

Semester: VII -Addon						
Materials and Manufacturing of Internal Combustion Engines						
Course Code	:	Addon_7		CIE	:	10
L:T:P	:	2: 0: 0		SEE	:	-----
Total Hours	:	30		SEE Duration	:	-----

	Topics	Hours
1. Introduction & Fundamentals	Types of IC engines (SI, CI, 2-Stroke, 4-Stroke), Applications, Basic working principles. Overview of performance parameters (power, torque, efficiency).	3
2. Materials in IC Engines – Overview	Role of material science in engine design; property requirements (strength, wear resistance, thermal conductivity, corrosion resistance). Trends in lightweight materials.	2
3. Component-wise Material Selection	Cylinder block & head, piston, piston rings, connecting rod, crankshaft, valves, bearings, manifolds, gaskets. Case studies of material failure.	4
4. Manufacturing Processes	Casting (sand, die), forging, machining, heat treatment, coating processes. Process selection criteria for engine components.	4
5. Precision & Quality in Engine Manufacturing	Tolerances, surface finish, balancing, assembly practices. Non-destructive testing (NDT) methods for engine parts.	3
6. Surface Treatments & Coatings	Chrome plating, molybdenum coating, ceramic thermal barrier coatings, DLC (Diamond-Like Carbon).	2
7. Engine Performance & Material Interaction	How material properties influence performance, fuel efficiency, and emissions.	2
8. Sustainability & Future Trends	Advanced alloys, composites, ceramics. Role of additive manufacturing (3D printing). Transition to hybrid/electric powertrains and their impact on IC engine design.	10

- CO1** – Explain the fundamentals, classifications, and operating principles of IC engines and their performance parameters.
- CO2** – Select suitable engineering materials for different IC engine components based on mechanical, thermal, and tribological properties.
- CO3** – Apply manufacturing processes, heat treatments, and surface coating techniques for producing and enhancing IC engine components.
- CO4** – Analyze the influence of material properties and manufacturing quality on engine performance, efficiency, and emissions.
- CO5** – Evaluate sustainability challenges, emerging material technologies, and manufacturing trends in the evolution of IC engines.

CO / PO & PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	1	1	-	-	-	1	-	1	1	1
CO2	3	2	2	2	1	1	-	-	-	1	-	1	1	1
CO3	3	2	3	2	2	1	-	-	1	1	-	2	1	1
CO4	3	3	3	3	2	1	-	-	1	1	-	2	1	1
CO5	2	2	2	2	2	2	1	3	-	1	-	3	2	2

Text Book

1. Internal Combustion Engine Fundamentals — John B. Heywood
(https://www.iust.ac.ir/files/mech/ayatgh_c5664/files/internal_combustion_engines_heywood.pdf)
2. I.C. Engines — V. Ganesan
3. The Science and Technology of Materials in Automotive Engines — Hiroshi Yamagata

Reference Books

1. Materials Science and Engineering: An Introduction — William D. Callister, Jr.

(*Signature*)
(*Dr. G. K. Katti*)

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COURSE PLAN

Semester: VII

Year: 2025-26 (Odd/Even)

Course Title	Materials and Manufacturing of Internal Combustion Engines	Course Code	Addon_7
Total Teaching Hours	30	Teaching hours/week	02
CIA: 10	SEE:-	Prerequisites	-
Course Plan prepared by	Dr. Gururaj Hatti	Approved by	Dr K S Pujari

Course Outcomes

CO1 - Explain the fundamentals, classifications, and operating principles of IC engines and their performance parameters.

CO2 - Select suitable engineering materials for different IC engine components based on mechanical, thermal, and tribological properties.

CO3 - Apply manufacturing processes, heat treatments, and surface coating techniques for producing and enhancing IC engine components.

CO4 - Analyze the influence of material properties and manufacturing quality on engine performance, efficiency, and emissions.

CO5 - Evaluate sustainability challenges, emerging material technologies, and manufacturing trends in the evolution of IC engines.

CO's And PO's Mapping Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	1	1	1	1	-	-	-	1	-	1	1	1
2	3	2	2	2	1	1	-	-	-	1	-	1	1	1
3	3	2	3	2	2	1	-	-	1	1	-	2	1	1
4	3	3	3	3	2	1	-	-	1	1	-	2	1	1
5	2	2	2	2	2	2	1	3	-	1	-	3	2	2

Text/Reference Books

Textbooks / Reference Books:

- Internal Combustion Engine Fundamentals – John B. Heywood
(https://www.iust.ac.ir/files/mech/ayatgh_c5664/files/internal_combustion_engines_heywood.pdf)
- I.C. Engines – V. Ganesan
- The Science and Technology of Materials in Automotive Engines – Hiroshi Yamagata
- Materials Science and Engineering: An Introduction – William D. Callister, Jr.
- Handbook of Advanced Ceramics and Composites Defense, Security, Aerospace and Energy Applications, Reference work © 2020, Yashwant R. Mahajan, Roy Johnson.
<https://link.springer.com/referencework/10.1007/978-3-030-16347-1>
- Additive Manufacturing Advanced Materials and Design Techniques, Edited By Pulak Mohan Pandey, Nishant Kumar Singh, Yashvir Singh, 1st Edition. ISBN 9781032192659, 220 Pages 65 Color & 11 B/W Illustrations, Published October 4, 2024 by CRC Press.
<https://www.routledge.com/Additive-Manufacturing-Advanced-Materials-and-Design-Techniques/Pandey-Singh-Singh/p/book/9781032192659>
- Hybrid Electric Power Train Engineering and Technology: Modeling, Control, and Simulation Part



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COURSE PLAN

of the Research Essentials Collection Antoni Szumanowski (Warsaw University of Technology, Poland), ISBN13: 9781466640429 | ISBN10: 1466640421 | EISBN13: 9781466640436. <https://www.igi-global.com/book/hybrid-electric-power-train-engineering/73555>

Module Wise Text/Reference Books

Module 1: 1,2

Module 2,3: 1,2,3

Module 4,5: 1,2,3,4

Module 6: 4

Module 7,8: 4,5,6,7

Syllabus for the Internal Assessment Test (Tentative)

IA Test

Test pattern

MCQuestions will be set based on above syllabus for 25 Marks reduce to 10 marks.


(Mr. G. Kattel)


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