

**UNIVERSITI KUALA LUMPUR
MALAYSIAN INSTITUTE OF INDUSTRIAL TECHNOLOGY**

**FINAL EXAMINATION
JANUARY 2016 SEMESTER**

COURSE CODE : JCB 30603
COURSE TITLE : MATERIAL MONITORING AND CONTROL APPARATUS
PROGRAMME LEVEL : BACHELOR
DATE : 31 MAY 2016
TIME : 9.00 AM – 12.00 PM
DURATION : 3 HOURS

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. This question paper consists of **TWO (2)** sections.
 4. Answer **ALL** questions in Section A. Choose **ONE (1)** question in Section B.
 5. Please write your answers on the answer booklet provided.
 6. Please answer all questions in English only.
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THERE ARE 6 PAGES OF QUESTIONS, EXCLUDING THIS PAGE.

SECTION A (Total: 80 Marks)**INSTRUCTION: Answer ALL Questions.****Please use the answer booklet provided.****Question 1**

- (a) There are abundance of materials around us which can be found in anything from buildings, clothes, metal silverware, and ceramic dishes to spacecraft. Define material and material science. (4 marks)
- (b) Materials made from metal are good conductors of heat and electricity. Polymer is defined as organic molecule assembled from many small molecule called monomer. Polymer can be further classified into three groups. List those **THREE (3)** groups and give **ONE (1)** example for each group. (6 marks)
- (c) Materials that are utilized in high-technology (or high-tech) applications are known as advanced materials. Explain **TWO (2)** of the properties of advance materials. (4 marks)
- (d) Smart fluid is a fluid whose properties (for example the viscosity) can be changed by applying an electric field or a magnetic field. Smart fluid is an example of the major advancement in materials used in industries; categorized as smart material. Give another **TWO (2)** example of smart material and describe their properties. (6 marks)

Question 2

- (a) FTIR is also known as Fourier Transform Infrared Spectroscopy. Describe FTIR and explain FIVE (5) FTIR applications in material and monitoring industries.

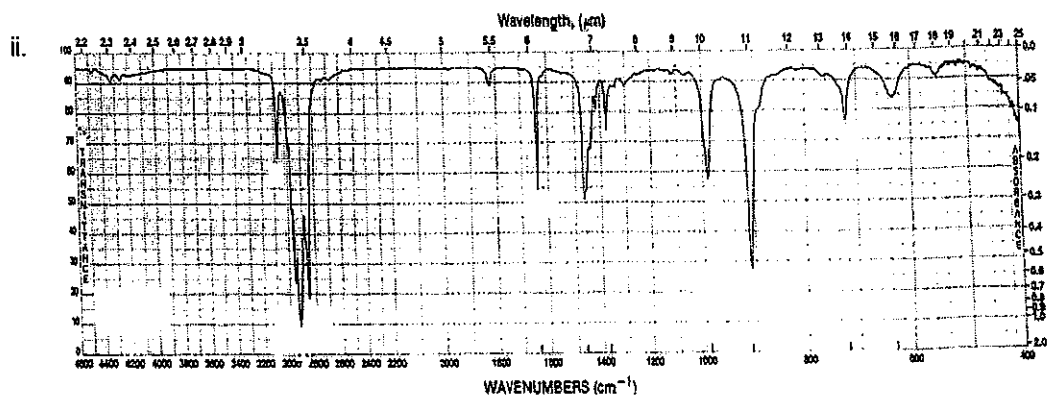
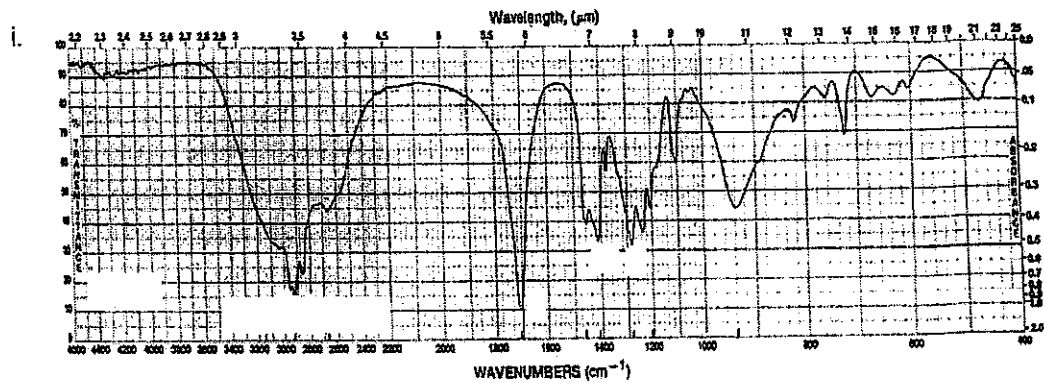
(7 marks)

- (b) A liquid mixture containing 20.0 mole% ethylene, 36.0 mole% of propane, and the 44.0 mole% of benzene. Explain how you are going to separate and analyze the mixture.

(10 marks)

- (c) Analyze the Infrared (IR) spectra below using Table 1; Characteristic IR Absorption Frequencies of Organic Functional Groups for the absorption frequencies. Explain their main functional group and THREE (3) bonds related to the compounds.

(8 marks)



Question 3

- (a) GCMS is a hyphenated technique of Gas Chromatography (GC) and Mass Spectroscopy (MS). Define GCMS. (2 marks)
- (b) Different types of chromatography was classified based on their working principles which is mobile and stationery phase. Besides gas and liquid Chromatography, list **THREE (3)** other types of chromatography methods. (3 marks)
- (c) After the analysis of an alcohol using GC and MS, the spectrum is obtained as in Figure 1. Interpret the spectrum obtained with regard to the ion fraction and the compound name. (10 marks)

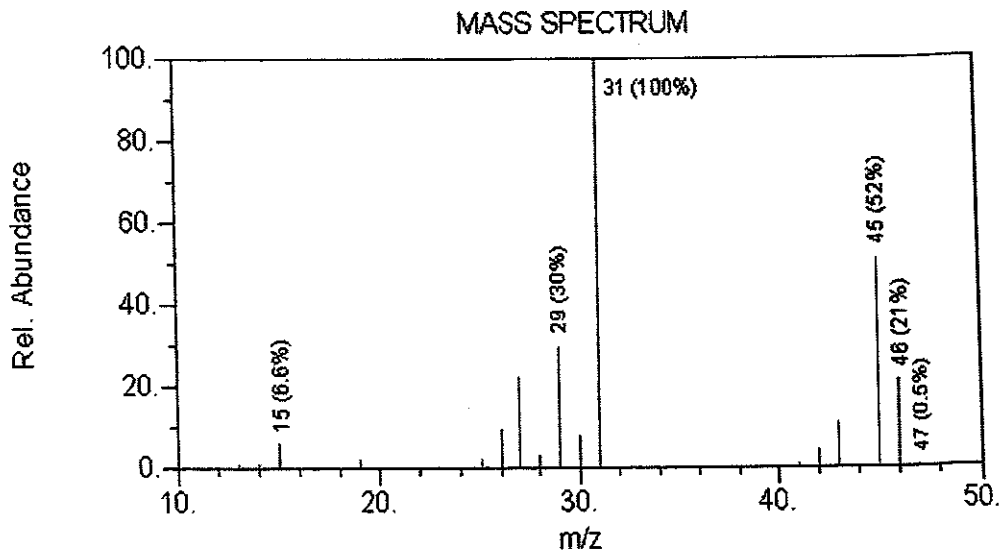


Figure 1

Question 4

- (a) *Maintenance* could be defined as the process of maintaining, keeping or preserving something in good condition. Describe **THREE (3)** preventive maintenance for instrumentation. (6 marks)
- (b) Explain the importance of instrument maintenance. (4 marks)
- (c) Describe the **SIX (6)** steps in troubleshooting tips in order to keep instrumentation loops at peak efficiency. (6 marks)
- (d) Validity and Reliability is the two important concepts in selection for the suitable apparatus in monitoring and controlling material. Give your opinion. (4 marks)

SECTION B (Total: 20 Marks)**INSTRUCTION: Answer ONE (1) Question only****Please use the answer booklet provided.****Question 1**

- (a) Analyze and categorized the materials below.
- | | |
|---------------|-------------------|
| i. Nylon | iv. Copper |
| ii. Boat | v. Superconductor |
| iii. Laminate | |
- (5 marks)
- (b) Material used in industries can be classified into five major categories. List and explain those **FIVE (5)** major classifications.
- (10 marks)
- (c) Explain the importance of material control and monitoring process.
- (5 marks)

Question 2

- (a) State the wavelength for Electromagnetic Spectrum and arrange them in the ascending energy.
- (8 marks)
- (b) Differentiate the single and dual-beam UV-Vis spectrophotometer with the drawing and explanation.
- (6 marks)
- (c) Describe the conjugation phenomena in spectrometry readings and give the **FOUR (4)** types of shift.
- (6 marks)

END OF EXAMINATION PAPER

| Table 1: Characteristic IR Absorption Frequencies of Organic Functional Groups | | | | |
|--|-------|---------------------|--|--|
| Functional Group | Bond | Type of Vibration | Characteristic Absorptions (cm ⁻¹) | Intensity |
| Alcohol | O-H | (stretch, H-bonded) | 3200-3600 | strong, broad |
| | O-H | (stretch, free) | 3500-3700 | strong, sharp |
| | C-O | (stretch) | 1050-1150 | strong |
| Alkane | C-H | stretch | 2850-3000 | strong |
| | -C-H | bending | 1350-1480 | variable |
| Alkene | =C-H | stretch | 3010-3100 | medium |
| | =C-H | bending | 675-1000 | strong |
| | C=C | stretch | 1620-1680 | variable |
| Alkyne | C-H | stretch | 3300 | strong, sharp |
| | -C≡C- | stretch | 2100-2260 | variable, not present in symmetrical alkynes |
| Amine | N-H | stretch | 3300-3500 | medium (primary amines have two bands; secondary have one band, often very weak) |
| | C-N | stretch | 1080-1360 | medium-weak |
| | N-H | bending | 1600 | medium |
| Aromatic | C-H | stretch | 3000-3100 | medium |
| | C=C | stretch | 1400-1600 | medium-weak, multiple bands |
| Carbonyl | C=O | stretch | 1670-1820 | strong |
| Ether | C-O | stretch | 1000-1300 (1070-1150) | strong |
| Nitrile | CN | stretch | 2210-2260 | medium |
| Nitro | N-O | stretch | 1515-1560 & 1345-1385 | strong, two bands |

| Table 2: IR Absorption Frequencies of Functional Groups Containing a Carbonyl (C=O) | | | | |
|---|------------------|-------------------|--|------------------------------|
| Functional Group | Bond | Type of Vibration | Characteristic Absorptions (cm ⁻¹) | Intensity |
| Acid | C=O | stretch | 1700-1725 | strong |
| | O-H | stretch | 2500-3300 | strong, very broad |
| | C-O | stretch | 1210-1320 | strong |
| Aldehyde | C=O | stretch | 1740-1720 | strong |
| | =C-H | stretch | 2820-2850 & 2720-2750 | medium, two peaks |
| Amide | C=O | stretch | 1640-1690 | strong |
| | N-H | stretch | 3100-3500 | unsubstituted have two bands |
| Anhydride | C=O | stretch | 1800-1830 & 1740-1775 | two bands |
| Ester | C=O | stretch | 1735-1750 | strong |
| | C-O | stretch | 1000-1300 | two bands or more |
| Ketone | acyclic | stretch | 1705-1725 | strong |
| | □, □-unsaturated | stretch | 1665-1685 | strong |
| | aryl ketone | stretch | 1680-1700 | strong |

