



**UNIVERSITI KUALA LUMPUR  
Malaysia France Institute**

---

**FINAL EXAMINATION  
SEPTEMBER 2013 SESSION**

---

**SUBJECT CODE** : FVB 40903  
**SUBJECT TITLE** : AUTOMOTIVE MATERIALS  
**LEVEL** : BACHELOR  
**TIME / DURATION** : 2.5 Hours  
**DATE** :

---

**INSTRUCTIONS TO CANDIDATES**

---

1. Please read the instructions given in the question paper CAREFULLY.
  2. This question paper is printed on both sides of the paper.
  3. Please write your answers on the answer booklet provided.
  4. Answer should be written in blue or black ink except for sketching, graphic and illustration.
  5. Answer all questions in English.
- 

**THERE ARE 4 PAGES OF QUESTIONS, EXCLUDING THIS PAGE.**

---

**INSTRUCTION: There are SIX (6) questions. Answer FOUR (4) questions only.**

**(Total: 100 marks)**

**Please use the answer booklet provided.**

**Question 1 (25 marks)**

The cylinder block is the portion of the engine between the cylinder head and sump (oil pan) and is the supporting structure for the entire engine.

(a) Explain the desirable properties of cylinder block material.

**(5 marks)**

(b) Many early engine blocks were manufactured from cast iron alloys. But nowadays aluminum alloy is used for engine blocks. Give the reason.

**(5 marks)**

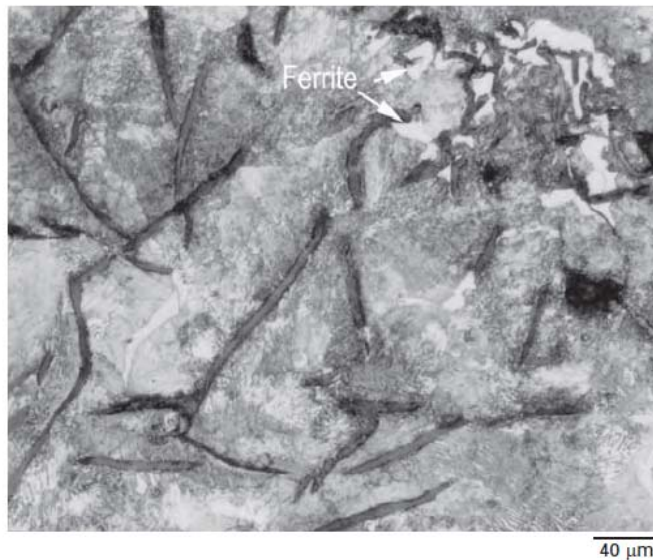
(c) The iron for the block is usually gray cast iron with a pearlite microstructure. The microstructure is shown in **Figure 1**.

(i) Describe the gray cast iron.

**(5 marks)**

(ii) Give the reason for the ferrite in the microstructure of the bore wall that must be avoided.

**(5 marks)**



**Figure 1**

- (d) Compare the advantages between cast iron cylinder block and aluminum cylinder block.

**(5 marks)**

**Question 2 (25 marks)**

Piston is considered to be one of the most important parts in a reciprocating engine in which it helps to convert the chemical energy obtained by the combustion of fuel into useful (work) mechanical power.

- (a) Describe how to select the materials used for the piston.

**(5 marks)**

- (b) Explain the effects of Si content in the piston materials.

**(10 marks)**

- (c) The pistons must ensure to have high wear resistance and good running properties. Describe the various ways that should be conducted to finish the surface treatment.

**(10 marks)**

**Question 3 (25 marks)**

Piston rings are directly exposed to the very high temperatures of combustion gas, but they also receive heat from the piston head.

- (a) Explain the required function of piston rings and required function for materials.

**(5 marks)**

- (b) Explain the surface treatment to improve initial wear of the piston rings during running in.

**(10 marks)**

- (c) Describe the surface treatments to employ with piston rings to protect against corrosion during storage, to cover up minor surface defects, to improve break-in properties, secondarily to reduce wear at the running surfaces and flanks, and not at all to increase burn resistance during the run-in period.

**(10 marks)**

**Question 4 (25 marks)**

The crankshaft is the principal member of the crank train or crank assembly, which latter converts the reciprocating motion of the pistons into rotary motion. It is subjected to both torsional and bending stresses. In modern high-speed, multi-cylinder engines these stresses may be greatly increased by resonance. It will not only renders the engine noisy, but also may fracture the shaft.

- (a) Great care must be observed in the manufacture of crankshafts since it is the most important part of the engine. Crankshafts are either cast or forged. Describe the advantages and disadvantages of Forged and Cast Crankshafts.

**(10 marks)**

- (b) Explain the Strengthening method for crankshaft process surface as listed below:

(i) Nitriding **(5 marks)**

(ii) Carburizing **(5 marks)**

(iii) Shot peening **(5 marks)**

**Question 5 (25 marks)**

Valves control the gas flowing into and out of the engine cylinder. The camshaft and valve spring make up the mechanism that lifts and closes the valves. The valve train determines the performance characteristics of four stroke-cycle engines.

- (a) Explain the Types of Valves and Manufacturing Techniques as listed below:

(i) Monometallic valves. **(5 marks)**

(ii) Bimetallic valves. **(5 marks)**

(iii) Hollow valves. **(5 marks)**

- (b) Describe the type of process to increase wear resistance of valve as listed below:

(i) Stellite coating. **(5 marks)**

(ii) The Ni-based super alloy valve. **(5 marks)**

**Question 6 (25 marks)**

Describe the effects of common alloying elements in automotive materials as listed below:

(a) Carbon. **(5 marks)**

(b) Manganese. **(5 marks)**

(c) Sulfur. **(5 marks)**

(d) Silicon.

**(5 marks)**

(e) Nickel.

**(5 marks)**

**END OF QUESTION**