| Reg. No. | | | | | | | | | | | | | | | |
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| Question Paper Code | 13518 |
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**B.E. / B.Tech. - DEGREE EXAMINATIONS, APRIL / MAY 2025**

Sixth Semester

**Mechanical Engineering**

(Common to Mechanical and Automation Engineering)

**20MEIE601 - ADVANCED FUEL INJECTION SYSTEM - II**

Regulations - 2020

Duration: 3 Hours Max. Marks: 100

**PART - A (MCQ) (10 × 1 = 10 Marks)**

Answer ALL Questions

| | | Marks | K – Level | CO |
|---|---|---|---|---|
| 1. | Which machining process is primarily used for precision hole-making in injector nozzles?<br>(a) Turning (b) Milling (c) Electrical Discharge Machining (EDM) (d) Drilling | 1 | K1 | CO1 |
| 2. | Which of the following is the most critical dimension in fuel injector nozzle manufacturing?<br>(a) Outer diameter (b) Spray hole diameter<br>(c) Length of the injector body (d) Surface roughness of the housing | 1 | K1 | CO1 |
| 3. | Which temperature range is typically used for tempering?<br>(a) -100°C to -50°C (b) 150°C to 700°C (c) 1000°C to 1500°C (d) 10°C to 50°C | 1 | K1 | CO2 |
| 4. | What is the cooling medium used in sub-zero treatment?<br>(a) Water (b) Liquid nitrogen (c) Helium gas (d) Engine oil | 1 | K1 | CO2 |
| 5. | What is the primary function of an Engine Control Unit (ECU) in a common rail system?<br>(a) Controlling air conditioning system (b) Regulating fuel injection and ignition timing<br>(c) Managing the infotainment system (d) Operating power windows | 1 | K1 | CO3 |
| 6. | Which sensor is responsible for detecting the crankshaft's position?<br>(a) MAP sensor (b) MAF sensor (c) Crankshaft position sensor (d) Knock sensor | 1 | K1 | CO3 |
| 7. | Catalytic converters are used to reduce the concentration of.....in the exhaust.<br>(a) CO (b) HC (c)NOx (d) CO2, HC and NOx | 1 | K1 | CO4 |
| 8. | The brake power is the power available<br>(a) In the engine cylinder (b) At the crankshaft<br>(c) At the crankpin (d) At the camshaft | 1 | K1 | CO4 |
| 9. | Which of the following sensors is commonly used for precise displacement measurement?<br>(a) Load cell (b) LVDT (c) Thermocouple (d) Proximity sensor | 1 | K1 | CO5 |
| 10. | What is the main purpose of a poka-yoke device?<br>(a) Reduce labor cost (b) Measure tool speed<br>(c) Prevent human errors in manufacturing (d) Enhance the finish of machined surfaces | 1 | K1 | CO5 |

**PART - B (12 × 2 = 24 Marks)**

Answer ALL Questions

| | | Marks | K – Level | CO |
|---|---|---|---|---|
| 11. | What is the main machining process used in injector nozzle hole manufacturing? | 2 | K1 | CO1 |
| 12. | Why is laser drilling used in injector nozzles? | 2 | K1 | CO1 |
| 13. | Explain need of EDM preferred for spray hole machining in injectors. | 2 | K2 | CO1 |
| 14. | Outline the significance of validation testing in fuel injector manufacturing. | 2 | K2 | CO2 |
| 15. | Explain the role of the electrical durability test. | 2 | K2 | CO2 |
| 16. | Explain the role of vibration test in injector validation. | 2 | K2 | CO2 |
| 17. | Classify the main components of an ECU in a common rail system. | 2 | K2 | CO3 |
| 18. | Summarize the significance of cam-crank synchronization in engine control. | 2 | K2 | CO3 |
| 19. | What are the causes of soot particles? | 2 | K1 | CO4 |
| 20. | Interpret how the specific fuel consumption is high in indirect injection type Combustion. | 2 | K2 | CO4 |

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|---|---|---|---|---|---|
| 21. | What is the function of a load cell in an assembly process? | | *2* | *K1* | *CO5* |
| 22. | How is laser measurement used in quality inspection? | | *2* | *K1* | *CO5* |

**PART - C (6 × 11 = 66 Marks)**

Answer ALL Questions

| | | | | | |
|---|---|---|---|---|---|
| 23. | a) | Explain the step-by-step machining process flow for an injector nozzle. | *11* | *K2* | *CO1* |
| | | **OR** | | | |
| | b) | Describe the challenges in maintaining tolerances during injector machining. | *11* | *K2* | *CO1* |
| 24. | a) | Explain the key principles of reliability engineering in automotive components. | *11* | *K2* | *CO2* |
| | | **OR** | | | |
| | b) | Describe the role of statistical methods in reliability engineering. | *11* | *K2* | *CO2* |
| 25. | a) | Explain the role of Electronic Control Unit (ECU) in a fuel injection system. | *11* | *K2* | *CO3* |
| | | **OR** | | | |
| | b) | Explain Cam-Crank Synchronization in a fuel injection system and its importance and working with respect to the ECU. | *11* | *K2* | *CO3* |
| 26. | a) | Select the role does urea play in the SCR system. How is it delivered and controlled during operation? | *11* | *K3* | *CO4* |
| | | **OR** | | | |
| | b) | Identify the causes of hydrocarbon emissions from SI engines. | *11* | *K3* | *CO4* |
| 27. | a) | Explain the role of sensors in machining operations. How force and power monitoring are used to improve process efficiency and tool life? | *11* | *K2* | *CO5* |
| | | **OR** | | | |
| | b) | Explain the laser measurement systems and vision measurement systems contribute to precision and quality control in automated assembly lines. | *11* | *K2* | *CO5* |
| 28. | a) (i) | Select the internationally accepted methods so measuring the Oxides of nitrogen emission. | *6* | *K3* | *CO4* |
| | (ii) | Identify the different types of sensors used in quality testing during assembly, highlighting their advantages and limitations. | *5* | *K3* | *CO5* |
| | | **OR** | | | |
| | b) (i) | Utilizing LNT regeneration, how the emissions can be controlled and achieved in modern engines. | *6* | *K3* | *CO4* |
| | (ii) | Apply the PPAP (Production Part Approval Process) and develop its role in process planning and customer validation. | *5* | *K3* | *CO5* |