NIRMA UNIVERSITY
School of Engineering, Institute of Technology
B.Tech. in Chemical Engineering
Third Year /Semester VI

Institute:	Institute of Technology
Name of Programme:	B. Tech. (Chemical Engineering)
Course Code:	3CH404ME24
Course Title:	Petroleum Refining Engineering
Course Type:	Department Elective
Year of introduction:	2024-25

L	**T**	**Practical component**			
		LPW	**PW**	**W**	**S**
3	-	2	-	-	-

Course Learning Outcomes (CLOs):

At the end of the course, the students will be able to –

1 measure and predict the properties of crude oil and refinery product fractions (BL3)
2 appreciate the modern techniques and recent developments for producing various refinery products (BL4)
3 analyse fuels and other refinery products (BL4)
4 apply hydrocarbon technology fundamentals in improving production methods (BL5)

Total Teaching hours: 45

Syllabus:

		Teaching hours
Unit I	**Crude Oil Detection & Exploration** Global and Indian petroleum industries, about up-stream and down-stream industries, integrated refinery & petrochemical complexes. Basics of crude oil: Reservoirs, origin and formation of petroleum crude oil, composition and classification of crude oil. Crude oil exploration & production: Detection of crude oil, exploration of crude oil, properties of crude oil, purification of crude oil. Crude assay: Properties and characteristics of crude oil and products, various distillation techniques for predicting characteristics and product fractions of crude oil.	**08**
Unit II	**Crude Oil Processing** Crude Oil Refining: Heating of crude oil, atmospheric distillation unit (ADU), vacuum distillation unit (VDU), crude oil refining and processing. Current trends and case studies. Comparison, production methods & properties of refinery products: Refinery gases, naphtha, gasoline, kerosene, jet fuel, diesel, gas oils, furnace oil, heating oil etc. Alternative fuels.	**10**
Unit III	**Cracking Operations** Thermal & Catalytic Cracking: Importance, feedstock, processes, technologies, products. Moving bed catalytic cracking, fluidised bed catalytic cracking (FCC), FCC advancement. Hydrocracking:	**12**

	Importance, feedstock, processes, technologies, products. Trickle bed hydrocracking, ebulliated bed hydrocracking. Coking: Basics, delayed cocking, fluid cocking, coke gasification.	
Unit IV	**Products & Residue Upgradation** Catalytic reforming, alkylation, polymeration, gasoline blending, atmospheric residue desulfurisation, residue upgradation	**07**
Unit V	**Hydrogen Production Technologies** Types of hydrogen, hydrogen production in refinery, steam and auto-thermal reforming, hydrogen storage and safety.	**08**

Self Study:
The self study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self study contents.

Laboratory Work:
Laboratory work will be based on the above content of course.

Suggested Readings/References:

1 Maples R. E., Petroleum Refinery Process Economics, PennWell Corporation.
2 Chaudhry U. R., Fundamentals of Petroleum and Petrochemical Engineering, CRC (Taylor & Francis)
3 Nelson W. L., Petroleum Refinery Engineering, McGraw-Hill International.
4 Treese S.A., Pujado P. R., Jones D. S. J., Hand Book of Petroleum Processes, Springer.
5 Gary J. H., Handwerk G. E., Petroleum Refining Technology and Economics, Marcel Dekker, Inc.
6 Raseev S., Thermal and Catalytic Processes in Petroleum Refining, Marcel Dekker, Inc.
7 Rao B. K. B., Modern Petroleum Refining Processes, Oxford & IBH Publication.

L= Lecture, T=Tutorial, P= Practical, C=Credit

List of Experiments:

Sr. No.	Practical	No. of Hours
1	To determine flash & fire point of a petroleum product using Cleaveland apparatus.	2
2	To determine flash & fire point of a petroleum product using Pensky-Martin apparatus.	2
3	To determine aniline point and diesel index of a given sample.	2
4	To determine cloud & pour point of a given sample of oil.	2
5	To determine smoke point of a given sample.	2
6	To find out carbon content of a given petroleum product.	2
7	To determine consistency of a given petroleum product.	2
8	To determine viscosity of a given sample using Redwood viscometer.	2
9	To determine viscosity of a given oil sample using Saybolt viscometer.	2
10	To determine drop point of a given grease sample.	2

NIRMA UNIVERSITY
School of Engineering, Institute of Technology
B.Tech. in Chemical Engineering
Department Elective
Third Year /Semester VI

Institute:	Institute of Technology
Name of Programme:	B. Tech. (Chemical Engineering)
Course Code:	3CH405ME24
Course Title:	Nanotechnology in Chemical Sciences
Course Type:	Elective
Year of introduction:	2024-25

L	**T**	**Practical component**			
		LPW	**PW**	**W**	**S**
3	-	2	-	-	-

Course Learning Outcomes (CLOs):

At the end of the course, the students will be able to –

1. interpret the key concepts of material science, chemistry, physics, biology and engineering in the field of nanotechnology (BL2)
2. distinguish various approaches for synthesis of nanomaterials (BL4)
3. demonstrate a conceptual knowledge of instrumentation for the characterisation of nanomaterials (BL2)
4. identify the societal issues that may impede the adoption of nanotechnology (BL3)

Total Teaching hours: 45

Syllabus:

		Teaching hours
Unit I	**Introduction to Nanoscience and Nanotechnology** Nanoscale science and technology, significances, historical perspectives, natural and man-made nanomaterials, properties of nanomaterials, ethical implications, environmental implications, future of nanotechnology.	**08**
Unit II	**Fabrication Methods** Top-down and bottom-up fabrication methods, self-assembly and sol-gel process, synthesis of carbon based and metallic nanomaterials.	**15**
Unit III	**Characterisation Methods** Electron microscopy methods, spectroscopic methods, other important characterisation methods.	**15**
Unit IV	**Applications of Nanomaterials** Nanobiotechnology, micro/nano electromechanical systems, medical nanotechnology, nanocatalysis, nanocomposites, environmental nanotechnology.	**07**

Self Study:

The self study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self study contents.

Laboratory Work:
Laboratory work will be based on the above content of course.

Suggested Readings/References:

1. Hornyak G L., Tibbals H F., Dutta J, Moore J., Introduction to Nanoscience and Nanotechnology, CRC Press.
2. Pradeep T., Nano: The Essentials-Understanding Nanoscience and Nanotechnology, McGraw-Hill Education.
3. Vo-Dinh T., Nanotechnology in Biology and Medicine: Methods, Devices and Application, CRC Press.
4. Shatkin J A., Nanotechnology: Health and Environmental Risk, CRC press.
5. Fulekar M H., Nanotechnology: Importance and Application, IK International.

List of Experiments:

Sr. No.	Practical	No. of Hours
1	Understanding of the presence of nanostructures on the composition of a natural material and how these affect its properties.	02
2	To synthesis gold nanoparticles by chemical reduction method.	02
3	Green synthesis of gold nanoparticles.	02
4	To synthesis silver nanoparticles by chemical reduction method.	02
5	Green synthesis of silver nanoparticles by chemical reduction method.	02
6	Synthesis of green copper nanoparticles using leaf extract of Azadirachta Indica.	02
7	Synthesis of nickel oxide nanoparticles by sol-gel method and Calculation of particle size by UV- Spectra	02
8	Preparation of CdS nanoparticles	02
9	Preparation of Manganese dioxide nanoparticles and determination of its optical band gap using Tauc Plot.	02
10	Synthesis of zinc oxide nanoparticles.	02

NIRMA UNIVERSITY
School of Engineering, Institute of Technology
B.Tech. in Chemical Engineering
Third Year /Semester VI

Institute:	Institute of Technology
Name of Programme:	B. Tech. (Chemical Engineering)
Course Code:	3CH702ME24
Course Title:	Fundamentals of Industrial Wastewater Treatment
Course Type:	Department Elective
Year of introduction:	2024-25

L	**T**	**Practical component**			
		LPW	**PW**	**W**	**S**
3	-	2	-	-	-

Course Learning Outcomes (CLOs):

At the end of the course, the students will be able to –

1. interpret concepts related to wastewater treatment (BL2)
2. apply conventional treatment units for industrial wastewater (BL3)
3. choose representative advanced technologies for industrial wastewater treatment (BL3)
4. analyse wastewater treatment units for process industries (BL4)

Total Teaching hours: 45

Syllabus:		**Teaching Hours**
Unit I	**Industrial wastewater scenario** Wastewater characteristics, current scenario, future directions	**02**
Unit II	**Wastewater treatment fundamentals** Sampling techniques and sample preparation for wastewater, Traditional and advanced analytical techniques for various parameters in wastewater, Flow measurement, characterisation of industrial wastewaters, stream pollution and self-purification, wastewater microbiology	**17**
Unit III	**Conventional Treatment Units for Industrial Wastewater** Preliminary, primary and secondary treatment of wastewater. Concepts of individual units of treatment plant such as, screen, grit chamber, equalisation, neutralisation, aeration, sedimentation, coagulation and flocculation, aerobic and anaerobic biological treatment, etc.	**18**
Unit IV	**Advanced Wastewater Treatment** Advanced oxidation systems, zero liquid discharge systems, membrane based systems – ultra, nano, MBR etc., water reuse and recycling in process industries	**04**
Unit V	**Case studies** Specific case of Common Effluent Treatment Plants (CETPs), Case studies of treatment of wastewater from major organic and inorganic chemicals manufacturing sectors	**04**

Self Study:
The self study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self study contents.

Laboratory Work:
Laboratory work will be based on the above content of course.

Suggested Readings/References:

1 Metcalf & Eddy, Burton, F. L., Stensel, H. D., & Tchobanoglous, G., Wastewater engineering: treatment and reuse, McGraw Hill Publication.
2 Mackenzie, L. D., Water and wastewater engineering: Design principles and practice, McGraw-Hill Education Publication.
3 Hammer Sr, M. J., & Hammer Jr, M. J., Water and wastewater technology, Pearson New International Edition. Pearson Publication.
4 Arceivala, S. J., & Asolekar, S. R., Wastewater treatment for pollution control and reuse, Tata McGraw-Hill Publication.
5 Patwardhan, A. D., Industrial wastewater treatment, PHI Publication.

L= Lecture, T=Tutorial, P= Practical, C=Credit

List of Experiments:

Sr. No.	Practical	No. of Hours
1	To determine oil and grease contents of sample	02
2	To determine acidity of sample	02
3	To determine residual chlorine of sample	02
4	To determine sulphate of sample	02
5	To determine alkalinity of sample	02
6	To determine Total Solids (TS), Total Dissolved Solids (TDS), Total Suspended Solids (TSS) in the given sample.	02
7	To determine the amount of chloride present in the given sample	02
8	Jar test for determining optimum coagulant dosage for sample	02
9	Microscopical observation	02
10	To determine Biological Oxygen Demand (BOD) and Chemical Oxygen Demand (COD) of sample	02