**SEMBODAI RUKMANI VARATHARAJAN ENGINEERING COLLEGE**

**Department of Mechanical Engineering**

**CME394 ADVANCED INTERNAL COMBUSTION ENGINEERING**

**course plan**

**UNIT I: SPARK IGNITION ENGINES**

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| **Sl. No.** | **TOPICS** | **Lecture Hours** | **Book /**  **Chapter/**  **Pages** | **Teaching Aids/ Method** | **Instructional Delivery Level** | **CO** | **PO/ PSO** |
|  | 1.1 Mixture requirements | 1,2 | RB1/ch7/Pg-251 | PPT | UNDERSTAND | CO1 | PO1/  PSO1 |
|  | 1.2 Fuel injection systems | 3,4 | RB1/ch7/ Pg-252 | PPT | UNDERSTAND | CO1 | PO1/  PSO1 |
|  | 1.3 -point, Multipoint & Direct injection | 5,6,7 | RB1/ch7/ Pg-292 | BB/ **ABL** | UNDERSTAND | CO1 | PO1/  PSO1 |
|  | 1.4 Stages of combustion,  Normal and Abnormal combustion, Spark Knock, Factors affecting knock | 8,9,10 | RB1/ch7/ Pg-278 | PPT | UNDERSTAND | CO1 | PO1/  PSO1 |
|  | 1.5 Combustion chambers. | 11,12 | RB1/ch7/ Pg-278-300 | PPT | UNDERSTAND | CO1 | PO1/  PSO1 |
| **ABL-ACTIVITY BASED**  **LEARNING** | | 1. Demonstration On Real Injectors 2. The students were told the required jobs and asked to **choose** the Different Types Of Injectors and belt for it | | | | | |

**UNIT II:** **COMPRESSION IGNITION ENGINES**

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| **Sl. No.** | **TOPICS** | **Lecture hours** | **Books/ Chapter** | **Teaching Method/ Aids** | **Instructional Delivery Level** | **CO** | **PO/ PSO** |
|  | 2.1 Diesel Fuel Injection Systems | 13,14 | RB1/ch9/ Pg-364-365 | PPT | UNDERSTAND | CO2 | PO1/ PSO1 |
|  | 2.2 Mechanical and Common Rail Direct Injection Systems | 15 | RB1/ch9/ Pg-364 | PPT | UNDERSTAND | CO2 | PO1/ PSO2 |
|  | 2.3 Stages of combustion | 16,17 | RB1/ch9/ Pg-365 | PPT | UNDERSTAND | CO2 | PO1/ PSO1 |
|  | 2.4 Knocking – Factors affecting knock | 18 | RB1/ch9/ Pg-389 | BB/**ABL** | UNDERSTAND | CO2 | PO1/ PSO2 |
|  | 2.5 Direct and Indirect injection systems –Fuel Spray behaviour | 19,20 | RB1/ch9/ Pg-400 | PPT | UNDERSTAND | CO2 | PO1/ PSO2 |
|  | 2.6 Spray structure and spray penetration – Air motion - Combustion chambers | 21,22 | RB1/ch10/ Pg-434 | PPT | UNDERSTAND | CO2 | PO1/ PSO2 |
|  | 2.7 Turbo charging – Waste Gate, Variable Geometry turbochargers.. | 23,24 | RB1/ch10/ Pg-430-467 | BB | UNDERSTAND | CO2 | PO1/ PSO2 |
| **ABL-ACTIVITY BADED**  **LEARNING** | | 1. Many gear models but different types of gear were placed before the students 2. **Spur and Helical** gears were asked to choose 3. From there the design is explained to see the **GEAR TEETH** | | | | | |

**UNIT III: EMISSION FORMATION AND CONTROL**

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| **Sl. No.** | **TOPICS** | **Lecture Hours** | **Books / Chapter** | **Teaching Method/ Aids** | **Instructional Delivery Level** | **CO** | **PO/ PSO** |
|  | 3.1 Sources – Formation of Carbon Monoxide, Unburnt hydrocarbon, Oxides of Nitrogen, Smoke and Particulate matter | 25,26 | RB1/ch10-6/ Pg-439 | PPT | UNDERSTAND | CO3 | PO3/ PSO1 |
|  | 3.2 Methods of controlling emissions | 27,28 | RB1/ch10-7/ Pg-441 | BB | APPLY | CO3 | PO3/ PSO2 |
|  | 3.3 In-cylinder treatments | 29,30 | RB1/ch10-10/ Pg-456 | PPT | UNDERSTAND | CO3 | PO3/ PSO2 |
|  | 3.4 After treatment systems  Three Way Catalytic converter, Selective Catalytic Reduction | 31,32 | RB1/ch10-10/ Pg-456 | BB | UNDERSTAND | CO3 | PO3/ PSO2 |
|  | 3.5 De-NOx Catalyst, Diesel Oxidation Catalyst and Particulate Traps | 33,34 | RB1/ch8-7/ Pg-323 | PPT | UNDERSTAND | CO3 | PO3/ PSO2 |
|  | 3.6 Methods of emission measurement – Emission norms and Driving cycles. | 35,36 | RB1/ch8-7/ Pg-323 | BB/**ABL** | UNDERSTAND | CO3 | PO3/ PSO1 |

**UNIT IV: ALTERNATIVE FUELS**

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| **Sl.**  **No.** | **TOPICS** | **Lecture Hour** | **Books referred/ Chapter** | **Teaching Method/ Aids** | **Instructional Delivery Level** | **CO** | **PO/**  **PSO** |
|  | 4.1 Alcohol Fuels | 37 | RB3/RB3/ Pg-6.1-6.5 | BB | UNDERSTAND | CO4 | PO3/  PSO1 |
|  | 4.2 Hydrogen | 38,39 | RB3/RB3/ Pg-6.1-6.5 | PPT | UNDERSTAND | CO4 | PO3/  PSO2 |
|  | 4.3 Compressed Natural Gas | 40,41 | RB3/RB3/ Pg-6.5-6.7 | BB | UNDERSTAND | CO4 | PO3/  PSO2 |
|  | 4.4 Liquefied Petroleum Gas and Bio Diesel | 42,43 | RB3/RB3/ Pg-6.7-6.10 | BB | UNDERSTAND | CO4 | PO3/ PSO2 |
|  | 4.5 Utilisation Methods | 44,45 | RB3/RB3/ Pg-6.12-6.18 | PPT | UNDERSTAND | CO4 | PO3/ PSO2 |
|  | 4.6 Engine Modifications. | 46,47,48 | RB3/RB3/ Pg-6.18-6.20 | BB | UNDERSTAND | CO4 | PO3/  PSO2 |

**UNIT V: ALTERNATE COMBUSTION AND POWER TRAIN SYSTEM**

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| **Sl. No.** | **TOPICS** | **Lecture Hour** | **Books / Chapter** | **Teaching Aids/ Methods** | **Instructional Delivery Level** | **CO** | **PO/**  **PSO** |
|  | 5.1 Low Temperature Combustion | 49 | RB3/ch15/ Pg-15.1-15.10 | PPT | UNDERSTAND | CO5 | PO3/ PSO1 |
|  | 5.2 Homogeneous charge compression ignition (HCCI) | 50,51 | RB3/ch15/ Pg-15.11-15.22 | BB | UNDERSTAND | CO5 | PO3/ PSO2 |
|  | 5.3 Reactivity Controlled Compression Ignition (RCCI) | 52,53 | RB3/ch12/ Pg-12.1-12.5 | PPT | UNDERSTAND | CO5 | PO3/ PSO2 |
|  | 5.4 Gasoline Compression Ignition | 54 | RB3/ch12/ Pg-12.1-12.10 | BB | UNDERSTAND | CO5 | PO3/ PSO2 |
|  | 5.5 Spark Assisted HCCI | 55,56 | RB3/ch12/ Pg-12.1-12.10 | PPT | UNDERSTAND | CO5 | PO3/ PSO2 |
|  | 5.6 Hybrid Electric and Electric Vehicles | 57,58 | RB3/ch12/ Pg-12.1-12.10 | PPT | APPLY | CO5 | PO3/ PSO2 |
|  | 5.7 Fuel Cells | 59,60 | RB3/ch13/ Pg-13.1-13.20 | BB/**FCL** | APPLY | CO5 | PO3/ PSO2 |
| **FCL-FLIPPED CLASS LEARNING** | | 1. That topic should be posted on the first day of class   (**FUEL CELL**)  2. It should be explained to the students in class | | | | | |

**Activities if any: (problem based)**

**Different Types of problem given a discuss about the problems.**

**Step 1:** Discuss about different types of problems in all units.

**Step 2:** From the whole unit the different types of questions based upon exam point are given to

all the students.

**Step 3:** The students have to prepare the questions and done the problems.

**Step 4:** The teacher will correct their assignments and discuss about their mistakes.

**Content beyond syllabus**

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| **S. No** | **Topics** | **Lecture hours** | **Books / Chapter** | **Teaching aids** | **Instructional Delivery Level** | **PO / PSO** |
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| 1 | IC ENGINE MATERIALS | 61,62 | RB3/ch16/ Pg-16.1-16.10 | BB/PPT | APPLY | PO3/  PSO5 |  |  |

**Signature of the Staff Signature of the HOD**