Petrochemical Processes

- 1. Course number and name: 020PPCCS4 Petrochemical Processes
- 2. Credits, contact hours: 4 credits, 2x1:15 contact hours
- 3. Names of instructors: Malek Msheik

4. Instructional materials:

- Course handouts
- Reference: The chemistry and technology of petroleum; J. G. Speight, 1999

5. Specific course information

a. Catalog description:

Introduction to Chemical Process Industries. Raw material for Organic Chemical Industries. Profile of petrochemical Industry and its structure. Feedstocks: present and emerging. Overview of unit processes with applications, Nitration- nitrobenzene, nitrotoluenes, Halogenation- DCM, MCA, VCM, chlorobenzene. Esterification- C1 to C4 alcohols Production of Olefins and Derivatives, Naphtha and gas cracking for production of olefins. Recovery of chemicals from FCC and steam cracking. Ethylene derivatives: Ethylene Oxide, Ethylene glycol, Vinyl chloride, Propylene and Propylene oxide. Production of Aromatics, Aromatics separation train. Aromatics product Profile-Benzene, Toluene, Xylene, Ethyl benzene &Styrene, Cumene and phenol, Bisphenol, Aniline Unit - V Polymers and Elastomers. Polymers: Polyethylene, Polypropylene, Polystyrene, Polyvinylchloride, polycarbonate, Thermoset resin: phenol formaldehyde, uriaformaldehyde and melamine formaldehyde Elastomers: Styrene Butadiene Rubber (SBR), Poly butadiene, Nitrile rubber Unit - VI Fibers. Polyimides or Nylons (PA), DMT and Terephthalic Acid, Polyester, Acrylic Fiber, Modified Acrylic Fiber, Acrylonitrile, Acrolein, Viscose Rayon and Acetate rayon.

- **b. Prerequisites:** 020PRPCS3 Refining processes
- c. Required/Selected Elective/Open Elective: Required

6. Specific goals for the course

a. Specific outcomes of instruction:

- At the end of this course, students should:
- Acquire the essential concepts of petrochemicals
- Know the main classes of chemical reactions involved in the petrochemical industry. List the main industrial processes involving each class of reactions
- Develop basic skills related to the techniques and processes used in the processing of petrochemicals...
- Become familiar with the processes for obtaining raw materials and monomers: cracking, steam-cracking, etc.

b. PIs addressed by the course:

PI	7.1	7.2
Covered	Х	Х
Assessed	Х	Х

7. Brief list of topics to be covered

- Chapter 0: introduction to petrochemicals, petrochemical synthesis, synthetic products, classification of petrochemicals.
- Chapter I: 1. Production of ethylene by cracking.
 - 2. Major products based on ethylene (production and applications).
 - Oxidation of ethylene (ethylene oxide, ethylene glycol, ethoxylates, ethanolamines, 1,3-propanediol, acetaldehyde, acetic acid, vinyl acetate, poly(vinyl acetate), acrylic acid, polyacrylates.
 - Chlorination of ethylene (vinyl chloride, perchloro and trichloroethylene).
 - Hydration of ethylene (ethanol).
 - Oligomerization of ethylene (alpha olefins, linear alcohols, 1butene).
 - Alkylation using ethylene
- Chapter II: Propylene and petrochemical products based on propylene (production and applications).
 - Oxidation of propylene (acrolein, acrylic acid)
 - Ammoxidation of propylene (acrylonitrile, propylene oxide)
 - Chlorination of proylene (allyl chloride)
 - Hydration of propylene (isopropanol, acetone)
 - Addition of organic acids to propylene: (Isopropyl acetate, isopropyl acrylate)
 - Hydroformylation of propylene (butyraldehyde)
 - Disproportionation of propylene
 - Alkylation using propylene
- Chapter III: Aromatic compounds. Benzene and its derivatives, toluene and xylene isomers, (BTX).

1. Reactions and chemicals of benzene :

- Alkylation
- Nitration
- Chlorination
- Hydrogenation
- Oxidation
- 2. Reactions and chemicals of toluene :
 - Oxidation
 - Dealkylation
 - Disproportionation
 - Chlorination
 - Nitration
 - Carbonylation
- 3. Reactions and chemicals of toluene :

- Terephtalic acid -
- Phtalic anhydride -
- _ Isophtalic acid
- Chapter IV : Methane -
 - 1. Chemicals based on direct reaction of methane;
 - Carbone disulfide -
 - Hydrogen cyanide
 - Chloromethane
 - 2. Synthesis gas
 - Hydrogen
 - Methanol
 - 3. Reactivity of methanol
 - Formaldehyde
 - Methyl chloride
 - Acetic acid
 - MTBE
 - TAME
 - Methylamine...
- Chapter V : Non-hydrocarbon intermediates:
 - -Hydrogen
 - Sulfur
 - Carbon black
 - _ Synthesis gas
- Chapter VI : Paraffins
- Ethane -
- Propane
- _ butane...

Chapter VII : C4 Olefins and diolefins-Based Chemicals

- 1-Butene _
- Isobutene
- Butadiene....