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Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESI 2019/2020

COURSE NAME : METROLOGY AND MEASUREMENT

COURSE CODE : BDX 10402

PROGRAMME : 1 BDX

EXAMINATION DATE : DECEMBER 2019/JANUARY 2020

DURATION : 2 HOURS

INSTRUCTION : **SECTION A:** ANSWER **ALL QUESTIONS** IN THIS SECTION.

SECTION B: ANSWER **TWO (2) QUESTIONS** FROM **THREE (3) QUESTIONS** PROVIDED IN THIS SECTION.

THIS PAPER CONSISTS OF **SEVEN (7) PAGES**

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SECTION A

Instruction: Please answer <u>all questions</u> in this section.

Q1   (a)   Metrology can be categorized into **THREE (3)** types. Identify all those types and explain at least **ONE (1)** of them.

(6 marks)

(b)   Explain why does measurement is important and what are the benefits of implementing it in machining and fabrication works.

(6 marks)

(c)   Too many mesuring activity will consequently increase the production lead time. Discuss at least **THREE (3)** factors need to be considered in implementing measurement process.

(6 marks)

(d)   Measurement System Analysis is applied to evaluate the statistical properties of process measurement system. The system evaluate the measurement system errors. Explain all **THREE (3)** components considered in evaluating measurement accuracy.

(7 marks)

Q2   (a)   With examples, compare the difference between graduated and non-graduated measuring tools.

(4 marks)

(b)   In milling machining shop producing mold, micrometers and vernier caliper are widely used. Based on the parts features, select the appropriate measuring instrument. Compare the advantages and disadvantages between micrometer and verneer caliper.

(6 marks)

(c)   Screw thread can be measured using direct and indirect measurement method. Select the measuring instrument can be used to measure screw diameter for each methods and discuss the influence of applying the methods from the point of measurement accuracy.

(8 marks)

(d)   A metal block need to be machined to get a flat surface with roughness need to be controlled according to part drawing. From the part drawing in **Figure Q2**, demonstrate the surface roughness measurement method including the measuring direction, sampling length and juggement value.

(7 marks)

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SECTION B

Instruction: Please <u>answer TWO (2) questions</u> from THREE (3) questions provided in this section.

Q3 (a) Solve the measurement from **Figure Q3**.

(4 marks)

(b) Bolt and screw diameter can be measured using micrometer and profile projector. Examine the major factor contribute to reading error from the point of the measurement tool characteristics.

(6 marks)

(c) A precision machine structure was inspected using autocolimeter. The Z axis structure and X-Y table must be perpendicular with maximum error of 0.2 degree. The rectile image in the autocolimeter was 3 mm shifted downwards from center position. Calculate the Z axis shaft angle against X-Y plane. The Autocolimeter focal length is 300 mm. Illustrate the condition of the Z axis structure.

(8 marks)

(d) A circular aluminum plate is polished to mirror surface in hard disc drive manufacturing. The surface need to be perfectly flat and no scratches are allowed. Select a method of measurement when the inspection lead time and accuracy is crutially important. Support your selection from the point of equipment accuracy, source or error and error compensation method.

(7 marks)

Q4 (a) In a mold making production line, cutting tool run out need to be controlled as minimum as possible. Assumed that a drilling process need to be done using a cutting tool with diameter of 10 mm and overhang of 50 mm. Using dial indicator, demonstrate how it can be done.

(5 marks)

(b) A dial indicator is used to measure flat metal part with initial thickness of 20 mm. The dial indicator with tip diameter of 4 mm was excidently mounted on a granite stand slanted $1°$ from vertical line.

i. Identify the type of error

(2 marks)

ii. Calculate the error of measurement.

(5 marks)

(c) In situation **Q4 (b)**, the dial indicator comes with calibration certificate showing that the measurement accuracy is ±0.001 mm. The flat metal part was designed with thickness of 20.0 ± 0.002 mm. Based to the calculated error in situation

Q4 (b), evaluate the reliability of the measurement results and judge action to be taken.

(4 marks)

(d)   Acording to ISO 9000 standard, measurement processes is to be considered as a support to obtain excellent quality level. Illustrate the model of measurement management system which shows the relation between customer requirement, customer satisfaction and measurement process.

(9 marks)

Q5   (a)   Interpret the drawing in **Figure Q5 (a)** and **(b)**.

(4 marks)

(b)   For the part in **Figure Q5 (a)** and **(b)**,

i. Select the appropriate measuring instrument.

(2 marks)

ii. Using schematic diagram, demonstrate how it can be measured.

(4 marks)

(c)   Two engineering parts come with technical drawing as shown in **Figure Q5 (c)**. Using MMC level 4, solve the virtual dimension and illustrate the part virtual condition.

(8 marks)

(d)   Coordinate measuring machine (CMM) is widely used in reverse engineering activity. Identify and explain **THREE (3)** features that make CMM is preferred in reverse engineering works.

(7 marks)

END OF QUESTIONS

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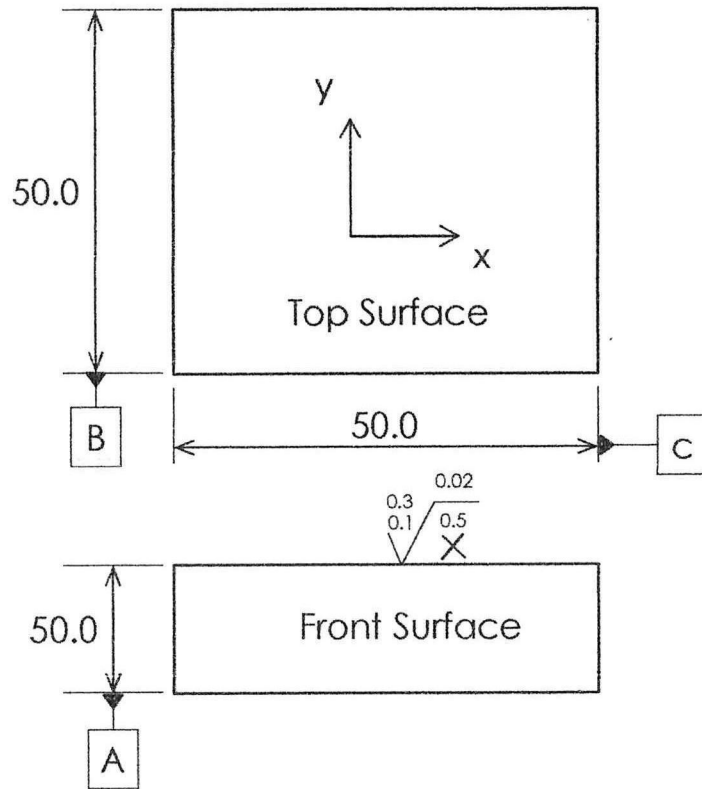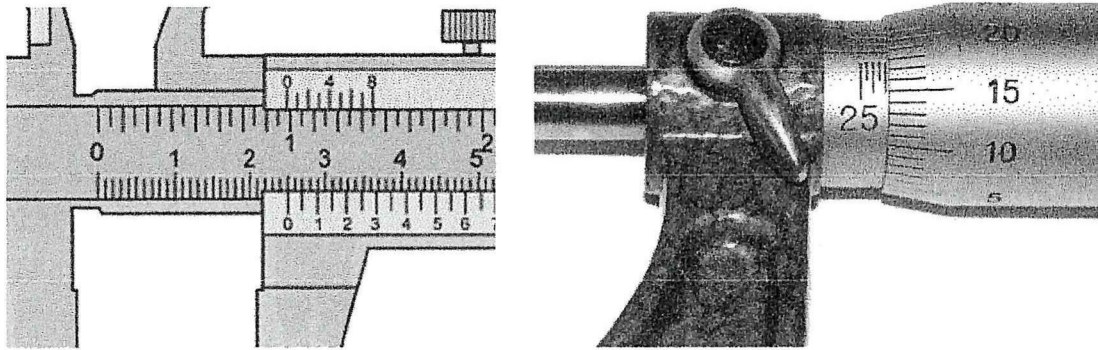COURSE NAME: METROLOGY AND MEASUREMENT   COURSE CODE: BDX 10402
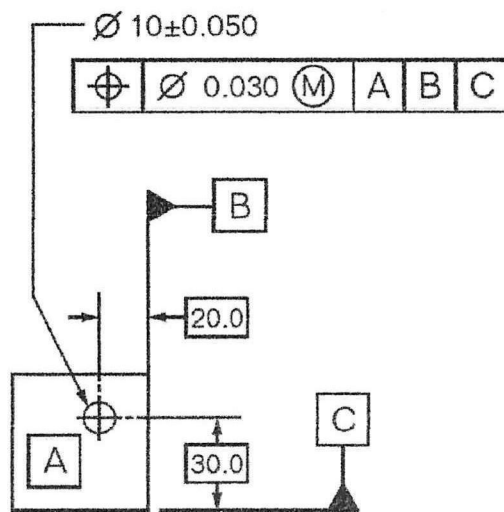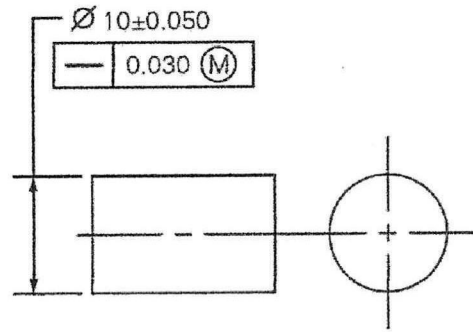
50.0

y

x

Top Surface

B

50.0

C

0.02
0.3
0.1 / 0.5
X

50.0

Front Surface

A

Figure Q2

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Figure Q3

Figure Q5 (a)

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Ø 10±0.050

| — | 0.030 Ⓜ |

Figure Q5 (b)

Drawings

Ø 1.006±.003

| ⊥ | Ø.004Ⓜ | A |

Ⓑ

Ø 514±.003

| ⌖ | Ø.005Ⓜ | A | BⓂ |

A

1.600

Ø .500±.001

| ⌖ | Ø.005Ⓜ | A | BⓂ |

Ø 994±.003

| ⊥ | Ø.002Ⓜ | A |

Ⓑ

A

1.600

Figure Q5 (c)

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