MANIPAL UNIVERSITY

Reg. No.										

Deemed- to -be -University under Section 3 of the UGC Act, 1956

DEPARTMENT OF SCIENCES

III[rd] SEMESTER M. Sc. (Chem.) END SEMESTER EXAMINATIONS, Nov./Dec. 2017

Subject: Green Chemistry [CHM 705]

(REVISED CREDIT SYSTEM)

Time: 3 Hours Date: 20.11.2017 MAX. MARKS: 50

Note: (i) Answer any FIVE FULL questions
(ii) Draw diagrams, and write equations wherever necessary

1A. Write four important steps involved in designing green synthesis and explain high-throughput syntheses with examples.

1B. What are the advantages of SC CO_2 solvent extraction for distillation process? Explain the dry cleaning mechanism of SC CO_2?

1C. Discuss the measure of a greenness of any reaction.

(4+4+2)

2A. Discuss the preparation and comparative E-factors of the following by conventional and green methods.
(i) Citral (ii) Adipic acid

2B. Discuss different methods of heterogenization of homogeneous catalysts for sustainable chemical processes.

2C. Write an example for a chemical synthesis using phosgene and give an example of green alternative to phosgene.

(4+4+2)

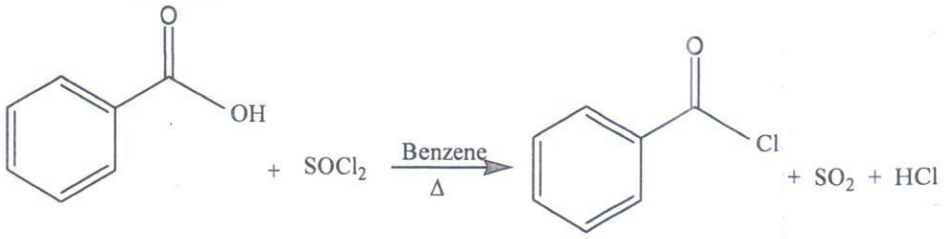
3A. What are microwaves? What are the conditions required to carry out the microwave reactions? Explain two chemical reactions using microwaves with their mechanisms.

3B. Describe demineralization process of water softening with the chemical reactions involved.

3C. What is a Phase Transfer Catalyst (PTC)? Explain three important roles of PTC in reactions.

(4+4+2)

4A. Calculate the E-factor, atom efficiency, effective mass yield, reaction mass efficiency and carbon efficiency for the following chemical process. The yield of the product obtained is 76 %. Given: At. wt. of C, O, H, S, Cl are 12, 16, 1, 32 and 35 respectively. Comment on the greenness of the reaction.



4B. (i) What are the advantages of styrene based polymer supported catalysts, used in green synthesis?
(ii) Discuss the production pathways of any two industrially important chemicals from biomass.

4C. What are the disadvantages of reducing risk through minimizing exposure?

(4+4+2)

5A. Explain the role of environmental management system (EMS) in a chemical industry. Using EMS, how to reduce the waste, control and monitor the chemical processes?

5B. (i) Write synthetic methods of ionic liquids. How to improve the yield of products using ionic liquids? Explain your answer with two organic reactions.
(ii) Define Crown ethers and explain any two reactions using crown ethers

5C. Define a biocatalyst. Explain the role of it in oxidation reactions.

(4+4+2)

6A. What are the aspects of a chemical process that should be a part of green chemistry evaluation?

6B. Explain the green chemistry principles with suitable examples, related to feed stocks and energy efficiency

6C. Define atom economy. Provide examples for chemical reactions with 100 % and <100 % atom economies and their calculations.

(4+4+2)

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