation:</b> Definition, Types of Automation, Reasons for Automation.</p> <p><b>Additive manufacturing:</b> Introduction, Basic principles (Steps in additive manufacturing), Additive manufacturing processes –classifications, Automotive and Aerospace applications.</p> <p><b>Applications of AI in Mechanical Engineering:</b> Automobile industry, manufacturing industry and Mechanical design.</p> <p><b>Introduction to digital twin technology:</b> Definition, concept, evolution &amp; core components(Lecture Video in one session; <i>NOT for SEE</i>)</p> <p style="text-align: right;"><b>Number of Hours:8</b></p>
<p><b>Course outcome (Course Skill Set)</b></p> <p>At the end of the course, the student will be able to:</p> <p>CO1.<b>Understand</b> the significance of advanced engineering materials catering to various industrial applications</p> <p>CO2.<b>Make use of</b> thermodynamic concepts to study properties of steam and performance of combustion engine &amp; EHV.</p> <p>CO3.<b>Demonstrate</b> the working and operations of machine tools and metal joining techniques.</p> <p>CO4.<b>Apply</b> the concepts of power transmission through belt, gear, Chain, and Rope drives and discuss the anatomy of robots.</p> <p>CO5.<b>Discuss</b> the role of computer systems in manufacturing, their contribution to automation, and the applications of 3D printing and AI in mechanical engineering.</p>
<p><b>Textbooks:</b></p> <ol style="list-style-type: none"> <li>1. K R Gopala Krishna, Elements of Mechanical Engineering, Subhash Publications, 2018.</li> <li>2. S K Hajra Choudhury and Nirjhar Roy, Elements of Workshop Technology (Vol. I and II), Media Promoters and Publishers Pvt. Ltd., 2016.</li> <li>3. Ganeshan. V, Internal Combustion Engines, Tata McGraw Hill, 4th Edition, 2012.</li> <li>4. Rajput R.K, Thermal Engineering, Laxmi Publications (Pvt) Ltd., New Delhi. 6th Edition, 2007.</li> <li>5. Mikell P. Grover, Automation Production Systems and Computer Integrated Manufacturing, PHI, 2004.</li> <li>6. Husain Iqbal, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, 3rd Edition, 2021.</li> </ol>

7. Ian Gibson, David. W. Rosen, Brent Stucker, Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing, Springer, 2nd Edition, 2014.
8. Mikell P. Groover and Emory W. Zimmers, CAD/CAM. Zimmer & Groover CAD/CAM, 2007.
9. Russeli and Norvig, Artificial Intelligence: A Modern approach, Khanna Publications, 2020

**Reference books / Manuals:**

1. Serope Kalpakjian and Steven R Schmid, Manufacturing Engineering and Technology, Fourth Edition, Pearson Education, Asia, 2000.
2. Radha Krishna & S. Subramanian, CAD/CAM/CIM, New Age International Publishers, 2009
3. F.L. Matthews and R.D. Rawlings, Composite materials: Engineering and Science, Woodhead Publishing Ltd. & CRC Press, 2003.
4. Mikell P.Groover and Mitchel Weiss and Roger N.Nagel Nicholas G.Odrey, Industrial Robotics technology, programming and applications, Tata McGraw Hill Edition, 2008

**Web links and Video Lectures (e-Resources):**

- <https://nptel.ac.in/courses/112104526>
- <https://nptel.ac.in/courses/112104616> • <https://nptel.ac.in/courses/112104769>
- <https://venturebeat.com/ai/how-ai-is-impacting-the-automotive-world/>
- <https://www.vlcsolutions.com/blog/artificial-intelligence-in-manufacturing/>
- <https://skill-lync.com/blogs/technical-blogs/design-applications-of-machine-learning-and-ai-in-mechanical-engineering>
- <https://caeassistant.com/blog/ai-in-mechanical-engineering-video/>
- <https://www.neuralconcept.com/post/how-is-ai-used-in-mechanical-engineering>
- <https://www.youtube.com/watch?v=MKiiXubKaGM>
- [https://www.youtube.com/watch?v=\\_canCYWZPsc](https://www.youtube.com/watch?v=_canCYWZPsc)
  - <https://www.youtube.com/watch?v=IQ-MYnyxh7M>

**Assessment Structure:**

The assessment in each course is divided equally between Continuous Internal Evaluation (CIE) and the Semester End Examination (SEE), with each carrying 50% weightage.

- To qualify and become eligible to appear for SEE, in the **CIE**, a student must score at least **40% of 50 marks, i.e., 20 marks.**
- To pass the **SEE**, a student must score at least **35% of 50 marks, i.e., 18 marks.**
- Notwithstanding the above, a student is considered to have **passed the course**, provided the combined total of **CIE and SEE is at least 40 out of 100 marks.**

**Continuous Comprehensive Assessments (CCA):**

CCA shall be conducted for 25 marks. It is evaluated through the learning activity which is aimed at enhancing the holistic development of students. These activities should align with course objectives and promote higher-order thinking and application-based learning.

Learning Activity : Case Study Presentation **(15 Marks)**

Learning Activity - 2: Material Selection and Justification for a chosen Real-world Engineering Product

**(10 Marks)**

**Rubrics for Learning Activity:**

**(To be conducted for 30 marks and the marks obtained shall be reduced to 15)**

**Case Study Presentation (15 Marks)**

Case Study topic should relate to key learning area from the syllabus and allow exploration of practical applications, challenges, and innovations relevant to engineering education and industry.

<b>Performance Indicators</b>	<b>Excellent</b>	<b>Good</b>	<b>Satisfactory</b>	<b>Needs Improvement</b>	<b>Poor</b>
<b>Understanding of Case (5 Marks) (PO 1)</b>	Demonstrates deep understanding (5)	Good understanding (4)	Adequate understanding. (3)	Limited understanding (2)	No clear understanding. (0-1)
<b>Analysis &amp; Critical Thinking (10 Marks) (PO 2)</b>	Thorough, logical analysis with strong reasoning and innovative insights. (9-10)	Clear analysis with mostly logical reasoning. (7-8)	Basic analysis with some reasoning gaps. (5-6)	Weak analysis; mostly descriptive without reasoning. (3-4)	No clear analysis or reasoning. (0-2)
<b>Documentation &amp; Presentation Skills (10 Marks) (PO 9)</b>	Documentation is complete, accurate, wellstructured, follows all formatting guidelines. Well-structured, clear, confident delivery; excellent visuals. (9-10)	Documentation is mostly complete and accurate, wellorganized, follows formatting guidelines with minor deviations. Good structure, clear delivery; visuals mostly effective. (7-8)	Documentation covers most required elements but has some inaccuracies or omissions. Average structure; delivery clear but lacks engagement. (5-6)	Documentation is incomplete with noticeable inaccuracies. Poor organization; visuals unclear. (3-4)	Documentation is largely missing or irrelevant, lacks structure. Unclear, disorganized presentation. (0-2)
<b>Q&amp;A Handling (5 Marks) (PO 9)</b>	Confident, accurate, and concise responses. (5)	Good responses with minor gaps. (4)	Adequate responses; some uncertainty. (3)	Weak or hesitant responses. (2)	Unable to answer questions. (0-1)

### **Rubrics for Learning Activity 2:**

Material Selection and Justification for a chosen Real-world Engineering Product (10 Marks) (To be conducted for 20 marks and the marks obtained shall be reduced to 10)

Students will select one real-world engineering product (e.g., aircraft wing, car chassis, biomedical implant, wind turbine blade, Tennis racket etc.) and they will justify the choice of materials (Ferrous/Non-ferrous, Composite, Smart, Nano) based on properties, advantages, disadvantages, and application suitability, etc.,

<b>Performance Indicators</b>	<b>Excellent</b>	<b>Good</b>	<b>Satisfactory</b>	<b>Needs Improvement</b>	<b>Poor</b>
<b>Material Selection &amp; Relevance (10 Marks) (PO 1)</b>	Chosen materials perfectly match the product	Mostly relevant materials with good justification.	Materials somewhat match requirements;	Poor material product match; weak reasoning. (3-4)	Irrelevant material choice; no justification. (0-2)

	requirements; strong justification using properties & industry relevance. <b>(9-10)</b>	<b>(7-8)</b>	justification partial. <b>(5-6)</b>		
<b>Technical Content Accuracy (5 Marks) (PO 2)</b>	All properties, types, advantages / disadvantages, and applications are correct and well explained. <b>(5)</b>	Mostly accurate with minor errors. <b>(4)</b>	Adequate content; a few gaps or inaccuracies. <b>(3)</b>	Several inaccuracies; missing key aspects. <b>(2)</b>	Mostly incorrect or missing technical details. <b>(0-1)</b>
<b>Organization &amp; Presentation (5 Marks) (PO 10)</b>	Well-structured, clear flow, good visuals/tables, and concise explanation. <b>(5)</b>	Clear structure; minor improvements needed. <b>(4)</b>	Acceptable structure but some clutter. <b>(3)</b>	Poor organization; difficult to follow. <b>(2)</b>	Disorganized; lacks clarity. <b>(0-1)</b>
<p><b>Suggest Innovative Deliver Methods may include (but are not limited to):</b></p> <ul style="list-style-type: none"> <li>- Flipped Classroom</li> <li>- Problem-Based Learning (PBL)</li> <li>- Case-Based Teaching</li> <li>- Simulation and Virtual Labs</li> <li>- Partial Delivery of course by Industry expert/ industrial visits</li> <li>- ICT-Enabled Teaching</li> <li>- Role Play</li> </ul>					