First Semester Examination
2023/2024 Academic Session

February 2024

EPP 331 – Manufacturing Technology II
(Teknologi Pembuatan II)

Duration: 3 hours
(Masa: 3 Jam)

Please check that this examination paper consists of SEVEN (7) pages of printed material before you begin the examination.

[Sila pastikan bahawa kertas peperiksaan ini mengandungi TUJUH (7) muka surat yang bercetak sebelum anda memulakan peperiksaan ini.]

Instructions: Answer ALL **SIX (6)** questions.

*[**Arahan**: Jawab **ENAM (6)** soalan]*

1. (a) Injection molding is one of the manufacturing processes which can provides a very high economical production quantity for plastic product.

(i) With the help of sketch, explain in detail the process of manufacturing a plastic product using injection molding. Explain your answer using one real example of plastic product that can be produced using injection molding.

(30 marks)

(ii) Defect is a common phenomenon when producing plastic components using the injection molding. With the help of sketch, name and describe **TWO (2)** types of defects that can be happened.

(20 marks)

(iii) Give **TWO (2)** methods that can be used to avoid defects in manufacturing the plastic products for the sustainability production using the injection molding.

(10 marks)

(b) Figure 1 (b) shows the 3D CAD design of the ceramic pottery that will be produced by XYZ company. Due to company financial constraint, the selected manufacturing process for this product must consider a low equipment cost.

Figure 1 (b)

(i) As an Engineer at XYZ company, suggest the most suitable manufacturing process to produce this ceramic pottery. Also, explain in detail the flow of manufacturing process for this product.

(30 marks)

(ii) Microwave sintering is an advance technology that can be used to improve the quality of the ceramic pottery. Give TWO (2) advantages of using the microwave sintering in producing the ceramic pottery.

(10 marks)

2. (a) Figure 2 (a) shows the chatter marks on the cylindrical metal part due to the uncontrolled vibration during the machining process. Suggest FOUR (4) solutions that can be taken to avoid this defect.

(40 marks)

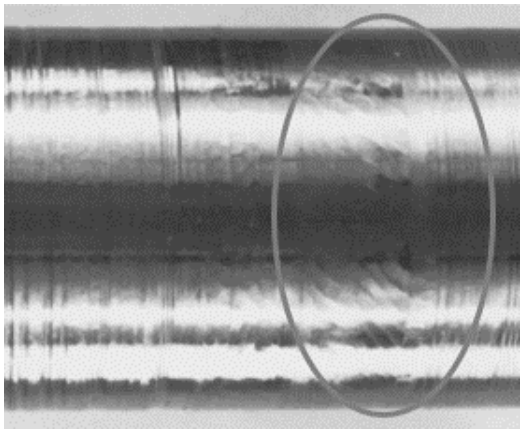

Figure 2 (a)

(b) Figure 2 (b) shows the graph of cutting speed against (i) cost per piece and (ii) time per piece in the machining of automotive engine valve. Given a_c, b_c, c_c, d_c and e_c in Figure 2 (b) (i) represents the costs to determine the optimum cutting speed, while a_t, b_t, c_t and d_t in Figure 2 (b) (ii) represents the time to determine the optimum cutting speed.

(i) In this machining of engine valve, the labor rate is RM 20.00 per hour and the general overhead rate is RM 13.50 per hour. The tool is cast alloy (n = 0.15) with six faces and costs RM 35.50, which take seven minutes to change and two minutes to index. From Figure Q2[b][ii], if the maximum cutting speed at point x_t = 194.56 m/min is twice the optimum cutting speed for maximum production, calculate the tool life constant value for this machining process.

(15 marks)

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(ii) By using answer in Question 2 (b) (i), calculate the optimum cutting speed in term of cost perspective for this machining process.

(20 marks)

(iii) Due to global economy challenges in 2023, the labor rate has to be increased to RM 40.00 per hour and the general overhead rate is RM 20.00 per hour. Based on your calculation, decide whether it still effective or not for the company to produce the engine valve.

(25 marks)

Given formula:

$$V_o = \frac{C\,(L_m + B_m)^n}{\left(\frac{1}{n} - 1\right)^n \Psi^n} \quad (1)$$

$$V_o = \frac{C}{\left[\left(\frac{1}{n} - 1\right)\left(\frac{T_c}{m} + T_i\right)\right]^n} \quad (2)$$

Where,

$$\Psi = \frac{1}{m}\left[T_c\,(L_m + B_m) + D_i\right] + T_i(L_m + B_m)$$

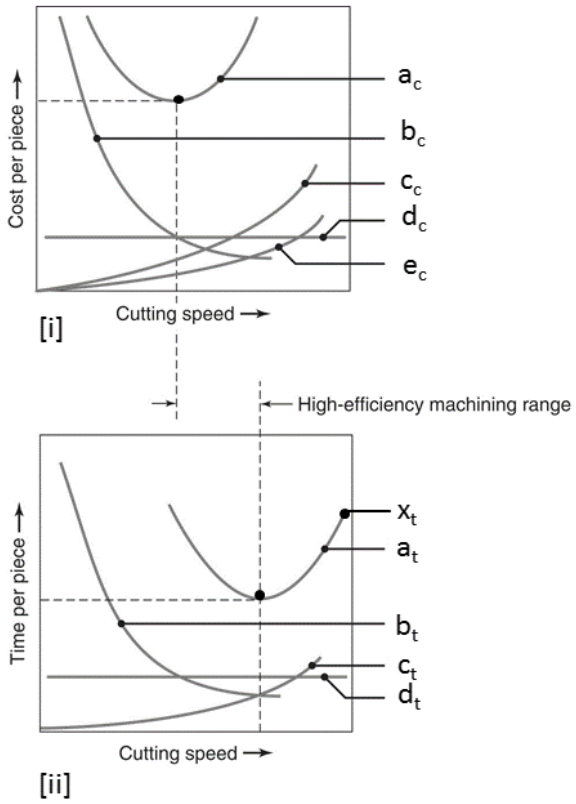

Figure 2 (b)

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3. (a) Automation involves a wide range of technologies and can be applied in various areas of manufacturing processes. By giving **ONE (1)** example, discuss how automation may contribute to sustainability.

(40 marks)

(b) (i) A t-shirt printing company has received an order from a primary school for the Sports Day t-shirt printing. Explain how lean manufacturing principles can be applied in the t-shirt manufacturing process.

(40 marks)

(ii) By giving **TWO (2)** examples of waste, explain how the waste can be eliminated during the manufacturing of the Sports Day t-shirt by applying lean manufacturing principles.

(20 marks)

4. (a) Design for Manufacturing and Assembly (DFMA) is a method applied to minimize the cost of production and time while maintaining an appropriate level of quality. Figure 4 (a) shows the components of the pressure recorder at the initial design and after redesign using DFMA. Based on the figure, justify **THREE (3)** changes that have been made to improve the design and identify the related DFMA design guidelines that have been applied.

(60 marks)

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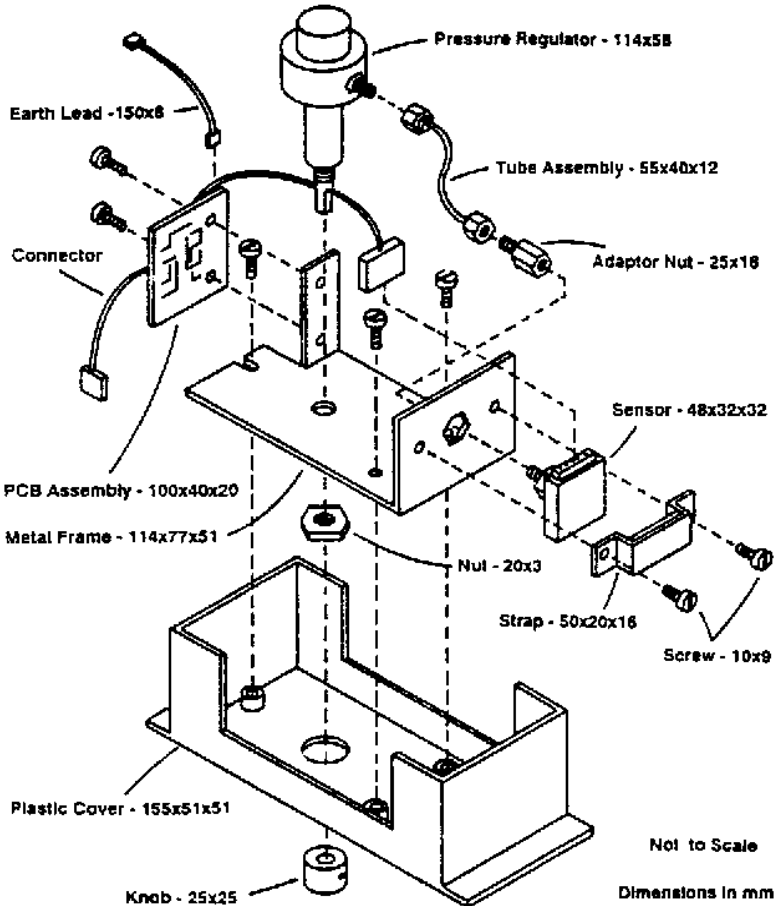
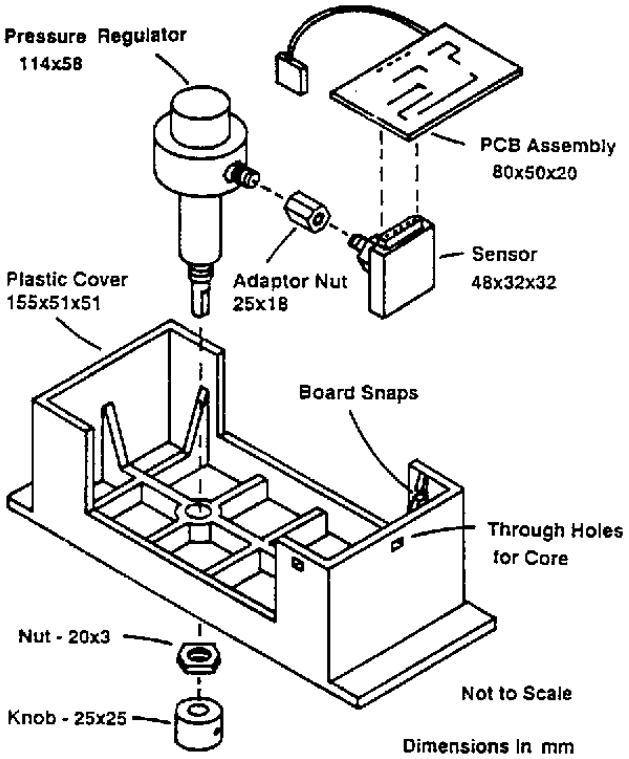


Initial design



After DFMA

Figure 4 (a)

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(b) (i) The selection of a suitable manufacturing process is important to produce a high-quality product in time. Explain **FOUR (4)** considerations that should be taken while selecting the manufacturing process.

(20 marks)

(ii) Explain **FOUR (4)** reasons why the manufacturing process of the higher quality surface finish normally requires a higher cost.

(20 marks)

5. Volatile Organic Compounds (VOCs) are organic chemicals that have high vapor pressure at ambient room temperature. Common examples of VOCs are benzene and formaldehyde.

(a) Explain how Fused Deposition Modeling (FDM) can cause the formation of VOCs.

(40 marks)

(b) Explain **TWO (2)** potential hazards of VOCs in both short and long terms to the workers in FDM process area.

(30 marks)

(c) Discuss **TWO (2)** ways of improving the process to mitigate the hazards.

(30 marks)

6. Laser is used in Laser Beam Machining (LBM) as a source of energy which focuses optical energy on the surface of the workpiece. In term of laser output power, the peak power can be up to 100 KW (or 100,000,000 mW).

(a) Explain how Laser Beam Machining (LBM) can cause the potential hazard of laser beam exposure to the workers.

(40 marks)

(b) If the exposure of at least 100 mW Nd:YAG laser is hazardous to human eyes, discuss what type of safety eyewear is suitable in order to mitigate the hazard with respect to Optical Density (OD) and Light Transmission (LT).

(30 marks)

(c) If the exposure of at least 1000 mW Nd:YAG laser can burn skin and clothes, discuss how safety interlock control of laser can be used to mitigate the hazards.

(30 marks)

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