

IIPM SCHOOL OF ENGINEERIN AND TECHNOLOGY

**LESSON PLAN: 2023-24**

**Sub: Thermal Engineering-1**

**Branch : Mechanical Semester: 3rd**

**Duration : 60**

**Faculty name : Saritprava Sahoo**

**SYLLABUS**

|  |  |
| --- | --- |
| **Unit – I** | **Thermodynamic concept & Terminology**  1.1 Thermodynamic Systems (closed, open, isolated)  1.2 Thermodynamic properties of a system (pressure, volume, temperature, entropy, enthalpy, Internal energy and units of measurement).  1.3 Intensive and extensive properties  1.4 Define thermodynamic processes, path, cycle , state, path function, point function.  1.5 Thermodynamic Equilibrium.  1.6 Quasi-static Process.  1.7 Conceptual explanation of energy and its sources  1.8 Work, heat and comparison between the two.  1.9 Mechanical Equivalent of Heat.  1.10Work transfer, Displacement work  **Self Study:** **Concepts to Understand** **Thermodynamic** |
| **Unit – II** | **Laws of Thermodynamics**  2.1 State & explain Zeroth law of thermodynamics.  2.2 State & explain First law of thermodynamics.  2.3 Limitations of First law of thermodynamics  2.4Application of First law of Thermodynamics (steady flow energy equation and its application to turbine and compressor)  2.4 Second law of thermodynamics (Claucius & Kelvin Plank statements).  2.5 Application of second law in heat engine, heat pump, refrigerator & determination of efficiencies & C.O.P (solve simple numerical)  **Self Study:** Conversion from Automata to Grammar and vice versa |
| **Unit – III** | **Properties Processes of perfect gas**  3.1 Laws of perfect gas: Boyle’s law, Charle’s law, Avogadro’s law, Dalton’s law of partial pressure, Guy lussac law, General gas equation, characteristic gas constant, Universal gas constant.  3.2 Explain specific heat of gas (Cp and Cv)  3.3 Relation between Cp & Cv.  3.4 Enthalpy of a gas.  3.5 Work done during a non- flow process.  3.6 Application of first law of thermodynamics to various non flow process (Isothermal, Isobaric, Isentropic and polytrophic process)  3.6 Solve simple problems on above.  3.7 Free expansion & throttling process.  **Self Study:** Ogden's lemma and Parikh’s theorem, Early’s algorithm. |
| **Unit – IV** | **Internal combustion engine**  4.1 Explain & classify I.C engine.  4.2 Terminology of I.C Engine such as bore, dead centers, stroke volume, piston speed &RPM.  4.3 Explain the working principle of 2-stroke & 4- stroke engine C.I & S.I engine.  4.4 Differentiate between 2-stroke & 4- stroke engine C.I & S.I engine.  **Self Study:** Linear Bounded Automata and Contest sensitive language and Modified PCP |
| **Unit – V** | **Gas Power Cycle**  5.1 Carnot cycle  5.2 Otto cycle.  5.3 Diesel cycle.  5.4 Dual cycle.  5.5 Solve simple numerical.  **Self Study:** Proofs on Class P, NP and NP-C. |
| **Unit – VI** | **Fuels and Combustion**  6.1 Define Fuel.  6.2 Types of fuel.  6.3 Application of different types of fuel.  6.4 Heating values of fuel.  6.5 Quality of I.C engine fuels Octane number, Cetane number.  **Self Study:** Proofs on Class P, NP and NP-C. |

**TEXT BOOKS& OTHER REFERENCES BOOKS**

|  |  |
| --- | --- |
| **Text Books** | |
| 1. | “Thermal Engineering”, R.S. Khurmi, S.Chand. |
| 2. | “Thermal Engineering”, A.S. Sarao, Satya Prakash. |
| **Suggested / Reference Books** | |
| 1. | “Thermal Engineering” A.R.Basu, Dhanpat Rai. |
| 2. | “Engineering Thermodynamics”, P.K.Nag, TMH. |
| 3. | “Thermal Engineering” Mahesh M Rathore, TMH. |

**Objective :** Thermal Engineering is the field of applied science which deals with energy possessed by heated gases and the laws which give the conversion of this energy into mechanical energy and vice versa

**Learning Outcome :** Understanding effectiveness of

* Thermodynamics properties in order to analyze a Thermodynamic system.
* Applying first & second law of thermodynamics in closed & open system and gas laws applicable to perfect gas in order to determine Thermodynamic properties.
* Concept of I.C engine and gas power cycle & computing work done & efficiency.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Sl.No** | **Chapter** | **Proposed Week for Teaching** | **Period**  **No.** | **Subject Topic** | **Important Teaching Points** | **Content Source** |
| 1 | **I** | 1st | 1 | **Thermodynamic**  **Concept & Terminology** | * Introduction of thermodynamic * Thermodynamic Systems (Closed, Open, Isolated) | Thermal engg  R .S. khrumi |
| 2 | 2 | * Thermodynamic Properties of a System (Pressure, Volume, Temperature, Entropy, Enthalpy |
| 3 | 3 | * Internal Energy and Units of Measurement). |
| 4 | 4 |
| 5 | 2nd | 1 | * Intensive And Extensive Properties * Define Thermodynamic Processes, Path, Cycle, State, |
| 6 |
| 7 | 2 | * Path Function, Point Function. * Thermodynamic Equilibrium. |
| 8 | 3 | * Quasi-Static Process. * Conceptual Explanation of Energy And Its Sources |
| 9 | 4 | * Work, Heat and Comparison between the Two. |
| 10 | 3rd | 1 | * Mechanical Equivalent of Heat. * Work Transfer, Displacement Work |
| 11 | 2 | * ASSIGNMENT |
| 12 | 3 | * CLASS TEST |
| 13 | **II** | 4 | **Laws of Thermodynamics** | * State & explain Zeroth law of thermodynamics. | Thermal engg  R .S. khrumi |
| 14 | 4th | 1 | * State & explain First law of thermodynamics. |
| 15 | 2 | * Limitations of First law of thermodynamics |
| 16 | 3 | * Application of First law of Thermodynamics * Steady Flow Energy Equation |
| 17 | 4 | * Steady Flow Energy Equation And Its Application To Turbine And Compressor |
| 18 | 5th | 1 | * Second law of thermodynamics (Claucius & Kelvin Plank statements). |
| 19 | 2 | * Application of second law in heat engine, heat pump, |
| 20 | 3 | * Refrigerator &Determination Of Efficiencies & C.O.P. |
| 21 | 4 | * Solved Simple Numerical |
| 22 | 6th | 1 | * ASSIGNMENT |
| 23 | 2 | * CLASS TEST |
| 24 | **III** | 3 | **Properties Processes of perfect gas** | * Laws of perfect gas   (Boyle’s law, Charle’s law, Avogadro’s law, Guy lussac law, | Thermal engg  R .S. khrumi |
| 25 | 4 | * Dalton’s law of partial   pressure, General gas equation, characteristic gas constant, Universal gas constant.) |
| 26 | 7th | 1 | * Explain specific heat of gas (Cp and Cv) * Relation between Cp & Cv. * Enthalpy of a gas. |
| 27 | 2 | * Work done during a non- flow process. * Application of first law of thermodynamics to various non flow process   (Isothermal,Isobaric,Isochoric process) |
| 28 | 3 | * Solve simple problems on (Isothermal,Isobaric,Isochoric |
| 29 |  | 4 | * Application of first law of thermodynamics to various non flow process (Isentropic and polytrophic process) | Thermal engg  R .S. khrumi |
| 30 | **8th** | 1 | * Solve simple problems on (Isentropic and polytrophic process) |
| 31 | 2 | * Free expansion & throttling process. |
| 32 | 3 | * ASSIGNMENT |
| 33 | 4 | * CLASS TEST |
| 34 | IV | **9th** | 1 | **Internal combustion engine** | * Explain & classify I.C engine. | Thermal engg  R .S. khrumi |
| 35 | 2 | * Terminology of I.C Engine such as bore, dead centers, stroke volume, piston speed &RPM. |
| 36 | 3 | * Explain the working principle of 2-stroke engine C.I & S.I engine. |
| 37 | 4 | * Explain the working principle of 4- stroke engine C.I & S.I engine. |
| 38 | **10th** | 1 |
| 39 | 2 | * Differentiate between 2-stroke & 4- stroke engine C.I & S.I engine. |
| 40 | 3 | * ASSIGNMENT |
| 4 | **Gas Power Cycle** | * CLASS TEST |
| 41 | **V** | **11th** | 1 | * Carnot cycle | Thermal engg  R .S. khrumi |
| 42 | 2 | * Solve simple numerical |
| 43 | 3 | * Otto cycle. |
| 44 | 4 | * Solve simple numerical |
| 45 | **12th** | 1 | * Diesel cycle. |
| 46 | 2 | * Solve simple numerical |
| 47 | 3 | * Dual cycle. |
| 48 | 4 | * Solve simple numerical |
| 49 | **13th** | 1 | * ASSIGNMENT |
| 50 | **VI** | 2 | * CLASS TEST |
| 51 | 3 | **Fuels and Combustion** | * Define Fuel. * Types of fuel. | Thermal engg  R .S. khrumi |
| 52 | 4 | * Application of different types of fuel. |
| 53 | **9th** | 1 | * Heating values of fuel. |
| 54 | 2 | * Quality of I.C engine fuels Octane number, Cetane number. |
| 55 |  |  | 3 | * ASSIGNMENT |
| 56 | 4 | * CLASS TEST |

Faculty HOD Principal/ Director