

**National Examinations May 2019**

**17-Ind-B2, Manufacturing Processes**

**3 hours duration**

**Notes:**

1. If doubt exists as to the interpretation of any question, the candidate is urged to submit with the answer paper, a clear statement of any assumptions made.
2. This is a **Closed Book** exam. Candidates may use one of two calculators, the Casio or Sharp approved models.
3. Any five questions constitute a complete paper. Only the first five questions as they appear in your answer book will be marked.
4. All questions are of equal value.
5. Write your answers in point-form whenever possible, but fully. Show all calculations. Please note that deductions will be made for any irrelevant issues that you include in your answer. So please be concise.

**Marking Scheme (marks)**

- |    |         |          |         |        |       |
|----|---------|----------|---------|--------|-------|
| 1. | (i) 6.5 | (ii) 6.5 | (iii) 7 |        |       |
| 2. | (i) 6   | (ii) 8   | (iii) 6 |        |       |
| 3. | (i) 10  | (ii) 10  |         |        |       |
| 4. | (i) 7   | (ii) 3   | (iii) 3 | (iv) 7 |       |
| 5. | 20      |          |         |        |       |
| 6. | 20      |          |         |        |       |
| 7. | (i) 4   | (ii) 4   | (iii) 4 | (iv) 4 | (v) 4 |

1. (i) Which of the following statement(s) is/are true for hot forming processes?
- (1) The metal materials become more ductile
  - (2) The yield stress is reduced
  - (3) The modulus of elasticity is reduced
    - a. (1) and (2)
    - b. (1) and (3)
    - c. (2) and (3)
    - d. None of the above
    - e. All of the above
- (ii) Which of the following is/are possible metal forming process(es) to make an I-beam?
- (1) Rolling
  - (2) Extrusion
  - (3) Bending
    - a. (1) and (2)
    - b. (1) and (3)
    - c. (2) and (3)
    - d. None of the above
    - e. All of the above
- (iii) Which of the following statements is/are true for chip formation in a metal machining process?
- (1) Continuous chips are desirable
  - (2) Large depths-of-cut may result in the formation of discontinuous chips
  - (3) Formation of discontinuous chips may shorten the tool-life
    - a. (1) only
    - b. (2) only
    - c. (1) and (2)
    - d. (1) and (3)
    - e. All of the above
2. (i) Briefly write the function of the “down-runner base” in sand casting.  
(ii) Briefly write the function of the “an expendable core” in casting.  
(iii) Briefly describe what a pattern is for in casting?
3. (i) Briefly describe why turbulence should be avoided in casting. Also, briefly describe how turbulence can be avoided.

(ii) If a manufacturing engineer prefers forging/stamping to casting in producing crankshafts, what could be the most important reason(s) for his choice?

4.

- (i) Write the 4 processing steps required for manufacturing spherical metal powders using the liquid/gas atomization technology.
- (ii) What is the typical range of the size of the metal powder that is manufactured from the liquid atomization technology?
- (iii) What is the typical range of the size of the metal powder that is manufactured from the gas atomization technology?
- (iv) Write two major processing steps of metal powder processing technology.

5. Three pieces being cast have the same volume but different shapes. One is a sphere, the second is a cube, and the third is a cylinder with a height equal to its diameter. Which piece will solidify the fastest and which one the slowest? Mathematically verify the reason(s).

6. Describe how you can melt a thermoplastic material uniformly and quickly.

7. Briefly explain what happens to the following when the thickness of an injection molded part is increased from 0.5 mm to 1 mm (with all the other dimensions and processing conditions unchanged). Be quantitative if you can. (i) Injection time (ii) cooling time (iii) material cost (iv) production rate (v) warpage.