

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION SEMESTER II **SESSION 2016/2017**

COURSE NAME

CHEMICAL PROCESS AND

SUSTAINABILITY

COURSE CODE

: DAK 32103

PROGRAMME

: DAK

EXAMINATION DATE : JUNE 2017

DURATION

: 3 HOURS

INSTRUCTION

SECTION A : ANSWER ALL

QUESTIONS

SECTION B : ANSWER TWO (2)

QUESSTIONS ONLY



THIS OUESTION PAPER CONSISTS OF FOUR (4) PAGES

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SECTION A

4.1%

- Q1 (a) Biomass is fuel that is developed from organic materials, renewable and sustainable source of energy used to create electricity or other forms of power.
 - (i) Define biofuel.

(1 marks)

(ii) Propose **TWO (2)** types of conversion process of biomass energy systems to biofuels.

(2 marks)

(iii) Explain each process to support the answer in Q6 (a) (ii).

(10 marks)

(b) The rationale for using biomass as a chemical feedstock is illustate by several important advantages. Demonstrate **FOUR** (4) advantages of biomass feedstocks.

(8 marks)

(c) Briefly discuss **TWO** (2) available basic platforms of biofuels production from renewable biomass.

(4 marks)

- Q2 (a) A number of metrics have been proposed over the past 5 to 10 years to make chemists aware of the need to change the methods used for chemical syntheses and chemical processes. Define the metric of:
 - (i) The atom economy (AE).
 - (ii) E-Factor.
 - (iii) Reaction mass efficiency (RME).
 - (iv) Mass Intensity (MI).
 - (v) Mass productivity (MP).

(15 marks)

- (b) Environmental impact indicators are focus on the impact of synthetic processes, by assigning impact scores to the raw materials.
 - (i) Describe the usage of environmental impact indicators.

(2 marks)

(ii) Explain TWO (2) types of environmental impact indicators

(8 marks)



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SECTION B

- Q3 (a) Green principle is a chemistry to produce chemical products that do not harm either our health or the environment.
 - (i) Propose **TWO** (2) example of industry which implement green chemistry principle.

(2 marks)

(ii) Describe the traditional route and greener route for the industry involved in Q1 (a) (i).

(10 marks)

(iii) Analyzed the TWO (2) green chemistry principles that related to the industry in Q1 (a) (ii).

(4 marks)

(b) Catalysis plays a critical role in promoting the feasibility, eco-efficiency and economics of over 90% of chemical processes and industry including mobility sector industry, fuel cell industry and chemical and refinery industry. Discuss the roles of catalyst in these **THREE** (3) industry.

(9 marks)

- Q4 Catalytic reagents are known superior to stoichiometric reagents.
 - (a) List the SIX (6) possible approaches for multiphase operation of catalysis to improve their usability and recycle.

(6 marks)

(b) Explain the role of multiphase operations in general aspects.

(4 marks)

(c) Demonstrate the FOUR (4) types of catalyst available in industry.

(8 marks)

(d) Outline the general characteristic of catalyst to enable sustainable chemical process.

(7 marks)



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- Q5 (a) Many assessment methodologies have been developed that include not only the product or process but also the entire supply chain and disposal that is the cradle to grave approach. One of the approach is life cycle assessment (LCA).
 - (i) Define Life Cycle Assessment (LCA)

(1 mark)

(ii) State **SIX** (6) assessment of Life Cycle Assessment (LCA) that includes the entire life cycle of the product, process or activity and encompassing.

(6 marks)

(ii) Explain SIX (6) reasons why conduct Life Cycle Assessment (LCA).

(12 marks)

(b) With rapidly rising costs of fossil fuels, the reduction of energy intensity of chemical production is a primary objective. Choose **THREE** (3) necessary indicators for energy intensity.

(6 marks)

- **Q6** (a) The ecological footprint (EF) is one of the most widely used indicators of sustainability.
 - (i) Define ecological footprint.

(3 marks)

(ii) Propose **TWO** (2) example of ecological footprint with the measurements unit.

(6 marks)

(b) Describe **THREE** (3) usage of ecological indicators.

(6 marks)

(c) Various metrics and methods in engineering design are used to evaluate and measure the different aspects of the environmental impact of industrial activities and services. Demonstrate the sustainability metrics classifications in FIVE (5) broad categories.

(10 marks)



-END OF QUESTIONS-

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