

| BMEE325L | Internal Combustion Engines | L | T | P | C |
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| Pre-requisite | BMEE303L, BMEE303P | Syllabus version | | | |
| | | 1.0 | | | |
| Course Objectives | | | | | |
| <ol style="list-style-type: none"> 1. To introduce students to the working of spark ignition and compression ignition engines. 2. To provide an in-depth knowledge of combustion process and engine management systems used in the engines. 3. To teach students about the usage of alternative fuels for IC engines. 4. To enhance the understanding of students in engine emissions and control techniques. 5. To create awareness about engine testing and certification. 6. To impart knowledge on the modern trends in IC engines. | | | | | |
| Course Outcome | | | | | |
| At the end of the course, the student will be able to | | | | | |
| <ol style="list-style-type: none"> 1. Compare the merits and demerits of different types of fuel injection and power boosting systems used in IC engines. 2. Realize the combustion process in engines and the various sensors incorporated in the engine management systems. 3. Analyze the emissions from IC engines and its effects on human beings and environment. 4. Comprehend the various engine testing and certification process. 5. Identify and critically evaluate different types of alternative fuels for automotive engines. 6. Demonstrate the recent developments to enhance the performance of IC engines. | | | | | |
| Module:1 | Engine configurations and mixture formation | 8 hours | | | |
| Basic components and terminology of IC engines, working of four stroke/two stroke - SI/CI engine, classification and application of IC engines, engine performance and emission parameters. Mixture formation in spark ignition engines - spark ignition (SI) engine mixture requirements, feedback control carburetors, properties of fuel, injection systems, monopoint and multipoint injection, gasoline direct injection - air motion. Mixture formation in compression ignition (CI) engines - direct and indirect injection systems, properties of fuel, fuel spray behaviour, spray structure, spray penetration and evaporation, air motion - injectors and nozzles. | | | | | |
| Module:2 | Combustion process in SI and CI engines | 6 hours | | | |
| Combustion stoichiometric, stages of combustion in SI and CI engines, knocking combustion in engines, features and design consideration of combustion chambers for engines, cyclic variations, heat release rate correlations. | | | | | |
| Module:3 | Engine management systems | 6 hours | | | |
| Fuel injection control, ignition timing control, lambda control, idle speed control, knock control, emission control, on-board diagnostics (OBD), open loop and closed loop control, basic sensor arrangement, types of sensors - oxygen sensor, fuel metering sensor, crank angle position sensor, MAF/MAP sensors, engine/vehicle speed sensor, detonation sensors, altitude sensor, throttle position sensor, engine oil/coolant temperature sensor. | | | | | |
| Module:4 | Engine emissions and control | 6 hours | | | |
| Pollutant - sources and types, effect on environment and human health, formation of NO _x , hydrocarbon emission mechanism, carbon monoxide formation, particulate emissions, methods of controlling emissions - catalytic converters and particulate traps, selective catalytic reduction (SCR), diesel oxidation catalyst (DOC), emissions measurement. | | | | | |
| Module:5 | Alternative fuels | 6 hours | | | |
| Alcohol, hydrogen, natural gas, liquefied petroleum gas, producer gas, biodiesel, biogas - properties and production process, engine modifications, benefits and challenges as fuels, Indian and Euro norms. | | | | | |

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| Module:6 | Engines testing and certification | 5 hours |
| Engine dynamometer, engine instrumentation - fuel flow measurement, air flow measurement, temperature and pressure measurement, in-cylinder combustion pressure measurement-Fuel injection pressure measurement. Engine certification - regulations overview (ECE, EEC, FMVSS, BS, ADR), type approval and conformity of production, regulation norms for engine, engine power test, Indian driving cycle, vehicle mass emission, evaporative emission. | | |
| Module:7 | Advanced engine technologies | 6 hours |
| Low heat rejection engines, lean burn engines, stratified charge spark ignition engine, low temperature combustion mode, solar powered vehicles, plasma ignition, electric/hybrid vehicles, fuel cell vehicles, six stroke engine concept, rotary engines. | | |
| Module:8 | Contemporary Issues | 2 hours |
| Total Lecture hours: | | 45 hours |
| Text Book | | |
| 1. | Ganesan V, Internal Combustion Engine, 2017, 4 th edition, Tata Mc-Graw Hill, New Delhi. | |
| 2. | Plint, Michael a Martyr, Anthony, Engine Testing : Theory and Practice, 2007, 3 rd edition, SAE Publication. | |
| Reference Books | | |
| 1. | John B. Heywood, Internal Combustion Engine Fundamentals, 2018. 2 nd Edition, McGraw-Hill Education. | |
| 2. | Richard Stone, Introduction to Internal Combustion Engines, 2012, 4 th edition, Palgrave Macmillan. | |
| 3. | Gasoline Engine Management, 2004, 3 rd Edition, Robert Bosch, Bentley Publications. | |
| 4. | Diesel Engine Management, 2005, 4 th Edition, Robert Bosch, Newness Publications. | |
| 4. | Colin R. Ferguson, Allan T. Kirkpatrick, Internal Combustion Engines: Applied Thermosciences, 2015, 3 rd Edition, John Wiley. | |
| Mode of Evaluation: CAT, written assignment, Quiz, FAT. | | |
| Recommended by Board of Studies | 09-03-2022 | |
| Approved by Academic Council | No. 65 | Date 17-03-2022 |