# MOHAMMED SATHAK A J COLLEGE OF ENGINEERING

Siruseri IT park, OMR, Chennai - 603103

## LESSON PLAN

**Department of Mechanical Engineering**

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| Name of the Subject | **THERMAL ENGINEERING** | Name of the handling Faculty | **Vigneshwaran V** |
| Subject Code | **ME3451** | Year / Sem | **II / IV** |
| Acad Year | **2022-2023** | Batch | **2021-2025** |

## Course Objective

To learn the concepts and laws of thermodynamics to predict the operation of thermodynamic cycles and performance of Interna Combustion(IC) engines and Gas Turbines.

To analyzing the performance of steam nozzle, calculate critical pressure ratio

To Evaluating the performance of steam turbines through velocity triangles, understand the need

To analyzing the working of IC engines and various auxiliary systems present in IC engines

To evaluating the various performance parameters of IC engines

## Course Outcome

CO1: Apply thermodynamics concepts to different air standard cycles and solve problem

CO2: To slove problems in steam nozzle and calculate critical pressure ratio

CO3: Explain the flow in the steam turbines, draw velocity diagrams, flow in gas turbines and slove problems

CO4: Explain the functioning and feature of IC engines, components and auxillaries

CO5: Calculate the various performance parameters of IC Engines.

**Lesson Plan**

| Sl. No. | Topic(s) | T / R* Book | Periods Required | Mode of Teaching (BB / PPT / NPTEL / MOOC / etc ) | Blooms Level (L1-L6) | CO |
|---|---|---|---|---|---|---|
| **UNIT I - Thermodynamic Cycles** | | | | | | |
| **1** | Air Standard Cycles | R2 | 1 | BB | L2 | 1 |
| **2** | Carnot Cycle | R2 | 1 | BB | L2 | 1 |
| **3** | Otto Cycle | R2 | 1 | BB | L2 | 1 |
| **4** | Diesel Cycle | R2 | 1 | BB | L2 | 1 |
| **5** | Dual Cycle | R2 | 1 | BB | L2 | 1 |
| **6** | Brayton Cycle | R2 | 1 | BB | L2 | 1 |
| **7** | Cycke Analysis, Performance & Combustion | R2 | 2 | BB | L3 | 1 |
| **8** | Basic Rankine Cycle | R2 | 1 | NPTEL | L2 | 1 |
| **9** | Reheat Cycle | R2 | 1 | NPTEL | L2 | 1 |
| **10** | Regenerative Cycle | R2 | 1 | NPTEL | L2 | 1 |

**Suggested Activity: Quiz - Group Seminar or presentation**

**Evaluation method:Content Delivery and PPT**

## Unit II - Steam Nozzle and Injectors

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|---|---|---|---|---|---|---|
| **11** | Types and Shapes of nozzles | R2 | 1 | NPTEL | L2 | 2 |
| **12** | Flow of steam through nozzles | R2 | 3 | BB | L2 | 2 |
| **13** | Critical pressure ratio | R2 | 2 | BB | L3 | 2 |
| **14** | Variation of mass flowrate with pressure ratio | R2 | 2 | BB | L3 | 2 |
| **15** | Effect of friction | R2 | 2 | BB | L2 | 2 |
| **16** | Metastable flow | R2 | 2 | BB | L2 | 2 |

**Suggested Activity: Case studies**

**Evaluation method: Evaluaion of Case Studies**

## UNIT III - Steam & Gas Turbines

| | | | | | | |
|---|---|---|---|---|---|---|
| **17** | Types, Impulse and reaction principles | R2 | 1 | PPT | L2 | 3 |
| **18** | Velocity diagrams | R2 | 2 | PPT | L3 | 3 |
| **19** | Work done and efficiency | R2 | 1 | PPT | L3 | 3 |
| **20** | Optimal operating conditions | R2 | 1 | PPT | L2 | 3 |
| **21** | Multi-staging | R2 | 1 | PPT | L2 | 3 |
| **22** | Compounding and Governing | R2 | 1 | PPT | L2 | 3 |
| **23** | Gas turbine cycle analysis | R2 | 1 | PPT | L2 | 3 |
| **24** | Open and Closed cycle | R2 | 1 | PPT | L2 | 3 |
| **25** | Performance and its improvement | R2 | 1 | BB | L3 | 3 |
| **26** | Regenerative & Intercooled | R2 | 1 | BB | L2 | 3 |
| **27** | Reheated cycles and their combination | R2 | 1 | BB | L2 | 3 |

**Suggested Activity: Quiz**

**Evaluation method: Evaluaion of Quiz**

## UNIT IV - Internal Combustion Engine Features & Combustion

| | | | | | | |
|---|---|---|---|---|---|---|
| **28** | IC engine Classification, working, components and their functions | T2 | 1 | NPTEL | L2 | 4 |
| **29** | Ideal and actual : Valve and port timing diagrams, P-V diagrams | T2 | 1 | NPTEL | L2 | 4 |
| **30** | Two stroke & Four stroke, and SI & CI engines & comparison | T2 | 1 | NPTEL | L2 | 4 |
| **31** | Geometric & operations of SI and CI engines | T2 | 2 | NPTEL | L2 | 4 |

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| **32** | Performance comparison of SI and CI engines | T2 | 1 | NPTEL | L3 | 4 |
| **33** | Desirable properties and qualities of fuels | T2 | 1 | BB | L2 | 4 |
| **34** | Air-fuel ratio calculation | T2 | 2 | BB | L2 | 4 |
| **35** | Lean and rich mixtures | T2 | 1 | BB | L2 | 4 |
| **36** | Combustion in SI & CI Engines | T2 | 1 | BB | L2 | 4 |
| **37** | Knocking: Phenomena and Control. | T2 | 1 | BB | L2 | 4 |

**Suggested Activity: Assignment given to students**

**Evaluation method: Evaluation of Assignment**

## Unit V - Internal Combustion Engine Performance and Auxillary Systems

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|---|---|---|---|---|---|---|
| **38** | Performance & Emission Testing | T2 | 1 | BB | L2 | 5 |
| **39** | Performance Parameters | T2 | 1 | BB | L2 | 5 |
| **40** | Calculation | T2 | 1 | BB | L2 | 5 |
| **41** | Morse test | T2 | 1 | BB | L2 | 5 |
| **42** | Heat Balance Test | T2 | 1 | BB | L3 | 5 |
| **43** | MFJS System | T2 | 1 | BB | L2 | 5 |
| **44** | CRDI System | T2 | 1 | BB | L2 | 5 |
| **45** | Magneto Ignition System | T2 | 1 | NPTEL | L2 | 5 |
| **46** | Batterey Ignition System | T2 | 1 | NPTEL | L2 | 5 |
| **47** | Electric Ignition System | T2 | 1 | NPTEL | L2 | 5 |
| **48** | Lubrication & Colling System | T2 | 1 | NPTEL | L2 | 5 |
| **49** | Concept of Supercharging and Turbocharging & Emission Norms | T2 | 1 | NPTEL | L2 | 5 |

**Suggested Activity: Assignment given to students**

**Evaluation method: Evaluation of Assignment**

**Content Beyond the Syllabus Planned**

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|---|---|
| 1 | Ericson Cycle |
| 2 | Sterling Cycle |

**Text Books**

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|---|---|
| **1** | Mahesh. M. Rathore, “Thermal Engineering”, 1st Edition, Tata McGraw Hill, 2010. |
| **2** | Ganesan.V, " Internal Combustion Engines" 4th Edition, Tata McGraw Hill, 2012. |

**Reference Books**

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|---|---|
| **1** | Ballaney. P, “Thermal Engineering”, 25th Edition, Khanna Publishers, 2017 |

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|---|---|
| 2 | Domkundwar, Kothandaraman, &Domkundwar, “A Course in Thermal Engineering”, 6th Edition, DhanpatRai& Sons, 2 |
| 3 | Gupta H.N, “Fundamentals of Internal Combustion Engines”, 2nd Edition Prentice Hall of India, 2013 |
| 4 | Mathur M.L and Mehta F.S., “Thermal Science and Engineering”, 3rd Edition, Jain Brothers Pvt. Ltd, 2017 |
| 5 | Soman. K, “Thermal Engineering”, 2nd Edition, Prentice Hall of India, 2011. |

**Website / URL References**

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|---|---|
| 1 | https://www.digimat.in/nptel/courses/video/112106310/L38.html |
| 2 | http://www.nitttrc.edu.in/nptel/courses/video/112107216/L20.html |
| 3 | https://www.youtube.com/watch?v=HpoilOJ1Ahc |
| 4 | https://www.youtube.com/watch?v=V8JhP_FWgNs |
| 5 | https://www.youtube.com/watch?v=V8JhP_FWgNs |

**Blooms Level**

| | | | | | |
|---|---|---|---|---|---|
| **Level 1 (L1) : Remembering** | Lower Order Thinking | Fixed Hour Exams | **Level 4 (L4) : Analysing** | | Higher Order Thinking |
| **Level 2 (L2) : Understanding** | | | **Level 5 (L5) : Evaluating** | | |
| **Level 3 (L3) : Applying** | | | **Level 6 (L6) : Creating** | | |

**Mapping syllabus with Bloom’s Taxonomy LOT and HOT**

| Unit No | Unit Name | L1 | L2 | L3 | L4 | L5 | L6 | LOT | HOT |
|---|---|---|---|---|---|---|---|---|---|
| **Unit 1** | THERMODYNAMIC CYCLES | | 9 | 1 | | | | 10 | 0 |
| **Unit 2** | STEAM NOZZLES AND INJECTOR | | 4 | 2 | | | | 6 | 0 |
| **Unit 3** | STEAM AND GAS TURBINES | | | 3 | | | | 3 | 0 |
| **Unit 4** | INTERNAL COMBUSTION ENGINES – FEATURES AND COMBUSTION | | 9 | 1 | | | | 10 | 0 |
| **Unit 5** | INTERNAL COMBUSTION ENGINE PERFORMANCE AND AUXILIARY SYSTEMS | | 11 | 1 | | | | 12 | 0 |
| **Total** | | 0 | 33 | 8 | 0 | 0 | 0 | 41 | 0 |
| **Total Percentage** | | 0 | 80.49 | 19.5122 | 0 | 0 | 0 | 100 | 0 |

**CO PO Mapping**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | 1 | 1 | | | | | | | | | |
| **CO2** | 3 | 2 | 2 | 1 | | | | | | | | | |
| **CO3** | 3 | 2 | 2 | 1 | | | | | | | | | |
| **CO4** | 3 | 2 | 1 | 1 | | | | | | | | | |
| **CO5** | 3 | 2 | 1 | 1 | | | | | | | | | |
| **Avg** | 3 | 2 | 1.4 | 1 | | | | | | | | | |

**Justification for CO-PO mapping**

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|---|---|
| **CO1** | PO1: Basic engineering knowledge is required PO2: Problem analysis is required and PO3: Design of complex engineeri Investigation of Complex Problem is done |

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| **CO2** | PO1: Basic engineering knowledge is required PO2: Problem analysis is required and PO3: Design of complex engineeri Investigation of Complex Problem is done |
| **CO3** | PO1: Basic engineering knowledge is required PO2: Problem analysis is required and PO3: Design of complex engineeri Investigation of Complex Problem is done |
| **CO4** | PO1: Basic engineering knowledge is required PO2: Problem analysis is required and PO3: Design of complex engineeri Investigation of Complex Problem is done |
| **CO5** | PO1: Basic engineering knowledge is required PO2: Problem analysis is required and PO3: Design of complex engineeri Investigation of Complex Problem is done |

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|---|---|---|---|---|---|
| **3** | **High level** | **2** | **Moderate level** | **1** | Low |

Name & Sign of Faculty Incharge : Vigneshwaran V

Name & Sign of Subject Expert : Muhammad Irfan A A

Head of the Department : Dr.S.Prasath

Format No :231

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