KOLEJ UNIVERSITI TEKNIKAL KEBANGSAAN MALAYSIA
PEPERIKSAAN SEMESTER 1
SESU 2006/2007
FAKULTI KEJURUTERAAN PEMBUATAN

KOD MATAPELAJARAN : BMFP 3543
MATAPELAJARAN : METROLOGI KEJURUTERAAN
PENYELARAS : SURIAI AKMAL
KURSUS : IJAZAH SARJANA MUDA KEJURUTERAAN PEMBUATAN
MASA : 2.15 PTG – 5.15 PTG (3 JAM)
TARIKH : 8 NOVEMBER 2006

Arahan kepada calon :

1) Kertas soalan ini mengandungi enam (6) soalan. Jawab lima (5) soalan shaja.
2) Plotkan graf dengan menggunakan kertas graf yang disediakan.
3) Lakarkan diagram yang sesuai sekiranya diperlukan.
4) Gunakan helaien kertas jawapan yang berasingan bagi setiap soalan.
5) Rumus yang berkaitan boleh didapati di Lampiran 2.

KERTAS SOALAN INI TERDIRI DARI PADA SEPULUH (10) MUKA SURAT SAHAJA
(TERMASUK MUKA SURAT HADAPAN)
ANSWER FIVE QUESTIONS ONLY

QUESTION 1

a) There are two important terms in metrology: PRECISION and ACCURACY. But, most of people understand accuracy and precision referring to the same meaning whereas someone who are involved in measurement has understood the both terms are different meanings. Explain the meaning of “precise but not accurate” with example.

[3 marks]

b) GMBH is a company, which produces LCD panel for the world market. Customer Service Department receiving a few complains from customers. You as a quality engineer at GMBH are given a task to check the product conformance. For the task given, you should use same measuring instrument and the measurement should be taken at 08:00, 14:00 and 20:00 hours. You are required to calibrate the instrument before the start of the measurement. You also have to provide a control chart by using the recorded measurement data. Based on the given tasks:

i) Verify five variations and errors in the measurement process that leads to customer dissatisfaction.

ii) Does it relate to accuracy and precision? Why?

iii) Why calibration is necessary in the measurement process?

[14 marks]

c) If the length of the component is the parameter of interest, show the hierarchy for length standards.

[3 marks]
QUESTION 2

a) Statistical Process Control (SPC) is used to monitor the production process that will meet up standards where control chart is used. There are a lot of terms specifically used for the purpose of control chart analysis. It is important to understand the meaning of these terms while analysing the control chart. What is **common variation** and **assignable variation**?

[4 marks]

b) Schweinsteiger (a QC engineer) was given a task to verify the production lot sample for every hour. The population standard deviation is known to be 1 gram with control limits is set to be 99.73% confidence. Samples of nine boxes are randomly selected and weighed. The nine boxes chosen for hour 1 are shown in Figure 1 below:

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Figure 1: Sample of nine boxes of cakes
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From the above statement:

i) Construct the related control chart, and,

ii) Give comments on the constructed control chart.

[10 marks]
c) Give your comments on each control chart behaviour in Figure 2 below.

[6 marks]

Figure 2: Control chart patterns
QUESTION 3

a) Give the definition of *tolerance, fit and allowances* together with the illustration of diagram.

[6 marks]

b) As an engineer, you are provided with the specifications of a plunger as shown in Figure 3 below:

![Figure 3: Resin type Plunger](image)

*The ball size, d is 80mm with accuracy *+0.02mm, -0.02mm* and maximum allowance should not be more than 0.08mm. The maximum and minimum allowances are to be 0.06mm and 0.01mm respectively.*

*From the above statement:*

i) Determine the size of hole, D.

ii) Shows the result in **bilateral system**.

iii) What is the **type of fit** according to the given plungers specifications. Why?

[10 marks]

c) Find the *Go and No Go gauge* dimensions of a plug gauge for diameter holes 65 + 0.05mm, - 0.05mm.

[4 marks]
QUESTION 4

Vernier calliper is the instrument used for product inspection at your production line. After some time, a calibration engineer was asked to check the condition of the calliper. As shown in Figure 4, the calibration engineer was trying to check the reading using gauge block.

![Figure 4: Vernier calliper](image)

a) What is the reading for the calliper? [2 marks]

b) Explain a proper method how to use the gauge blocks in getting the reading in question (a) using table in Appendix 1. [15 marks]

c) Define and describe what are the three (3) gage blocks preparation steps to make a measurement. [3 marks]
QUESTION 5

a) Interferometer is used to measure the surface roughness of a product after the electro polish process. Name and define the parameters that need to be confirmed before starting the measurement. Why?

[6 marks]

b) The implications of surface roughness are significant in terms of fatigue, friction and the wear characteristics of a manufactured product. Define and explain three important parameters with formula related to surface roughness based on the graph shown below.

i.

\[ Y_1, Y_2, Y_3, Y_4, Y_5, Y_6, Y_7, Y_8 \]

ii.

\[ Y_1, Y_2, Y_3, Y_4, Y_5, Y_6, Y_7, Y_8 \]

iii.

\[ Y_1, Y_2, Y_3, Y_4, Y_5, Y_6, Y_7, Y_8 \]

[9 marks]

c) Name five factors that effect surface roughness.

[5 marks]
QUESTION 6

a) There are many different thread forms in use today. State all the types of thread form together with appropriate diagram. 
[12 marks]

b) Define and explain four errors in screw thread. How does it affect the screw thread? 
[6 marks]

c) How can machinists differentiate between tolerance for grade and position? 
[2 marks]
# Appendix 1

## Table 12-2: Sizes in an 88-piece set of metric gauge blocks

<table>
<thead>
<tr>
<th>0.001-mm Series—9 Blocks</th>
<th>0.01-mm Series—49 Blocks</th>
<th>0.01-mm Series—49 Blocks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.001</td>
<td>1.002</td>
<td>1.003</td>
</tr>
<tr>
<td>1.01</td>
<td>1.02</td>
<td>1.03</td>
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<tr>
<td>1.46</td>
<td>1.47</td>
<td>1.48</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>0.5-mm Series—1 Block</th>
<th>0.5-mm Series—18 Blocks</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5</td>
<td>6</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>10-mm Series—9 Blocks</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
</tr>
</tbody>
</table>

Two 2-mm wear blocks

Table 1: Sizes in an 88-piece set of metric gauge blocks
Formula 1:

Upper control limit, \( UCL = \bar{x} + z\sigma_x = \bar{x} + z\left(\frac{1}{\sqrt{n}}\right) \)

Lower control limit, \( LCL = \bar{x} - z\sigma_x = \bar{x} - z\left(\frac{1}{\sqrt{n}}\right) \)

Where

\( \bar{x} = \) mean of the sample means or a target value set for the process
\( z = \) number of normal standard deviations
\( 2 \) for 95.45% confidence
\( 3 \) for 99.73% confidence
\( \sigma = \) population (process) standard deviation
\( n = \) sample size

Formula 2:

1) Max allowance = maximum hole – minimum shaft
2) Min allowance = minimum hole – maximum shaft