

**National Institute of Technology Srinagar, J&K**  
**Department of Mechanical Engineering**  
 Major Examination Autumn 2024  
**I. C. ENGINE (MET 305)**  
 Fifth Semester (Third Year)

Enrollment No.															
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Time: 2 Hour 30 Minutes  
 Total number of questions: 04

Max Marks: 50  
 Printed page: 02

**Course Outcome(s)**

- CO1- Execute and compare the air standard cycles for SI engine and CI engines.  
 CO2- Analyze the operating characteristics of different engines with actual air/fuel cycle.  
 CO3- Examine and compare the stages of combustion for SI engine and CI engine.  
 CO4- Identify the essential systems of IC engine and demonstrate its working.

**Note:** Attempt all four Questions. Marks are mentioned against each question. However, Question 4 has an internal choice. You can attempt either Question 3 or Question 3\*.

(Assume the properties of air:  $\gamma = 1.4$ ,  $C_p = 1.004 \text{ kJ/kg K}$  and  $C_v = 0.717 \text{ kJ/kg K}$ )

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|----|-----|---|---|---------------|
| Q1 | (a) | Explain a two-stroke SI engine's working and construction features with schematics and a valve timing diagram.  | 4 | (CO1)<br>BTL4 |
|    | (b) | The pressure and temperature at the end of the suction stroke are 1 bar and 30 °C respectively. The maximum temperature during the cycle is 1500 °C and the compression ratio is 16. Find the Diesel cycle efficiency and cut-off volume for those mentioned earlier. | 5 | (CO1)<br>BTL5 |
|    | (c) | Using suitable assumptions and sketches, estimate the cycle efficiency and mean effective pressure for the Otto cycle.  | 4 | (CO1)<br>BTL4 |
| Q2 | (a) | Define the principle of carburation. Enumerate the factors that are affecting the carburation.  | 3 | (CO2)<br>BTL3 |
|    | (b) | What are the functional requirements of an injection system? Show the working of the jerk pump type injection system using neat sketches.   | 5 | (CO2)<br>BTL4 |
|    | (c) | Describe the battery ignition system. Why is a battery ignition system unsuitable for high-speed engines?   | 4 | (CO2)<br>BTL4 |
| Q3 | (a) | Explain the factors that reduce the detonation in SI engine and increase knocking in CI engine.   | 2 | (CO3)<br>BTL5 |
|    | (b) | Evaluate and explain the stages of combustion in CI engine using the P- $\theta$ diagram of the combustion process.   | 5 | (CO3)<br>BTL4 |
|    | (c) | What is a liquid-cooling system and also explain the mechanism of the cooling system using a schematic diagram.   | 5 | (CO4)<br>BTL3 |

--OR--

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|-----|-----|--|---|---------------|
| Q3* | (a) | What is the necessity for gasoline injection? Explain the workings of gasoline direct injection using a suitable sketch.   | 3 | (CO4)<br>BTL4 |
|     | (b) | Briefly explains a typical electronic engine management system using line diagram for SI Engines. Also, write the name of the sensors which prove the data to ECU. | 5 | (CO4)<br>BTL4 |

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- (c) What is meant by supercharging? What is its effect on engine performance? Briefly explains the centrifugal type of supercharging using a neat schematic diagram. 4 (CO4) BTL4
- Q4 (a) What are catalytic converters? How does catalytic converter help in reducing HC, CO and NO<sub>x</sub> emissions? Write the main catalytic equations and discuss its working with help of a neat sketch. 4 (CO4) BTL4
- (b) Draw the heat balance sheet for the test in % and kJ/h for a single-cylinder, four-stroke Diesel engine. Also determine the Indicated thermal efficiency, and Brake thermal efficiency. 9 (CO3) BTL6
- If the following data have been observed during engine trial:
- Brake Power = 31.5 kW;  
Mechanical Efficiency = 60%;  
Fuel consumption = 10.5 kg/h;  
Calorific value of fuel = 43 MJ/kg;  
Cooling water flow rate = 540 kg/min;  
Air/fuel ratio = 19:1  
Rise in cooling water temperature = 56°C;  
Temperature of exhaust gases = 450°C;  
Room temperature = 15°C;  
Mean specific heat of exhaust gas = 1 kJ/kg K;  
Specific heat of water = 4.18 kJ/kg K.