



Study Programme : Bachelor of Science (Honours) in Engineering
Name of the Examination : Final Examination
Course Code and Title : DMX5208 Automobile Engineering
Academic Year : 2023/2024
Date : 20th March 2025
Time : 1330-1630 hrs
Duration : 3 hours

General instructions

1. Read all instructions carefully before answering the questions.
2. This question paper consists of five (05) questions. All questions carry equal marks.
3. **Answer all five (05) questions.**

Question 01

A four-cylinder, four-stroke diesel engine has the following specifications:

- Bore: 105 mm
- Stroke: 128 mm
- Compression ratio: 18:1
- Operating speed: 1950 rpm
- Ambient conditions: 25°C, 101.3 kPa

The engine was tested at full load with the following results:

- Brake power: 100 kW
- Indicated power: 128 kW
- Fuel consumption: 18.4 kg/hr (diesel with LCV of 42,700 kJ/kg)
- Air-fuel ratio: 14:1

- a) Determine the mechanical efficiency of the engine [3 marks]
- b) Calculate the brake thermal efficiency and the indicated thermal efficiency [4 marks]
- c) Determine the volumetric efficiency at the given ambient conditions [4 marks]
- d) Calculate the BMEP of the engine [3 marks]
- e) Calculate the brake specific fuel consumption [3 marks]
- f) Determine the friction power [3 marks]

Question 02

- a) Explain the four stages of combustion in diesel engines with a neat sketch of the diesel combustion pressure versus crank angle graph. [6 marks]
- b) Using your combustion pressure versus crank angle graph, explain the term diesel knock and identify its main characteristics. [5 marks]
- c) Briefly explain the cetane number and explain its influence to diesel knock. [4 marks]
- d) List three common diesel fuel additives and explain how each additive improves specific performance characteristics. [5 marks]

Question 03

- a) Name 5 sensors used in a modern gasoline electronic fuel system and briefly describe their functions. [5 marks]
- b) Compare and contrast the cylinder-charge control systems in conventional throttle systems versus those with Electronic Throttle Control (ETC). [5 marks]
- c) Describe how the throttle valve position is adjusted during cold start compared to normal operation, and explain the purpose of these adjustments. [5 marks]
- d) What is the lambda ratio? Explain the function of the lambda closed-loop control system in the ME-Motronic fuel injection system. [5 marks]

Question 04

- a) Draw a graph to illustrate the relationship between biodiesel concentration (0-100%) and the percent change in emissions (NO_x, PM, CO, and HC). [5 marks]

- b) By using the answer in part (a), explain the behaviour of the emission (NO_x, PM, CO, and HC) along the variation of the biodiesel concentration (0-100%).

[6 marks]

- c) Explain the basic operating principle of a fuel cell and describe the chemical reactions that occur at the anode and cathode.

[5 marks]

- d) Describe the battery management system in the Toyota Prius, including the target SOC and how it maintains optimal battery conditions.

[4 marks]

Question 05

- a) Explain three advantages of common rail fuel injection systems over conventional diesel injection systems.

[5 marks]

- b) Describe the purpose and function of pilot injection in common rail diesel systems. How does it help reduce noise and emissions.

[5 marks]

- c) Describe the role of the pre-charge pump in the ABS hydraulic system and its operation.

[5 marks]

- d) Explain the purpose and operation of the learning control function in an automatic transmissions.

[5 marks]