SEMESTER 2nd
MAJOR / MINOR COURSE

ICM222M INDUSTRIAL CHEMISTRY

CREDITS: THEORY: 04; PRACTICAL: 02

COURSE OBJECTIVES:

- *To introduce students to the basic concepts of fuels.*
- *To understand basics of petroleum and Petrochemical Industry.*
- *To understand the core concepts of oil, fats and food additives.*
- *To know the fundamental relationship between industries and environment.*

LEARNING OUTCOMES:

On completion of the course, the student should be able to:

- *Understand the general aspects of fuels.*
- *Understand the chemistry behind petroleum.*
- *Recognize the main chemistry of oils, fats and additives.*
- *Understand environment and industrial water quality parameters*

THEORY (04 CREDITS)

UNIT 1: FUELS AND COMBUSTION

Review of energy sources (renewable and non-renewable)
Classification of fuels: Based on Occurrence and Physical State. Calorific value: Gross Caloric Value and Net Calorific Value. Characteristics of a good fuel. Alternate fuels and their utlity.
Coal: Origin, Composition, Classification of Coal: Peat, Lignite, Bituminous and Anthracite. **Analysis of Coal**: Proximate and Ultimate Analysis. Carbonization of coal: Low Temperature and High Temperature Carbonization.
Gaseous Fuels: Coal gas, Producer gas, Water gas, Biogas and Gobar gas, Coal gasification (Hydro Gasification and Catalytic gasification), Coal liquefaction and Solvent Refining.
Clean fuels.

UNIT II: PETROLEUM AND PETROCHEMICAL INDUSTRY

Petroleum: composition of crude petroleum, Refining of petroleum: Fractional Distillation (Principle and Process). Different types of petroleum products and their applications.
Cracking: Thermal and Catalytic cracking. Reforming petroleum and non-petroleum fuels (LPG, CNG, LNG, biogas, fuels derived from biomass). Thermal and Catalytic reforming. Knocking and Octane Rating, antiknocking agents. Synthetic Petrol.
Petrochemicals: Vinyl acetate, Isoprene, Butadiene, toluene, xylene.
Lubricants: Classification of lubricants, lubricating oils (conducting and non-conducting), solid and semisolid lubricants. Properties of lubricants (viscosity index, cloud point, pore point).

UNIT III: OILS, FATS AND FOOD ADDITIVES

Classification of oils, fat splitting, distillation of completely miscible and non-miscible oils, hydrogenation of oils, rancidity, saponification value, iodine number, acid value, soap and synthetic detergent, preparation of soap and detergent, different types of soap and their composition, surfactants (LAS, ABS, LABS), detergent binders and builders.
Food additives: A general study of food flavours, colours and preservatives, artificial sweeteners.

UNIT IV: ENVIRONMENT

Air Pollution: Sources, types of air pollutants, pollution by SO_2, CO_2, CO, NOx. Methods of estimation of CO, NOx, SOx. Environmental effects of air pollution: Green House effect and Global warming, Ozone depletion, photochemical smog and acid rain. Air pollution control: Source correction methods, Air pollution control devices (Cyclonic separators, Fabric filters, Electrostatic precipitators)
Water pollution and Water Quality Standards: Sources of water pollution, classification of water pollutants. Water analysis - Hardness, alkalinity, Dissolved Oxygen, Biological Oxygen Demand, Chemical Oxygen Demand, Total Solids. Waste Water treatment: Primary, secondary (trickling Filters and Activated

Sludge process) and tertiary treatment. Water treatment for domestic/municipal purpose: Screening, sedimentation, coagulation, filtration, disinfection.

BOOKS RECOMMENDED:

1. Handbook of Industrial Chemistry; J. A. Kent, CBS Publishers, New Delhi, 1997.
2. Engineering Chemistry; Jain and Jain, 16th Edition 2013, DhanpatRai Publishing Company(P) Ltd.
3. Industrial Chemistry; B.K. Sharma; Goel Publishing House, New Delhi, 2016.
4. Environmental Chemistry; K. De; New Age International Pvt., Ltd, New Delhi.
5. A. Mishra, Environmental Studies. Selective and Scientific Books, New Delhi (2005).
6. A Textbook of Engineering Chemistry; S.S. Dara; S. Chand & Company Ltd. New Delhi.
7. Introduction to petroleum chemicals, H. Steiner. Pergamon Press.
8. Handbook of petroleum refining processes: R. A. Meyers, Mc Graw Hill, New York.
9. Fundamentals of Analytical Chemistry. D.A. Skoog, D.M. West, F.J. Holler, S.R. Crouch, 9th Ed. 2014; Mary Finch, USA.

PRACTICAL (02 CREDITS)

COURSE OBJECTIVES:

- *To design curriculum framework to suit the requirements of the various industries.*
- *To make the students well-grounded in the principles and through knowledge of scientific techniques of industrial Chemistry.*

LEARNING OUTCOMES:

On completion of the course, the student should be able to:

- *Understand important industrial process.*
- *Apply processes and evaluate industrial and environmental uses of chemistry.*

EXPERIMENTS:

1. Determination of moisture content and ash content of coal sample.
2. Determination of smoke point of kerosene oil.
3. Determination of flash point of petrol/diesel sample.
4. Estimation of percentage of carbon and hydrogen in coal sample.
5. Estimation of glucose in any three food samples.
6. Analysis of oils and fats (iodine value, saponification value, acid value)
7. Estimation of hardness of water by titration with soap solution/EDTA
8. Determination of alkanity of water samples and soap solutions.
9. Determination of conductivity of a given water sample.
10. Determination of Biological Oxygen Demand (BOD) of a given water sample.

BOOKS RECOMMENDED:

1. Modern Analytical Chemistry. D. Harvey, McGraw Hill, 2000.
2. Analytical Chemistry; Gary D-Christian; 6 th ed.; Wiley; 2010.
3. Laboratory manual on Engineering Chemistry; S. K.Bhasin, Sudha Rani; D.R.Publishing Company-2015.
4. Practical industrial chemistry, Zeba N. Siddiqui, Anmol publications Pvt. Ltd New Delhi
5. Advanced Practical Inorganic Chemistry; Gurdeep Raj; 24th ed.; Goel Publishing House; 2012.
6. Fundamentals of Analytical Chemistry. D.A. Skoog, D.M. West, F.J. Holler, S.R. Crouch, 9th Ed. 2014; Mary Finch, USA.