

Sant Gadge Baba Amravati University, Amravati



THREE /FOUR YEAR DEGREE OF BACHELOR OF SCIENCE

Bachelor of Science

SUBJECT: PETROCHEMICAL SCIENCE

FACULTY: SCIENCE AND TECHNOLOGY

(Courses effective from Academic Year 2026-2027)

Under Uniform NEP 2020

SYLLABUS

Semester I and II

Semester III and IV

Semester V and VI

Contents

Preamble:	3
Programme Attributes of a Chemistry Graduate.....	3
Qualification Descriptors	4
Program Outcomes for BSc	4
Program Specific Outcomes for BSc (Petrochemical Science)	5
Employability Potential of the Programme:.....	5
Credit Distribution	7
Examination and Assessment Process:	9
Continuous Assessment Tests (CAT).....	9
Conduction of the Examination:	10
TLE Scheme for FIRST YEAR: SEMESTER – I (Petrochemical Science) (Level 4.5).....	11
TLE Scheme for FIRST YEAR: SEMESTER – II (Level 4.5).....	12
TLE Scheme for SECOND YEAR: SEMESTER – III (Level 5.0).....	13
TLE Scheme for SECOND YEAR: SEMESTER – IV (Level 5.0).....	14
TLE Scheme for THIRD YEAR: SEMESTER – V (Level 5.5)	15
TLE Scheme for THIRD YEAR: SEMESTER – VI (Level 5.5)	16

Preamble:

The syllabus of Petrochemical Science for First year has been redesigned for National Education policy under Choice based Credit System (CBCS) to be implemented from 2024-2025. In CBCS pattern semester system has been adopted for FY, SY and TY which includes Discipline Specific Core Course (DSC) at F. Y. level, Ability Enhancement Compulsory Course (AEC), Discipline Specific Elective Course (DSE) and Open Elective Course (OE), Skill Enhancement Course (SEC), Indian Knowledge Science (IKS), Vocational Skill course (VSC) etc.

It imbibes the guidelines of UGC, UGC LOCF, NEP-2020 and Government of Maharashtra for all its Under Graduate programmes. The Board of Study in Chemistry of the SGB Amravati University prepared the syllabus for the first year undergraduate of Petrochemical science. The new curriculum of B. Sc. (Petrochemical science) and B. Sc. (Honors with Research) Petrochemical science offer courses in the areas of Industrial introduction to Petroleum:- exploration, Fuel, classification, separation technique, Products. Basic raw material used petrochemical industries, Polymer Chemistry, manufacturing process (e.g. ethylene oxide, ethanol, isopropyl alcohol, aniline, phenol etc.) processes like Cracking (Thermal, Catalytic and hydro) reforming, Analytical Chemistry, Green Chemistry etc. All the courses are having defined objectives and learning outcomes, which will help prospective students in choosing the elective courses to broaden their skills in the field of chemical and interdisciplinary areas. The courses will train students with sound theoretical and experimental knowledge that suits the need of academics and petrochemical industry. The courses also offer ample skills to pursue research as career in the field of chemical and allied areas.

Programme Attributes of a Petrochemical Science Graduate

Attributes of Petrochemical Science graduates under the outcome-based teaching-learning framework may encompass the following:

- **Core competency:** The Petrochemical Science graduates are expected to know the fundamental concepts of chemistry and applied chemistry. These fundamental concepts would reflect the latest understanding of the field, and therefore, are dynamic in nature and require frequent, regular, and time-bound revisions.
- **Communication skills:** Petrochemical Science graduates are expected to possess minimum standards of communication skills expected of a science graduate in the country. They are expected to read and understand documents with in-depth analyses and logical arguments. Graduates are expected to be well-versed in speaking and communicating their ideas/findings/concepts to a wider audience.
- **Critical thinking:** Petrochemical Science graduates are expected to know the basics of cognitive biases, mental models, logical fallacies, scientific methodology, and constructing cogent scientific arguments.
- **Psychological skills:** Graduates are expected to possess basic psychological skills required to face the world at large, as well as the skills to deal with individuals and students of various sociocultural, economic and educational levels. Psychological skills may include feedback loops, self-compassion, self-reflection, goal-setting, interpersonal relationships, and emotional management.
- **Problem-solving:** Graduates are expected to be equipped with problem-solving philosophical approaches that are pertinent across the disciplines.
- **Analytical reasoning:** Graduates are expected to acquire formulate cogent arguments and spot logical flaws, inconsistencies, circular reasoning etc.
- **Research skills:** They are expected to be keenly observant about what is going on in the natural surroundings to awaken their curiosity. Graduates are expected to design a scientific

experiment through statistical hypothesis testing and other *a priori* reasoning including logical deduction.

- **Teamwork:** Graduates are expected to be team players, with productive cooperations involving members from diverse socio-cultural backgrounds.
- **Digital Literacy:** Graduates are expected to be digitally literate for them to enroll and increase their core competency via e-learning resources such as MOOC and other digital tools for lifelong learning. Graduates should be able to spot data fabrication and fake news by applying rational skepticism and analytical reasoning.
- **Moral and ethical awareness:** Graduates are expected to be responsible citizen of India and be aware of moral and ethical baseline of the country and the world. They are expected to define their core ethical virtues good enough to distinguish what construes as illegal and crime in Indian constitution. Emphasis be given on academic and research ethics, including fair Benefit Sharing, Plagiarism, Scientific Misconduct and so on.
- **Leadership readiness:** Graduates are expected to be familiar with decision making process and basic managerial skills to become a better leader. Skills may include defining objective vision and mission, how to become charismatic inspiring leader and so on.

Qualification Descriptors

The qualification descriptors for a Bachelor's degree in Petrochemical Science may include following:

- i. Systematic and fundamental understanding of Petrochemical Science as a discipline.
- ii. Skill and related developments for acquiring specialization in the subject.
- iii. Identifying chemistry related problems, analysis and application of data using appropriate methodologies.
- iv. Applying subject knowledge and skill to solve complex problems with defined solutions.
- v. Finding opportunity to apply subject-related skill for acquiring jobs and self-employment.
- vi. Understanding new frontiers of knowledge in chemistry for professional development.
- vii. Applying subject knowledge for solving societal problems related to application of chemistry in day-to-day life.
- viii. Applying subject knowledge for sustainable environment friendly green initiatives.
- ix. Applying subject knowledge for new research and technology.

(Source: Learning Outcomes based Curriculum Framework (LOCF) for (B.Sc. with Chemistry) Undergraduate Programme 2020 https://www.ugc.gov.in/pdfnews/0614691_LOCF-chemistry.pdf)

Program Outcomes for BSc

POs:

At the time of graduation, Students would be able to

PO1.Critical Thinking: Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational, and personal) from different perspectives.

PO2.Effective Communication: Speak, read, write, and listen clearly in person and through electronic media in English and in one Indian language, and make meaning of the world by connecting people, ideas, books, media, and technology.

PO3. Social Interaction: Elicit views of others, mediate disagreements, and help reach conclusions in group settings.

PO4. Effective Citizenship: Demonstrate empathetic social concern and equity centred national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.

PO5. Ethics: Recognize different value systems including your own, understand the moral dimensions of your decisions, and accept responsibility for them.

PO6. Environment and Sustainability: Understand the issues of environmental contexts and sustainable development.

PO7. Self-directed and Life-long Learning: Acquire the ability to engage in independent and life-long learning in the broadest context of socio-technological change.

Program Specific Outcomes for BSc (Petrochemical Science)

PSOs:

Upon completion of the programme successfully, the learners would be able to-

1. Understand the scope, methodology and application of modern Petrochemical Science.
2. Apply theoretical and practical concepts of instruments that are commonly used-in most Petrochemical Science field.
3. Plan and conduct scientific experiments and record the results of such experiments.
4. Get acquainted with safety of chemicals, transfer, and measurements of chemicals, preparation of solutions, and using physical properties to identify compounds and chemical reactions.
5. Describe how Petrochemical Science is useful to solve social, economic and environmental problem and issues facing our society in energy, medicine, and health.
6. Develop and design optimized operation for petroleum and petrochemical products and processes

Employability Potential of the Programme:

A degree in Petrochemical Science allows the aspirant to develop excellent laboratory techniques. The degree program with Petrochemical Science offers him the necessary knowledge, develop skills and nurture creativity to achieve success. A degree in Petrochemical Science is a smart option intended for employability and earning. Petrochemical Science is studied in environmental as well as socio-economic context so that one can achieve its ethical implications and issues relating to energy requirements, consumer commodities, environmental impact, conservation and sustainability.

Petrochemical Science for its graduates provides the skills not only in the Petro-chemical industries but also in the areas of environmental sciences, and industrial equipment sales, science communication, teaching or academic research etc. Thus, a degree in Petrochemical Science broadens frequent prospects and opportunities for a number of Petrochemical Science not only expands critical thinking and the ability to understand other scientific and engineering concepts more easily, but also opens new perspectives to pursue career in different fields like refining. It offers the knowledge of unit processes, unit operations, heat and mass transfer, process equipments, various chemical manufactures, energy and fuels, pollution and management, instrumental methods of analysis etc. Many industries like pharmaceuticals, agrochemicals, fertilizers paints, dyes, oil, plastic, rubber and many more based on petrochemicals prefer to employ chemists. After completion of degree programme in Petrochemical Science and find job opportunities in such industries. The candidates can be placed at a position of production supervisor, production manager, chemists in quality control as well as pollution monitoring, analytical chemist, lab manager, research associate etc.

Apart from the subject specific knowledge, an Petrochemical Science graduate also acquires fundamental professional transferable skills including:

- Effective listening, written and oral communication

- Analysis and problem solving
- Monitoring/ maintaining records and data
- Research and presentation
- Time management and organization
- Modern ICT enabled skills
- Teamwork

Future scope for B.Sc. Petrochemical Science graduates:

- Prestigious institutions offer higher studies such M.Sc. and Ph.D.
- Petrochemical science student can become small or medium scale entrepreneur (own industry).
- Laboratory technician in various Public Sector Units like ONGC, IOCL, BPCL, HPCL, BARC, and Private sector industries.
- Students can become Content Developer for IT industries.
- Students can become Quality Control / Quality assurance Chemists
- Laboratory technicians to look after sophisticated instruments like NMR, Mass Spectrometer, UV-Visible Spectrophotometer, Single crystal machines, XRD, SEM, AAS, TEM etc. in research laboratory of academic institutions as well as private sector companies
- Research Scientist/ Operations Manager/ Chemists / Quality Manager / Research Manager at various industries like Pharmaceuticals, Cement, Plastic, Rubber, Drugs, Paint, Dyes, Agricultural sector, etc.

Credit Distribution

Three/Four-year UG Degree Programme (Level 4.5 to 5.5)

Vertical	Vertical Type	I	II		III	IV	V	VI	Total Credits	Grand Total
	(i) Three-year UG Degree Programme (Level 4.5.to 5.5)									
A	Major DSC (60–64) (Minimum 50% of Total Credits)	4	4	Major	6	8	8	8	38	48
				IKS	2				2	
		0	0	Elective	0	0	4	4	8	
B	Minor (from same faculty of DSC) (18–24)	4	4		4	4	4	4	24	24
C	Generic/Open Elective (OE) (Faculty-wise basket other than Major/Minor faculty) (10–12)	4	4		2	2	0	0	12	12
D(i)	Vocational Skill Courses (VSEC) corresponding to Major/Minor (8–10)	0	2		2	2	2	2	10	16
D(ii)	Skill Enhancement Courses (SEC)	2	2		0	0	2	0	6	
E(i)	Ability Enhancement Courses (AEC) (English + Modern Indian Language)	1+1	1+1		1+1	1+1	0	0	8	14
E(ii)	Indian Knowledge System (IKS) 2 Generic	2	0		0	0	0	0	2	
E(iii)	Value Education Courses (VEC) (Understanding India, EVS, Digital & Technological Solution) 4	2	2		0	0	0	0	4	
F(i)	Internship / Apprenticeship corresponding to Major 8 (OJT)	0	0		0	0	0	4	4	18
F(ii)	Field Projects / Community Engagement & Service (CEP) corresponding to Major 4-6	0	0		2	2	2	0	6	
F(iii)	Co-curricular Courses (CC) (health & wellness, yoga education, sports, fitness, cultural activities, NSS/ NCC & Fine/ Applied/ Visual/ Performing Arts) 8	2	2		2	2	0	0	8	
	Total Credits per Semester	22	22		22	22	22	22	132	132

(ii) Four-year UG Degree programme (Level 6.0) Honors Degree in Major or Minor						
A. Honors Degree in Major or Minor						
	Vertical Type			Semester VII	Semester VIII	
	Major (Offered at Three-year UG Programme)	Mandatory		12-14(2*4+2*2 or 3*4+2)	12-14(2*4+2*2 or 3*4+2)	28
		Elective		4	4	8
	Research Methodology (RM)			4	0	8
	On the Job Training (OJT)			0	4	4
	Total			22	22	44
	Cumulative			(132+44) 176		
(ii) Four-year UG Degree Programme (Level 6.0)						
B. Honors with Research Degree in Major or Minor						
	Major (Offered at Three-year UG Programme)			Semester VII	Semester VIII	
		Mandatory		8-10 (24+2 or 24)	8-10 (24+2 or 24)	20
		Elective		4	4	8
	Research Methodology (RM)			4	0	4
	Research Project (RP)			4	8	12
	Total			22	22	44
	Cumulative			(132+44) 176		

Examination and Assessment Process:

- i. The basic principle of the Credit framework is that Credits are a function of the successful completion of a program of study/ vocational education/ training and assessment. No Credit can be earned by the student unless the student is assessed for the achievement of the desired competencies and outcome of a program.
- ii. Exit options are provided with Certificate, Diploma and Basic Bachelor’s degrees to the students at the end of the second, fourth and sixth semesters of a Four Years Multidisciplinary Degree Programme. Students will receive a Bachelor’s degree with Honors/ Research on successfully completing of all eight semesters of the UG Program either at a stretch or with opted exits and re-entries.
- iii. For the smooth success of four-year degree programme with multiple entry and exit systems, the examination mode should be based on the combination of innovative trends in formative (informal and formal tests administered during the learning process) and summative (evaluation of students learning at the end of an instructional unit) examination modes in line with the UGC Report on ‘Evaluation Reforms in Higher Educational Institutions (2019).

Examination, Evaluation and Assessment Scheme

The total marks for each Course shall be based on Continuous Assessment and Semester End Examination. Each theory course of Major, Minor, GE/OE, AEC, IKS, VEC as mentioned in **Teaching Learning Scheme** prepared by the Board of Studies shall be evaluated as per the scheme as mentioned in the following table

Examination, Evaluation and Assessment Scheme

Vertical I No.	The Vertical	Mode of Examination , Evaluation & Assessment	Theory				Theory (Total)		Practical				Practical (Total)	
			External		Internal				External		Internal			
			Max. Marks	Min Mar ks	Max. Marks	Min. Marks	Max. Marks	Min. Marks	Max. Marks	Min. Marks	Max. Marks	Min. Marks	Max. Marks	Min. Marks
A	Major	External & Internal	30/ 60	9/ 18	20/ 40	6/ 12	50/ 100	20/ 40	25/ 50	10/ 20	25/ 50	10/ 20	25/ 50	10/ 20
B	Minor		30/ 60	9/ 18	20/ 40	6/ 12	50/ 100	20/ 40	25/ 50	10/ 20	25/ 50	10/ 20	25/ 50	10/ 20
C	Generic/ Open Elective	Internal			50	20	50	20	--	--	50	20	50	20
D	VSC	Internal			50	20	50	20			50	20	50	20
	SEC	Internal	--	--	50	20	50	20			50	20	50	20
e	AEC (Eng. & One MIL Composite)	Internal			50	20	50	20						
	IKS (Generic)	Internal			50	20	50	20						
	VEC	Internal			50	20	50	20						
F	Internship/ Apprenticeship	Internal	Assessment of these verticals shall be based on various activities/practices. The evaluation/assessment shall be done by appointing external examiner by principal from Industry/Organisation/Academia. The mentor faculty shall be the internal examiner. It shall be evaluated by giving maximum 50 marks per 2 Credit Course with separate activity weightages/levels. A detailed SOP for this assessment process shall be prescribed separately.											
	FP/CEP													
	CC													

Continuous Assessment Tests (CAT)

For internal assessment, the Continuous Assessment Tests (CAT) shall be conducted as under-

- i. Three CAT each of 8 / 10 Marks (Theory) as applicable and 10 Marks (Practical).
 - First on completion of 25% Syllabus of the course or on completion of 25 teaching days,
 - Second on completion of 50% Syllabus of the course or on completion of 50 teaching days,
 - Third on completion of 75% Syllabus of the course or on completion of 75 teaching days.

- ii. Each concurrent assessment (CAT-I, II & III) will be mapped to relevant Course Learning Outcome.
- iii. Total Performance in CAT (i.e.40 %) shall be based on the **best two out of three** in CAT examinations
- iv. Internal assessment (CAT) shall be carried out by the respective course teacher by choosing variety of assessment tools/methods such as class test, record book, seminar, case study, field work, mini project work, quiz or any innovative method, which may be deemed to be appropriate for assessing the relevant course outcome.

Conduction of the Examination:

As per the scheme of teaching, learning, examination and evaluation, theory/practical examinations of Semester-I, II, III, IV, V, VI, VII and VIII shall be conducted by the University (except for Internal Examinations as applicable) at the end of each semester.

The theory/practical examinations of all the Semesters shall be held as per the following Schedule

Sr.No.	Name of the Examination	End Sem Examination	Supplementary Examination*
1	Semester-I, III, V and VII	Winter	Summer
2	Semester-II, IV, VI and VIII	Summer	Winter

*The University may evolve mechanism for conducting repeat end semester examination.

Such repeat examinations shall have to be conducted within one month of the regular even semester examination and on demand examination.

1. The practical examination of all semesters shall be conducted by the University at the end of each semester. The HEI shall conduct the Practical examination of odd semesters as per the schedule announced by the University. **However, the appointment of the External and Internal Examiners shall be done by the Head or Principal of respective HEI to conduct external examination of the odd semester and the same should be communicated to the University before commencement of the practical examination.** The University shall conduct the external practical examination of all even semester by appointing external and internal examiners.
2. The examinations specified above shall be held twice in a year at such places and on such dates as may be prescribed by the University.
3. An applicant to an examination specified above, shall pursue a regular course of study in courses prescribed for the examination concerned for not less than one semester in a particular semester in a College/Institute/University department.
4. Provided that the student shall be eligible to appear for examination if -
 - a. He/she complies with the provisions of the Ordinance pertaining to the Examination in general from time to time.
 - b. He/she has prosecuted a regular course of study in a university department/college affiliated to the University.
 - c. He/she has in the opinion of the Principal shown satisfactory progress in his/her studies.
5. The provisions of Ordinance No. 6 and Ordinance No. 9 shall be *mutatis-mutandis* applicable to every collegiate/non-collegiate student.
6. The fees for each theory examination and practical examination conducted by the university shall be as prescribed by the University, from time to time.

Sant Gadge Baba Amravati University, Amravati
Teaching and Learning Scheme: for the Degree of Bachelor of Science
FACULTY: SCIENCE AND TECHNOLOGY
TLE Scheme for FIRST YEAR: SEMESTER – I (Petrochemical Science) (Level 4.5)
(As per uniform NEP Scheme)

The Vertical	Type of Course	Course Code	Course Title	Credits	Workload	Theory/Practical				Theory/Pract	
						External		Internal		(Total)	
						Max. Marks	Min. Marks	Max. Marks	Min. Marks	Max. Marks	Min. Marks
Major / Minor	Theory	128200	Basic Concept in Petro-Chemistry	2	2	30	9	20	6	50	20
	Lab/Practical	128201	Basic techniques in Petrochemical Science	2	4	25	10	25	10	50	20
Minor / Major	Theory	-	-	2	2	30	9	20	6	50	20
	Lab/Practical	-	-	2	4	25	10	25	10	50	20
Generic/Open Elective	Theory	128202	Introduction of Petroleum and Their Uses	2	2	30	9	20	6	50	20
	Theory	128203	Introduction of Petroleum origin and exploration	2	2	30	9	20	6	50	20
VSC	-	-	-	-	-	-	-	50	20	50	20
SEC	Lab/Practical	128204	Calibration and standardization	2	4	-	-	50	20	50	20
AEC - English	Theory		Refer University basket	1	1						
AEC –MIL	Theory		Refer University basket	1	1						
IKS-Generic	Theory		Refer University basket	2	2						
VEC	Theory		Refer University basket	2	2						
CC	Outdoor		Separate SOP will be released	2	4						
TOTAL				22	30						

TLE Scheme for FIRST YEAR: SEMESTER – II (Level 4.5)

The Vertical	Type of the Course	Course Code	Course Title	Credits	Workload	Theory/Practical				Theory/Pract	
						External		Internal		(Total)	
						Max. Marks	Min. Marks	Max. Marks	Min. Marks	Max. Marks	Min. Marks
Major / Minor	Theory	128205	Exploration and Classification of Petroleum	2	2	30	9	20	6	50	20
	Lab/Practical	128206	Identification of various Petroleum tests	2	4	30	9	20	6	50	20
Major / Minor	Theory		-	2	2	25	10	25	10	50	20
	Lab/Practical		-	2	4	30	9	20	6	50	20
Generic/ Open Elective	Theory	128207	Introduction of Petrochemical and their Uses	2	2	25	10	25	10	50	20
	Theory	128208	Introduction to production of Synthesis gas and their uses	2	2	30	9	20	6	50	20
VSC	Lab/Practical	128209	Science Laboratory practices	2	4	-	-	50	20	50	20
SEC	Lab/Practical	128210	Basic Fuel Analysis	2	4	-	-	50	20	50	20
AEC - English			Refer University basket	1	1	-	-	50	20	50	20
AEC –MIL			Refer University basket	1	1	-	-	50	20	50	20
VEC			Refer University basket	2	2						
CC			Separate SOP will be released	2	4						
TOTAL				22	32						

*** Important:**

- VSC Should be Complementary to Major/Minor
- SEC has to be selected from the Basket Provided by University, from the same Faculty/Discipline of the Major/Minor

TLE Scheme for SECOND YEAR: SEMESTER – III (Level 5.0)

Subject	The Vertical	Course Code	Course Title	Credits	Workload	Theory/Practical				Theory/Pract (Total)	
						External		Internal			
						Max. Marks	Min. Marks	Max. Marks	Min. Marks	Max. Marks	Min. Marks
Petrochemical Science	Major-T	128211	Quality Monitoring of petroleum product and Overview of Petrochemical industry and feedstock’s	2	2	30	9	20	6	50	20
Petrochemical Science	Major-T	128212	Basic Operation in Petrochemical industries	2	2	30	9	20	6	50	20
Petrochemical Science	IKS-T	128213	Indian knowledge System in Petrochemical Industries.	2	2	30	9	20	6	50	20
Petrochemical Science	Major-P	128214	Identification of various Petroleum Products test.	2	4	25	10	25	10	50	20
Petrochemical Science	Minor-T	128215	Petroleum laboratory test and introduction to petrochemical industries and raw material	2	2	30	9	20	6	50	20
Petrochemical Science	Minor-P	128216	Petroleum Products Tests	2	4	25	10	25	10	50	20
Petrochemical Science	GOEC-T	128217	Overview of Petroleum and Petrochemical	2	2	30	9	20	6	50	20
Petrochemical Science	VSC-P	128218	Basic Operation and Safety measures in Laboratory	2	4	-	-	50	20	50	20
Petrochemical Science	FP/CES	128219	Field Project/ Community Engagement Services Petrochemical Science Lab 09	2	4	-	-	50	20	50	20
Petrochemical Science	CC		Separate SOP will be released	2	4	-	-	50	20	50	20

Important: * VSC Should be Complementary to Major

** SEC has to be selected from the Basket Provided by University, from the same Faculty/Discipline of the Major/Minor

TLE Scheme for SECOND YEAR: SEMESTER – IV (Level 5.0)

Subject	The Vertical	Course Code	Course Title	Credits	Workload	Theory/Practical				Theory/Pract (Total)	
						External		Internal		Max. Marks	Min. Marks
						Max. Marks	Min. Marks	Max. Marks	Min. Marks		
Petrochemical Science	Major-T	128220	Cracking and Reforming of Petroleum-I	2	2	30	9	20	6	50	20
Petrochemical Science	Major-T	128221	Cracking and Reforming of Petroleum-I	2	2	30	9	20	6	50	20
Petrochemical Science	Major-T*	128229*	Rebuilding of Hydrocarbon/Extraction/ Corrosion	2	2	30	9	20	6	50	20
Petrochemical Science	Major-P	128225	Chemical based on some Paraffin and Olefin	2	4	25	10	25	10	50	20
Petrochemical Science	Minor-T	128226	Petroleum Geology	2	2	30	9	20	6	50	20
Petrochemical Science	Minor-P	128227#	Fundamental of Titrimetric Analysis	2	4	25	10	25	10	50	20
Petrochemical Science	GOEC-T	128225	Chemical based on some Paraffin and Olefin	2	2	30	9	20	6	50	20
Petrochemical Science	VSC-P	128226	Petroleum Geology	2	4	-	-	50	20	50	20
Petrochemical Science	SEC-P#	128227#	Fundamental of Titrimetric Analysis	2	4	-	-	50	20	50	20
Petrochemical Science	FP/CES	128228	Petrochemical science Lab 14	2	4	-	-	50	20	50	20
Petrochemical Science	CC		Separate SOP shall be consulted from University website	2	4	-	-	50	20	50	20

*** To be implemented w.e.f. academic session 2026-27 # - Only applicable up to academic session 2025-26**

Important: VSC Should be Complementary to Major and SEC has to be selected from the Basket Provided by University, from the same Faculty/Discipline of the Major/Minor

TLE Scheme for THIRD YEAR: SEMESTER – V (Level 5.5)

Level	The Vertical	Course Code	Course Title	Credits	Workload	Theory/Practical Marks				Theory/Pract (Total) Marks	
						External		Internal			
						Max.	Min.	Max.	Min.	Max.	Min.
5.5	Major-T	128230	Petrochemicals and their Derivative- I	2	2	30	9	20	6	50	20
5.5	Major-T	128231	Petrochemicals and their Derivative- II	2	2	30	9	20	6	50	20
5.5	Major-T	128232	Third Generation Petrochemicals	2	2	30	9	20	6	50	20
5.5	Major-P	128233	Petrochemical Lab. 15 (Preparation of Dyes and Soaps)	2	4	25	10	25	10	50	20
5.5	Major-Elective T1	128234	Polymers from Petroleum (Basic concept in Polymerization)	2	2	30	9	20	6	50	20
5.5	Major-Elective P1	128235	Petrochemical Science Lab 16 A (Monomer Synthesis)	2	4	25	10	25	10	50	20
OR											
5.5	Major-Elective T2	128236	Instrumental techniques and Equipment for Petroleum and Petrochemical	2	2	30	9	20	6	50	20
5.5	Major-Elective P2	128237	Petrochemical Science Lab-16 B (Separation technique)	2	4	25	10	25	10	50	20
5.5	Minor-T	128238	Introduction to Petrochemicals and their Derivative	2	2	30	9	20	6	50	20
5.5	Minor-P	128239	Petrochemical Lab. 17 (Lab synthesis of dyes and sops)	2	4	25	10	25	10	50	20
5.5	VSC-P	128240	(Petrochemical Lab. 18) Basic Experiment in daily used products	2	4	-	-	50	20	50	20
5.5	SEC-P	128241	Petrochemical Lab. 19 (Titrimetric Analysis)	2	4	-	-	50	20	50	20
5.5	FP/CEP	128242	Petrochemical Lab. 20 (FP/ CES in Petrochemical Science - III)	2	4	-	-	50	20	50	20
5.5	Non Credit		Foundation of Artificial Intelligence	NC	2			30+20	9+6	50	20

Important:

- **VSC Should be Complementary to Major**
- **SEC must be selected from the Basket Provided by University, from the same Faculty/Discipline of the Major/Minor**
- As per Sant Gadge Baba Amravati University, Amravati Extra-Ordinary Notification No. No. 241/2025 Dated 24/12/2025 “Foundation of Artificial Intelligence” is the mandatory **Non Credit Course** compulsory course for all the UG students in fifth semester of all undergraduate programs of all faculties in Sant Gadge Baba Amravati University, Amravati to earn their degree
- NC is Non Credit Course
- Students must select **Any One** of the Major-Elective Courses (T1 to T2) with respective Practical Course in Semester V.

TLE Scheme for THIRD YEAR: SEMESTER – VI (Level 5.5)

Level	The Vertical	Course Code	Course Title	Credits	Workload	Theory/Practical Marks				Theory/Pract (Total) Marks	
						External		Internal			
						Max.	Min.	Max.	Min.	Max.	Min.
5.5	Major-T	128243	Petroleum Specialty Products and Catalyst in Petroleum and Petrochemical industries	2	2	30	9	20	6	50	20
5.5	Major-T	128244	Pollution and Future Fuels	2	2	30	9	20	6	50	20
5.5	Major-T			2	2	30	9	20	6	50	20
5.5	Major-P	128245	Operations and Future in Petro-Chemical Industries	2	4	25	10	25	10	50	20
5.5	Major-Elective T1			2	2	30	9	20	6	50	20
5.5	Major-Elective P1	128246	Petrochemical Lab. 21 (Lab. Tests for Lube oil, Bitumen, Grease and Wax/ Water Analysis)	2	4	25	10	25	10	50	20
OR											
5.5	Major-Elective T2	128249	Petroleum and Petrochemical Products Characterization Methods	2	2	30	9	20	6	50	20
5.5	Major-Elective P2	128250	(Petrochemical Lab. 22B) Experiment based on Spectroscopy	2	4	25	10	25	10	50	20
5.5	Minor-T	128251	Non energy Petroleum/ Pollution/ Future fuels	2	2	30	9	20	6	50	20
5.5	Minor-P	128252	(Petrochemical Lab. 23) Waste Water and non-energy Petroleum Analysis	2	4	25	10	25	10	50	20
5.5	VSC-P	128253	(Petrochemical Lab. 24) PCH Lab.	2	4	-	-	50	20	50	20
5.5	Intern/Apprenticeship	128254	FRS Lab 25 Internship /Apprenticeship/ OJT	4	8	-	-	50	20	50	20

Important:

- VSC Should be Complementary to Major has to be selected from the Basket Provided by University, from the same Faculty/Discipline of the Major/Minor
- **Students** must select **Any One** of the Major-Elective Courses (T1 to T2) with respective Practical Course in Semester VI.

Sant Gadge Baba Amravati University, Amravati



**Semester-wise Course Structure, Course Code and Credit
distribution and Syllabus for**

Faculty of Science and Technology

Degree of Bachelor of Science

Petrochemical Science

Semester I and II

**(Courses effective from Academic Year 2026-27) Under
NEP 2020 (As per Uniform NEP Scheme)**

Contents

TLE Scheme for FIRST YEAR: SEMESTER – I (Petrochemical Science) (Level 4.5)	3
TLE Scheme for FIRST YEAR: SEMESTER – II (Level 4.5)	4
Examination and Assessment Process:	5
Examination, Evaluation and Assessment Scheme.....	5
Examination, Evaluation and Assessment Scheme.....	5
Continuous Assessment Tests (CAT)	5
Conduction of the Examination:	6
128200: Basic concept in Petro-chemistry:.....	7
128201: Lab 1 Basic techniques in Petrochemical Science	9
128202: Introduction of Petroleum and Their Uses.....	10
128203: Introduction of Petroleum origin and exploration.....	11
128204: Calibration and standardization	13
128205: Exploration and Classification of Petroleum	14
128206: Lab 3 Identification of various Petroleum products tests	16
128207: Introduction of Petrochemical and Their Uses	17
128208: Introduction to production of synthesis gas and their uses.....	18
128209: Lab 4 Science Laboratory Practices	20
128210: Lab 5- Basic Fuel Analysis	21

Sant Gadge Baba Amravati University, Amravati

Teaching and Learning Scheme: for the Degree of Bachelor of Science

FACULTY: SCIENCE AND TECHNOLOGY

TLE Scheme for FIRST YEAR: SEMESTER – I (Petrochemical Science) (Level 4.5)

(As per uniform NEP Scheme)

The Vertical	Type of Course	Course Code	Course Title	Credits	Workload	Theory/Practical				Theory/Pract	
						External		Internal		(Total)	
						Max. Marks	Min. Marks	Max. Marks	Min. Marks	Max. Marks	Min. Marks
Major / Minor	Theory	128200	Basic Concept in Petro-Chemistry	2	2	30	9	20	6	50	20
	Lab/Practical	128201	Basic techniques in Petrochemical Science	2	4	25	10	25	10	50	20
Minor / Major	Theory	-	-	2	2	30	9	20	6	50	20
	Lab/Practical	-	-	2	4	25	10	25	10	50	20
Generic/Open Elective	Theory	128202	Introduction of Petroleum and Their Uses	2	2	30	9	20	6	50	20
	Theory	128203	Introduction of Petroleum origin and exploration	2	2	30	9	20	6	50	20
VSC	-	-	-	-	-	-	-	50	20	50	20
SEC	Lab/Practical	128204	Calibration and standardization	2	4	-	-	50	20	50	20
AEC - English	Theory		Refer University basket	1	1						
AEC –MIL	Theory		Refer University basket	1	1						
IKS-Generic	Theory		Refer University basket	2	2						
VEC	Theory		Refer University basket	2	2						
CC	Outdoor		Separate SOP will be released	2	4						
TOTAL				22	30						

TLE Scheme for FIRST YEAR: SEMESTER – II (Level 4.5)

The Vertical	Type of the Course	Course Code	Course Title	Credits	Workload	Theory/Practical				Theory/Pract (Total)	
						External		Internal		Max. Marks	Min. Marks
						Max. Marks	Min. Marks	Max. Marks	Min. Marks		
Major / Minor	Theory	128205	Exploration and Classification of Petroleum	2	2	30	9	20	6	50	20
	Lab/Practical	128206	Identification of various Petroleum tests	2	4	30	9	20	6	50	20
Major / Minor	Theory		-	2	2	25	10	25	10	50	20
	Lab/Practical		-	2	4	30	9	20	6	50	20
Generic/ Open Elective	Theory	128207	Introduction of Petrochemical and their Uses	2	2	25	10	25	10	50	20
	Theory	128208	Introduction to production of Synthesis gas and their uses	2	2	30	9	20	6	50	20
VSC	Lab/Practical	128209	Science Laboratory practices	2	4	-	-	50	20	50	20
SEC	Lab/Practical	128210	Basic Fuel Analysis	2	4	-	-	50	20	50	20
AEC - English			Refer University basket	1	1	-	-	50	20	50	20
AEC –MIL			Refer University basket	1	1	-	-	50	20	50	20
VEC			Refer University basket	2	2						
CC			Separate SOP will be released	2	4						
TOTAL				22	32						

*** Important:**

- VSC Should be Complementary to Major/Minor
- SEC has to be selected from the Basket Provided by University, from the same Faculty/Discipline of the Major/Minor

Examination and Assessment Process:

- i. The basic principle of the Credit framework is that Credits are a function of the successful completion of a program of study/ vocational education/ training and assessment. No Credit can be earned by the student unless the student is assessed for the achievement of the desired competencies and outcome of a program.
- ii. Exit options are provided with Certificate, Diploma and Basic Bachelor’s degrees to the students at the end of the second, fourth and sixth semesters of a Four Years Multidisciplinary Degree Programme. Students will receive a Bachelor’s degree with Honors/ Research on successfully completing of all eight semesters of the UG Program either at a stretch or with opted exits and re-entries.
- iii. For the smooth success of four-year degree programme with multiple entry and exit systems, the examination mode should be based on the combination of innovative trends in formative (informal and formal tests administered during the learning process) and summative (evaluation of students learning at the end of an instructional unit) examination modes in line with the UGC Report on ‘Evaluation Reforms in Higher Educational Institutions (2019).

Examination, Evaluation and Assessment Scheme

The total marks for each Course shall be based on Continuous Assessment and Semester End Examination. Each theory course of Major, Minor, GE/OE, AEC, IKS, VEC as mentioned in **Teaching Learning Scheme** prepared by the Board of Studies shall be evaluated as per the scheme as mentioned in the following table

Examination, Evaluation and Assessment Scheme

Vertica l No.	The Vertical	Mode of Examination , Evaluation & Assessment	Theory				Theory (Total)		Practical				Practical (Total)	
			External		Internal				External		Internal			
			Max. Marks	Min Mar ks	Max. Marks	Min. Marks	Max. Marks	Min. Marks	Max. Marks	Min. Marks	Max. Marks	Min. Marks	Max. Marks	Min. Marks
A	Major	External & Internal	30/ 60	9/ 18	20/ 40	6/ 12	50/ 100	20/ 40	25/ 50	10/ 20	25/ 50	10/ 20	25/ 50	10/ 20
B	Minor		30/ 60	9/ 18	20/ 40	6/ 12	50/ 100	20/ 40	25/ 50	10/ 20	25/ 50	10/ 20	25/ 50	10/ 20
C	Generic/ Open Elective	Internal			50	20	50	20	--	--	50	20	50	20
D	VSC	Internal			50	20	50	20			50	20	50	20
	SEC	Internal	--	--	50	20	50	20			50	20	50	20
e	AEC (Eng. & One MIL Composite)	Internal			50	20	50	20						
	IKS (Generic)	Internal			50	20	50	20						
	VEC	Internal			50	20	50	20						
F	Internship/ Apprenticeshi p	Internal	Assessment of these verticals shall be based on various activities/practices. The evaluation/assessment shall be done by appointing external examiner by principal from Industry/Organisation/Academia. The mentor faculty shall be the internal examiner. It shall be evaluated by giving maximum 50 marks per 2 Credit Course with separate activity weightages/levels. A detailed SOP for this assessment process shall be prescribed separately.											
	FP/CEP													
	CC													

Continuous Assessment Tests (CAT)

For internal assessment, the Continuous Assessment Tests (CAT) shall be conducted as under-

- i. Three CAT each of 8 / 10 Marks (Theory) as applicable and 10 Marks (Practical).
 - First on completion of 25% Syllabus of the course or on completion of 25 teaching days,
 - Second on completion of 50% Syllabus of the course or on completion of 50 teaching days,
 - Third on completion of 75% Syllabus of the course or on completion of 75 teaching days.
- ii. Each concurrent assessment (CAT-I, II & III) will be mapped to relevant Course Learning Outcome.

- iii. Total Performance in CAT (i.e.40 %) shall be based on the **best two out of three** in CAT examinations
- iv. Internal assessment (CAT) shall be carried out by the respective course teacher by choosing variety of assessment tools/methods such as class test, record book, seminar, case study, field work, mini project work, quiz or any innovative method, which may be deemed to be appropriate for assessing the relevant course outcome.

Conduction of the Examination:

As per the scheme of teaching, learning, examination and evaluation, theory/practical examinations of Semester-I, II, III, IV, V, VI, VII and VIII shall be conducted by the University (except for Internal Examinations as applicable) at the end of each semester.

The theory/practical examinations of all the Semesters shall be held as per the following Schedule

Sr.No.	Name of the Examination	End Sem Examination	Supplementary Examination*
1	Semester-I, III, V and VII	Winter	Summer
2	Semester-II, IV, VI and VIII	Summer	Winter

*The University may evolve mechanism for conducting repeat end semester examination. Such repeat examinations shall have to be conducted within one month of the regular even semester examination and on demand examination.

1. The practical examination of all semesters shall be conducted by the University at the end of each semester. The HEI shall conduct the Practical examination of odd semesters as per the schedule announced by the University. **However, the appointment of the External and Internal Examiners shall be done by the Head or Principal of respective HEI to conduct external examination of the odd semester and the same should be communicated to the University before commencement of the practical examination.** The University shall conduct the external practical examination of all even semester by appointing external and internal examiners.
2. The examinations specified above shall be held twice in a year at such places and on such dates as may be prescribed by the University.
3. An applicant to an examination specified above, shall pursue a regular course of study in courses prescribed for the examination concerned for not less than one semester in a particular semester in a College/Institute/University department.
4. Provided that the student shall be eligible to appear for examination if -
 - a. He/she complies with the provisions of the Ordinance pertaining to the Examination in general from time to time.
 - b. He/she has prosecuted a regular course of study in a university department/college affiliated to the University.
 - c. He/she has in the opinion of the Principal shown satisfactory progress in his/her studies.
5. The provisions of Ordinance No. 6 and Ordinance No. 9 shall be *mutatis-mutandis* applicable to every collegiate/non-collegiate student.
6. The fees for each theory examination and practical examination conducted by the university shall be as prescribed by the University, from time to time

Course: B.Sc I Semester I (Petrochemical Science)

Course Category: Major (Theory)

128200: Basic concept in Petro-chemistry:							
Level	Semester	Course code	Course Name	Credits	Teaching Hours	Exam Duration	Max marks
4.5	I	128200	Basic concept in Petro-chemistry:	2	30	2Hrs	30 + 20 = 50

Course Objectives	• To make the students aware about fundamentals of Petrochemical science • To impart knowledge about scope of petrochemical science with its basics and applications • To update the students about features of different types of fuels and functions			
Course Outcomes	Upon completion of this course successfully, students would be able to • Know basic principles and concepts of petro-chemistry • To get in-depth knowledge of fuels and petroleum industries • Use basic quality monitoring and laboratory test • Importance of nonconventional energy resources			
Unit System	Contents	Workload Allotted	Weightage of Marks Allotted	Incorporation of Pedagogies
Unit I	P ^H , Molarity, Normality, Mole, Molality, Mole fraction, Mole ratio,Parts per million (ppm), Weight fraction, Vapor pressure, Calorific value, Acid, Base, Equivalent weight, Atomic weight, Molecular weight, API Gravity.	8 Hrs	8 Marks	Chalk & Board, Power Point Presentation, Videos, Group Discussion, Assignments, surprise quizzes, question and answering sessions Interactive Lectures:
Unit II	Specific heat, Heat of Combustion, Latent heat of vaporization, Thermal expansion, spontaneous ignition temperature, IP, ASTM. Units and Conversion of: Temperature, Pressure, Length, Weight, Residence time, Viscosity.	7 Hrs	7 Marks	
Unit III	Fuel : Conventional and nonconventional fuels. Type of Petroleum fuel: Primary and secondary. Types of petroleum gas: Associated gas, Casing head gas, Dissolved gas, Refinery off gas, Liquefied petroleum gas (LPG), Compressed natural gas (CNG), Liquefied natural gas(LNG). Advantages and disadvantages of petroleum.	8 Hrs	8 Marks	Use multimedia presentations, interactive slides, and animations to illustrate complex concepts. Ask students to create concept maps that illustrate the relationships between different concepts.
Unit IV	Petroleum Industry Definition of Petroleum International Petroleum Scenario, National natural gas and petroleum scenario, Map of petroleum reservoir in India. Petroleum refineries in India, their location, capacity, year of commissioning, and organization. Commonly used crude oil terms like WTI, Brent and OPEC.	7 Hrs	7 Marks	
References	Text books:			

	- Petroleum refining and Petrochemical. N. K. Sinha, Umesh Publication Delhi - Advance Petrochemical, Dr. G. N. Sarkar, Khanna Publication, Delhi - text on Petrochemical, Dr. B. K. Bhaskararao, Khanna Publication, Delhi - Introduction to petrochemical, Sukumar Maiti - Fuels and combustion, Samir Sarkar, Orient Longman Ltd. Hyderabad - Modern Petroleum Refining Processes, B.K. Bhaskara Rao, Oxford and IBH Publication, New Delhi Reference Books: - Fundamentals of Petroleum and Petrochemical Engineering by Uttam Ray Chaudhuri CRC press - The Chemistry and technology of Petroleum 4th edition by James G. Speight CRC Press - Systematic Experimental Physical Chemistry, S. W. Rajbhoj, Dr. T. K. Chondhekar, Anjali Publication, Aurangbad - Petroleum Refining technology, Dr. Ram Prasad, Khanna Publication, Delhi - Industrial Organic Chemistry, K. Weissmermel, and H. J. Arpe, Veriagchemie, New York - Chemical From Petroleum, A.L. Waddms, Murry, London - An Introduction to industrial organic chemistry, P. Wiseman, Applied Science, London
Model Questions	Short Type - Define Normality and Morality with their formula - What is ppm ? explain with example - Which is nonconventional fuel give their advantages - compare wet gas and associated gas with their composition - Describe the role of OPEC - Define petroleum give the composition of Dry natural gas. - Focus on advantages and disadvantages of petroleum fuel - Draw map of refineries located in India Long Type - Classify physical quantities and units in detail. - Describe calorific value in detail. - Classify secondary fuels with example. - Illustrate history of petroleum industries in India. M.C.Q. - The molarity of a solution containing 11.522 grams of KOH in enough water to make 350 mL of solution is A) 5.86 M B) 58.6 M C) 0.586 M D) 586 M - Quantity of solute per million parts of solvent is called as..... A) PPM B) Molality C) Molarity D) mole fraction - The equivalent weight of NaOH is..... A) 36 B) 40 C) 32 D) 20 - Crude petroleum oil is a _____ fuel. A) primary B) fossil C) both (a) & (b) D) secondary - Indian Refineries Limited was merged with Indian Oil Company Limited to form Indian Oil Corporation Limited in September, A) 1962 B) 1957 C) 1974 D) 1964 - BPCL was the first refinery to process newly found indigenous crude from... A) Bombay high B) Godavari Basin C) Hazira D) Naharkatia - On august 1, Bharat Refineries was renamed as Bharat Petroleum Corporation Ltd. A) 1971 B) 1975 C) 1977 D) 1973 grams of KMnO_4 are required to prepare 1.0 L of a solution of 1.5 M KMnO_4 A) 207 B)227 C) 237 D) 257

Course Category: MajorLab-1

128201: Lab 1 Basic techniques in Petrochemical Science							
Level	Semester	Course code	Course Name	Credits	Teaching Hours	Exam Duration	Max marks
4.5	I	128201	Lab 1: Basic techniques in Petrochemical Science	2	60	4 Hrs	25+25

Course Objectives	• To train the students for basic techniques in chemical Science. • To introduce the students with handling and working of common equipments used in laboratory.			
Course Outcomes	After completion of this course students will be able to • Prepare standard chemical solutions and standardize them. • Determine melting point of petroleum wax and other solid petroleums. • Magnify specific gravity of petroleum samples. • Calculate acid value and saponification value of petroleum samples.			
List of Practical				
1. Determination of API gravity of given sample 2. Determination of acid value of given Petroleum sample 3. Determination of Saponification value of petroleum sample 4. Determination of Congealing point of wax 5. Numerical problems on unit conversion . (Minimum 05) 6. Preparation of standard solution (Minimum 05)				
References				

Distribution of Marks and the scheme of Practical Examination is as follows:

Section 1: Internal Assessment

• Active participation in activities	10 Marks
• Continuous Assessment Tests (CAT) (At least three tests) *	10 Marks
• Submission of duly certified practical record	05 Marks
Total	25 Marks

*Note: Total Performance in CAT (i.e. 40 %) shall be based on the best two out of three in CAT examinations

Section 2: External Assessment

• Exercise 1	10 Marks
• Exercise 2	10 Marks
• Viva-Voce (external)	05 Marks
Total	25 Marks

Course Category: Generic/Open Elective Theory - 1

128202: Introduction of Petroleum and Their Uses							
Level	Semester	Course code	Course Name	Credits	Teaching Hours	Exam Duration	Max marks
4.5	I	128202	Introduction of Petroleum and Their Uses	2	30	2Hrs	30
Course Objectives	- To make the students aware about importance of petroleum - To impart knowledge about composition of crude oil - To make aware the students about the difference between Petroleum and petrochemical						
Course Outcomes	Upon completion of this course successfully, students would be able to - Apply basic concepts petroleum fuels and industries - Recognize composition petroleum gases - Classify various method for classification of crude oil - Able to know petroleum industries in India with location						
Unit System	Contents			Workload Allotted	Weightage of Marks Allotted		Incorporation of Pedagogies
Unit I	Definition of Petroleum Type of Petroleum fuel: Primary and secondary. Types of petroleum gas: Associated gas, Casing head gas, Dissolved gas, Refinery off gas, Liquefied petroleum gas (LPG), Compressed natural gas (CNG), Liquefied natural gas(LNG). Advantages and disadvantages of petroleum.			8 Hrs	8 Marks		Chalk & Board, Power Point Presentation, Videos, Group Discussion, Assignments, surprise quizzes, question and answering sessions
Unit II	National natural gas and petroleum scenario, Map of petroleum reservoir in India. Petroleum refineries in India, their location, capacity, year of commissioning, and organization.			7 Hrs	7 Marks		
Unit III	Composition, Characteristics, Constituents of Petroleum or crude oil. Types of Hydrocarbons and Non- hydrocarbons present in petroleum, their physical and chemical properties.			8 Hrs	8 Marks		
Unit IV	Classification of crude oil and natural gas: Characterization factor, Correlation index, US Bureau of mines method, sour and sweet gas, dry gas, wet gas and lean gas.			7 Hrs	7 Marks		
References	Reference Books: 1. Petroleum refining and Petrochemical. N. K. Sinha, Umesh Publication Delhi 2. Modern Petroleum Refining Processes, B.K. Bhaskara Rao, Oxford and IBH Publication, New Delhi 3. Fundamentals of Petroleum and Petrochemical Engineering by Uttam Ray Chaudhuri CRC press 4.Fuels and combustion, Samir Sarkar,, Orient Longman Ltd. Hyderabad 5.Advance Petroleum Refining, Dr. G. N. Sarkar, Khanna Publication, Delhi 6.Petroleum Refining technology, Dr. Ram Prasad, Khanna Publication, Delhi						
Model Question	Short Type 1. List secondary fuel with their composition 2. What is CNG? State significance of CNG in modern world 3. Discuss Indian natural gas scenario 4. List Indian petroleum refineries with their origination 5. Which hydrocarbon present in crude oil give their general formula						

	6. Describe properties of paraffin 7. Illustrate lean gas and casing head gas with their composition 8. Describe classification method based on residue Long Type 1. Describe primary petroleum fuel with their advantages 2 List petroleum refineries in India with their location and production capacity 3. Illustrate composition of crude petroleum in detail 4. Discuss characterization factor method for classification of crude oil M.C.Q. 1 Prior to 1918, organic chemicals were manufactured from A) Coal B) Agricultural raw material C) Wood D) All of these 2 Indian Refineries Limited was merged with Indian Oil Company Limited to form Indian Oil Corporation Limited in September, A) 1962 B) 1957 C) 1974 D) 1964 3 Crude petroleum oil is a fuel. A) primary B) fossil C) both (a) & (b) D) secondary 4 Petroleum..... A) is optically active. B) constitutes mainly of olefins C) does not contain asphalt. D) does not contain aromatics. 5 Naphthenic acid is a/an compound. A) oxygen B) sulphur C) none of these D) nitrogen 6 Paraffin base crude oil as compared to asphalt base crude gives A) lower viscosity index lube oil. B) higher yield of straight run gasoline. C) poorer yield of lube oil. D) higher octane number gasoline. 7 Which is almost absent in crude petroleum? A) Olefins B) Mercaptans C) Naphthenes D) Cycloparaffins 8 The characterisation factor of a crude oil is calculated as 12.5. It means that; it is ... A) paraffinic B) naphthenic C) intermediate D) none of these
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Course Category: Generic/Open Elective - 2

128203: Introduction of Petroleum origin and exploration							
Level	Semester	Course code	Course Name	Credits	Teaching Hours	Exam Duration	Max marks
4.5	I	128203	Introduction of Petroleum origin and exploration	2	30	2Hrs	30
Course Objectives	- To make the students about importance of origin of petroleum - To impart knowledge about exploration of crude oil - To give the knowledge regarding the different primary purification process						
Course Outcomes	Upon completion of this course successfully, students would be able to - Apply basic concepts in formation, exploration and drilling for petroleum - Recognize prospecting for crude oil and petroleum gases - Classify various operations & processes carried out in petroleum refinery - Able to how refinery operation conducted.						
Unit System	Contents			Workload Allotted	Weightage of Marks Allotted	Incorporation of Pedagogies	
Unit I	Organic and inorganic theories of petroleum formation, Occurrence of Petroleum, conditions for petroleum accumulations. Introduction to borehole logging.			8 Hrs	8 Marks	Chalk & Board, Power Point Presentation, Videos, Group Discussion, Assignments, surprise quizzes,	
Unit II	Prospecting for petroleum and gas field: Geological prospecting methods, Geophysical			7 Hrs	7 Marks		

	prospecting methods (Seismic method, Magnetic method, Gravity method, Electric method) and Geochemical prospecting methods.			question and answering sessions
Unit III	Field operation, Desalting & Dehydration crude oil, Definition of refining, Objective of refining, Fractions from ADU and VDU, carbon number of the hydrocarbons present in various units.	8 Hrs	8 Marks	
Unit IV	Basic test properties of petroleum: Flash point, Fire point, Octane number, Cetane number, Aniline point, Diesel index, Calorific value, Smoke Point, Viscosity, Density and API Gravity,	7 Hrs	7 Marks	
References	Reference Books: 1.Petroleum refining and Petrochemical. N. K. Sinha, Umesh Publication Delhi 2. Modern Petroleum Refining Processes, B.K. Bhaskara Rao, Oxford and IBH Publication, New Delhi 3.Fuels and combustion, Samir Sarkar,, Orient Longman Ltd. Hyderabad 4.Advance Petroleum Refining, Dr. G. N. Sarkar, Khanna Publication, Delhi 5.Petroleum Refining technology, Dr. Ram Prasad, Khanna Publication, Delhi 6. Fundamentals of Petroleum and Petrochemical Engineering by Uttam Ray Chaudhuri CRC press			
Model Question	Short Type 1. Describe inorganic theory for formation of petroleum 2. What is borehole logging? List type of borehole logging 3. List the prospecting method for petroleum/crude oil 4. Focus on geophysical method for prospecting of crude oil 5. Why desalting and dehydration of crude oil necessary 6. Draw well label diagram of vacuum distillation tower 7. Define aniline point and diesel index with their formula 8. What is smoke point? Give significance of this properties Long Type 1. Describe origin on petroleum detail 2. Explain Seismic method for prospecting of petroleum 3. Draw and explain ADU in detail 4. Which test prescribe for gasoline explain with example M.C.Q. 1 The average boiling point of aviation turbine fuel is closest to that of A) diesel B) lubricating oils C) Kerosene D) LPG 2 Which of the following has the lowest cetane number? A) Aromatics B) <i>i</i> -paraffins C) Naphthene D) Olefins 3 Refinery capacity is typically expressed in terms ofthroughput capacity. A) VDU B) crude oil distillation C) Reformer D) Hydrocracker 4. The residue from VDU has boiling range more than A) 450 °C B) 690°C C) 500 °C D) 600°C 5 A good lubricant should have high			

	A) none of these B) volatility C) viscosity index D) pour point 6 Octane number of gasoline is a measure of its A) ignition delay B) knocking tendency C) ignition temperature D) smoke point 7 Which of the following has the lowest cetane number? A) Aromatics B) <i>i</i>-paraffins C) Naphthene D) Olefins 8 Aniline point is the temperature at which A) equal weight of diesel & the aniline are completely miscible. B) equal weight of aniline & the test sample are completely miscible. C) equal volume of aniline & the test sample are completely miscible. D) aniline vaporises.
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Course Category: Skill Enhancement Course (SEC) Lab 2

128204: Calibration and standardization							
Level	Semester	Course code	Course Name	Credits	Teaching Hours	Exam Duration	Maximum marks
4.5	I	128204	Calibration and standardization	2	60	--	50
Course Objectives:		- To train the students in methods of sterilization using high temperature. - To impart training in using and studying the effect of different methods of chemical control. - To introduce glassware and instruments used in a laboratory. - To understand the importance of calibration of glassware and instruments in tune with concepts of precision and accuracy. - To develop awareness about safety measures for handling chemicals. - To identify and comprehend the major components present in food samples.					
Course Outcomes:		Upon completion of this course successfully, students would be able to - Apply the knowledge of chemical control in the laboratory as well as day-to-day life. - Calibrate glassware and instruments. - Understand the concept of minimizing errors. - Handle various chemicals with the necessary care. - Apply analytical techniques for the analysis - Acquire the necessary basic skills for the analysis of food samples.					
Unit System		Content				Incorporation of Pedagogies	
Experiments		- Understanding the meaning of boiling point range - Use of various measuring apparatus - Preparation of standard solution of 0.1 N and 0.1 M solutions solid chemical - Preparation of standard solution of 0.1 N and 0.1 M solutions liquid chemical - Conversion of 1 M solution in to 0.5 M, 0.1 M, 0.01 M, and 0.05 M. - Preparation of standard solution of 0.1 M and 0.01 M solutions of liquid chemical - Preparation of 1 ppm and 10 ppm solutions - Preparation of standard solution of 0.1 M and 0.1 - Preparation of 5% solutions of solid and liquid chemical - Preparation of a buffer solution of pH= 4. - Preparation of a buffer solution of pH= 7. - Preparation of a buffer solution of pH= 9.2.				Lab Reports: Students prepare detailed lab reports on their findings. Discussion Sessions: Group discussions. Group Projects: Assign group projects on formulation methods. Class Debates: Discuss the findings amongst the students.	

References:	Text books: https://eatrightindia.gov.in/dart/ - Handbook of Analysis and Quality Control for Fruits and Vegetables 2nd Edition; S. Ranganna. - Manual of Methods of Analysis of Foods (Fruit and Vegetable Products), FSSAI, 2016 - Nutritive Value of Indian Food; Dr. C. Gopalan NIN Hyderabad - UNIDO Technology Manual, Small-scale Fruit and Vegetable, Processing and Products, 2004 - Dr. D. K. Maharaj (2017), Laboratory Manual for Soil Testing, S.K. Kataria & Sons. - Bandyopadhyay, P. C. (2012), Soil analysis, Genetech. - S.K. Pal (2013), Soil Sampling and Methods of Analysis, New India Publishing Agency. - Dr. G.S. Wagh (1905), Experimental Methods for Water Analysis, Nirali Prakashan. - Patrick, G. (2017), Introduction to Medicinal Chemistry, Oxford University Press. - Singh H.; Kapoor V.K. (1996), Medicinal and Pharmaceutical Chemistry, Vallabh Prakashan.
Model Questions:	NA

Distribution of Marks and the scheme of (SEC) Practical Examination is as follows:

Internal Assessment

• Active participation in activities	15 Marks
• Continuous Assessment Tests (CAT) (At least three tests) *	20 Marks
• Submission of duly certified practical record	10 Marks
• Internal examiner viva-voce	05 Marks
Total	50 Marks

*Note: Total Performance in CAT (i.e. 40 %) shall be based on the best two out of three in CAT examinations

Course Category: Major (Theory) - 2

128205: Exploration and Classification of Petroleum							
Level	Semester	Course code	Course Name	Credits	Teaching Hours	Exam Duration	Max marks
4.5	II	128205	Exploration and Classification of Petroleum	2	30	2Hrs	30
Course Objectives	- To make the students aware about importance of origin of petroleum - To impart knowledge about exploration of crude oil - To make aware the students about the difference between Petroleum and petrochemical - To give the knowledge regarding the different types Classification of petroleum or crude oil						
Course Outcomes	Upon completion of this course successfully, students would be able to - Apply basic concepts in formation, exploration and drilling for petroleum - Recognize composition and classification of petroleum - Classify various operations & processes carried out in petroleum refinery - Able to how refinery operation conducted.						
Unit System	Contents			Workload Allotted	Weightage of Marks Allotted	Incorporation of Pedagogies	
Unit I	Origin and Formation of Petroleum: Organic and inorganic theories of petroleum formation, Occurrence of Petroleum, conditions for petroleum accumulations, types of petroleum traps. Prospecting for petroleum and gas field: Geological prospecting methods, Geophysical prospecting methods (Seismic method, Magnetic method, Gravity method, Electric method) and Geochemical prospecting methods. Introduction to borehole logging.			8 Hrs	8 Marks	Chalk & Board, Power Point Presentation, Videos, Group Discussion, Assignments, surprise quizzes, question and answering sessions	
Unit II	Drilling: Drilling methods Cable tool drilling, Rotary drilling, Turbo drilling, Offshore Drilling Rigs: Jack-up rig, Semi-submersible rig, drillship Drilling fluid: Function, Composition, and Classification.			7 Hrs	7 Marks		

	Type of drill bits, casings, well control systems.			
Unit III	Chemistry and Composition of Petroleum: Composition, Characteristics, Constituents of Petroleum or crude oil. Types of Hydrocarbons and Non-hydrocarbons present in petroleum, their physical and chemical properties. Salty crude oil, sweet and sour crude oil. Classification of crude oil and natural gas: Characterization factor, Correlation index, US Bureau of mines method, waxy and wax free crude oil Wobbe no. sour and sweet gas, dry gas, wet gas and lean gas.	8 Hrs	8 Marks	
Unit IV	Refinery Operation Field operation, Desalting & Dehydration crude oil, Conditioning of waxy crude oil. Definition of refining, Objective of refining, classification of Petroleum refining processes and operations, crude oil distillation Introduction to Atmospheric distillation (ADU), side stream strippers, vacuum distillation (VDU). Fractions from ADU and VDU, carbon number of the hydrocarbons present in various	7 Hrs	7 Marks	
References	Text books: 1. Petroleum refining and Petrochemical. N. K. Sinha, Umesh Publication Delhi 2. Modern Petroleum Refining Processes, B.K. Bhaskara Rao, Oxford and IBH Publication, New Delhi 3. Fuels and combustion, Samir Sarkar,, Orient Longman Ltd. Hyderabad 4. Modern Petroleum Refining Processes, B.K. Bhaskara Rao, Oxford and IBH Publication, New Delhi Reference Books: 1. Fundamentals of Petroleum and Petrochemical Engineering by Uttam Ray Chaudhuri CRC press 2. Hand book of petroleum Processing Edited by David S. J. “Stan” Jones and Peter R. Pujado Springer 3. The Chemistry and technology of Petroleum 4th edition by James G. Speight CRC Press 4. Systematic Experimental Physical Chemistry, S. W. Rajbhoj, Dr. T. K. Chondhekar, Anjali Publication, Aurangbad 5. Advance Petroleum Refining, Dr. G. N. Sarkar, Khanna Publication, Delhi 6. Petroleum Refining technology, Dr. Ram Prasad, Khanna Publication, Delhi 7. Chemical From Petroleum, A.L. Waddms, Murry, London 8. Modern Petroleum Technology, G. D. Hobson, John Wily, Chichester			
Model Questions	Short Type 1. Focus on Engler organic theory for formation of petroleum 2. Describe geological prospecting method for exploration of crude oil 3. Name the various part if rotary drilling 4. State the function of drilling mud			

	5. Which non-hydrocarbon present in crude oil give their example 6. List the quantitative composition of crude oil 7. Draw well label diagram of electrical desalter 8. List the fraction obtained from ADU with their boiling ranges Long Type 1. Illustrate occurrence of petroleum. 2. Describe borehole logging in detail. 3. Illustrate non-hydrocarbon compounds present in crude oil with their disadvantages. 4. Explain API gravity of key fraction method for classification of crude oil. M.C.Q. 1 The reservoir rock containing petroleum has..... A) low porosity B) high permeability C) high porosity D) both (b) and (c) 2 Crude oil produced by Indian oil fields is predominantly in nature. A) paraffinic B) naphthenic C) asphaltic D) mixed base 3 What kinds of rocks usually contain crude oil and natural gas? A) Sedimentary B) Igneous C) Metamorphic D) All above 4 Low viscosity of mud fluid will its capacity for retaining the rock debris. A) Increase B) Decrease C) Maintain D) None of these 5 Quinoline is a/an compound. A) sulphur B) nitrogen C) oxygen D) none of these 6 The characterisation factor of a crude oil is calculated as 12.5. It means that; it is A) paraffinic B) naphthenic C) intermediate D) none of these 7 The residue from VDU has boiling range more than A) 450 °C B) 690°C C) 500 °C D) 600°C 8 Bottom product of atmospheric pressure crude oil distillation column is termed as A) reduced crude B) heavy ends C) asphalt D) residuum
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Course Category: Major Lab-3

128206: Lab 3 Identification of various Petroleum products tests							
Level	Semester	Course code	Course Name	Credits	Teaching Hours	Exam Duration	Max marks
4.5	II	128206	Identification of various Petroleum products tests	2	60	4 Hrs	25+25

Course Objectives	- To train the students for basic techniques in petroleum tests. - To introduce the students with handling and working of common IP equipments used in laboratory.
Course Outcomes	After completion of this course students will be able to - Identify flash point of petroleum samples - Calculate density and specific gravity of petroleum samples for API gravity - Identify smoke point of various petroleum samples - Estimate diesel index by using aniline point of given petroleum samples - Determine viscosity of petroleum samples by using slandered Redwood viscometer apparatus - Melting point of various solid petroleum wax and chemicals

List of Practical	
1.	Determination of Flash point and Fire point of petroleum sample by Cleveland open cup apparatus
2.	Determination of flash point of petroleum sample by Abels closed cup apparatus
3.	Determination of flash point of petroleum sample by Pensky Martin apparatus
4.	Determination of smoke point of given petroleum sample
5.	Determination of aniline point of given petroleum sample
6.	Determination of diesel index of given petroleum sample
7.	Determination of viscosity by redwood viscometer I apparatus.
8.	Determination of melting point of wax by melting point apparatus
9.	Determination of viscosity by U-tube Viscometer

Distribution of Marks and the scheme of Practical Examination is as follows:

Section 1: Internal Assessment

• Active participation in activities	10 Marks
• Continuous Assessment Tests (CAT) (At least three tests) *	10 Marks
• Submission of duly certified practical record	05 Marks
Total	25 Marks

*Note: Total Performance in CAT (i.e. 40 %) shall be based on the best two out of three in CAT examinations

Section 2: External Assessment

• Exercise 1	10 Marks
• Exercise 2	10 Marks
• Viva-Voce (external)	05 Marks
Total	25 Marks

Course Category: Generic/Open Elective-3

128207: Introduction of Petrochemical and Their Uses							
Level	Semester	Course code	Course Name	Credits	Teaching Hours	Exam Duration	Max marks
4.5	II	128207	Introduction of Petrochemical and Their Uses	2	30	2Hrs	30 + 20 =50
Course Objectives		• To make the students aware about importance of petrochemical products • To impart knowledge about composition of raw material used in petrochemical industries • To make aware the students about the difference between sweet gas and sour gas					
Course Outcomes		Upon completion of this course successfully, students would be able to • Apply basic concepts petrochemical industries • Recognize history petrochemical industries • Classify various method for gases impurities removal • Able to know petrochemical industries in India with location					
Unit System		Contents			Workload Allotted	Weightage of Marks Allotted	Incorporation of Pedagogies
Unit I		Definition of Petrochemical , History and Development of petrochemical industry in India. Role of MGCC, IPCL, HBJ gas line, TNC, Fertilizer in India.			8 Hrs	8 Marks	Chalk & Board, Power Point Presentation, Videos, Group Discussion, Assignments, surprise quizzes, question and answering sessions
Unit II		Three generation of petrochemical, various olefin used in petrochemical industries with their physical and chemical properties.			7 Hrs	7 Marks	

Unit III	various aromatic used in petrochemical industries with their physical and chemical properties. (Benzene, Toluene and xylene)	8 Hrs	8 Marks	
Unit IV	Impurities present in gases raw material used in petrochemical industries. Impact of these impurities, removal of those impurities	7 Hrs	7 Marks	
References	Reference Books: 1. Petroleum refining and Petrochemical. N. K. Sinha, Umesh Publication Delhi 2. Modern Petroleum Refining Processes, B.K. Bhaskara Rao, Oxford and IBH Publication, New Delhi 3. Fundamentals of Petroleum and Petrochemical Engineering by Uttam Ray Chaudhuri CRC press 4.Fuels and combustion, Samir Sarkar,, Orient Longman Ltd. Hyderabad 5.Advance Petroleum Refining, Dr. G. N. Sarkar, Khanna Publication, Delhi 6.Petroleum Refining technology, Dr. Ram Prasad, Khanna Publication, Delhi			
Model Question	Short Type 1. List the fertilizer units present in India 2. Tabulate IPCL products list 3. Focus primary first generation chemical with their application/market 4. Focus market of propylene in various industries 5. List the various derivatives of toluene 6. Describe physical properties of aromatic 7. Which impurities present in raw material used in petrochemical industries 8. List the various impurities removal processes Long Type 1. Describe History of petrochemical industries in detail 2. What is raw material? Explain three generation of petrochemical products 3. BTX (Benzene, Toluene, and Xylene) plays important role in petrochemical industries hoe? 4. What is the impact of impurities on raw material? How we will remove those impurities M.C.Q. 1. Which are the polymer industry from following A. Reliance B. NOCIL C. Haldia D. All above 2. The second industries was started by NOCIL in January _____ at Thane Mumbai A. 1948 B. 1958 C. 1968 D. 1078 3. Bongaigon petrochemical complex under public sector industries priorityly separation of_____ A. Paraffin B. Olefin C. Aromatic D. Di-olefin 4. Monomer required for production of PVC is _____ A. Vinyl chloride B. Propylene C. butane D. butane 5. Water vapor impurities present in gases rises the problem like A. Corrosion B. malign catalyst C. clogging D. All above 6. In gases impurities sulfur exists in the form of _____ A. mercaptans B. thiophanes C. thiophenes D. All above 7. The absorption is usually a _____ process A. biological B. physical C. geological D. logical 8. Saturated open chain hydrocarbons are known as..... A. Olefins B. Paraffins C. Aromatics D. Naphthenes			

Course Category: Generic/Open Elective Theory-4

128208: Introduction to production of synthesis gas and their uses							
Level	Semester	Course code	Course Name	Credits	Teaching Hours	Exam Duration	Max marks

4.5	II	128208	Introduction to production of synthesis gas and their uses	2	30	2Hrs	30 + 20 = 50
Course Objectives	- To make the students aware about importance of synthesis gas - To impart knowledge about composition of various paraffin and olefin - To make aware the students about the difference between saturated and unsaturated hydrocarbon						
Course Outcomes	Upon completion of this course successfully, students would be able to - Apply basic concepts how to utilized CO and Hydrogen gas - Recognize history production of synthesis gas - Classify various production method for Synthesis gas - Able to know prosperities paraffins and olefins						
Unit System	Contents			Workload Allotted	Weightage of Marks Allotted	Incorporation of Pedagogies	
Unit I	Synthesis gas, Production of synthesis gas, chemistry, role of steam hydrocarbon ratio and uses of synthesis gas			8 Hrs	8 Marks	Chalk & Board, Power Point Presentation, Videos, Group Discussion, Assignments, surprise quizzes, question and answering sessions	
Unit II	Various processes production of Synthesis gas Natural gas steam reforming, Coal gasification process, Lurgi process.			7 Hrs	7 Marks		
Unit III	Products obtained through synthesis gas with their basic chemistry and uses			8 Hrs	8 Marks		
Unit IV	Introduction to Aliphatic and olefinic basic Petrochemical like Paraffin (Methane, Ethane, propane, butane), olefin (Ethylene, Propylene, Butyienes)			7 Hrs	7 Marks		
References	Reference Books: 1. Petroleum refining and Petrochemical. N. K. Sinha, Umesh Publication Delhi 2. Modern Petroleum Refining Processes, B.K. Bhaskara Rao, Oxford and IBH Publication, New Delhi 3. Fundamentals of Petroleum and Petrochemical Engineering by Uttam Ray Chaudhuri CRC press 4.Fuels and combustion, Samir Sarkar,, Orient Longman Ltd. Hyderabad 5.Advance Petroleum Refining, Dr. G. N. Sarkar, Khanna Publication, Delhi 6.Petroleum Refining technology, Dr. Ram Prasad, Khanna Publication, Delhi 7.Chemical from Synthesis Gas, R. A. Sheldon, B. Reidel publication company, Dordrecht						
Model Question	Short Type 1. State the application of synthesis gas 2. Discuss the role of steam hydrocarbon ratio in steam reforming operation 3. Draw well label diagram of Lurgi process 4. What is synthesis gas? List processes for their production 5. Define oxo-synthesis? Which products obtained from this process 6. Compare catalyst used in production of butyraldehyde by oxo process with process parameter and yield 7. State the physical prosperities of ethane, propane and butane 8. What is olefin? Describe with their formula and chemical properties Long Type 1. Describe steam reforming reaction by using natural gas as a feed stock 2. Describe synthesis gas production through steam reforming process using natural gas as a feed stock 3. Draw and explain oxo synthesis process for production propanealdehyde 4. Focus major olefin used in petrochemical industries M.C.Q. 1. Steam hydrocarbon ratio strictly depends upon the _____ of feedstock’s A. Atomic weight B. gross weight C. molecular weight D. Non of above 2. Hydro-desulphurization process carried out at _____ degree Celsius and 35-40 atm. Pressure in presence of cobalt-molybdenum catalyst. A. 200 B. 300 C. 400 D. 500 3. The use of secondary reformer is obviously to convert about 10% _____ still unreacted in primary reformer A. Methane B. ethylene C. propylene D. butane 4. The secondary reformer is single bed reactor and uses _____ catalyst A.Iron B. nickel C. silver D. titanium 5. Which are coal based technology from following for production of synthesis gas A.Winkler process B. Koppers-Totzek process C. Lurgi process D. All above 6. Carbon monoxide combines with _____ to give phosgene A. Hydrogen B. nitrogen C. chlorine D. oxygen 7. _____ reacts with methyl amine to produce di methyl formamide A.Carbon monoxide B. carbon dioxide C. carbon trioxide D. None of above 8. In steam reforming operation all CO is converted in to carbon dioxide in _____ A. Shift converter B. cooler C. reformer D. absorber						

Course Category: Vocational Skill Course (VSC) Lab 4

128209: Lab 4 Science Laboratory Practices							
Level	Semester	Course code	Course Name	Credits	Teaching Hours	Exam Duration	Maximum marks
4.5	II	128209	Science Laboratory Practices	2	60	--	50
Course Objectives:		- To train the students in basic skills of using the equipment laboratory - To introduce glassware, chemicals, and instruments used in a laboratory. - To develop skills to prepare solutions of different types and different chemicals. - To develop awareness about safety measures for handling chemicals.					
Course Outcomes:		Upon completion of this course successfully, students would be able to - Apply practical skills in science courses with the understanding of general laboratory practices - Use various stoichiometric techniques used in sciences - Apply various techniques to study chemical compounds, salts - Explore various standardization technique					
Unit System		Content			Incorporation of Pedagogies		
Experiments		- Introduction and study of various lab equipment - To study simple titration - Determination of acid value of the given sample - Determination of saponification value of the given sample of oil - Identification of various oil seeds - Use of various lab equipments - Standardization of the solutions - Preparation of solutions for the determination of acid value - Preparation of solutions for the determination of saponification value - Determination of boiling point - Determination of melting point - Inter-conversion of CGS units to SI and vice versa - Determination of density - Preparation of buffer solution - preparation of solution of given normality, molarity, percentage - Determination of boiling points of various liquid food			Lab Reports: Students prepare detailed lab reports on their findings. Discussion Sessions: Group discussions. Group Projects: Assign group projects on Mass Transfer Operations. Class Debates: Discuss the findings amongst the students.		
References:		Text books: https://eatrightindia.gov.in/dart/ - Handbook of Analysis and Quality Control for Fruits and Vegetables 2nd Edition; S. Ranganna. - Manual of Methods of Analysis of Foods (Fruit and Vegetable Products), FSSAI, 2016 - Nutritive Value of Indian Food; Dr. C. Gopalan NIN Hyderabad - UNIDO Technology Manual, Small-scale Fruit and Vegetable, Processing and Products, 2004 - Dr. D. K. Maharaj (2017), Laboratory Manual for Soil Testing, S.K. Kataria & Sons. - Bandyopadhyay, P. C. (2012), Soil analysis, Genetech. - S.K. Pal (2013), Soil Sampling and Methods of Analysis, New India Publishing Agency. - Dr. G.S. Wagh (1905), Experimental Methods for Water Analysis, Nirali Prakashan. - Patrick, G. (2017), Introduction to Medicinal Chemistry, Oxford University Press. - Singh H.; Kapoor V.K. (1996). Medicinal and Pharmaceutical Chemistrv. Vallabh Prakashan.					
Model Questions:		NA					

Distribution of Marks and the scheme of (VSC) Practical Examination is as follows:

Internal Assessment

• Active participation in activities	15 Marks
• Continuous Assessment Tests (CAT) (At least three tests) *	20 Marks
• Submission of duly certified practical record	10 Marks
• Internal examiner viva-voce	05 Marks
Total	50 Marks

*Note: Total Performance in CAT (i.e. 40 %) shall be based on the best two out of three in CAT examinations

Course Category: Skill Enhancement Course (SEC-2) Lab 5

128210: Lab 5- Basic Fuel Analysis							
Level	Semester	Course Code	Course Name	Credits	Teaching Hours	Exam Duration	Max Marks
4.5	II	128210	Lab 5- Basic Fuel Analysis	2	60	--	50
Course Objectives:		1. To understand the Parameters of Good quality of oil. 2. To understand the various aspects of lubricant oil					
Course Outcomes:		After completion of the course student should 1. Able to apply basic knowledge for fuel analysis. 2. Able to analyzed solid fuel. 3. Able to apply different methods for analysis of solid and liquid fuels. 4. Able to handle the fuel analysis equipments.					
Unit System		Content			Incorporation of Pedagogies		
Experiments		1. To determine Flash point of Oil. 2. To determine Fire point of Oil. 3. To determine Aniline point of oil. 4. To determine the Smoke point of a given oil using smoke point apparatus. 5. To determine the Acid value of a given oil 6. To determine the viscosity of the given oil sample using Engler’s viscometer. 7. To determine the Cloud point and Pour point of a given fuel / lubricant / oil using Cloud and Pour point apparatus. 8. To determine moisture content of coal. 9. To determine ash content of coal. 10. Determination of Viscosity of the given specimen oil by using Red Wood Viscometer. 11. To determine the calorific of a supplied sample by using Bomb calorimeter.			Lab Reports: Students prepare detailed lab reports on their findings. Discussion Sessions: Group discussions. Group Projects: Assign group projects on formulation methods. Class Debates: Discuss the findings amongst the students.		
References:		Text books: 1. Practical Chemistry, by Ambrish Agarwal, Shivalal Agrawal and Co. 2. Laboratory Manual Chemistry by NCERT 3. GCE Chemistry Practical Handbook Department of Science Faculty of Science and Technology National Institute of Education. 4. Text Book: Practical General Chemistry by Dr. Ahmad Al-Owais & Dr. Abdulaziz Al-Wassil. 5. Laboratory Manual for Engineering Chemistry Practical. 6. Engineering Chemistry Laboratory Manual, Maharaj Vijayaram Gajapathi Raj College of Engineering. 7. Understanding 0 level Chemistry Practical 8. A Textbook on Experiments and Calculations in Engineering Chemistry By S.S Dara. S Chand Ltd. 9. Practical Lab Manual of Pharmaceutical Organic Chemistry – I by Dr. Shivendra Kumar Dwivedi, IP Innovative Publication Pvt. Ltd.					
Model Questions:		NA					

Distribution of Marks and the scheme of (SEC) Practical Examination is as follows:

Internal Assessment

• Active participation in activities	15 Marks
• Continuous Assessment Tests (CAT) (At least three tests) *	20 Marks
• Submission of duly certified practical record	10 Marks
• Internal examiner viva-voce	05 Marks
Total	50 Marks

*Note: Total Performance in CAT (i.e. 40 %) shall be based on the best two out of three in CAT examinations

**SANT GADGE BABA AMRAVATI UNIVERSITY,
AMRAVATI**



**Degree of Bachelor of Science
Petrochemical Science
Semester III and IV**

FACULTY: SCIENCE AND TECHNOLOGY

**(Courses effective from Academic Year 2025-26)
Under NEP 2020**

SYLLABUS

Contents

TLE Scheme for SECOND YEAR: SEMESTER – III (Level 5.0)	3
TLE Scheme for SECOND YEAR: SEMESTER – IV (Level 5.0).....	4
Examination and Assessment Process:	5
Continuous Assessment Tests (CAT)	5
Conduction of the Examination:	6
128211: Quality Monitoring of petroleum product and Overview of Petrochemical industry and feedstock's	7
128212: Basic operations in Petrochemical Industries	9
128213: Indian Knowledge System in Petrochemical Science	11
128214: Lab 6: Identification of various Petroleum products tests	15
128215: Petroleum laboratory test and Introduction to Petrochemical industries and raw material.....	16
128216: Lab 7 Petroleum products tests	18
128217: Overview of petroleum and Petrochemical.....	19
128218: Lab 8 Basic Operations and safety measures in Laboratory	21
128219: Petrochemical Science (FP/ CEP - I)	22
128220: Cracking and Reforming of Petroleum-I	24
128221: Cracking and Reforming of Petroleum-II	26
128229: Rebuilding of Hydrocarbon/Extraction/ Corrosion.....	29
128222: Lab 10 Experiment to identify various parameter	30
128223: Introduction to Cracking processes.....	31
128224: Lab 11: Exercise to identify various parameter of petroleum products	33
128225: Chemical based on Some Paraffin and Olefin	34
128226: Lab 12 Petroleum Geology	36
128227: Lab 13 Fundamentals of Titrimetric Analysis	37
128228: Lab 14 Petrochemical Science (FP/ CEP-II).....	39

TLE Scheme for SECOND YEAR: SEMESTER – III (Level 5.0)

Subject	The Vertical	Course Code	Course Title	Credits	Workload	Theory/Practical				Theory/Pract (Total)	
						External		Internal			
						Max. Marks	Min. Marks	Max. Marks	Min. Marks	Max. Marks	Min. Marks
Petrochemical Science	Major-T	128211	Quality Monitoring of petroleum product and Overview of Petrochemical industry and feedstock’s	2	2	30	9	20	6	50	20
Petrochemical Science	Major-T	128212	Basic Operation in Petrochemical industries	2	2	30	9	20	6	50	20
Petrochemical Science	IKS-T	128213	Indian knowledge System in Petrochemical Industries.	2	2	30	9	20	6	50	20
Petrochemical Science	Major-P	128214	Identification of various Petroleum Products test.	2	4	25	10	25	10	50	20
Petrochemical Science	Minor-T	128215	Petroleum laboratory test and introduction to petrochemical industries and raw material	2	2	30	9	20	6	50	20
Petrochemical Science	Minor-P	128216	Petroleum Products Tests	2	4	25	10	25	10	50	20
Petrochemical Science	GOEC-T	128217	Overview of Petroleum and Petrochemical	2	2	30	9	20	6	50	20
Petrochemical Science	VSC-P	128218	Basic Operation and Safety measures in Laboratory	2	4	-	-	50	20	50	20
Petrochemical Science	FP/CES	128219	Field Project/ Community Engagement Services Petrochemical Science Lab 09	2	4	-	-	50	20	50	20
Petrochemical Science	CC		Separate SOP will be released	2	4	-	-	50	20	50	20

Important: * VSC Should be Complementary to Major

** SEC has to be selected from the Basket Provided by University, from the same Faculty/Discipline of the Major/Minor

TLE Scheme for SECOND YEAR: SEMESTER – IV (Level 5.0)

Subject	The Vertical	Course Code	Course Title	Credits	Workload	Theory/Practical				Theory/Pract (Total)	
						External		Internal		Max. Marks	Min. Marks
						Max. Marks	Min. Marks	Max. Marks	Min. Marks		
Petrochemical Science	Major-T	128220	Cracking and Reforming of Petroleum-I	2	2	30	9	20	6	50	20
Petrochemical Science	Major-T	128221	Cracking and Reforming of Petroleum-I	2	2	30	9	20	6	50	20
Petrochemical Science	Major-T*	128229*	Rebuilding of Hydrocarbon/Extraction/ Corrosion	2	2	30	9	20	6	50	20
Petrochemical Science	Major-P	128225	Chemical based on some Paraffin and Olefin	2	4	25	10	25	10	50	20
Petrochemical Science	Minor-T	128226	Petroleum Geology	2	2	30	9	20	6	50	20
Petrochemical Science	Minor-P	128227#	Fundamental of Titrimetric Analysis	2	4	25	10	25	10	50	20
Petrochemical Science	GOEC-T	128225	Chemical based on some Paraffin and Olefin	2	2	30	9	20	6	50	20
Petrochemical Science	VSC-P	128226	Petroleum Geology	2	4	-	-	50	20	50	20
Petrochemical Science	SEC-P#	128227#	Fundamental of Titrimetric Analysis	2	4	-	-	50	20	50	20
Petrochemical Science	FP/CES	128228	Petrochemical science Lab 14	2	4	-	-	50	20	50	20
Petrochemical Science	CC		Separate SOP shall be consulted from University website	2	4	-	-	50	20	50	20

* To be implemented w.e.f. academic session 2026-27 # - Only applicable up to academic session 2025-26

Important: VSC Should be Complementary to Major and SEC has to be selected from the Basket Provided by University, from the same Faculty/Discipline of the Major/Minor

Examination and Assessment Process:

- i. The basic principle of the Credit framework is that Credits are a function of the successful completion of a program of study/ vocational education/ training and assessment. No Credit can be earned by the student unless the student is assessed for the achievement of the desired competencies and outcome of a program.
- ii. Exit options are provided with Certificate, Diploma and Basic Bachelor’s degrees to the students at the end of the second, fourth and sixth semesters of a Four Years Multidisciplinary Degree Programme. Students will receive a Bachelor’s degree with Honors/ Research on successfully completing of all eight semesters of the UG Program either at a stretch or with opted exits and re-entries.
- iii. For the smooth success of four-year degree programme with multiple entry and exit systems, the examination mode should be based on the combination of innovative trends in formative (informal and formal tests administered during the learning process) and summative (evaluation of students learning at the end of an instructional unit) examination modes in line with the UGC Report on ‘Evaluation Reforms in Higher Educational Institutions (2019).

Examination, Evaluation and Assessment Scheme

The total marks for each Course shall be based on Continuous Assessment and Semester End Examination. Each theory course of Major, Minor, GE/OE, AEC, IKS, VEC as mentioned in **Teaching Learning Scheme** prepared by the Board of Studies shall be evaluated as per the scheme as mentioned in the following table

Examination, Evaluation and Assessment Scheme

Vertical No.	The Vertical	Mode of Examination , Evaluation & Assessment	Theory				Theory (Total)		Practical				Practical (Total)	
			External		Internal		Max. Marks	Min. Marks	External		Internal		Max. Marks	Min. Marks
			Max. Marks	Min. Marks	Max. Marks	Min. Marks			Max. Marks	Min. Marks	Max. Marks	Min. Marks		
A	Major	External & Internal	30/60	9/18	20/40	6/12	50/100	20/40	25/50	10/20	25/50	10/20	25/50	10/20
B	Minor		30/60	9/18	20/40	6/12	50/100	20/40	25/50	10/20	25/50	10/20	25/50	10/20
C	Generic/ Open Elective	Internal			50	20	50	20	--	--	50	20	50	20
D	VSC	Internal			50	20	50	20			50	20	50	20
	SEC	Internal	--	--	50	20	50	20			50	20	50	20
e	AEC (Eng. & One MIL Composite)	Internal			50	20	50	20						
	IKS (Generic)	Internal			50	20	50	20						
	VEC	Internal			50	20	50	20						
F	Internship/ Apprenticeship	Internal	Assessment of these verticals shall be based on various activities/practices. The evaluation/assessment shall be done by appointing external examiner by principal from Industry/Organisation/Academia. The mentor faculty shall be the internal examiner. It shall be evaluated by giving maximum 50 marks per 2 Credit Course with separate activity weightages/levels. A detailed SOP for this assessment process shall be prescribed separately.											
	FP/CEP													
	CC													

Continuous Assessment Tests (CAT)

For internal assessment, the Continuous Assessment Tests (CAT) shall be conducted as under-

- i. Three CAT each of 8 / 10 Marks (Theory) as applicable and 10 Marks (Practical).
 - First on completion of 25% Syllabus of the course or on completion of 25 teaching days,
 - Second on completion of 50% Syllabus of the course or on completion of 50 teaching days,
 - Third on completion of 75% Syllabus of the course or on completion of 75 teaching days.
- ii. Each concurrent assessment (CAT-I, II & III) will be mapped to relevant Course Learning Outcome.
- iii. Total Performance in CAT (i.e.40 %) shall be based on the **best two out of three** in CAT examinations

- iv. Internal assessment (CAT) shall be carried out by the respective course teacher by choosing variety of assessment tools/methods such as class test, record book, seminar, case study, field work, mini project work, quiz or any innovative method, which may be deemed to be appropriate for assessing the relevant course outcome.

Conduction of the Examination:

As per the scheme of teaching, learning, examination and evaluation, theory/practical examinations of Semester-I, II, III, IV, V, VI, VII and VIII shall be conducted by the University (except for Internal Examinations as applicable) at the end of each semester.

The theory/practical examinations of all the Semesters shall be held as per the following Schedule

Sr.No.	Name of the Examination	End Sem Examination	Supplementary Examination*
1	Semester-I, III, V and VII	Winter	Summer
2	Semester-II, IV, VI and VIII	Summer	Winter

*The University may evolve mechanism for conducting repeat end semester examination. Such repeat examinations shall have to be conducted within one month of the regular even semester examination and on demand examination.

1. The practical examination of all semesters shall be conducted by the University at the end of each semester. The HEI shall conduct the Practical examination of odd semesters as per the schedule announced by the University. **However, the appointment of the External and Internal Examiners shall be done by the Head or Principal of respective HEI to conduct external examination of the odd semester and the same should be communicated to the University before commencement of the practical examination.** The University shall conduct the external practical examination of all even semester by appointing external and internal examiners.
2. The examinations specified above shall be held twice in a year at such places and on such dates as may be prescribed by the University.
3. An applicant to an examination specified above, shall pursue a regular course of study in courses prescribed for the examination concerned for not less than one semester in a particular semester in a College/Institute/University department.
4. Provided that the student shall be eligible to appear for examination if -
 - a. He/she complies with the provisions of the Ordinance pertaining to the Examination in general from time to time.
 - b. He/she has prosecuted a regular course of study in a university department/college affiliated to the University.
 - c. He/she has in the opinion of the Principal shown satisfactory progress in his/her studies.
5. The provisions of Ordinance No. 6 and Ordinance No. 9 shall be *mutatis-mutandis* applicable to every collegiate/non-collegiate student.
6. The fees for each theory examination and practical examination conducted by the university shall be as prescribed by the University, from time to time.

Course: B.Sc. II Semester III (Petrochemical Science)

Course Category: Major Theory

128211: Quality Monitoring of petroleum product and Overview of Petrochemical industry and feedstock's							
Level	Semester	Course code	Course Name	Credits	Teaching Hours	Exam Duration	Max marks
5.0	III	128211	Quality Monitoring of petroleum product and Overview of Petrochemical industry and feedstock's	2	30	2Hrs	30 + 20 = 50

Course Objectives	- Identify the petrochemicals and petrochemical industry. - Use of hydrocarbons and how these can be converted into building blocks for various petrochemicals and consumer commodities. - Comparison of the hydrocarbons and their physical or chemical properties. - Use basic quality monitoring and laboratory test			
Course Outcomes	Upon completion of this course successfully, students would be able to - Apply the knowledge of petrochemical industries. - Understand the basic feed stocks and gas purification techniques utilized in petrochemical Industries. - Recognize the primary raw materials for various Petrochemicals. - Prepare the theoretical background of tests for various petroleum products and their significances.			
Unit System	Contents	Workload Allotted	Weightage of Marks Allotted	Incorporation of Pedagogies
Unit I	Classification of Laboratory tests-I Distillation, Vapor pressure, Flash point, Fire point, Octane number, Cetane number, Aniline point, Diesel index, Calorific value, Smoke Point, Viscosity, Viscosity index. Conradson carbon Residue (CCR).	8 Hrs	8 Marks	Chalk & Board, Power Point Presentation, Videos, Group Discussion, Assignments, surprise quizzes, question and answering sessions
Unit II	Classification of Laboratory tests-II Penetration index, Freezing point, Cloud and pour point, Drop point of grease, Melting and Setting point of wax, softening point of bitumen, Ductility of bitumen, Gum content (Oxidation stability), acidity and alkalinity, Copper strip corrosion test, Density and API Gravity, Refractive index,	7 Hrs	7 Marks	
Unit III	Overview of Petrochemical industry Definition of Petrochemical History and Development of petrochemical industry in India. Role of MGCC, IPCL, HBJ gas line, TNC, Fertilizer in India.	8 Hrs	8 Marks	
Unit IV	Petrochemical feedstock Feed stock for petrochemical from Natural gas and Petroleum. Most common impurities present in gases, Water vapor, Mechanical, Chemical, and other suspended impurities and impurities removal technique.	7 Hrs	7 Marks	
References	Text books: 1. Petroleum refining and Petrochemical. N. K. Sinha, Umesh Publication Delhi 2.Advance Petrochemical, Dr. G. N. Sarkar, Khanna Publication, Delhi 3. text on Petrochemical, Dr. B. K. Bhaskararao, Khanna Publication, Delhi 4. Introduction to petrochemical, Sukumar Maiti 5. Fuels and combustion, Samir Sarkar, Orient Longman Ltd. Hyderabad 6. Modern Petroleum Refining Processes, B.K. Bhaskara Rao, Oxford and IBH Publication, New Delhi			

	Reference Books: 1. Fundamentals of Petroleum and Petrochemical Engineering by Uttam Ray Chaudhuri CRC press 2. The Chemistry and technology of Petroleum 4th edition by James G. Speight CRC Press 3. Systematic Experimental Physical Chemistry, S. W. Rajbhoj, Dr. T. K. Chondhekar, Anjali Publication, Aurangbad 4. Petroleum Refining technology, Dr. Ram Prasad, Khanna Publication, Delhi 5. Industrial Organic Chemistry, K. Weissmermel, and H. J. Arpe, Veriagchemie, New York 6. Chemical From Petroleum, A.L. Waddms, Murry, London 7. An Introduction to industrial organic chemistry, P. Wiseman, Applied Science, London
Model Questions	Short Type 1. What is distillation? List the type of distillation with their function 2. Define viscosity describe viscosity index 3. Define cloud point name the petroleum fraction for prescribe for this test 4. Define API with their formula 5. Describe role of MGCC 6. What is petrochemical? List petrochemical complexes in India 7. Explain disadvantages of water vapor impurities present I petroleum gas 8. Focus primary raw material used in petrochemical industries Long Type 1. Describe aniline point test prescribed for petroleum fraction with their significance 2. Which test prescribed for bitumen explain any one in detail 3. Focus history and development of petrochemical industries in India 4. Which impurities present in petroleum gases explain chemical impurities with removal technique M.C.Q. 1 Which of the following fractions of a crude oil will have the maximum gravity API (i.e. °API)? A) Gasoline B) Diesel C) Vacuum gas oil D) Atmospheric gas oil 2 Cetane number of a diesel fuel is the measure of it's A) ignition delay B) smoke point C) viscosity D) oxidation stability 3 Which of the following has the lowest cetane number? A) Aromatics B) <i>i</i>-paraffins C) Naphthene D) Olefins 4 Which of the following has the lowest viscosity (at a given temperature) of all? A) Naphtha B) Diesel C) Lube oil D) Kerosene 5 In India second petrochemical industry was started by..... A) Reliance industries B) NOCIL C) IPCL D) Union carbide 6 The main source of important feedstock for petrochemicals today is.... A) coal B) molasses C) crude oil D) biomass 7 Synthesis gas is mixture of..... A) CO & H₂ B) H₂& N₂ C) CO & CO₂ D) CO₂ & H₂ 8 The average boiling point of ATF is closest to that of _____. A) Diesel B) Lubricating oil C) Kerosene D) LPG

Course Category: Major Theory

128212: Basic operations in Petrochemical Industries							
Level	Semester	Course code	Course Name	Credits	Teaching Hours	Exam Duration	Max marks
5.0	III	128212	Basic operations in Petrochemical Industries	2	30	2Hrs	30 + 20 = 50

Course Objectives	- Understand the various separation processes that are applied in petroleum and petrochemical industry. - Choose the various processes to convert basic hydrocarbons into petrochemicals as a feedstock for petrochemicals. - Study the composition of synthesis gas and processes available.			
Course Outcomes	Upon completion of this course successfully, students would be able to - Apply separation and purification processes of petroleum gases in to individual constituents. - Identify steam reforming processes with their definition, reactions, reactivity, to know the synthesis gas production through various processes. - use various applications of synthesis gas with the processes involved.			
Unit System	Contents	Workload Allotted	Weightage of Marks Allotted	Incorporation of Pedagogies
Unit I	Primary raw material for petrochemicals: Introduction to paraffinic hydrocarbons, olefinic hydrocarbon, dienes and aromatic hydrocarbons with their properties. uses as building blocks for various petrochemicals.	8 Hrs	8 Marks	Chalk & Board, Power Point Presentation, Videos, Group Discussion, Assignments, surprise quizzes, question and answering sessions
Unit II	Separation of gases (From Natural gas and Petroleum) in to individual constituents Various process:- Absorption Desorption, Compression Liquifaction, Low temperature fractionation, Adsorption, and special technique.	7 Hrs	7 Marks	
Unit III	Steam reforming Definition of reforming, various steam reforming reaction, Reactivity of hydrocarbons, Role of steam hydrocarbon ratio. Production of synthesis gas, and uses of synthesis gas	8 Hrs	8 Marks	
Unit IV	Various Steam reforming processes Natural gas steam reforming, Naphtha steam reforming, Partial oxidation hydrocarbon process, Coal gasification process, Lurgi process.	7 Hrs	7 Marks	
References	Text Books: - Petroleum refining and Petrochemical. N. K. Sinha, Umesh Publication Delhi - Advance Petrochemical, Dr. G. N. Sarkar, Khanna Publication, Delhi - A text on Petrochemical, Dr. B. K. Bhaskararao, Khanna Publication, Delhi - Introduction to petrochemical, Sukumar Maiti - Modern Petroleum Refining Processes, B.K. Bhaskara Rao, Oxford and IBH Publication, New Delhi Reference Books: - Chemistry of petrochemical processes 2nd edition by Sami Matar , Lewis F. Hatch Gulf publishing company - Fundamentals of Petroleum and Petrochemical Engineering by Uttam Ray Chaudhuri CRC press - Hand book of petroleum Processing Edited by David S. J. “Stan” Jones and Peter R. Pujado Springer - The Chemistry and technology of Petroleum 4th edition by James G. Speight CRC Press - Systematic Experimental Physical Chemistry, S. W. Rajbhoj, Dr. T. K. Chondhekar, Anjali Publication, Aurangabad - Advance Petroleum Refining, Dr. G. N. Sarkar, Khanna Publication, Delhi			

	7) Petroleum Refining technology, Dr. Ram Prasad, Khanna Publication, Delhi 8) Industrial Organic Chemistry, K. Weissmerl, and H. J. Arpe, Veriagchemie, New York 9) Chemical From Petroleum, A.L. Waddms, Murry, London 10) Chemical from Synthesis Gas, R. A. Sheldon, B. Reidel publication company, Dordrecht
Model Questions	Short Type 1. What is olefin ? describe their physical properties 2. List the petrochemical products obtained from benzene 3. List the process for separation of petroleum gases with their function 4. Which mechanism used in comparison and liquefaction process 5. What is the role of steam in steam reforming operation 6. Give application of Synthesis gas 7. Draw well label process flow for production of synthesis gas through Natural gas 8. Describe coal gasification process for production of synthesis gas Long Type 1. Illustrate physical and chemical properties of paraffin. Describe application paraffin 2. Draw and explain sulphur sweetening process in detail 3. What is steam reforming? Explain overall steam reforming reaction in detail 4. Describe production of synthesis gas through naphtha wit respect to process flow and operating parameter of each unit M.C.Q. 1 Natural gas contain large amount of _____ A. methane B. ethylene C. propylene D. butane 2. _____ are vastly used natural gas and air liquefaction plants A. Molecular sieves B. Bauxite C. glycol D. betonite clay 3. Usually all type of _____ impurities can be removed by washing with water A. Water vapor B. mechanical C. chemical D. biological 4. Gases ranging from C1-C4 are freely available in _____ streams A. cracked B. ADU C. Stabilizer D. All above 5. Synthesis gas abundantly produced from A. Coal B. Coke C. natural gas D. All above 6. 80% words _____ is accounted by steam reforming of natural gas A. ammonia B. urea C. ethane D. propane 7. _____ being a sever poison for nickel catalyst due to chemisorptions on metal surface easily deactivates catalyst A. Nitrogen B. Oxygen C. Sulfur D. hydrogen 8. High temperature tubes made by nickel chromium alloys 20:25 and carbon 0.35% is known as A. HK-40 B. HP modified alloy C. 800 H alloy D. None of above

Course Category: **Major (Theory)**

128213: Indian Knowledge System in Petrochemical Science							
Level	Semester	Course Code	Course Name	Credits	Teaching Hours	Exam Duration	Max Marks
5.0	III	128213	Indian Knowledge System in Petrochemical Science	2	30	2 Hrs.	30+20=50
Course Objectives:		To help the students to bridge the gap between ancient Indian knowledge and modern scientific inquiry, providing them a holistic understanding of the subject.					
Course Outcomes:		Upon completion of this course, students will be able to: 1. Explain the importance and scope of IKS in Petrochemical Science 2. Describe the knowledge about the Indian scholars and their contribution to Petrochemical Science. 3. Analyze vedic metallurgical techniques and their impact on material sciences. 4. Explore the chemistry behind natural dyes and pigments used in historical contexts. 5. Describe different chemical processes used in ancient chemistry.					
Unit	Contents			Workload Allotted	Weightage of Marks Allotted	Incorporation of Pedagogies	
Unit I	Introduction to Indian Alchemy (Rasa Shastra) Overview of alchemy in ancient India and its evolution: Vedic Chemistry and the terms used therein., Overview of Indian Chemistry in post Vedic period. CSIR National Chemical Laboratory: History and milestones. Indian Scholar in Chemistry and Indian literature Contributions of ancient and medieval Indians in the area of chemistry: Nagarjuna, Maharshi Kanada, Prafulla Chandra Ray, CNR Rao, Har Gobind Khorana, Govardhan Mehata, Shanti Swarup Bhatnagar and Venkataraman Ramakrishnan			8 Hrs	8 Marks	Chalk & Board, Power Point Presentation, Videos, Group Discussion, Assignments, surprise quizzes, question and answering sessions	
Unit II	Concepts of acid and bases in Indian chemistry from organic fruit, vegetable-based. acids, plant-ash-based bases to mineral acids of the medieval period. Chemistry of dyes, pigments, and other coloring materials used in paintings, fabrics, beads, and other day-to-day utilities since ancient times and their constant evolution through different periods of time.			7 Hrs	7 Marks		
Unit III	Vedic Metallurgy- Introduction, Sources of Vedic metallurgy (Rigveda, Yajurveda, Atharvaveda), Metal known to Vedic Indian (Copper, Iron, Lead, Zinc, Gold and Silver). Processing of gold, silver, copper, iron, tin, mercury, lead and zinc as mentioned in the Indian texts in the ancient and medieval period. Zinc distillation as mentioned in Rasārṇava and Rasaratnasamukāyā. Metallurgical processes (smelting, alloying, Forging, Casting), Application of Vedic Metallurgy.			8 Hrs	8 Marks		

Unit IV	Sustainability and Future Prospects of IKS in Industry Eco-Friendly Chemical Practices in Ancient India: Sustainable chemical production and green chemistry concepts. Biodegradable Materials from Traditional Knowledge: Natural polymers, bioplastics, and their industrial scope. Role of IKS in Modern Industrial R&D: Integration of traditional knowledge with cutting-edge technology	7 Hrs	7 Marks	
References:	1. R.M. Pujari, Pradeep Kolhe, N. R. Kumar, ‘Pride of India: A Glimpse into India's Scientific Heritage’, Samskrita Bharati Publication. 2. ‘Indian Contribution to science’, compiled by Vijnana Bharati. 3. A Concise History of Science in India, ed. D M Bose, S N Sen and B V Subbarayappa; INSA; 2009 4. Science and Technology in Medieval India - A Bibliography of Source Materials in Sanskrit, Arabic and Persian by A Rahman, M A Alvi, S A Khan Ghori and K V Samba Murthy; 1982. 5. Science and Technological Exchanges between India and Soviet Central Asia (Medieval Period), ed B V Subbarayappa; 1985 6. Scientific and Technical Education in India, 1781-1900 by S N Sen; 1991 7. History of Technology in India, Vol. I, ed. A K Bag (1997); Vol III, ed. K V Mital (2001); Vol-II by Harbans Mukhia (2012). 8. Acharya Prafulla Chandra Ray, A History of Hindu Chemistry, 1902, republ., Shaibya Prakashan Bibhag, centenary edition, Kolkata, 2002 9. R. Balasubramaniam, Delhi Iron Pillar: New Insights, Indian Institute of Advance Study, Shimla & Aryan Books International, New Delhi, 2002 10. R. Balasubramaniam, Marvels of Indian Iron through the Ages, Rupa & Infinity Foundation, New Delhi, 2008. 11. Mahadevan, B., Bhat, V. R., & Nagendra, P. R. N. (2022). <i>Introduction to Indian Knowledge System: Concepts and Applications</i>. PHI Learning Pvt. Ltd. 12. Kapoor, K., & Singh, A. (2021). <i>Indian Knowledge Systems</i> (Vols. I & II). Indian Institute of Advanced Study. 13. Frawley, D., & Ranade, S. (2001). <i>Ayurveda, Nature's Medicine</i>. Lotus Press. 14. Dharmapal. (1971). <i>Indian Science and Technology in the Eighteenth Century</i>. Other India Press. 15. Indian Knowledge Systems: Concepts and Applications – Kapil Kapoor (Editor) Web resources: 1. Vedic Chemistry: https://www.puranavedas.com/vedic-chemistry/ 2. Indian Alchemy as a yogic practices: https://youtu.be/ozuT0Az9_Lk 3. Savrikar, S. S., & Ravishankar, B. (2011). Introduction to 'Rasashastra' the Iatrochemistry of Ayurveda. <i>African journal of traditional, complementary, and alternative medicines: AJTCAM</i>, 8(5 Suppl), 66–82. https://doi.org/10.4314/ajtcam.v8i5S.1 https://artsandculture.google.com/story/rasashala-ancient-indian-alchemical-lab-national-council-of-science-museums/VAVBaP1RF0y-KQ?hl=en 4. Indian Knowledge Systems Division, Ministry of Education (GoI) https://iksindia.org 5. CSIR – Traditional Knowledge Digital Library (TKDL) https://www.csir.res.in/tkdl 6. IGNCA – Indira Gandhi National Centre for the Arts https://ignca.gov.in 7. Infinity Foundation India https://infinityfoundation.com 8. Indian National Science Academy (INSA) – History of Science https://insaindia.res.in			

Model Questions:	Short Type (At least 8) 1. What is the significance of Vedic chemistry in the evolution of Indian alchemy? 2. How did Nagarjuna influence the development of Indian chemistry? 3. How did Prafulla Chandra Ray contribute to inorganic chemistry? 4. Explain the role of Ayurveda in shaping early chemical practices in India. 5. How were plant ashes utilized to produce alkaline substances in early Indian chemistry? 6. How was lime (calcium hydroxide) used as a base in ancient India? 7. What are the key differences between organic and mineral pigments used in Indian paintings? 8. How did ancient Indian artisans ensure the durability of their pigments on paintings and fabrics? 9. How was gold processed in ancient India according to Vedic texts? 10. What were the primary applications of lead in Vedic metallurgy? 11. What role did mercury play in alchemical processes in medieval India? 12. What were the key metallurgical techniques used for iron processing in ancient India? 13. What are some purification techniques described in Indian scriptures?
	Long Type (At least 4) 1. Explain how modern Indian scientists like CNR Rao and Venkatraman Ramakrishnan have contributed to global chemistry. 2. What are the key contributions of Indian chemists to global scientific advancements? 3. Describe the evolution of Indian chemistry from the Vedic period to the post-Vedic period. 4. Explain the role of plant ash in the production of bases and its applications in ancient Indian industries. 5. Describe the chemistry behind natural dye extraction and how Indian artisans perfected the dyeing process over centuries. 6. Discuss the significance of indigo dye in Indian history and its chemical composition. 7. Discuss the contributions of Rigveda, Yajurveda, and Atharvaveda in shaping early Indian metallurgy. 8. Describe the role of gold and silver in ancient Indian economy and craftsmanship 9. Explain the role of Rasārṇava and Rasaratnasamukāyā in documenting metallurgical advancements. 10. Discuss the importance of Good Agricultural Practices (GAP) in Ayurveda for ensuring medicinal plant quality. 11. Discuss the significance of applied traditional knowledge in the evolution of Indian medicine.
	MCQs (At least 8) 1. Which ancient Indian text extensively discusses Rasa Shastra? a) Charaka Samhita b) Sushruta Samhita c) Rasaratnakara d) Arthashastra 2. Who among the following is known as the "Father of Indian Chemistry"? a) Prafulla Chandra Ray b) Nagarjuna c) CNR Rao d) Har Gobind Khorana 3. Maharshi Kanada is known for proposing which of the following concepts in chemistry? a) Atomic theory b) The periodic table c) The structure of DNA d) Thermodynamics 4. Which Indian scientist is known for his pioneering work in solid-state and materials chemistry? a) CNR Rao b) Prafulla Chandra Ray c) Har Gobind Khorana d) Govardhan Mehta 5. Which of the following natural substances was traditionally used as a source of acid in ancient Indian chemistry? a) Tamarind b) Turmeric c) Ashwagandha d) Sandalwood 6. Which mineral acid was commonly prepared and used in medieval Indian alchemy? a) Nitric acid b) Sulfuric acid c) Hydrochloric acid d) All of the above 7. Which of the following traditional Indian substances is not acidic? a) Lemon juice

	b) Tamarind extract c) Turmeric paste d) Amla juice 8. The blue dye extracted from <i>Indigofera tinctoria</i> is chemically classified as: a) A flavonoid b) A carotenoid c) An organic nitrogen compound d) A polysaccharide 9. What was the primary source of black ink in ancient Indian manuscripts? a) Charcoal and gum b) Indigo extract c) Hematite powder d) Copper sulfate 10. The <i>Rasaratnasamukāyā</i> and <i>Rasārṇava</i> texts provide detailed knowledge about the distillation of which metal? a) Copper b) Iron c) Zinc d) Gold 11. The lost-wax casting technique (used for making metal sculptures) was widely practiced in: a) Vedic period b) Harappan civilization c) Medieval India d) Modern India 12. Which alloy, widely used in ancient Indian metallurgy, is a mixture of copper and tin? a) Brass b) Bronze c) Pewter d) Bell metal
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Course Category: Major Lab

128214: Lab 6: Identification of various Petroleum products tests							
Level	Semester	Course code	Course Name	Credits	Teaching Hours	Exam Duration	Max marks
5.0	III	128214	Identification of various Petroleum products tests	2	60	4 Hrs	25+25

Course Objectives	- To train the students for basic techniques in petroleum tests. - To introduce the students with handling and working of common IP equipments used in laboratory.
Course Outcomes	After completion of this course students will be able to - Compare flash point and fire point of petroleum samples - Estimate diesel index by using aniline point of given petroleum samples - Determine viscosity of petroleum samples by using slandered Redwood viscometer apparatus - Preparation of chats
List of Practical	
1. Compare Flash point and Fire point of Various petroleum sample by Cleveland open cup apparatus 2. Compare of flash point of various petroleum sample by Abels closed cup apparatus 3. Compare of flash point of various petroleum sample by Pensky Martin apparatus 4. Determination of Copper strip corrosion test for petroleum products 5. Determination of Refractive index of given petroleum sample 6. Determination of diesel index of given petroleum sample 7. Determination of viscosity by redwood viscometer II apparatus. 8. Determination of viscosity index of given petroleum sample 9. Prepare chart of various petroleum products with test prescribed for those test	

Distribution of Marks and the scheme of Practical Examination is as follows:

Section 1: Internal Assessment

• Active participation in activities	10 Marks
• Continuous Assessment Tests (CAT) (At least three tests) *	10 Marks
• Submission of duly certified practical record	05 Marks
Total	25 Marks

*Note: Total Performance in CAT (i.e. 40 %) shall be based on the best two out of three in CAT examinations

Section 2: External Assessment

• Exercise 1	10 Marks
• Exercise 2	10 Marks
• Viva-Voce (external)	05 Marks
Total	25 Marks

Course Category: Minor Theory

128215: Petroleum laboratory test and Introduction to Petrochemical industries and raw material							
Level	Semester	Course code	Course Name	Credits	Teaching Hours	Exam Duration	Max marks
5.0	III	128215	Petroleum laboratory test and Introduction to Petrochemical industries and raw material	2	30	2Hrs	30 + 20 =50

Course Objectives	- Identify the parameter tests for various petroleum products. - Use of hydrocarbons and how these can be converted into building blocks for various petrochemicals and consumer commodities. - Use basic quality monitoring and laboratory test			
Course Outcomes	Upon completion of this course successfully, students would be able to - Apply the knowledge of petroleum tests. - Understand the basic feed stocks utilized in petrochemical Industries. - Recognize the primary raw materials for various Petrochemicals. - Prepare the theoretical background of tests for various petroleum products and their significances.			
Unit System	Contents	Workload Allotted	Weightage of Marks Allotted	Incorporation of Pedagogies
Unit I	Laboratory tests-I Distillation, Flash point, Fire point, Octane number, Aniline point, Diesel index, Calorific value, Smoke Point, Viscosity, Viscosity index. Conradson carbon Residue (CCR).	8 Hrs	8 Marks	Chalk & Board, Power Point Presentation, Videos, Group Discussion, Assignments, surprise quizzes, question and answering sessions
Unit II	Laboratory tests-II Penetration index, Cloud and pour point, Drop point of grease, Melting and Setting point of wax, softening point of bitumen, acidity and alkalinity, Copper strip corrosion test, Density and API Gravity	7 Hrs	7 Marks	
Unit III	Overview of Petrochemical industry History and Development of petrochemical industry in India. Role of MGCC, IPCL, HBJ gas line, TNC, Fertilizer in India.	8 Hrs	8 Marks	
Unit IV	Petrochemical feedstock Feed stock for petrochemical from Natural gas and Petroleum. Primary raw material for petrochemicals:Introduction to paraffinic hydrocarbons, olefinic hydrocarbon, dienes and aromatic hydrocarbons with their properties. uses as building blocks for various petrochemicals.	7 Hrs	7 Marks	
References	Reference Books: 1. Petroleum refining and Petrochemical. N. K. Sinha, Umesh Publication Delhi 2. Advance Petrochemical, Dr. G. N. Sarkar, Khanna Publication, Delhi 3. text on Petrochemical, Dr. B. K. Bhaskararao, Khanna Publication, Delhi 4. Introduction to petrochemical, Sukumar Maiti 5. Fuels and combustion, Samir Sarkar,, Orient Longman Ltd. Hyderabad			

Model Question	Short Type 1. What is distillation? List the type of distillation with their function 2. Define viscosity describe viscosity index 3. Define cloud point name the petroleum fraction for prescribe for this test 4. Define API with their formula 5. Describe role of MGCC 6. What is petrochemical? List petrochemical complexes in India 7. Explain disadvantages of water vapor impurities present I petroleum gas 8. Focus primary raw material used in petrochemical industries Long Type 1. Describe aniline point test prescribed for petroleum fraction with their significance 2. Which test prescribed for middle distillate explain any one in detail 3. Focus history and development of petrochemical industries in India 4. Illustrate various raw material used in petrochemical industries with their example M.C.Q. 1. Which of the following fractions of a crude oil will have the maximum gravity API (i.e. °API)? A) Gasoline B) Diesel C) Vacuum gas oil D) Atmospheric gas oil 2 Cetane number of a diesel fuel is the measure of it's A) ignition delay B) smoke point C) viscosity D) oxidation stability 3 Which of the following has the lowest viscosity (at a given temperature) of all? A) Naphtha B) Diesel C) Lube oil D) Kerosene 4 In India second petrochemical industry was started by..... A) Reliance industries B) NOCIL C) IPCL D) Union carbide 5 The main source of important feedstock for petrochemicals today is.... A) coal B) molasses C) crude oil D) biomass 6 Synthesis gas is mixture of..... A) CO & H₂ B) H₂& N₂ C) CO & CO₂ D) CO₂ & H₂ 7 The average boiling point of ATF is closest to that of _____. A) Diesel B) Lubricating oil C) Kerosene D) LPG
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Course Category: Minor Lab

128216: Lab 7 Petroleum products tests							
Level	Semester	Course code	Course Name	Credits	Teaching Hours	Exam Duration	Max marks
5.0	III	128216	Petroleum products tests	2	60	4 Hrs	25+25

Course Objectives	- To train the students for basic techniques in petroleum tests. - To introduce the students with handling and working of common IP equipments used in laboratory.
Course Outcomes	After completion of this course students will be able to - Identify flash point of petroleum samples - Calculate density and specific gravity of petroleum samples for API gravity - Identify smoke point of various petroleum samples - Estimate diesel index by using aniline point of given petroleum samples - Determine viscosity of petroleum samples by using standered Redwood viscometer apparatus
List of Practical	
- Compare Flash point and Fire point of various petroleum sample by Cleveland open cup apparatus - Compare of flash point of various petroleum sample by Abels closed cup apparatus - Compare of flash point of various petroleum sample by Pensky Martin apparatus - Compare of smoke point of Various petroleum sample - Compare of diesel index of various diesel sample - Determination of viscosity by redwood viscometer I apparatus. - Determination of melting point of wax by melting point apparatus - Preparer chart of various petrochemical industries with their products, Location of industries and establishment year	

Distribution of Marks and the scheme of Practical Examination is as follows:

Section 1: Internal Assessment

• Active participation in activities	10 Marks
• Continuous Assessment Tests (CAT) (At least three tests) *	10 Marks
• Submission of duly certified practical record	05 Marks
Total	25 Marks

*Note: Total Performance in CAT (i.e. 40 %) shall be based on the best two out of three in CAT examinations

Section 2: External Assessment

• Exercise 1	10 Marks
• Exercise 2	10 Marks
• Viva-Voce (external)	05 Marks
Total	25 Marks

Course Category: Generic Open Elective Theory

128217: Overview of petroleum and Petrochemical							
Level	Semester	Course code	Course Name	Credits	Teaching Hours	Exam Duration	Max marks
5.0	III	128217	Overview of petroleum and Petrochemical	2	30	2Hrs	30 + 20 =50

Course Objectives	- To make students to understand composition of petroleum. - To make students acquaint the importance of petroleum in modern society. - To make students to understand basic refinery operations and their roles. - To make students to understand the relevance of Petrochemical Industry. - To make them aware of role of hydrocarbons as starting materials for manufacture of various petrochemicals, feedstock, and consumer commodities. - To make students to understand the various separation processes associated with different hydrocarbons.			
Course Outcomes	Upon completion of this course successfully, students would be able to - Gain knowledge about hydrocarbons, their sources and potential uses. - Recognize the importance of petroleum in modern society. - Have in-depth knowledge of refinery and refinery operations. . understand about Indian Petrochemical Industry. - classify basic Petrochemical Feedstocks their compositions.			
Unit System	Contents	Workload Allotted	Weightage of Marks Allotted	Incorporation of Pedagogies
Unit I	Uses of Petroleum Fuels, Composition of crude oil. Types of hydrocarbons, impurities present in petroleum. Advantages and disadvantages of petroleum, importance of petroleum in the petrochemical sector.	8 Hrs	8 Marks	Chalk & Board, Power Point Presentation, Videos, Group Discussion, Assignments, surprise quizzes, question and answering sessions
Unit II	Formation theories of petroleum, Introduction to prospecting of petroleum. Various petroleum products and their applications, Production and consumption of petroleum products in India. Natural gas and its uses in various field	7 Hrs	7 Marks	
Unit III	Introduction to Petrochemicals, Indian Petrochemical Industry, Role of Petrochemical Industry in India, basic raw materials for Petrochemical Industry, impurities present in the feedstocks.	8 Hrs	8 Marks	
Unit IV	Various separation processes- Steam reforming process for synthesis gas, partial oxidation process, coal gasification: reactions involved, uses of synthesis gas. Introduction to basic petrochemicals that acts as building blocks for various petrochemicals.	7 Hrs	7 Marks	
References	Reference Books: - Petroleum refining and Petrochemical. N. K. Sinha, Umesh Publication Delhi - Advance Petrochemical, Dr. G. N. Sarkar, Khanna Publication, Delhi - text on Petrochemical, Dr. B. K. Bhaskararao, Khanna Publication, Delhi - Introduction to petrochemical, Sukumar Maiti - Fuels and combustion, Samir Sarkar,, Orient Longman Ltd. Hyderabad			

Model Question	Short Type 1. Which is petroleum fuel? Describe with their advantages 2. List impurities present in crude oil with their disadvantages 3. state prospecting method for exploration of crude petroleum 4. What is natural gas? Describe various sources of natural gas with their composition 5. Focus role of petrochemical industries in development of India 6. State the basic raw material used in petrochemical complex 7. List the various products obtained from ethylene 8. focus application of mixture of carbon monoxide and hydrogen Long Type 1. Describe the composition of crude oil with which type hydrocarbon present in crude oil 2. Explain biological formation theory for occurrence of petroleum crude 3. State and explain feed stock used in petrochemical industries with example 4. Describe partial oxidation process for production of synthesis gas with process flow and process description M.C.Q. 1. Indian Refineries Limited was merged with Indian Oil Company Limited to form Indian Oil Corporation Limited in September, A) 1962 B) 1957 C) 1974 D) 1964 2. Which region of the world contains the highest reserves of petroleum? A)Western hemisphere B)Middle East C)Eastern hemisphere D) North Pole 3. Crude petroleum oil is a _____ fuel. A) primary B) fossil C) both (a) & (b) D) secondary 4. Petroleum is found in _____. A) Core of earth B) In Seas C) In air D) Crust of the earth 5. IPCL has a programme of Rs. 4875 crores in _____ to run on going project and starts a grass root cracker at Gandhar. A) 5th Plan B) 6th Plan C) 7th Plan D) 8th Plan 7. Nagaarjuna fertilizer and chemical limited its largest _____ manufacture in south part A) Urea B) Poly-ethylene C) plastic D) resin 8. Which are gases feed stock from following A) Associated gas B) Lean gas C) Refinery off gas D) All Above
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Course Category: Vocational Skill Course (VSC) Lab 8

128218: Lab 8 Basic Operations and safety measures in Laboratory							
Level	Semester	Course Code	Course Name	Credits	Teaching Hours	Exam Duration	Max Marks
5.0	III	128218	VSC Lab 8 Basic Operations and safety measures in Laboratory	2	60	--	50
Course Objectives:	1. To understand the applications of various operation. 2. To Understand the separation methods. 3. Aware the students about the essential safety protocols in a chemical laboratory.						
Course Outcomes:	After completion of the course student should 1. Able to apply basic knowledge in unit operation experiments. 2. Able to extract oil from oil seeds. 3. Able to carry out solvent extraction process. 4. To implement fundamental safety protocols, ensuring a secure working environment in the chemical laboratory.						
Unit System	Content				Incorporation of Pedagogies		
Experiments	1. Distillation of tap water. 2. Distillation of hexane and oil solution. 3. Extraction of oil from oil seed. 4. Separation of two miscible liquids by distillation. 5. Separation of solute by solvent extraction. 6. Separation of immiscible liquid by separating funnel. 7. Recognition of Safety symbols, chemical packings and instruments together with the conception of MSDS. 8. Introduction to pictogram of chemical used. (Acids, Bases, Solvents and Salts) 9. Material Safety Data Sheets with reference to hazardous chemicals like K ₂ Cr ₂ O ₇ , Benzene, Cadmium nitrate, β-naphthol, CCl ₄ and Mercury. 10. Precautions in handling of hazardous substances like conc. acids, ammonia, organic solvents like ether and alcohol. 11. Demonstration of first aid measures for chemical accidents. 12. Demonstration of first aid measures, when chemical materials entered in human body through Eye, Mouth and Skin				Lab Reports: Students prepare detailed lab reports on their findings.		
					Discussion Sessions: Group discussions.		
					Group Projects: Assign group projects on Mass Transfer Operations.		
					Class Debates: Discuss the findings amongst the students.		
References:	Text books: 1. Shivalal Practical Chemistry, Shivalal Agrawal and Co. 2. Laboratory Manual Chemistry by NCERT 3. GCE Chemistry Practical Handbook Department of Science Faculty of Science and Technology National Institute of Education. 4. Text Book: Practical General Chemistry By Dr. Ahmad Al-Owais & Dr. Abdulaziz Al-Wassil. 5. Laboratory Manual for Engineering Chemistry Practical. 6. Engineering Chemistry Laboratory Manual, Maharaj VijayaramGajapathi Raj College of Engineering. 7. Understanding 0 (Zero) level Chemistry Practical 8. A Textbook on Experiments and Calculations in Engineering Chemistry By S.S Dara. S Chand Ltd. 9. Practical Lab Manual of Pharmaceutical Organic Chemistry – I by Dr. Shivendra Kumar Dwivedi, IP Innovative Publication Pvt. Ltd. 10. Instrumental Analysis by Douglas A. Skoog, F. James Holler, Stanley R. Crouch (2006)						
Model Questions:	NA						

Distribution of Marks and the scheme of (VSC) Practical Examination is as follows:

Section I: Continuous Internal Assessment

• Continuous Assessment Tests (CAT) (At least three tests) *	15 Marks
• Submission of duly certified practical record	10 Marks
Total	25 Marks

Section II: End Semester Examination (Internal only)

• Exercise 1	20 Marks
• Viva-Voce (internal)	05 Marks
Total	25 Marks

Total (Section I and II)	50 Marks
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*Note: Total Performance in CAT (i.e. 40 %) shall be based on the best two out of three in CAT examinations

128219: Petrochemical Science (FP/ CEP - I)							
Level	Semester	Course Code	Course Name	Credits	Teaching Hours	Exam Duration	Max Marks
5.0	III	128219	Petrochemical Science (FP/ CEP - I)	2	60	--	50
Course Objectives:	The intended objectives are: • To develop an appreciation of rural culture, lifestyle and wisdom amongst students. • To learn about the status of various agricultural and development programmes. • To understand the causes of distress and poverty faced by vulnerable households and explore solutions for the same. • To apply classroom knowledge of courses to field realities and thereby improve the quality of learning.						
Course Outcomes:	Upon successful completion of this course, students will be able to: 1. Gain an understanding of rural life, Indian culture and ethos and social realities 2. Develop a sense of empathy and bonds of mutuality with the local community 3. Appreciate significant contributions of local communities to Indian society and Economy 4. Learn to value the local knowledge and wisdom of the community 5. Identify opportunities for contributing to community's socio-economic improvements						
Guidelines/ SoP for FP/CEP							
For understanding key principles of CE, forms of CE, operational guidelines and implementation strategy please refer https://www.ugc.gov.in/pdfnews/4187860_Revised-Final-Guidelines.pdf							
As per NEP 2020, students of B Sc. II of Semester III and IV need to perform a Field Project (FP) for TWO (2) credits i.e. 50 Marks. The guidelines regarding the field project are as follows:							
1 The total time allocation for the student to carry out field project is 60 hours. 2 Students should participate in field-based projects under the supervision of faculty. 3 Assignment of project topics to individual students or groups of students (max 4 students in one group) and one faculty member from the department will act as Guide for the student or group of students. 4 For a SURVEY based project related questionnaire (15 or more questions) should be prepared. 5 The departmental coordinator/guide should check the questions and finalize the questionnaire. The question that may create unnecessary complications should be avoided. The questions should be qualitative as well as quantitative. 6 If the project is related to work that does not involve survey work, then the questionnaire part can be replaced accordingly (e.g. Sample collection/Data collection/ Experimental base etc). 7 The student should compile all the relevant data and carry out its analysis. 8 A project report should be written individually in the standard format (2 Copies): Index, Introduction, Materials, Methods, Result, Conclusion/output, References (Numeric citation type) etc. 9 The project report should be of minimum 6 pages (excluding Title page, Certificate, Index, Acknowledgement etc.) Submit the project report with the Guide's signature to the department. 10 The oral /poster presentation for all the projects should be arranged in the department. To evaluate the project, examiner should be appointed by HoD. 11 The total project work including preparation of questionnaire to presentation should be evaluated for 2 credits (50 Marks).							
Some suggested forms of FP/ CEP are:							
1. Linking learning with community service: For example, students of Petrochemical science can conduct petrol (Gasoline) diesel, kerosene and lube oil testing in local areas and share the results with the local community. 2. Linking research with community knowledge: Community-based Participatory Research (CBPR) approaches are gaining recognition in this regard. For example, students of chemistry can undertake research in partnership with the community on solid and liquid waste disposal. 3. Knowledge sharing and knowledge mobilization: These can take the forms of enumerations, surveys, awareness camps and campaigns, training, learning manuals/films, maps, study reports, public hearings, policy briefs, cleanliness and hygiene teachings, legal aid clinics, etc. For example, students can undertake a 'swachhta survekshana' and/or nutrition survey for mothers and children, and educate them about hygiene and nutrition. 4. Social innovations by students: The students can be encouraged to initiate learning projects with a social impact and supported by HEIs. Incubation of such social innovation projects by students can also have meaningful links to existing curriculum and courses							

A few suggested (not exclusive) areas which not only provide practical applications of Petrochemical science concepts but also foster collaboration, education, and sustainable practices within the community. are:

1. Understanding the chemical footprints of household products such as toothpaste, haircare, facecare food products etc
2. Enhance science literacy among school students through interactive chemistry demonstrations.
3. Managing organic waste to composting and improve soil health.
4. Explore the extraction and application of natural dyes as alternatives to synthetic dyes.
5. Identify and mitigate lead exposure risks in the community.
6. Implement a community-wide recycling initiative focusing on chemical waste and recyclable materials.
7. Introduce and demonstrate the principles of renewable energy sources, such as biofuels or solar energy.
8. Assess local air quality and raise awareness about pollution sources and mitigation strategies.
9. Educate community members on the safe use, storage, and disposal of household chemicals.
10. Assist local farmers in understanding soil nutrient content and composition to optimize crop production.
11. Evaluate local water sources for contaminants such as heavy metals, nitrates, and pH levels.

References	1. https://www.ugc.gov.in/pdfnews/4187860_Revised-Final-Guidelines.pdf 2. https://en.wikipedia.org/wiki/OU_Citizen_Science_Soil_Collection_Program 3. https://www.immerse.education/study-tips/100-ideas-for-research-projects-in-chemistry/ 4. https://pubs.rsc.org/en/content/articlelanding/2021/rp/d0rp00374c 5. https://www.acs.org/education/student-communities/activities.html 6. https://www.nettercenter.upenn.edu/academically-based-community-service-chemistry-outreach
Model Questions:	NA

Distribution of Marks and the scheme of FP/CEP Examination is as follows:

- | | |
|--|----------|
| • Students’ performance | 20 Marks |
| • Submission of duly certified FP/CEP report | 20 Marks |
| • Presentation (PPT or Poster) | 10 Marks |

Total	50 Marks
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Course: B.Sc. II Semester IV (Petrochemical Science)

Course Category: Major Theory

128220: Cracking and Reforming of Petroleum-I							
Level	Semester	Course code	Course Name	Credits	Teaching Hours	Exam Duration	Max marks
5.0	IV	128220	Cracking and Reforming of Petroleum-I	2	30	2Hrs	30 + 20 = 50

Course Objectives	- Know the various process used in petroleum industries - Basic effect of raw material and operating condition - Visualizes chemical Reaction occurred in various process			
Course Outcomes	Upon completion of this course successfully, students would be able to - Understand the objectives of conversion processes like cracking & reforming - Apply the concepts, mechanism and chemistry involved in the conversion processes - Recognizes of process parameters involved in the conversion processes and optimizing process parameters - To control the product composition and product characteristics as per the requirement .			
Unit System	Contents	Workload Allotted	Weightage of Marks Allotted	Incorporation of Pedagogies
Unit I	Thermal Cracking - Introduction to thermal cracking - Mechanism for thermal cracking - Thermal Cracking reactions - Effect of operating variables on cracking - Properties of cracked material	8 Hrs	8 Marks	Chalk & Board, Power Point Presentation, Videos, Group Discussion, Assignments, surprise quizzes, question and answering sessions
Unit II	Catalytic Cracking - Introduction to catalytic cracking - Mechanism for catalytic cracking - Reactions in catalytic cracking - Feed stocks and catalytic cracking conditions - Composition and structure of cracking catalysts (Zeolites) - Difference between amorphous silica-alumina and zeolites	7 Hrs	7 Marks	
Unit III	Hydro cracking - Introduction to hydrocracking. - Hydrocracking reactions - Advantages of hydrocracking - Reactions in catalytic hydrocracking - Hydrocracking catalysts - Process variables	8 Hrs	8 Marks	
Unit IV	Reforming - Introduction to thermal reforming - Introduction to catalytic reforming - Reforming feedstock & catalysts - Reforming reactions and chemistry involved	7 Hrs	7 Marks	
References	Text books: - Petroleum refining and Petrochemical. N. K. Sinha, Umesh Publication Delhi - Advance Petrochemical, Dr. G. N. Sarkar, Khanna Publication, Delhi - text on Petrochemical, Dr. B. K. Bhaskararao, Khanna Publication, Delhi - Introduction to petrochemical, Sukumar Maiti - Fuels and combustion, Samir Sarkar,, Orient Longman Ltd. Hyderabad - Modern Petroleum Refining Processes, B.K. Bhaskara Rao, Oxford and IBH Publication, New Delhi Reference Books: - Fundamentals of Petroleum and Petrochemical Engineering by Uttam Ray Chaudhuri CRC press - The Chemistry and technology of Petroleum 4th edition by James G. Speight CRC Press - Systematic Experimental Physical Chemistry, S. W. Rajbhoj, Dr. T. K. Chondhekar, Anjali Publication, Aurangbad - Petroleum Refining technology, Dr. Ram Prasad, Khanna Publication, Delhi - Industrial Organic Chemistry, K. Weissermel, and H. J. Arpe, Veriagchemie, New York - Chemical From Petroleum, A.L. Waddms, Murry, London			

	7. An Introduction to industrial organic chemistry, P. Wiseman, Applied Science, London
Model Questions	Short Type 1 Define thermal cracking 2 List the type of thermal cracking 3 Which mechanism involved in catalytic cracking operation 4 Which changes observed in cracking products 5 Define hydrocracking 6 Define reforming with example Long Type 1. Illustrate mechanism of thermal cracking 2. Classify thermal cracking reaction 3. Describe various feed stocks used in catalytic cracking operation 4. List the various cracking catalyst with their composition 5. Explain which reaction involved in hydrocracking operation 6. Explain importance hydrocracking operation in petroleum field 7. Describe reaction involved I reforming operation M.C.Q. 1. What type of reaction is thermal cracking? A) Exothermic B) Endothermic C) Isothermal D) Adiabatic 2. Which of the following is a solid byproduct of thermal cracking? A) Charcoal B) Coke C) Butane D) Sodium chloride 3. What is the primary purpose of thermal cracking in petroleum refining? A) To remove sulfur compounds B) To convert heavy hydrocarbons into lighter ones C) To increase the viscosity of fuels D) To polymerize small molecules 4. Which catalyst is commonly used in fluid catalytic cracking (FCC)? A) Platinum B) Zeolite C) Iron oxide D) Nickel 5. What is the main advantage of catalytic cracking over thermal cracking? A) Lower operational cost B) Higher yield of gasoline C) Simpler equipment D) No catalyst regeneration required 6. In FCC, what is the purpose of the regenerator? A) To cool down the cracked products B) To remove sulfur compounds C) To burn off coke deposits from the catalyst D) To separate different hydrocarbon fractions 7. Hydrocracking is typically conducted in the presence of: A) Oxygen B) Hydrogen C) Nitrogen D) Carbon dioxide 8. Which of the following is an advantage of hydrocracking? A) Produces high-sulfur fuels B) Operates at low pressure C) Produces high-octane gasoline D) Requires no catalyst 9. Hydrocracking catalysts are typically: A) Monofunctional B) Bifunctional C) Trifunctional D) Non-functional

Course: B.Sc. II Semester IV (Petrochemical Science)

Course Category: Major Theory

128221: Cracking and Reforming of Petroleum-II							
Level	Semester	Course code	Course Name	Credits	Teaching Hours	Exam Duration	Max marks
5.0	IV	128221	Cracking and Reforming of Petroleum-II	2	30	2Hrs	30 + 20 = 50

Course Objectives	- Identify the cracking and reforming Process for petroleum - Effect of operating variable on processes - By using process diagram understand the actual working			
Course Outcomes	Upon completion of this course successfully, students would be able to - Understand the objectives of conversion processes like cracking & reforming - Apply the concepts, mechanism and chemistry involved in the conversion processes - Recognizes of process parameters involved in the conversion processes and optimizing process parameters - To control the product composition and product characteristics as per the requirement.			
Unit System	Contents	Workload Allotted	Weightage of Marks Allotted	Incorporation of Pedagogies
Unit I	Thermal Cracking Processes - Vis-breaking: operation and description operating conditions and products - Coking: Delayed and fluid coking - Steam naphtha cracking: Various routes Chemistry, Process parameters, flow scheme. - Composition of pyrolysis products - Break up of ethylene market - Ethylene product tree	8 Hrs	8 Marks	Chalk & Board, Power Point Presentation, Videos, Group Discussion, Assignments, surprise quizzes, question and answering sessions
Unit II	Catalytic cracking processes - Various cracking processes - Types and working of catalytic processes - Reaction variables and operating modes - Impact of catalyst to oil contact time on selectivity - Houdry fixed bed cracking unit - Modern fluidized bed catalytic cracking unit - Product profile of catalytic crackers - Recovery of propane and propylene from cracked gases - Relative yields of propylene and ethylene from various hydrocarbon feed stocks - Market for propylene Tree diagram of propylene products	7 Hrs	7 Marks	
Unit III	Hydro cracking process - Available hydro-cracking processes - Isomax process H. G. Hydrocracking - Moving bed Hydrocracking - Hydro-desulfurization. - Hydrotreatment and Hydrofining	8 Hrs	8 Marks	
Unit IV	Reforming Process Process flow and description of - Platforming - Fixed-bed, - Moving bed and - Fluidized bed catalytic reforming - Reaction conditions effect of temperature and pressure	7 Hrs	7 Marks	

References	Text books: 1. Petroleum refining and Petrochemical. N. K. Sinha, Umesh Publication Delhi 2. Advance Petrochemical, Dr. G. N. Sarkar, Khanna Publication, Delhi 3. text on Petrochemical, Dr. B. K. Bhaskararao, Khanna Publication, Delhi 4. Introduction to petrochemical, Sukumar Maiti 5. Fuels and combustion, Samir Sarkar,, Orient Longman Ltd. Hyderabad 6. Modern Petroleum Refining Processes, B.K. Bhaskara Rao, Oxford and IBH Publication, New Delhi Reference Books: 1. Fundamentals of Petroleum and Petrochemical Engineering by Uttam Ray Chaudhuri CRC press 2. The Chemistry and technology of Petroleum 4th edition by James G. Speight CRC Press 3. Systematic Experimental Physical Chemistry, S. W. Rajbhoj, Dr. T. K. Chondhekar, Anjali Publication, Aurangbad 4. Petroleum Refining technology, Dr. Ram Prasad, Khanna Publication, Delhi 5. Industrial Organic Chemistry, K. Weissmermel, and H. J. Arpe, Veriagchemie, New York 6. Chemical From Petroleum, A.L. Waddms, Murry, London 7. An Introduction to industrial organic chemistry, P. Wiseman, Applied Science, London
Model Questions	Short Type 1. Define Vis-breaking with example 2. Draw ethylene product tree 3. Draw well label diagram of fixed bed catalytic cracking process 4. List the market for propylene 5. State the various hydrocracking process 6. Draw well label diagram of Isomax hydrocracking process 7. Illustrate platformng with example Long Type 1. Explain two coil process for visbreaking operation 2. Illustrate Delayed coking operation for production of coke 3. Explain Hourdy fixed bed catalytic cracking process in detail 4. Draw and explain recovery of propane and propylene 5. Describe moving bed hydrocracking process 6. Explain hydrodesulphurization with example 7. Elaborate reaction involved in reforming operationn MCQs 1. What is the primary objective of visbreaking in petroleum refining? A) Increase gasoline yield B) Reduce viscosity of residual oils C) Produce ethylene D) Remove sulfur compounds 2. Which of the following is a characteristic product of delayed coking? A) High-octane gasoline B) Ethylene C) Petroleum coke D) Diesel 3. In steam naphtha cracking, the primary product is: A) Propane B) Butane C) Ethylene D) Methane 4. Which of the following is a major component in the composition of pyrolysis products? A) Methanol B) Ethylene C) Acetone D) Benzene 5. The largest consumer segment in the ethylene market is: A) Polyethylene production B) Ethylene oxide production C) Styrene production D) Vinyl chloride production

	6. Which of the following is a fixed-bed catalytic cracking process? A) Houdry process B) Fluid catalytic cracking (FCC) C) Thermal cracking D) Hydrocracking 7. In catalytic cracking, increasing the catalyst-to-oil ratio generally: A) Decreases gasoline yield B) Increases coke formation C) Improves selectivity towards desired products D) Reduces reaction temperature 8. Which catalyst is commonly used in modern fluidized bed catalytic cracking units? A) Alumina B) Silica C) Zeolites D) Iron oxide 9. The primary purpose of the regenerator in an FCC unit is to: A) Cool the reactor B) Burn off coke from the catalyst C) Separate products D) Hydrogenate feedstock 10. Which hydrocarbon feedstock yields the highest amount of propylene upon cracking? A) Naphtha B) Gas oil C) Propane D) Butane 11. The Isomax process is associated with: A) Catalytic reforming B) Hydrocracking C) Thermal cracking D) Visbreaking 12. Which of the following is a key advantage of hydrocracking? A) High sulfur content in products B) Low hydrogen consumption C) Production of high-quality middle distillates D) Operation at atmospheric pressure 13. Hydrotreatment primarily aims to: A) Increase octane number B) Remove impurities like sulfur and nitrogen C) Crack heavy hydrocarbons D) Polymerize olefins 14. In hydrodesulfurization, the primary reactant used to remove sulfur is: A) Oxygen B) Hydrogen C) Nitrogen D) Methane 15. Moving bed hydrocracking differs from fixed bed in that: A) Catalyst is stationary B) Catalyst moves continuously C) No catalyst is used D) Reaction occurs without hydrogen
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Course: B.Sc. II Semester IV (Petrochemical Science)

Course Category: Major Theory

128229: Rebuilding of Hydrocarbon/Extraction/ Corrosion							
Level	Semester	Course code	Course Name	Credits	Teaching Hours	Exam Duration	Max marks
5.0	IV	128229	Rebuilding of Hydrocarbon/Extraction/ Corrosion	2	30	2Hrs	30 + 20 = 50

Course Objectives	- Study the Isomerization Alkylation Process for Rebuilding of petroleum - Effect of Corrosion on processes - By using process diagram understand the actual working			
Course Outcomes	Upon completion of this course successfully, students would be able to - Understand the objectives of conversion processes like Alkylation & Isomerization - Apply the concepts, mechanism and chemistry involved in the conversion processes - Recognizes of process parameters involved in the conversion processes and optimizing process parameters - To Understand Extraction process for recovery from complex mixture.			
Unit System	Contents	Workload Allotted	Weightage of Marks Allotted	Incorporation of Pedagogies
Unit I	Rebuilding Of Hydrocarbon:- Alkylation- Introduction, Feedstock, Chemistry, Cascads sulfuric acid alkylation, H. F. alkylation. Isomerization:- Introduction, Definition, Processes (Process flow diagram & Process parameter) Polymer gasoline production processes.	8 Hrs	8 Marks	Chalk & Board, Power Point Presentation, Videos, Group Discussion, Assignments, surprise quizzes, question and answering sessions
Unit II	Polymerization for H. C. Production:- Introduction, Mechanism, Polymerization in Presence of Sulphuric acid & Phosphoric acid (Process diagram and Process description) Define the processes and their Hydro carbon Products (Oxidation, Hydration, Halogenation, Nitration, De-polymerization, Hydrogenation, Dehydrogenation)	7 Hrs	7 Marks	
Unit III	Extraction:- Introduction, Principle, Process Definition of term related extraction (Like Partition coefficient, Partial Solubility, Solvent to feed ratio, Solvent recovery, separation of Phases, Selectivity, Solvent power, and critical solution temperature) Batch extraction, Continuous extraction. (Process Flow, Description & Process Parameter)	8 Hrs	8 Marks	
Unit IV	Corrosion Control:- Type of corrosion, Forms of Corrosion. Corrosion control in ADU, VDU, Thermal and Catalytic Cracking operation, Gas Processing. Corrosion control in Steam and Condensate line:- Introduction, Causes, Control.	7 Hrs	7 Marks	
References	Text books: 1. Petroleum refining and Petrochemical. N. K. Sinha, Umesh Publication Delhi 2.Advance Petrochemical, Dr. G. N. Sarkar, Khanna Publication, Delhi 3. text on Petrochemical, Dr. B. K. Bhaskararao, Khanna Publication, Delhi 4. Introduction to petrochemical, Sukumar Maiti 5. Fuels and combustion, Samir Sarkar,, Orient Longman Ltd. Hyderabad 6. Modern Petroleum Refining Processes, B.K. Bhaskara Rao, Oxford and IBH Publication, New Delhi Reference Books: 1. Fundamentals of Petroleum and Petrochemical Engineering by Uttam Ray Chaudhuri CRC press 2. The Chemistry and technology of Petroleum 4 th edition by James G. Speight CRC Press			

	3. Systematic Experimental Physical Chemistry, S. W. Rajbhoj, Dr. T. K. Chondhekar, Anjali Publication, Aurangbad 4. Petroleum Refining technology, Dr. Ram Prasad, Khanna Publication, Delhi 5. Industrial Organic Chemistry, K. Weissmehl, and H. J. Arpe, Veriagchemie, New York 6. Chemical From Petroleum, A.L. Waddms, Murry, London 7. An Introduction to industrial organic chemistry, P. Wiseman, Applied Science, London
Model Questions	Short Type 1) Define Alkylation with example 2) List the alkylation Process with their advantages 3) Draw well label diagram of fixed bed catalytic cracking process 4) Define Hydrogenation with example 5) State the polymerize gasoline 6) Define Extraction with example 7) List the type of Corrosion Long Type 1. Explain Alkylation process with process diagram and process parameter 2. Illustrate Polymer gasoline with process flow 3. Explain extraction in petroleum with their advantages 4. Describe corrosion in ADU process MCQs 1. Alkylation mainly produced A) Wax B) Diesel C) High octane Gasoline D) LPG 2. Raw material for Alkylation process is A) Benzene + Toluene B) Isobutane + Olifine C) Petroleum coke D) Methane + Ethane 3. Which compound commonly cause corrosion in petroleum industries A) Propane B) Butane C) Ethylene D)Hydrogen sulfide 4. HCL corrosion in refineries is due to A) Decomposition of salt B) Oxidation reaction C) Nitration reaction D) Methane Oxidation

Course Category: Major Lab-10

128222: Lab 10 Experiment to identify various parameter							
Level	Semester	Course code	Course Name	Credits	Teaching Hours	Exam Duration	Max marks
5.0	IV	128222	Experiment to identify various parameter	2	60	4 Hrs	25+25

Course Objectives	- To train the students for basic techniques in petroleum tests. - To introduce the students with handling and working of common IP equipments used in laboratory.
Course Outcomes	After completion of this course students will be able to - Identify CCR for CDE - Estimate moisture, volatile and fix carbon in given coal sample - To know separation of binary mixture according to boiling point - Identify fractional distillation
List of Practical 1. Calculate proximate analysis of coal 2. Determination of carbon residue of given petroleum sample 3. Determination of bromine number of given sample. 4. Determination of Iodine number of given sample 5. ASTM distillation of petroleum sample 6. Simple distillation of binary mixture 7. Determination of Cloud point of given petroleum sample 8. Determination of pour point of given petroleum sample	

Distribution of Marks and the scheme of Practical Examination is as follows:

Section 1: Internal Assessment

• Active participation in activities	10 Marks
• Continuous Assessment Tests (CAT) (At least three tests) *	10 Marks
• Submission of duly certified practical record	05 Marks
Total	25 Marks

*Note: Total Performance in CAT (i.e. 40 %) shall be based on the best two out of three in CAT examinations

Section 2: External Assessment

• Exercise 1	10 Marks
• Exercise 2	10 Marks
• Viva-Voce (external)	05 Marks
Total	25 Marks

Course Category: Minor Theory 11

128223: Introduction to Cracking processes							
Level	Semester	Course code	Course Name	Credits	Teaching Hours	Exam Duration	Max marks
5.0	IV	128223	Introduction to Cracking processes	2	30	2Hrs	30 + 20 =50

Course Objectives	- Know cracking processes and their importance. - Understand reaction mechanism of cracking processes - Understand market of ethylene and propylene						
Course Outcomes	Upon completion of this course successfully, students would be able to - Understand the objectives of conversion processes like cracking. - Apply the concepts, mechanism and chemistry involved in the conversion processes - To control the product composition and product characteristics as per the requirement.						
Unit System	Contents	Workload Allotted	Weightage of Marks Allotted	Incorporation of Pedagogies			
Unit I	Introduction to thermal cracking Mechanism for thermal cracking Thermal Cracking reactions Effect of operating variables on cracking Properties of cracked material	8 Hrs	8 Marks	Chalk & Board, Power Point Presentation, Videos, Group Discussion, Assignments, surprise quizzes, question and answering sessions			
Unit II	Vis-breaking: operation and description operating conditions and advantages Coking: Delayed coking Introduction Steam naphtha cracking: Various routes Chemistry, Process parameters, flow scheme. ethylene market Ethylene product tree	7 Hrs	7 Marks				
Unit III	Introduction to catalytic cracking Mechanism for catalytic cracking Reactions in catalytic cracking Feed stocks and catalytic cracking conditions Introduction to hydrocracking	8 Hrs	8 Marks				
Unit IV	Recovery of propane and propylene from cracked gases Relative yields of propylene and ethylene from various hydrocarbon feed stocks Market for propylene Tree diagram of propylene products Isomax process for hydrocracking	7 Hrs	7 Marks				

References	Reference Books: 1. Petroleum refining and Petrochemical. N. K. Sinha, Umesh Publication Delhi 2. Advance Petrochemical, Dr. G. N. Sarkar, Khanna Publication, Delhi 3. text on Petrochemical, Dr. B. K. Bhaskararao, Khanna Publication, Delhi 4. Introduction to petrochemical, Sukumar Maiti 5. Fuels and combustion, Samir Sarkar,, Orient Longman Ltd. Hyderabad
Model Question	Short Type 1. What is thermal cracking? 2. What is the primary mechanism involved in thermal cracking? 3. Name two main products of thermal cracking. 4. What is delayed coking? 5. What is steam naphtha cracking? 6. What is catalytic cracking? 7. What catalysts are commonly used in catalytic cracking? 8. How are propane and propylene recovered from cracked gases? 9. What is the Isomax process? Long Type 1. Describe the methods used for the recovery of propane and propylene from cracked gases and their significance in the petrochemical industry. 2. Elaborate on the Isomax hydrocracking process, its operating conditions, and its advantages in refining operations. 3. Discuss the process of steam naphtha cracking, including the chemistry involved, process parameters, and the significance of the ethylene product tree. 4. Compare and contrast thermal cracking, catalytic cracking, and hydrocracking in terms of mechanisms, operating conditions, catalysts used, and product distribution. 5. Describe the process of catalytic cracking, highlighting the role of catalysts and the advantages over thermal cracking. 6. Explain the mechanism of thermal cracking and discuss the factors influencing the yield and composition of the products. M.C.Q. 1. What is the primary purpose of thermal cracking in petroleum refining? A) To remove sulfur compounds B) To convert heavy hydrocarbons into lighter ones C) To increase the viscosity of fuels D) To polymerize small molecules 2. Which of the following is a solid byproduct of thermal cracking? A) Charcoal B) Coke C) Butane D) Sodium chloride 3. In thermal cracking, the reaction is: A) Exothermic B) Endothermic C) Isothermal D) Adiabatic 4. Which method is used to separate cracked products in thermal cracking? A) Destructive distillation B) Fractional distillation C) Steam distillation D) Vacuum distillation 5. What is the main objective of visbreaking in petroleum refining? A) To increase gasoline yield B) To reduce viscosity of residual oils C) To produce ethylene D) To remove sulfur compounds 6. Which of the following is a characteristic product of delayed coking? A) High-octane gasoline B) Ethylene C) Petroleum coke D) Diesel 7. In steam naphtha cracking, the primary product is: A) Propane B) Butane C) Ethylene D) Methane 8. Which of the following is a major component in the composition of pyrolysis products? A) Methanol B) Ethylene C) Acetone D) Benzene 9. The largest consumer segment in the ethylene market is: A) Polyethylene production B) Ethylene oxide production C) Styrene production D) Vinyl chloride production

Course Category: Minor Lab

128224: Lab 11: Exercise to identify various parameter of petroleum products							
Level	Semester	Course code	Course Name	Credits	Teaching Hours	Exam Duration	Max marks
5.0	IV	128224	Exercise to identify various parameter of petroleum products	2	60	4 Hrs	25+25

Course Objectives	- To train the students for basic techniques in petroleum tests. - To introduce the students with handling and working of common IP equipments used in laboratory.
Course Outcomes	After completion of this course students will be able to - Identify CCR for CDE - Estimate moisture, volatile and fix carbon in given coal sample - To know separation of binary mixture according to boiling point - Identify fractional distillation
List of Practical	
- Calculate proximate analysis of coal - Determination of carbon residue of given petroleum sample (Grease) - Determination of bromine number of given sample - Determination of Iodine number of given sample - ASTM distillation of petroleum sample (Petrol or Gasoline) - Simple distillation of binary mixture (Oil and Hexane) - Determination of Cloud point of given petroleum sample (Diesel oil) - Determination of pour point of given petroleum sample (Lube oil)	

Distribution of Marks and the scheme of Practical Examination is as follows:

Section 1: Internal Assessment

• Active participation in activities	10 Marks
• Continuous Assessment Tests (CAT) (At least three tests) *	10 Marks
• Submission of duly certified practical record	05 Marks
Total	25 Marks

*Note: Total Performance in CAT (i.e. 40 %) shall be based on the best two out of three in CAT examinations

Section 2: External Assessment

• Exercise 1	10 Marks
• Exercise 2	10 Marks
• Viva-Voce (external)	05 Marks
Total	25 Marks

Course Category: Generic Open Elective Theory

128225: Chemical based on Some Paraffin and Olefin							
Level	Semester	Course code	Course Name	Credits	Teaching Hours	Exam Duration	Max marks
5.0	IV	128225	Chemical based on Some Paraffin and Olefin	2	30	2Hrs	30 + 20 =50

Course Objectives	- To make students to understand products from paraffin and olefin. - To make students acquaint the importance raw materials used in petrochemical industries . - To make students to understand basic manufacture processes. - To make students to understand the relevance of Petrochemical Industry. - To make them aware of role of paraffin and olefin as starting materials for manufacture of various petrochemicals, feedstock, and consumer commodities.			
Course Outcomes	Upon completion of this course successfully, students would be able to - Gain knowledge about paraffin and olefin their sources and potential uses. - Recognize the importance of oxidation, chlorination reactions - Have in-depth knowledge of products obtained from paraffin and olefin.			
Unit System	Contents	Workload Allotted	Weightage of Marks Allotted	Incorporation of Pedagogies
Unit I	Chemical based on Ethane, Propane, N-Butane and Iso-butane. With products, Process parameter, Chemical reaction and uses	8 Hrs	8 Marks	Chalk & Board, Power Point Presentation, Videos, Group Discussion, Assignments, surprise quizzes, question and answering sessions
Unit II	Chemical based on Ethylene Oxidation of ethylene, oxidative carbonylation of ethylene, chlorination of ethylene and hydration of ethylene with chemical reaction and process parameter	7 Hrs	7 Marks	
Unit III	Chemical based on Propylene Oxidation of Propylene, oxyacylation of Propylene, chlorination of Propylene and hydration of Propylene with chemical reaction and process parameter	8 Hrs	8 Marks	
Unit IV	C4 Olefins Chemical Chemical from n-butene, Isobutene. with chemical reaction and process parameter	7 Hrs	7 Marks	
References	Reference Books: - Petroleum refining and Petrochemical. N. K. Sinha, Umesh Publication Delhi - Advance Petrochemical, Dr. G. N. Sarkar, Khanna Publication, Delhi - text on Petrochemical, Dr. B. K. Bhaskararao, Khanna Publication, Delhi - Introduction to petrochemical, Sukumar Maiti - Fuels and combustion, Samir Sarkar, Orient Longman Ltd. Hyderabad - Chemistry of petrochemical processes, second edition, Sami Matar Lewis F. Hatch			
Model Question	Short Type - What is the primary product obtained from the steam cracking of ethane? - Write the chemical reaction for the dehydrogenation of ethane. - What is the typical temperature range for steam cracking of ethane? - Name a common catalyst used in propane dehydrogenation - What is a major use of isobutane in the petrochemical industry?			

	6. What is the primary use of ethylene oxide? 7. What is the main product of propylene oxidation? 8. Name a major use of propylene oxide. Long Type 1. Explain the mechanism of thermal cracking and discuss the factors affecting the yield and composition of the cracked products. 2. Describe the process of vis-breaking, including its operating conditions, advantages, and the types of products obtained. 3. Compare and contrast delayed coking and fluid coking processes in terms of their operation, products, and applications. 4. Outline the steam naphtha cracking process, detailing the various routes, chemistry involved, process parameters, and a typical flow scheme. 5. Discuss the composition of pyrolysis products obtained from steam cracking and explain the significance of the ethylene market and its product tree. 6. Provide an overview of the hydrocracking process, including its reactions, advantages, and typical catalysts used. 7. Describe the Isomax process for hydrocracking, detailing its operation, catalysts, and applications in the petrochemical industry. 8. Explain the differences between thermal reforming and catalytic reforming processes, including their feedstocks, catalysts, and reaction conditions. M.C.Q. 1: What is the primary product obtained from the steam cracking of ethane? a) Methane b) Ethylene c) Propylene d) Butadiene 2: Which catalyst is commonly used in the oxidative dehydrogenation of ethane to produce ethylene? a) Vanadium oxide b) Platinum c) Nickel d) Iron oxide 3. The dehydrogenation of propane primarily yields: a) Methane b) Ethylene c) Propylene d) Butylene 4. Which process is used for the selective oxidation of propane to acrylic acid? a) Steam reforming b) Ammonoxidation c) Hydroformylation d) Friedel-Crafts acylation 5.The oxidation of n-butane in the presence of a catalyst produces: a) Maleic anhydride b) Acetic acid c) Formaldehyde d) Methanol 6. The hydration of ethylene produces: a) Methanol b) Ethanol c) Acetaldehyde d) Acetic acid 7. Hydration of propylene yields: a) Isopropanol b) Methanol c) Ethanol d) n-Propano 8. The oxidation of propylene leads to the formation of: a) Acetone b) Acrylic acid c) Acetic acid d) Formaldehyde
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Course Category: **Vocational Skill Course VSC**

128226: Lab 12 Petroleum Geology							
Level	Semester	Course Code	Course Name	Credits	Teaching Hours	Exam Duration	Max Marks
5.0	IV	128226	Lab 12: Petroleum Geology	2	60	4 Hrs	50
Course Objectives:		The intended objectives are: 1. To develop practical skills in identification of rocks and fossils. 2. To understand structures of sedimentary rocks					
Course Outcomes:		Upon successful completion of this course, students will be able to: 1. Understand Petroleum geology. 2. Study types of various type of sedimentary rocks 3. Apply the microscopic analysis of rocks and fossils 4. Understand formation of kerogen					
Unit System		Contents			Incorporation of Pedagogies		
Tutorial and Discussion		A. Study of sedimentary Rocks Introduction, Formation, Environment of formation, Classification of sedimentary, Structure of sedimentary Rocks Important sedimentary Rocks, Sandstone, Shale, Limestone and Dolomite B. Shale and Petroleum Modern organic deposits, Oil shale's, Formation of kerogen, Petroleum composition and occurrence, Transformation of organic matter into petroleum Bacterial action, Evolution of hydrogen Exercise Identification of various Megascopic Sedimentary Rocks Identification of various Fossils			Chalk & Board, Power Point Presentation, Videos, Group Discussion, Assign ments, surprise quizzes, question and answering sessions		
References		1. Engineering and General Geology, Prof . Prabin Singh S. K. Kataria & Sons 2. A text book of general Geology G. B. Mahapatra CBS publishers & distributors 3. Sedimentary Petrology 3 rd edition Maurice E. Tuekar CBS publishers & distributors 4. Geology of Petroleum A. L. Levorsend 2 nd edition CBS publishers & distributors					
Model Questions:		NA					

Distribution of Marks and the scheme of (VSC) Practical Examination is as follows:

Section I: Continuous Internal Assessment

- Continuous Assessment Tests (CAT) (At least three tests) * 15 Marks
 - Submission of duly certified practical record 10 Marks
- Total 25 Marks**

Section II: End Semester Examination (Internal only)

- Exercise 1 20 Marks
 - Viva-Voce (internal) 05 Marks
- Total 25 Marks**
- Total (Section I And II) 50 Marks**

*Note: Total Performance in CAT (i.e. 40 %) shall be based on the best two out of three in CAT examinations

128227: Lab 13 Fundamentals of Titrimetric Analysis							
Level	Semester	Course Code	Course Name	Credits	Teachig Hours	Exam Duration	Max Marks
5.0	IV	128227	Lab 13: Fundamentals of Titrimetric Analysis	2	60	4 Hrs	50
Course Objectives:		1.To comprehend the theoretical foundations of acid-base, redox, complexometric, and precipitation titrations, including the role of indicators, equivalence points, and stoichiometry. 2.To gain hands-on experience in accurately preparing solutions, standardizing reagents, and performing titrations across various categories (e.g., acid-base, redox, EDTA, Mohr’s method). 3.To accurately calculate molarity, percent composition, and unknown concentrations using titration data, applying correct formulas and error analysis. 4.To relate titration methods to real-world applications, such as quality control in food, pharmaceuticals, water treatment, and environmental analysis.					
Course Outcomes:		1.Upon successful completion of this course, students will be able to: 2.Understand the Principles of Titration Techniques 3.Develop Proficiency in Performing Different Titration Methods 4.Analyze and Interpret Experimental Data 5.Apply Titration Techniques to Real-Life and Industrial Scenarios					
Unit System		Contents			Incorporation of Pedagogies		
		Acid-Base Titrations 1. Standardization of NaOH using Oxalic Acid 2. Determination of Acetic Acid Content in Vinegar 3. Determination of Citric Acid in Lemon Juice 4. Titration of Strong Acid (HCl) with Strong Base (NaOH) 5. Titration of Weak Acid (CH ₃ COOH) with Strong Base (NaOH) 6. Determination of Unknown Concentration of H ₂ SO ₄ using NaOH 7. Back Titration of Calcium Carbonate in Chalk 8. Titration of Antacid Tablets to Determine Neutralizing Capacity. B. Redox Titrations 9. Standardization of KMnO ₄ using Oxalic Acid 10. Estimation of Iron (Fe ²⁺) Using KMnO ₄ 11. Estimation of Hydrogen Peroxide (H ₂ O ₂) Using KMnO ₄ 12. Titration of Sodium Thiosulfate with Iodine (Iodometry) 13. Estimation of Copper (II) using Iodometric Titration 14. Estimation of Vitamin C (Ascorbic Acid) by Iodine Titration C. Complexometric Titrations 15. Determination of Hardness of Water Using EDTA 16. Estimation of Mg ²⁺ and Ca ²⁺ Ions in a Water Sample (Separate/Combined) 17. Standardization of EDTA Solution Using Zinc Sulfate D. Precipitation Titrations 18. Mohr’s Method – Determination of Chloride Ion Using AgNO ₃ 19. Volhard’s Method – Back Titration of Chloride Ions Using Fe ³⁺ Indicator			Chalk & Board, Power Point Presentation, Videos, Group Discussion, Assign ments, surprise quizzes, question and answering sessions Assessment through Reflective Learning Encourage students to maintain lab journals for recording observations and interpretations. Conduct oral presentations and report writing to develop scientific communication skills.		

References	1. Vogel's Textbook of Quantitative Chemical Analysis – G.H. Jeffery et al. 2. A Textbook of Practical Chemistry – V.S. Kulkarni, G.H. Hegde 3. Laboratory Manual in Organic and Inorganic Chemistry – R.K. Bansal 4. Practical Chemistry for Class 12 (NCERT) – NCERT (India) 5. Comprehensive Practical Chemistry (Laxmi Publications) – Dr. J.N. Gurtu & Dr. R. Kapoor 6. Practical Chemistry Lab Manual – O.P. Agarwal 7. Introductory Practical Chemistry – G.S. Sodhi 8. Analytical Chemistry: A Modern Approach to Analytical Science – David Harvey 9. Practical Analytical Chemistry – M. Satake, Y. Sugiura et al. 10. Experiments in General Chemistry – C. H. Sorum Web resources: 1. Acid-Base Titration Procedure https://alameda.edu/wp-content/uploads/2024/08/Titration-short-version-of-Lab-11.pdf 2. Redox Titration Lab Guide https://study.com/academy/lesson/redox-titration-lab.html 3. Complexometric Titration with EDTA https://chem.libretexts.org/Ancillary_Materials/Demos_Techniques_and_Experiments/General_Lab_Techniques/Titration/Complexation_Titration 4. Precipitation Titration: Determination of Chloride by the Mohr Method https://www.uobabylon.edu.iq/eprints/publication_3_16276_250.pdf 5. Iodometric Titration Procedure https://usptechnologies.com/iodometric-titration/
Model Questions:	NA

Distribution of Marks and the scheme of (SEC) Practical Examination is as follows:

Section I: Continuous Internal Assessment

- | | |
|--|-----------------|
| • Continuous Assessment Tests (CAT) (At least three tests) * | 15 Marks |
| • Submission of duly certified practical record | 10 Marks |
| Total | 25 Marks |

Section II: End Semester Examination (Internal only)

- | | |
|------------------------|-----------------|
| • Exercise 1 | 20 Marks |
| • Viva-Voce (internal) | 05 Marks |
| Total | 25 Marks |

Total (Section I And II)	50 Marks
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*Note: Total Performance in CAT (i.e. 40 %) shall be based on the best two out of three in CAT examinations

128228: Lab 14 Petrochemical Science (FP/ CEP-II)							
Level	Semester	Course Code	Course Name	Credits	Teaching Hours	Exam Duration	Max Marks
5.0	IV	128228	Petrochemical Science Lab 14 (FP/ CEP II)	2	60	--	50

Course Objectives:	The intended objectives are: • To develop an appreciation of rural culture, lifestyle and wisdom amongst students. • To learn about the status of various agricultural and development programmes. • To understand the causes of distress and poverty faced by vulnerable households and explore solutions for the same. • To apply classroom knowledge of courses to field realities and thereby improve the quality of learning.
Course Outcomes:	Upon successful completion of this course, students will be able to: 1) Gain an understanding of rural life, Indian culture and ethos and social realities 8) Develop a sense of empathy and bonds of mutuality with the local community 9) Appreciate significant contributions of local communities to Indian society and Economy 10) Learn to value the local knowledge and wisdom of the community 11) Identify opportunities for contributing to community's socio-economic improvements
Guidelines/ SoP for FP/CEP For understanding key principles of CE, forms of CE, operational guidelines and implementation strategy please refer https://www.ugc.gov.in/pdfnews/4187860_Revised-Final-Guidelines.pdf As per NEP 2020, students of B Sc. II of Semester III and IV need to perform a Field Project (FP) for TWO (2) credits i.e. 50 Marks. The guidelines regarding the field project are as follows: 12 The total time allocation for the student to carry out field project is 60 hours. 13 Students should participate in field-based projects under the supervision of faculty. 14 Assignment of project topics to individual students or groups of students (max 4 students in one group) and one faculty member from the department will act as Guide for the student or group of students. 15 For a SURVEY based project related questionnaire (15 or more questions) should be prepared. 16 The departmental coordinator/guide should check the questions and finalize the questionnaire. The question that may create unnecessary complications should be avoided. The questions should be qualitative as well as quantitative. 17 If the project is related to work that does not involve survey work, then the questionnaire part can be replaced accordingly (e.g. Sample collection/Data collection/ Experimental base etc). 18 The student should compile all the relevant data and carry out its analysis. 19 A project report should be written individually in the standard format (2 Copies): Index, Introduction, Materials, Methods, Result, Conclusion/output, References (Numeric citation type) etc. 20 The project report should be of minimum 6 pages (excluding Title page, Certificate, Index, Acknowledgement etc.). Submit the project report with the Guide's signature to the department. 21 The oral /poster presentation for all the projects should be arranged in the department. To evaluate the project, examiner should be appointed by HoD. 22 The total project work including preparation of questionnaire to presentation should be evaluated for 2 credits (50 Marks). Some suggested forms of FP/ CEP are: 1. Linking learning with community service: For example, students of Petrochemical science can conduct petrol (Gasoline) diesel, kerosene and lube oil testing in local areas and share the results with the local community. 2. Linking research with community knowledge: Community-based Participatory Research (CBPR) approaches are gaining recognition in this regard. For example, students of petrochemical Science can undertake research in partnership with the community on solid and liquid waste disposal. 3. Knowledge sharing and knowledge mobilization: These can take the forms of enumerations, surveys, awareness camps and campaigns, training, learning manuals/films, maps, study reports, public hearings, policy briefs,	

cleanliness and hygiene teachings, legal aid clinics, etc. For example, students can undertake a ‘swachhta survekshana’ and/or nutrition survey for mothers and children, and educate them about hygiene and nutrition. 4. Social innovations by students: The students can be encouraged to initiate learning projects with a social impact and supported by HEIs. Incubation of such social innovation projects by students can also have meaningful links to existing curriculum and courses. A few suggested (not exclusive) areas which not only provide practical applications of Petrochemical science concepts but also foster collaboration, education, and sustainable practices within the community. are: 1. Understanding the chemical footprints of household products such as toothpaste, haircare, facecare food products etc 2. Enhance science literacy among school students through interactive chemistry demonstrations. 3. Managing organic waste to composting and improve soil health. 4. Explore the extraction and application of natural dyes as alternatives to synthetic dyes. 5. Identify and mitigate lead exposure risks in the community. 6. Implement a community-wide recycling initiative focusing on chemical waste and recyclable materials. 7. Introduce and demonstrate the principles of renewable energy sources, such as biofuels or solar energy. 8. Assess local air quality and raise awareness about pollution sources and mitigation strategies. 9. Educate community members on the safe use, storage, and disposal of household chemicals. 10. Assist local farmers in understanding soil nutrient content and composition to optimize crop production. 11. Evaluate local water sources for contaminants such as heavy metals, nitrates, and pH levels.	
References	1. https://www.ugc.gov.in/pdfnews/4187860_Revised-Final-Guidelines.pdf 2. https://en.wikipedia.org/wiki/OU_Citizen_Science_Soil_Collection_Program 3. https://www.immerse.education/study-tips/100-ideas-for-research-projects-in-chemistry/ 4. https://pubs.rsc.org/en/content/articlelanding/2021/rp/d0rp00374c 5. https://www.acs.org/education/student-communities/activities.html 6. https://www.nettercenter.upenn.edu/academically-based-community-service-chemistry-outreach
Model Questions:	NA

Distribution of Marks and the scheme of FP/CEP Examination is as follows:

• Students’ performance	20 Marks
• Submission of duly certified FP/CEP report	20 Marks
• Presentation (PPT or Poster)	10 Marks

Total	50 Marks
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**SANT GADGE BABA AMRAVATI UNIVERSITY,
AMRAVATI**



**Degree of Bachelor of Science
Petrochemical Science
Semester V and VI**

FACULTY: SCIENCE AND TECHNOLOGY

**(Courses effective from Academic Year 2026-27)
Under NEP 2020**

SYLLABUS

Contents

TLE Scheme for THIRD YEAR: SEMESTER – V (Level 5.5)	3
TLE Scheme for THIRD YEAR: SEMESTER – VI (Level 5.5)	4
Examination and Assessment Process:	5
Continuous Assessment Tests (CAT)	5
Conduction of the Examination:	6
128230: Petrochemicals and their Derivative- I.....	7
128231: Petrochemicals and their Derivative- II	9
128232: Third Generation Petrochemicals	11
128233: Petrochemical Lab. 15 (Preparation of Dyes and Sops)	13
128234: Polymers from Petroleum. (Basic concept in Polymerization).....	14
128235: Petrochemical Science Lab 16 A (Monomer Synthesis)	16
128236: Instrumental techniques and Equipment for Petroleum and Petrochemical	17
128237: Petrochemical Science Lab-16 B (Separation technique).....	19
128238: Introduction to Petrochemicals and their Derivative	20
128239: Lab 17 Synthesis of dyes and sops	22
128240: Lab 18 Basic Experiment in daily used products.....	23
128241: Lab 19 Titrimetric Analysis	25
128242 Petrochemical Science Lab- 20 (FP/ CES in Petrochemical Science - III)	27
Foundation of Artificial Intelligence.....	31
128243: Petroleum Specialty Products and Catalyst in Petroleum and Petrochemical industries	34
128244: Pollution and Future Fuels	36
128245: Operations and Future in Petro-Chemical Industries.....	38
128246: Lab21 Tests for Lube oil, Bitumen, Grease and Wax/ Water Analysis	40
128247: Production of Polymer (Plastic, Rubber, Fiber and Resin).....	41
128248: Lab 22A Preparation of Some Polymer	43
128249: Petroleum and Petrochemical Products Characterization Methods	44
128250: Lab 22B: Identification of various Petroleum products tests.....	47
28251: Non energy Petroleum/ Pollution/ Future fuels	48
128252: Lab23 Waste Water and non-energy Petroleum Analysis	50
128253: Lab 24 PCH Lab	51
128254 Internship / Apprenticeship/ OJT (On the Job Training)	52

TLE Scheme for THIRD YEAR: SEMESTER – V (Level 5.5)

Level	The Vertical	Course Code	Course Title	Credits	Workload	Theory/Practical Marks				Theory/Pract (Total) Marks	
						External		Internal		Max.	Min.
						Max.	Min.	Max.	Min.		
5.5	Major-T	128230	Petrochemicals and their Derivative- I	2	2	30	9	20	6	50	20
5.5	Major-T	128231	Petrochemicals and their Derivative- II	2	2	30	9	20	6	50	20
5.5	Major-T	128232	Third Generation Petrochemicals	2	2	30	9	20	6	50	20
5.5	Major-P	128233	Petrochemical Lab. 15 (Preparation of Dyes and Soaps)	2	4	25	10	25	10	50	20
5.5	Major-Elective T1	128234	Polymers from Petroleum (Basic concept in Polymerization)	2	2	30	9	20	6	50	20
5.5	Major-Elective P1	128235	Petrochemical Science Lab 16 A (Monomer Synthesis)	2	4	25	10	25	10	50	20
OR											
5.5	Major-Elective T2	128236	Instrumental techniques and Equipment for Petroleum and Petrochemical	2	2	30	9	20	6	50	20
5.5	Major-Elective P2	128237	Petrochemical Science Lab-16 B (Separation technique)	2	4	25	10	25	10	50	20
5.5	Minor-T	128238	Introduction to Petrochemicals and their Derivative	2	2	30	9	20	6	50	20
5.5	Minor-P	128239	Petrochemical Lab. 17 (Lab synthesis of dyes and sops)	2	4	25	10	25	10	50	20
5.5	VSC-P	128240	(Petrochemical Lab. 18) Basic Experiment in daily used products	2	4	-	-	50	20	50	20
5.5	SEC-P	128241	Petrochemical Lab. 19 (Titrimetric Analysis)	2	4	-	-	50	20	50	20
5.5	FP/CEP	128242	Petrochemical Lab. 20 (FP/ CES in Petrochemical Science - III)	2	4	-	-	50	20	50	20
5.5	Non Credit		Foundation of Artificial Intelligence	NC	2			30+20	9+6	50	20

Important:

- VSC Should be Complementary to Major
- SEC must be selected from the Basket Provided by University, from the same Faculty/Discipline of the Major/Minor
- As per Sant Gadge Baba Amravati University, Amravati Extra-Ordinary Notification No. No. 241/2025 Dated 24/12/2025 “Foundation of Artificial Intelligence” is the mandatory **Non Credit Course** compulsory course for all the UG students in fifth semester of all undergraduate programs of all faculties in Sant Gadge Baba Amravati University, Amravati to earn their degree
- NC is Non Credit Course
- Students must select **Any One** of the Major-Elective Courses (T1 to T2) with respective Practical Course in Semester V.

TLE Scheme for THIRD YEAR: SEMESTER – VI (Level 5.5)

Level	The Vertical	Course Code	Course Title	Credits	Workload	Theory/Practical Marks				Theory/Pract (Total) Marks	
						External		Internal			
						Max.	Min.	Max.	Min.	Max.	Min.
5.5	Major-T	128243	Petroleum Specialty Products and Catalyst in Petroleum and Petrochemical industries	2	2	30	9	20	6	50	20
5.5	Major-T	128244	Pollution and Future Fuels	2	2	30	9	20	6	50	20
5.5	Major-T			2	2	30	9	20	6	50	20
5.5	Major-P	128245	Operations and Future in Petro-Chemical Industries	2	4	25	10	25	10	50	20
5.5	Major-Elective T1			2	2	30	9	20	6	50	20
5.5	Major-Elective P1	128246	Petrochemical Lab. 21 (Lab. Tests for Lube oil, Bitumen, Grease and Wax/ Water Analysis)	2	4	25	10	25	10	50	20
OR											
5.5	Major-Elective T2	128249	Petroleum and Petrochemical Products Characterization Methods	2	2	30	9	20	6	50	20
5.5	Major-Elective P2	128250	(Petrochemical Lab. 22B) Experiment based on Spectroscopy	2	4	25	10	25	10	50	20
5.5	Minor-T	128251	Non energy Petroleum/ Pollution/ Future fuels	2	2	30	9	20	6	50	20
5.5	Minor-P	128252	(Petrochemical Lab. 23) Waste Water and non-energy Petroleum Analysis	2	4	25	10	25	10	50	20
5.5	VSC-P	128253	(Petrochemical Lab. 24) PCH Lab.	2	4	-	-	50	20	50	20
5.5	Intern/Apprenticeship	128254	FRS Lab 25 Internship /Apprenticeship/ OJT	4	8	-	-	50	20	50	20

Important:

- VSC Should be Complementary to Major has to be selected from the Basket Provided by University, from the same Faculty/Discipline of the Major/Minor
- **Students** must select **Any One** of the Major-Elective Courses (T1 to T2) with respective Practical Course in Semester VI.

Examination and Assessment Process:

- i. The basic principle of the Credit framework is that Credits are a function of the successful completion of a program of study/ vocational education/ training and assessment. No Credit can be earned by the student unless the student is assessed for the achievement of the desired competencies and outcome of a program.
- ii. Exit options are provided with Certificate, Diploma and Basic Bachelor’s degrees to the students at the end of the second, fourth and sixth semesters of a Four Years Multidisciplinary Degree Programme. Students will receive a Bachelor’s degree with Honors/ Research on successfully completing of all eight semesters of the UG Program either at a stretch or with opted exits and re-entries.
- iii. For the smooth success of four-year degree programme with multiple entry and exit systems, the examination mode should be based on the combination of innovative trends in formative (informal and formal tests administered during the learning process) and summative (evaluation of students learning at the end of an instructional unit) examination modes in line with the UGC Report on ‘Evaluation Reforms in Higher Educational Institutions (2019).

Examination, Evaluation and Assessment Scheme

The total marks for each Course shall be based on Continuous Assessment and Semester End Examination. Each theory course of Major, Minor, GE/OE, AEC, IKS, VEC as mentioned in **Teaching Learning Scheme** prepared by the Board of Studies shall be evaluated as per the scheme as mentioned in the following table

Examination, Evaluation and Assessment Scheme

Vertical No.	The Vertical	Mode of Examination , Evaluation & Assessment	Theory				Theory (Total)		Practical				Practical (Total)	
			External		Internal		Max. Marks	Min. Marks	External		Internal		Max. Marks	Min. Marks
			Max. Marks	Min. Marks	Max. Marks	Min. Marks			Max. Marks	Min. Marks	Max. Marks	Min. Marks		
A	Major	External & Internal	30/60	9/18	20/40	6/12	50/100	20/40	25/50	10/20	25/50	10/20	25/50	10/20
B	Minor		30/60	9/18	20/40	6/12	50/100	20/40	25/50	10/20	25/50	10/20	25/50	10/20
C	Generic/ Open Elective	Internal			50	20	50	20	--	--	50	20	50	20
D	VSC	Internal			50	20	50	20			50	20	50	20
	SEC	Internal	--	--	50	20	50	20			50	20	50	20
e	AEC (Eng. & One MIL Composite)	Internal			50	20	50	20						
	IKS (Generic)	Internal			50	20	50	20						
	VEC	Internal			50	20	50	20						
F	Internship/ Apprenticeship	Internal	Assessment of these verticals shall be based on various activities/practices. The evaluation/assessment shall be done by appointing external examiner by principal from Industry/Organisation/Academia. The mentor faculty shall be the internal examiner. It shall be evaluated by giving maximum 50 marks per 2 Credit Course with separate activity weightages/levels. A detailed SOP for this assessment process shall be prescribed separately.											
	FP/CEP													
	CC													

Continuous Assessment Tests (CAT)

For internal assessment, the Continuous Assessment Tests (CAT) shall be conducted as under-

- i. Three CAT each of 8 / 10 Marks (Theory) as applicable and 10 Marks (Practical).
 - First on completion of 25% Syllabus of the course or on completion of 25 teaching days,
 - Second on completion of 50% Syllabus of the course or on completion of 50 teaching days,
 - Third on completion of 75% Syllabus of the course or on completion of 75 teaching days.
- ii. Each concurrent assessment (CAT-I, II & III) will be mapped to relevant Course Learning Outcome.
- iii. Total Performance in CAT (i.e.40 %) shall be based on the **best two out of three** in CAT examinations

- iv. Internal assessment (CAT) shall be carried out by the respective course teacher by choosing variety of assessment tools/methods such as class test, record book, seminar, case study, field work, mini project work, quiz or any innovative method, which may be deemed to be appropriate for assessing the relevant course outcome.

Conduction of the Examination:

As per the scheme of teaching, learning, examination and evaluation, theory/practical examinations of Semester-I, II, III, IV, V, VI, VII and VIII shall be conducted by the University (except for Internal Examinations as applicable) at the end of each semester.

The theory/practical examinations of all the Semesters shall be held as per the following Schedule

Sr.No.	Name of the Examination	End Sem Examination	Supplementary Examination*
1	Semester-I, III, V and VII	Winter	Summer
2	Semester-II, IV, VI and VIII	Summer	Winter

*The University may evolve mechanism for conducting repeat end semester examination. Such repeat examinations shall have to be conducted within one month of the regular even semester examination and on demand examination.

1. The practical examination of all semesters shall be conducted by the University at the end of each semester. The HEI shall conduct the Practical examination of odd semesters as per the schedule announced by the University. **However, the appointment of the External and Internal Examiners shall be done by the Head or Principal of respective HEI to conduct external examination of the odd semester and the same should be communicated to the University before commencement of the practical examination.** The University shall conduct the external practical examination of all even semester by appointing external and internal examiners.
2. The examinations specified above shall be held twice in a year at such places and on such dates as may be prescribed by the University.
3. An applicant to an examination specified above, shall pursue a regular course of study in courses prescribed for the examination concerned for not less than one semester in a particular semester in a College/Institute/University department.
4. Provided that the student shall be eligible to appear for examination if -
 - a. He/she complies with the provisions of the Ordinance pertaining to the Examination in general from time to time.
 - b. He/she has prosecuted a regular course of study in a university department/college affiliated to the University.
 - c. He/she has in the opinion of the Principal shown satisfactory progress in his/her studies.
5. The provisions of Ordinance No. 6 and Ordinance No. 9 shall be *mutatis-mutandis* applicable to every collegiate/non-collegiate student.
6. The fees for each theory examination and practical examination conducted by the university shall be as prescribed by the University, from time to time.

Course: B.Sc. III Semester V (Petrochemical Science)

Course Category: Major Theory -

128230: Petrochemicals and their Derivative- I							
Level	Semester	Course code	Course Name	Credits	Teaching Hours	Exam Duration	Max marks
5.5	V	128230	Petrochemicals and their Derivative- I	2	30	2Hrs	30 + 20 = 50

Course Objectives	- Understand the various basic petrochemicals that can be used as basic building blocks to manufacture the various products as per the market requirement. - Identify the characteristics of basic raw materials that may act as a basic building block in the manufacture of intermediates - Understand the various chemicals and catalysts that may play the important role in conversion of basic raw materials into various consumer commodities - Compare various processes to manufacture the particular product and study these processes and find their utility, suitability and sustainability			
Course Outcomes	Upon completion of this course successfully, students would be able to - Understand the role of basic olefins like ethylene, propylene as a building block in the manufacture of various intermediates and consumer commodities understand the basic feed stocks utilized in petrochemical Industries. - Apply the knowledge of these basic raw materials in manufacturing various petrochemical - Recognize and optimize the various processes and process designs to manufacture the various petrochemical			
Unit System	Contents	Workload Allotted	Weightage of Marks Allotted	Incorporation of Pedagogies
Unit I	Production (Process Parameter, Chemistry, Process flow), properties and application of Methanol, Formaldehyde, Acetylene, and Acetic anhydride	8 Hrs	8 Marks	Chalk & Board, Power Point Presentation, Videos, Group Discussion, Assignments, surprise quizzes, question and answering sessions
Unit II	Ethylene And Derivatives-I Production (Process Parameter, Chemistry, Process flow) properties and application of Vinyl Chloride Monomer, Vinyl acetate monomer, Acetaldehyde. Role of PdCl ₂ and Cucl ₂	7 Hrs	7 Marks	
Unit III	Ethylene And Derivatives-II Production (Process Parameter, Chemistry, Process flow) properties and application of Ethanol, Ethylene Oxide, Ethylene Glycol and Ethanolamine	8 Hrs	8 Marks	
Unit IV	Propylene And Derivatives- Production (Process Parameter, Chemistry, Process flow) properties and application of Propylene oxide, Isopropyl alcohol, Acetone, Allyl Alcohol, Glycerol, and Acrylonitrile	7 Hrs	7 Marks	
References	Text books: 1. Petroleum refining and Petrochemical. N. K. Sinha, Umesh Publication Delhi 2.Advance Petrochemical, Dr. G. N. Sarkar, Khanna Publication, Delhi 3. text on Petrochemical, Dr. B. K. Bhaskararao, Khanna Publication, Delhi 4. Introduction to petrochemical, Sukumar Maiti 5. Fuels and combustion, Samir Sarkar, Orient Longman Ltd. Hyderabad 6. Modern Petroleum Refining Processes, B.K. Bhaskara Rao, Oxford and IBH Publication, New Delhi Reference Books: 1. Fundamentals of Petroleum and Petrochemical Engineering by Uttam Ray Chaudhuri CRC press 2. The Chemistry and technology of Petroleum 4 th edition by James G. Speight CRC Press			

	3. Systematic Experimental Physical Chemistry, S. W. Rajbhoj, Dr. T. K. Chondhekar, Anjali Publication, Aurangbad 4. Petroleum Refining technology, Dr. Ram Prasad, Khanna Publication, Delhi 5. Industrial Organic Chemistry, K. Weissmermel, and H. J. Arpe, Veriagchemie, New York 6. Chemical From Petroleum, A.L. Waddms, Murry, London 7. An Introduction to industrial organic chemistry, P. Wiseman, Applied Science, London
Model Questions	Short Type 1. What is the structural formula for Methanol and Acetylene? 2. What is the Boiling point of methanol? 3. List different catalyst used in VCM production 4. State the process parameter used in production of ethylene glycol production 5. Describe application of ethylene oxide 6. State the raw material used for production propanol 7. State properties of Propylene Oxide 8. Focus primary raw material used in production of VCM and VAM Long Type 1. Describe general properties and application of Formaldehyde 2. Illustrate production of VCM with respect to their chemistry and process parameter 3. Explain Manufacture of ethylene oxide with chemical reaction and process parameter 4. Explain Isopropyl alcohol production which involved chemistry, raw material and process parameter M.C.Q. Ethylene route for VAM is the extension of _____ process A. Phillips B. UOP C. Wacker D. Celanese In Celanese process for production of VAM which raw material or starting material used A. Butane B. ethylene C. acetylene D. propane VAM production through acetylene and _____ used as a raw material A. Hydrochloric acid B. sulphuric acid C. acetic acid D. nitric acid Oxy chlorination of ethylene process ethylene reacts with mixture of HCL and _____ A. Hydrogen B. oxygen C. nitrogen D. Sulfur Propylene oxide is used for production of _____ A. Polyether polyols B. propylene glycol C. surfactant D. All above Propylene oxide is manufacture by the indirect oxidation method via _____ process A. cyanohydrin B. carbonization C. chlorohydrin D. none of above In ICI process for production of isopropyl alcohol propylene and _____ are passed over fixed bed of catalyst. A. oxygen B. water C. carbon monoxide D. ethylene Which process from following used for production of isopropyl alcohol A. ICI process B. Tokuyama Soda process C. Texaco process D. All above

Course Category: Major Theory -

128231: Petrochemicals and their Derivative- II							
Level	Semester	Course code	Course Name	Credits	Teaching Hours	Exam Duration	Max marks
5.5	V	128231	Petrochemicals and their Derivative- II	2	30	2Hrs	30 + 20 = 50

Course Objectives	- Understand the various basic petrochemicals that can be used as basic building blocks to manufacture the various products as per the market requirement. - Identify the characteristics of basic raw materials that may act as a basic building block in the manufacture of intermediates - Understand the various chemicals and catalysts that may play the important role in conversion of basic raw materials into various consumer commodities - Compare various processes to manufacture the particular product and study these processes and find their utility, suitability and sustainability			
Course Outcomes	Upon completion of this course successfully, students would be able to - Use aromatics like benzene, xylenes a building block in the manufacture of various intermediates and consumer commodities - Apply the knowledge of these basic raw materials in manufacturing various petrochemical - Recognize and optimize the various processes and process designs to manufacture the various petrochemical			
Unit System	Contents	Workload Allotted	Weightage of Marks Allotted	Incorporation of Pedagogies
Unit I	Acrylic Acid and Derivatives-I Production (Process Parameter, Chemistry, Process flow), properties and application of Methanol, Formaldehyde, Acetylene, and Acetic anhydride	8 Hrs	8 Marks	Chalk & Board, Power Point Presentation, Videos, Group Discussion, Assignments, surprise quizzes, question and answering sessions
Unit II	Recovery of Aromatic (Benzene) and Derivatives Production (Process Parameter, Chemistry, Process flow) properties and application of Phenol, Aniline, ethyl benzene polymethyl benzene and Cumene.	7 Hrs	7 Marks	
Unit III	Recovery of Aromatic (Xylene) and Derivatives Production (Process Parameter, Chemistry, Process flow) properties and application of O-Xylene, Phthalonitrile Separation of xylene, Xylene isomerization	8 Hrs	8 Marks	
Unit IV	Recovery and Production of Butadiene and Isoprene- Production (Process Parameter, Chemistry, Process flow) properties and application. Separation of butadiene by selective extraction and extractive distillation from C4 cuts, Dehydrogenation of butane, dehydration of ethyl alcohol. Isoprene production. Good-Year Scientific design process , dehydrogenation of tert-amylenes (Shell process) /dehydrogenation of C ₅ stream, acetone-acetylene route	7 Hrs	7 Marks	
References	Text books: 1. Petroleum refining and Petrochemical. N. K. Sinha, Umesh Publication Delhi 2.Advance Petrochemical, Dr. G. N. Sarkar, Khanna Publication, Delhi 3. text on Petrochemical, Dr. B. K. Bhaskararao, Khanna Publication, Delhi 4. Introduction to petrochemical, Sukumar Maiti 5. Fuels and combustion, Samir Sarkar, Orient Longman Ltd. Hyderabad 6. Modern Petroleum Refining Processes, B.K. Bhaskara Rao, Oxford and IBH Publication, New Delhi Reference Books:			

	1. Fundamentals of Petroleum and Petrochemical Engineering by Uttam Ray Chaudhuri CRC press 2. The Chemistry and technology of Petroleum 4th edition by James G. Speight CRC Press 3. Systematic Experimental Physical Chemistry, S. W. Rajbhoj, Dr. T. K. Chondhekar, Anjali Publication, Aurangbad 4. Petroleum Refining technology, Dr. Ram Prasad, Khanna Publication, Delhi 5. Industrial Organic Chemistry, K. Weissermel, and H. J. Arpe, Veriagchemie, New York 6. Chemical From Petroleum, A.L. Waddms, Murry, London 7. An Introduction to industrial organic chemistry, P. Wiseman, Applied Science, London
Model Questions	Short Type 1. What is the chemical formula of o-xylene? 2. State two physical properties of o-xylene. 3. Why is o-xylene classified as an aromatic hydrocarbon? 4. State two physical properties of phthalonitrile. 5. Why is separation of xylene isomers necessary? 6. Name the xylene isomers obtained during separation. 7. Which separation technique is commonly used for xylene isomers? 8. Why is fractional distillation difficult for xylene separation? Long Type 1. Explain the production of o-xylene with process parameters, chemistry and process flow diagram. 2. Discuss the physical and chemical properties of o-xylene and its industrial applications. 3. Describe the catalytic reforming process used for the production of o-xylene. 4. Discuss the role of catalysts in xylene isomerization reactions. 5. Explain the important process parameters affecting xylene isomerization. 6. Describe the mechanism of conversion of xylene isomers during isomerization. M.C.Q. 1. The chemical formula of o-xylene is: a) C₆H₆ b) C₈H₁₀ c) C₇H₈ d) C₉H₁₂ 2. O-xylene belongs to which class of compounds? a) Alcohols b) Ketones c) Aromatic hydrocarbons d) Aldehyde 3. Phthalonitrile contains which functional group? a) Alcohol b) Aldehyde c) Nitrile d) Ester 4. Phthalonitrile is mainly used in the manufacture of: a) Fertilizers b) Dyes and resins c) Soaps d) Sugars 5. Which property is important for phthalonitrile in polymer applications? a) Low thermal stability b) High thermal stability c) High water solubility d) Non-reactivity 6. Phthalonitrile is mainly used in: a) Food industry b) Polymer industry c) Textile washing d) Sugar industry 7. Xylene separation is difficult because the isomers have: a) Different colors b) Similar boiling points c) Different odors d) High viscosity 8. Xylene isomerization involves: a) Oxidation reaction b) Rearrangement reaction c) Polymerization d) Hydrolysis

Course Category: Major Theory -

128232: Third Generation Petrochemicals							
Level	Semester	Course code	Course Name	Credits	Teaching Hours	Exam Duration	Max marks
5.5	V	128232	Third Generation Petrochemicals	2	30	2Hrs	30 + 20 = 50

Course Objectives	- Understand the various basic petrochemicals that can be used as basic building blocks to manufacture the various products as per the market requirement. - Identify the characteristics of basic raw materials that may act as a basic building block in the manufacture of intermediates - Understand the various chemicals and catalysts that may play the important role in conversion of basic raw materials into various consumer commodities - Compare various processes to manufacture the particular product and study these processes and find their utility, suitability and sustainability			
Course Outcomes	Upon completion of this course successfully, students would be able to - Apply the knowledge of these basic manufacturing of various Resins, Detergents, Dyes, Pesticides, Proteins and Explosive - Recognize and optimize the various processes and process designs to manufacture the various petrochemical - Study the Chemical reactions and process parameter required for above.			
Unit System	Contents	Workload Allotted	Weightage of Marks Allotted	Incorporation of Pedagogies
Unit I	Resin and rubber chemical Polymer chemical Classification:- Stabilizer- Antioxidant, Anitonzonants, and UV-stabilizer. Accelerator and Plasticizer. Natural Rubber:- Structure, Latex, Collection and Properties.	8 Hrs	8 Marks	Chalk & Board, Power Point Presentation, Videos, Group Discussion, Assignments, surprise quizzes, question and answering sessions
Unit II	Synthetic Detergents Historical survey of Detergent, Classification (Anionic, Cationic, Non-ionic and Amphoteric), Structure, Hard and soft Detergents, (Chemistry and Process parameter) Finishing of Detergent (Builder, Bleaches, Whitener, Fillers, Corrosion inhibitor, Foam-Agents, and other additives) Bio-Degradability	7 Hrs	7 Marks	
Unit III	Pesticides and Protein from Petroleum Introduction, Raw materials for Pesticides, Synthesis (Chemistry), Structure and Biological activity of organic pesticides, future of pesticides and Petroleum protein.	8 Hrs	8 Marks	
Unit IV	Organic Dyes, Paints and Explosives Synthesis, Type, Raw materials, Classification ,chemistry, structure and Application	7 Hrs	7 Marks	
References	Text books: 1. Petroleum refining and Petrochemical. N. K. Sinha, Umesh Publication Delhi 2.Advance Petrochemical, Dr. G. N. Sarkar, Khanna Publication, Delhi 3. text on Petrochemical, Dr. B. K. Bhaskararao, Khanna Publication, Delhi 4. Introduction to petrochemical, Sukumar Maiti 5. Fuels and combustion, Samir Sarkar, Orient Longman Ltd. Hyderabad 6. Modern Petroleum Refining Processes, B.K. Bhaskara Rao, Oxford and IBH Publication, New Delhi			

	Reference Books: 1. Fundamentals of Petroleum and Petrochemical Engineering by Uttam Ray Chaudhuri CRC press 2. The Chemistry and technology of Petroleum 4th edition by James G. Speight CRC Press 3. Systematic Experimental Physical Chemistry, S. W. Rajbhoj, Dr. T. K. Chondhekar, Anjali Publication, Aurangbad 4. Petroleum Refining technology, Dr. Ram Prasad, Khanna Publication, Delhi 5. Industrial Organic Chemistry, K. Weissmehl, and H. J. Arpe, Veriagchemie, New York 6. Chemical From Petroleum, A.L. Waddms, Murry, London 7. An Introduction to industrial organic chemistry, P. Wiseman, Applied Science, London
Model Questions	Short Type 1. What is meant by polymer chemical classification? 2. Define stabilizers used in polymers. 3. What is the function of antioxidants in polymer industries? 4. Why are UV-stabilizers added to plastics and rubber products? 5. Define accelerator in rubber processing. 6. What is the role of plasticizers in polymers? 7. Write the structure unit of natural rubber. 8. Differentiate between hard detergents and soft detergents with suitable examples Long Type 1. Discuss different types of polymer stabilizers and explain their importance in polymer industries. 2. Describe antioxidants used in polymers, their mechanism of action and industrial applications. 3. Explain the synthesis of organic dyes with suitable reaction chemistry, raw materials and process flow diagram. 4. Discuss the classification, chemical structure and industrial applications of organic dyes. 5. Describe the raw materials used in dye manufacture and explain their role in dye synthesis. 6. Explain the synthesis of explosives with suitable reaction chemistry, raw materials and process flow diagram. M.C.Q. 1. Which type of detergent produces negatively charged ions in water? a) Cationic detergent b) Non-ionic detergent c) Anionic detergent d) Amphoteric detergent 2. Hard detergents are generally: a) Easily biodegradable b) Non-biodegradable c) Insoluble in water d) Acidic in nature 3. Which detergent type can act as both cationic and anionic depending on pH? a) Non-ionic b) Amphoteric c) Hard detergent d) Soap detergent 4. The main raw material used in the manufacture of many organic pesticides is: a) Cellulose b) Petroleum hydrocarbons c) Starch d) Proteins 5. Which of the following is an organochlorine pesticide? a) Urea b) DDT c) Methanol d) Ethanol 6. The biological activity of pesticides mainly depends on their: a) Colour b) Chemical structure c) Odour d) Density 7. Petroleum protein is mainly produced using: a) Microorganisms grown on petroleum fractions b) Coal tar c) Vegetable oils d) Natural rubber 8. Which of the following is an important future consideration in pesticide development? a) Increased toxicity b) Non-biodegradability c) Eco-friendly and biodegradable pesticides d) High persistence in soil

Course Category: Major Lab-15

128233: Petrochemical Lab. 15 (Preparation of Dyes and Sops)							
Level	Semester	Course code	Course Name	Credits	Teaching Hours	Exam Duration	Max marks
5.5	V	128233	Petrochemical Lab. 15 (Preparation of Dyes and Sops)	2	60	4 Hrs	25+25

Course Objectives	- To understand the principles and laboratory techniques involved in the preparation, formulation, and analysis of dyes, paints, pigments, and varnishes. - To develop practical skills in synthesis, testing, and evaluation of dyes and paint materials using standard laboratory methods. - To study the physical and chemical properties of dyes and paints and correlate them with industrial applications and performance.
Course Outcomes	After completion of this course students will be able to - Prepare simple dyes, pigments, paints, or varnishes using standard laboratory procedures safely and accurately. - Perform analysis and quality testing of dyes and paints such as viscosity, drying time, pH, adhesion, hiding power, and wash fastness. - Explain the role of different constituents such as binders, solvents, pigments, fillers, and additives in paint and dye formulations. - Interpret experimental observations and relate the properties of dyes and paints with their industrial and commercial applications.
List of Practical - Preparation of Dyes - Preparation of Sops - Determination of viscosity of paint using a viscometer. - Measurement of drying time of paint films. - Determination of paint coverage and hiding power. - Preparation of oil paint or emulsion paint. - Determination of gloss and adhesion of paint films. - Synthesis of an azo dye (e.g., methyl orange or orange II). - Synthesis of picric acid dye. - Dyeing of cotton fabric using direct dyes. - Dyeing of wool or silk using acid dyes. - Extraction of natural dyes from turmeric, marigold, or hibiscus.	
References - Practical Book of Paint and Varnish Technology by Aparesh Barman, Power Publishers - Experiments in Applied by Dr. Sunita Rattan, S. K. Kataria & Sons - Organic Lab Manual by Dr. Shailendra Kumar Sinha, Atlantic Publishers & distributors - A Laboratory Manual of polymers by S. M. Ashraf, Sharif Ahmad, Ufana Riaz, Techsar Pvt. Ltd. - Practicals in Polymer Science by Siddaramaiah, CBS Publishers & distributors. - Natural Dyeing Processes of India by B. C. Mohanty, K. V. Chandramouli, H. D. Naik, Calico Museum publications.	

Distribution of Marks and the scheme of Practical Examination is as follows:

Section 1: Internal Assessment

• Active participation in activities	10 Marks
• Continuous Assessment Tests (CAT) (At least three tests) *	10 Marks
• Submission of duly certified practical record	05 Marks
Total	25 Marks

*Note: Total Performance in CAT (i.e. 40 %) shall be based on the best two out of three in CAT examinations

Section 2: External Assessment

• Exercise 1	10 Marks
• Exercise 2	10 Marks
• Viva-Voce (external)	05 Marks
Total	25 Marks

Course Category: Major Theory Elective T1-

128234: Polymers from Petroleum. (Basic concept in Polymerization)							
Level	Semester	Course code	Course Name	Credits	Teaching Hours	Exam Duration	Max marks
5.5	V	128234	Polymers from Petroleum (Basic concept in Polymerization)	2	30	2Hrs	30 + 20 = 50

Course Objectives	- Understand the various basic Polymerization process that can be used as basic building blocks to manufacture the various Polymer as per the market requirement. - Identify the characteristics of basic raw materials that may act as a basic building block in the manufacture of Polymers. - Understand the various chemicals and catalysts that may play the important role in conversion of basic raw materials into various Polymers			
Course Outcomes	Upon completion of this course successfully, students would be able to - Use Basic chemical like Caprolactam, Hexamethylenediamine, Adipic Acid, Sebacic Acid, Lauryl Lactum a building block in the manufacture of various Nylon - Apply the knowledge of these basic raw materials in manufacturing various Polymer like Nylon, Polyester, Rubber etc. - Recognize and optimize the various processes and process designs to manufacture the various Polymer - Study the market and demand of Polymer			
Unit System	Contents	Workload Allotted	Weightage of Marks Allotted	Incorporation of Pedagogies
Unit I	Definition of polymer, Types of polymer, Physical properties of polymer. Introductory polymer chemistry, Common polymer monomer with their structure, Degree of polymerization, Chain polymerization, Step polymerization Classification polymer:- Homo-polymer and Co-polymer	8 Hrs	8 Marks	Chalk & Board, Power Point Presentation, Videos, Group Discussion, Assignments, surprise quizzes, question and answering sessions
Unit II	Polymerization Process:- Bulk or Mass, Solution, Suspension and Emulsion Polymerization. Thermoplastic and thermoset. Mechanism of polymerization (Free radical, Anionic and Cationic)	7 Hrs	7 Marks	
Unit III	Monomer production for Nylon (Polymer) Caprolactam, Hexamethylenediamine, Adipic Acid, Sebacic Acid, Lauryl Lactum and New nylon monomer. With their Chemical reaction, Process Parameter and application	8 Hrs	8 Marks	
Unit IV	Monomer production for Polyester and other Polymer. Terephthalic Acid, Dimethyl Terephthalate, Maleic Anhydride, Phthalic Anhydride, New polyester Monomer. Styrene, Bisphenol-A, Epichlorohydrin, Diisocyanates and Pentaerythritol With Chemical reaction, Process Parameter, Process flow diagram and Application	7 Hrs	7 Marks	
References	Text books: 1. Petroleum refining and Petrochemical. N. K. Sinha, Umesh Publication Delhi 2.Advance Petrochemical, Dr. G. N. Sarkar, Khanna Publication, Delhi 3. text on Petrochemical, Dr. B. K. Bhaskararao, Khanna Publication, Delhi 4. Introduction to petrochemical, Sukumar Maiti 5. Fuels and combustion, Samir Sarkar, Orient Longman Ltd. Hyderabad 6. Modern Petroleum Refining Processes, B.K. Bhaskara Rao, Oxford and IBH Publication, New Delhi			

	Reference Books: 1. Fundamentals of Petroleum and Petrochemical Engineering by Uttam Ray Chaudhuri CRC press 2. The Chemistry and technology of Petroleum 4th edition by James G. Speight CRC Press 3. Systematic Experimental Physical Chemistry, S. W. Rajbhoj, Dr. T. K. Chondhekar, Anjali Publication, Aurangbad 4. Petroleum Refining technology, Dr. Ram Prasad, Khanna Publication, Delhi 5. Industrial Organic Chemistry, K. Weissmermel, and H. J. Arpe, Veriagchemie, New York 6. Chemical From Petroleum, A.L. Waddms, Murry, London 7. An Introduction to industrial organic chemistry, P. Wiseman, Applied Science, London 8. A Textbook of Polymer (Basic Concept) Volume-I M. S. Bhatnagar S. Chand & Company Ltd.
Model Questions	Short Type 1. Define polymer and explain different types of polymers with suitable examples. 2. Discuss the physical properties of polymers and factors affecting them. 3. Explain introductory polymer chemistry and describe common polymer monomers with their structures. 4. Differentiate between chain polymerization and step polymerization with examples. 5. Explain the classification of polymers into homo-polymers and co-polymers with suitable examples. 6. Explain bulk (mass), solution, suspension and emulsion polymerization processes with suitable examples. 7. Differentiate between thermoplastic and thermosetting polymers based on properties and applications. 8. Explain anionic polymerization and cationic polymerization with examples. Long Type 1. Explain the production of Caprolactam with suitable chemical reactions, process parameters, process flow diagram and industrial applications. 2. Discuss the manufacture of Hexamethylenediamine and Adipic Acid including raw materials, reaction chemistry, operating conditions and applications in nylon production. 3. Describe the synthesis of Lauryl Lactam with suitable reactions, catalyst conditions, process flow and applications in polymer industries. 4. Write detailed notes on new nylon monomers, including their synthesis methods, chemical reactions, process parameters, properties and modern industrial applications. 5. Discuss the manufacture of Maleic Anhydride including raw materials, reaction chemistry, catalyst, operating conditions and industrial applications. 6. Explain the production process of Phthalic Anhydride with reaction mechanism, process parameters, process flow sheet and applications in resin and plastic industries. M.C.Q. 1. Caprolactam is mainly used in the manufacture of: a) Nylon-6 b) Nylon-6,6 c) Polyester d) Bakelite 2. Hexamethylenediamine reacts with Adipic Acid to produce: a) Polyethylene b) Nylon-6,6 c) PVC d) Polystyrene 3. Sebacic Acid is commonly used in the production of: a) Nylon-6,10 b) Polyester c) Rubber d) Acrylic fiber 4. During nylon monomer production, temperature and pressure are important: a) Catalysts only b) Process parameters c) Additives d) Fillers 5. Terephthalic Acid is mainly used in the manufacture of: a) Nylon b) Polyester (PET) c) PVC d) Bakelite 6. Maleic Anhydride is industrially produced mainly by oxidation of: a) Methane b) Benzene or n-butane c) Ethanol d) Acetylen 7. Styrene is the monomer used in the production of: a) Polystyrene b) Polyethylene c) Nylon-6 d) Teflon

Course Category: Major Lab-16 A

128235: Petrochemical Science Lab 16 A (Monomer Synthesis)							
Level	Semester	Course code	Course Name	Credits	Teaching Hours	Exam Duration	Max marks
5.5	V	128235	Petrochemical Science Lab 16 A (Monomer Synthesis)	2	60	4 Hrs	25+25

Course Objectives	- To train the students for basic techniques in monomer production. - To introduce the students with handling of common chemical used in laboratory.
Course Outcomes	After completion of this course students will be able to - Understand the processes involved in synthesis of monomers - Know importance of process parameter involved in monomer synthesis - Handle raw material involved in monomer synthesis - Characterize the basic polymers
List of Practical 2. - –Preparation of styrene monomer from cinnamic acid – Preparation of vinyl acetate monomer – Preparation of methyl methacrylate – Preparation of Acrylamide monomer – Preparation of lactic acid monomer – Bulk density determination of Polymer – Glass transition temperature determination of polymer - Synthesis of Bakelite	

Distribution of Marks and the scheme of Practical Examination is as follows:

Section 1: Internal Assessment

• Active participation in activities	10 Marks
• Continuous Assessment Tests (CAT) (At least three tests) *	10 Marks
• Submission of duly certified practical record	05 Marks
Total	25 Marks

*Note: Total Performance in CAT (i.e. 40 %) shall be based on the best two out of three in CAT examinations

Section 2: External Assessment

• Exercise 1	10 Marks
• Exercise 2	10 Marks
• Viva-Voce (external)	05 Marks
Total	25 Marks

Course Category: Major Theory Elective T2-

128236: Instrumental techniques and Equipment for Petroleum and Petrochemical							
Level	Semester	Course code	Course Name	Credits	Teaching Hours	Exam Duration	Max marks
5.5	V	128236	Instrumental techniques and Equipment for Petroleum and Petrochemical	2	30	2Hrs	30 + 20 = 50

Course Objectives	- Understand the various basic Instrument used in petrochemical industries. - Identify the Operating Technique. - Understand the various Distillation equipment			
Course Outcomes	Upon completion of this course successfully, students would be able to - Use Basic Knowledge of Unit operation conducted in industries. - Apply skill for identifying which equipment used for perfect processes - Recognize and optimize the various Evaporation system, Distillation process, Heat exchange system, etc. operated in Industries - Study the Operating data of various Instrument			
Unit System	Contents	Workload Allotted	Weightage of Marks Allotted	Incorporation of Pedagogies
Unit I	Unit Operation:- Introduction, Features, Classification (Fluid flow, Mechanical Operation, Heat Transfer, Mass Transfer) Unit system, Basic SI units and their conversion. Compressors:- Introduction, Types of compressors (Centrifugal, Axial, Reciprocating, Rotary) Control, Suction & Seals.	8 Hrs	8 Marks	Chalk & Board, Power Point Presentation, Videos, Group Discussion, Assignments, surprise quizzes, question and answering sessions
Unit II	Heat exchange Equipment:- Introduction, Types of Heat exchanger and their function, Shell and Tube type heat exchanger, Difference between Shell and Tube heat exchanger, U-tube heat exchanger, Finned tube heat exchanger & Plate type heat exchanger.	7 Hrs	7 Marks	
Unit III	Evaporator:- Introduction, Types of Evaporator (Open Pan, Horizontal tube, Short tube, Long tube and Forced circulating evaporator) Their Working and Advantages.	8 Hrs	8 Marks	
Unit IV	Distillation:- Introduction, Definition, Boiling Point, Equilibrium, Boiling point diagram, Raoult's law, Dalton's law. Methods of Distillation (Simple distillation, Equilibrium distillation & Fractionation) Process flow diagram and process parameter. ADU and VDU with their Operating data	7 Hrs	7 Marks	
References	Text books: 1. Petroleum refining and Petrochemical. N. K. Sinha, Umesh Publication Delhi 2.Advance Petrochemical, Dr. G. N. Sarkar, Khanna Publication, Delhi 3. text on Petrochemical, Dr. B. K. Bhaskararao, Khanna Publication, Delhi 4. Introduction to petrochemical, Sukumar Maiti 5. Fuels and combustion, Samir Sarkar, Orient Longman Ltd. Hyderabad 6. Modern Petroleum Refining Processes, B.K. Bhaskara Rao, Oxford and IBH Publication, New Delhi Reference Books: 1. Fundamentals of Petroleum and Petrochemical Engineering by Uttam Ray Chaudhuri CRC press 2. The Chemistry and technology of Petroleum 4 th edition by James G. Speight CRC Press			

	3. Systematic Experimental Physical Chemistry, S. W. Rajbhoj, Dr. T. K. Chondhekar, Anjali Publication, Aurangbad 4. Petroleum Refining technology, Dr. Ram Prasad, Khanna Publication, Delhi 5. Industrial Organic Chemistry, K. Weissmermel, and H. J. Arpe, Veriagchemie, New York 6. Chemical From Petroleum, A.L. Waddms, Murry, London 7. An Introduction to industrial organic chemistry, P. Wiseman, Applied Science, London 8. Unit Operations-II, K. A. Gavhane, Nirali Prakashan, Pragati Books Pvt. Ltd. Pune
Model Questions	Short Type 1. Define unit operation and explain its importance in chemical industries. 2. Discuss the features and classification of unit operations into fluid flow, mechanical operation, heat transfer and mass transfer. 3. Explain the concept of unit systems and describe the SI system of units. 4. Write short notes on basic SI units and their industrial applications. 5. Explain the conversion of units with suitable examples used in chemical engineering calculations. 6. Define distillation and explain its importance in separation processes. 7. Explain boiling point, vapor-liquid equilibrium and boiling point diagram in distillation. 8. State and explain Raoult's Law and Dalton's Law used in distillation. Long Type 1. Explain heat exchange equipment with introduction, classification, types of heat exchangers and their industrial functions. 2. Describe the construction, working principle, advantages and applications of Shell and Tube Heat Exchanger with neat diagram. 3. Differentiate between shell and tube heat exchanger and plate type heat exchanger with respect to construction, operation and applications. 4. Explain the construction, working, advantages and limitations of U-Tube Heat Exchanger and Finned Tube Heat Exchanger. 5. Discuss the construction, operation, advantages and industrial applications of Plate Heat Exchanger with suitable diagrams. M.C.Q. 1. The main function of a heat exchanger is to: a) Increase pressure b) Transfer heat between fluids c) Separate solids d) Reduce viscosity 2. In a Shell and Tube Heat Exchanger, heat transfer occurs between fluids flowing through: a) Plates only b) Shell only c) Tubes and shell d) Open tank 3. Which heat exchanger is suitable for handling high-pressure fluids? a) Plate heat exchanger b) Open pan exchanger c) Shell and tube heat exchanger d) Cooling tower 4. Finned Tube Heat Exchanger is mainly used to: a) Reduce heat transfer area b) Increase heat transfer surface area c) Increase pressure drop d) Separate liquids 5. Plate Heat Exchanger mainly consists of: a) Parallel metal plates b) Rotating drums c) Horizontal tubes d) Packed columns 6. Raoult's Law states that the partial vapor pressure of a component is proportional to its: a) Density b) Mole fraction in liquid phase c) Temperature only d) Viscosity 7. Dalton's Law is related to: a) Liquid density b) Total vapor pressure of gas mixtures c) Heat transfer d) Surface tension 8. Which method of distillation is used for separating liquids with close boiling points? a) Simple distillation b) Fractional distillation c) Filtration d) Sedimentation

Course Category: Major Lab

128237: Petrochemical Science Lab-16 B (Separation technique)							
Level	Semester	Course code	Course Name	Credits	Teaching Hours	Exam Duration	Max marks
5.5	V	128237	Petrochemical Science Lab-16 B (Separation technique)	2	60	4 Hrs	25+25

Course Objectives	- To train the students for basic knowledge of fractional distillation, fractions and additive & non-additive properties of petroleum fractions. - To introduce the students with distillation equipment's and principle involved in separations
Course Outcomes	After completion of this course students will be able to - Physical properties of fractions - Prepare the fractions and corresponding blends of these fractions and study the variations in properties of blends - Understand the concepts involved in separation techniques
List of Practical	
3. 1. – TBP distillation of Petroleum sample. 2. – Analysis of TBP fraction (Specific gravity, viscosity, Aniline Point, RI, etc.) 3. –Preparation of distillate blends. 4. – Drying / evaporation of moisture from coal/wet chalk. 5. – Simple distillation of salty water 6. – Separation of alcohol water mixture by fractional distillation 7. – Steam distillation of essential oil.	

Distribution of Marks and the scheme of Practical Examination is as follows:

Section 1: Internal Assessment

• Active participation in activities	10 Marks
• Continuous Assessment Tests (CAT) (At least three tests) *	10 Marks
• Submission of duly certified practical record	05 Marks
Total	25 Marks

*Note: Total Performance in CAT (i.e. 40 %) shall be based on the best two out of three in CAT examinations

Section 2: External Assessment

• Exercise 1	10 Marks	
• Exercise 2	10 Marks	
• Viva-Voce (external)	05 Marks	
Total		25 Marks

Course Category: Minor Theory

128238: Introduction to Petrochemicals and their Derivative							
Level	Semester	Course code	Course Name	Credits	Teaching Hours	Exam Duration	Max marks
5.5	V	128238	Introduction to Petrochemicals and their Derivative	2	30	2Hrs	30 + 20 =50

Course Objectives	- Understand the various basic petrochemicals that can be used as basic building blocks to manufacture the various products as per the market requirement. - Identify the characteristics of basic raw materials that may act as a basic building block in the manufacture of intermediates - Understand the various chemicals and catalysts that may play the important role in conversion of basic raw materials into various consumer commodities			
Course Outcomes	Upon completion of this course successfully, students would be able to - Use aromatics like benzene, xylenes a building block in the manufacture of various intermediates and consumer commodities - Apply the knowledge of these basic raw materials in manufacturing various petrochemical - Recognize and optimize the various processes and process designs to manufacture the various petrochemical - Study the market and demand of consumer commodities			
Unit System	Contents	Workload Allotted	Weightage of Marks Allotted	Incorporation of Pedagogies
Unit I	Ethylene Derivatives Production (Process Parameter, Chemistry, Process flow) properties and application of Vinyl Chloride Monomer, Vinyl acetate monomer, Acetaldehyde. Ethanol, Ethylene Oxide, Ethylene Glycol and Ethanolamine	8 Hrs	8 Marks	Chalk & Board, Power Point Presentation, Videos, Group Discussion, Assignments, surprise quizzes, question and answering sessions
Unit II	Propylene And Derivatives- Production (Process Parameter, Chemistry, Process flow) properties and application of Propylene oxide, Isopropyl alcohol, Acetone, Allyl Alcohol, Glycerol, and Acrylonitrile	7 Hrs	7 Marks	
Unit III	Recovery of Aromatic and Derivatives Production (Process Parameter, Chemistry, Process flow) properties and application of Phenol, Aniline, ethyl benzene polymethyl benzene, Xylene O-Xylene and Cumene.	8 Hrs	8 Marks	
Unit IV	Resin and rubber chemical Polymer chemical Classification:- Stabilizer- Antioxidant, Anitonzonants, and UV-stabilizer. Accelerator and Plasticizer. Synthetic Detergents. Historical survey of Detergent, Classification Structure, Hard and soft Detergents, (Chemistry and Process parameter) Finishing of Detergent (Builder, Bleaches, Whitener, Fillers, Corrosion inhibitor, Foam-Agents, and other additives) Bio-Degradability Dyes and Paint. Classification , Chemistry, Application	7 Hrs	7 Marks	
References	Text Books: - Petroleum refining and Petrochemical. N. K. Sinha, Umesh Publication Delhi - Advance Petrochemical, Dr. G. N. Sarkar, Khanna Publication, Delhi - text on Petrochemical, Dr. B. K. Bhaskararao, Khanna Publication, Delhi - Introduction to petrochemical, Sukumar Maiti - Fuels and combustion, Samir Sarkar., Orient Longman Ltd. Hyderabad			

	Reference Books: 1. Fundamentals of Petroleum and Petrochemical Engineering by Uttam Ray Chaudhuri CRC press 2. The Chemistry and technology of Petroleum 4th edition by James G. Speight CRC Press 3. Systematic Experimental Physical Chemistry, S. W. Rajbhoj, Dr. T. K. Chondhekar, Anjali Publication, Aurangbad 4. Petroleum Refining technology, Dr. Ram Prasad, Khanna Publication, Delhi 5. Industrial Organic Chemistry, K. Weissmehl, and H. J. Arpe, Veriagchemie, New York 6. Chemical From Petroleum, A.L. Waddms, Murry, London 7. An Introduction to industrial organic chemistry, P. Wiseman, Applied Science, London
Model Question	Short Type 1. State the important properties and industrial applications of Vinyl Chloride Monomer and Vinyl Acetate Monomer. 2. Explain the physical and chemical properties of Acetaldehyde and mention its industrial applications. 3. Discuss the properties, uses and industrial importance of Ethanol. 4. Explain the properties and applications of Ethylene Oxide and Ethylene Glycol. 5. Describe the important properties, applications and industrial uses of Ethanolamine. 6. Explain the important properties and industrial applications of Phenol and Aniline. 7. Discuss the physical properties and applications of Ethylbenzene in petrochemical industries. 8. What is polymethyl benzene? Explain its properties and industrial applications. 9. Describe the important properties and uses of Xylene and O-Xylene. 10. Explain the properties, industrial applications and importance of Cumene in chemical industries Long Type 1. Explain the production of Vinyl Chloride Monomer with process parameters, reaction chemistry, process flow diagram, properties and industrial applications. 2. Discuss the manufacture of Vinyl Acetate Monomer including raw materials, chemical reactions, operating conditions, properties and applications. 3. Explain the production of Acetaldehyde and Ethanol with suitable process flow diagrams, chemistry, properties and industrial uses. 4. Describe the industrial production of Ethylene Oxide and Ethylene Glycol with process parameters, reaction mechanism, properties and applications. 5. Explain the manufacture of Ethanolamine with chemical reactions, process conditions, properties and industrial applications. 6. Explain the production of Propylene Oxide with process parameters, reaction chemistry, process flow diagram, properties and industrial applications. 7. Discuss the manufacture of Isopropyl Alcohol and Acetone including raw materials, chemical reactions, operating conditions, properties and applications. 8. Explain the industrial production of Allyl Alcohol with suitable process flow diagram, chemistry, properties and industrial uses. 9. Describe the production of Glycerol with reaction mechanism, process parameters, properties and applications in chemical industries. 10. Explain the manufacture of Acrylonitrile with suitable chemical reactions, process flow diagram, operating conditions, properties and industrial applications. M.C.Q. 1. Vinyl Chloride Monomer is mainly used in the manufacture of: a) Nylon b) PVC c) Bakelite d) Polyester 2. Vinyl Acetate Monomer is widely used for the production of: a) Polyvinyl acetate adhesives b) Urea c) Phenol resin d) Synthetic rubber only 3. Ethylene Oxide reacts with water to form: a) Acetaldehyde b) Ethanolamine c) Ethylene Glycol d) Acetone 4. Acetaldehyde is commonly produced by oxidation of: a) Methanol b) Ethanol c) Benzene d) Toluene 5. Ethanolamine is industrially prepared by the reaction of ammonia with: a) Ethylene oxide b) Acetic acid c) Acetylene d) Vinyl chloride 6. Propylene Oxide is mainly used in the manufacture of: a) Polyurethane foams b) Nylon fibers c) PVC d) Bakelite 7. Isopropyl Alcohol is commonly prepared by: a) Oxidation of benzene b) Hydration of propylene c) Polymerization of ethylene d) Chlorination of methane 8. Acetone is widely used as: a) Fertilizer b) Solvent c) Fuel gas d) Lubricant 9. Acrylonitrile is mainly used in the production of: a) Acrylic fibers b) Glass c) Soap d) Cemen

Course Category: Minor Lab

128239: Lab 17 Synthesis of dyes and sops							
Level	Semester	Course code	Course Name	Credits	Teaching Hours	Exam Duration	Max marks
5.5	V	128239	Lab 17 Synthesis of dyes and sops	2	60	4 Hrs	25+25

Course Objectives	- To train the students for basic production techniques Dyes and soap - To introduce the students with handling and working of common production method
Course Outcomes	After completion of this course students will be able to - Identify the quantities of raw material. - Know operating parameter for production. - Prepare simple dyes, pigments, paints, or varnishes using standard laboratory procedures safely and accurately. - Perform analysis and quality testing of dyes and paints such as viscosity, drying time, pH, adhesion, hiding power, and wash fastness. - Explain the role of different constituents such as binders, solvents, pigments, fillers, and additives in paint and dye formulations. - Interpret experimental observations and relate the properties of dyes and paints with their industrial and commercial applications.
List of Practical	
- Preparation of Sops - Measurement of drying time of paint films. - Determination of paint coverage and hiding power. - Preparation of oil paint or emulsion paint. - Determination of gloss and adhesion of paint films. - Synthesis of an azo dye (e.g., methyl orange or orange II). - Synthesis of picric acid dye. - Dyeing of cotton fabric using direct dyes. - Dyeing of wool or silk using acid dyes. - Extraction of natural dyes from turmeric, marigold, or hibiscus.	

Distribution of Marks and the scheme of Practical Examination is as follows:

Section 1: Internal Assessment

• Active participation in activities	10 Marks
• Continuous Assessment Tests (CAT) (At least three tests) *	10 Marks
• Submission of duly certified practical record	05 Marks
Total	25 Marks

*Note: Total Performance in CAT (i.e. 40 %) shall be based on the best two out of three in CAT examinations

Section 2: External Assessment

• Exercise 1	10 Marks
• Exercise 2	10 Marks
• Viva-Voce (external)	05 Marks
Total	25 Marks

Course Category: Vocational Skill Course (VSC) Lab

128240: Lab 18 Basic Experiment in daily used products							
Level	Semester	Course Code	Course Name	Credits	Teaching Hours	Exam Duration	Max Marks
5.5	V	128240	VSC Lab 18 Basic Experiment in daily used products	2	60	--	50
Course Objectives:		To develop practical skills in estimation and quality analysis of edible oils, oil seeds, and milk using standard analytical techniques relevant to food, pharmaceutical, and chemical industries.					
Course Outcomes:		After completion of the course student should - Perform physicochemical analysis of oil seeds and edible oils using standard analytical methods. - Determine important quality parameters of oils such as acid value, iodine value, peroxide value, saponification value, and ester value. - Analyze milk samples for physicochemical properties including pH, acidity, fat content, total solids, and SNF. - Detect adulteration and assess quality and purity of edible oils and milk samples. - Apply laboratory analytical and quality control techniques relevant to food, dairy, and edible oil industries.					
Unit System		Content			Incorporation of Pedagogies		
Experiments		1. Determination of moisture content in oil seed 2. Estimation of oil content from oil seed by solvent extraction 3. Determination of ash contents in oil seed 4. Determination of acid value of an oil sample 5. Determination of saponification value of an oil sample 6. Determination of iodine value of an oil sample 7. Determination of peroxide value of an oil sample 8. Determination of ester value of an oil sample 9. Determination of specific gravity and refractive index of an oil sample Detection of rancidity of an oil sample 1. Determination of pH and acidity of milk 2. Determination of specific gravity using lactometer 3. Estimation of fat content in milk 4. Determination of total solids and solids-not-fat (SNF) Detection of adulterants in milk: Water, Starch, Urea, Detergent, Formalin			Lab Reports: Students prepare detailed lab reports on their findings. Discussion Sessions: Group discussions. Group Projects: Assign group projects on Mass Transfer Operations. Class Debates: Discuss the findings amongst the students.		
References:		Text books: - Quantitative Inorganic Analysis including Elementary Instrumental Analysis by A. I. Vogels, 3rdEd. ELBS (1964) - Vogel's textbook of quantitative chemical analysis, Sixth Ed. Mendham, Denny, Barnes - Nielsen, S. Suzanne, ed. "Food analysis." (2010). - Nielsen, S. Suzanne. "Introduction to food analysis." In <i>Nielsen's food analysis</i>, pp. 3-14. Cham: Springer International Publishing, 2024. - A Textbook on Experiments and Calculations in Engineering Chemistry By S.S Dara. S Chand Ltd. - Practical Lab Manual of Pharmaceutical Organic Chemistry – I by Dr. Shivendra Kumar Dwivedi, IP Innovative Publication Pvt. Ltd. - Instrumental Analysis by Douglas A. Skoog, F. James Holler, Stanley R. Crouch (2006) Web resources: http://elibrary.mukuba.edu.zm:8080/jspui/bitstream/123456789/144/1/Food%20Analysis%20Laboratory%20Manual.pdf https://www.academia.edu/download/54933601/S. Suzanne Nielsen auth. S. Suzanne Nielsen eds. Food Analysis.pdf#page=15					
Model Questions:		NA					

Distribution of Marks and the scheme of (VSC) Practical Examination is as follows:

Section I: Continuous Internal Assessment		
•	Continuous Assessment Tests (CAT) (At least three tests) *	15 Marks
•	Submission of duly certified practical record	10 Marks
	Total	25 Marks
Section II: End Semester Examination (Internal only)		
•	Exercise 1	20 Marks
•	Viva-Voce (internal)	05 Marks
	Total	25 Marks
	Total (Section I and II)	50 Marks
*Note: Total Performance in CAT (i.e. 40 %) shall be based on the best two out of three in CAT examinations		

128241: Lab 19 Titrimetric Analysis							
Level	Semester	Course Code	Course Name	Credits	Teaching Hours	Exam Duration	Max Marks
5.5	V	128241	Titrimetric Analysis	2	60	4 Hrs	50
Course Objectives:		1.To comprehend the theoretical foundations of acid-base, redox, complexometric, and precipitation titrations, including the role of indicators, equivalence points, and stoichiometry. 2.To gain hands-on experience in accurately preparing solutions, standardizing reagents, and performing titrations across various categories (e.g., acid-base, redox, EDTA, Mohr’s method). 3.To accurately calculate molarity, percent composition, and unknown concentrations using titration data, applying correct formulas and error analysis. 4.To relate titration methods to real-world applications, such as quality control in food, pharmaceuticals, water treatment, and environmental analysis.					
Course Outcomes:		1.Upon successful completion of this course, students will be able to: 2.Understand the Principles of Titration Techniques 3.Develop Proficiency in Performing Different Titration Methods 4.Analyze and Interpret Experimental Data 5.Apply Titration Techniques to Real-Life and Industrial Scenarios					
Unit System		Contents			Incorporation of Pedagogies		
		Acid-Base Titrations 1. Standardization of NaOH using Oxalic Acid 2. Determination of Acetic Acid Content in Vinegar 3. Determination of Citric Acid in Lemon Juice 4. Titration of Strong Acid (HCl) with Strong Base (NaOH) 5. Titration of Weak Acid (CH₃COOH) with Strong Base (NaOH) 6. Determination of Unknown Concentration of H₂SO₄ using NaOH 7. Back Titration of Calcium Carbonate in Chalk 8. Titration of Antacid Tablets to Determine Neutralizing Capacity. B. Redox Titrations 9. Standardization of KMnO₄ using Oxalic Acid 10. Estimation of Iron (Fe²⁺) Using KMnO₄ 11. Estimation of Hydrogen Peroxide (H₂O₂) Using KMnO₄ 12. Titration of Sodium Thiosulfate with Iodine (Iodometry) 13. Estimation of Copper (II) using Iodometric Titration 14. Estimation of Vitamin C (Ascorbic Acid) by Iodine Titration C. Complexometric Titrations 15. Determination of Hardness of Water Using EDTA 16. Estimation of Mg²⁺ and Ca²⁺ Ions in a Water Sample (Separate/Combined) 17. Standardization of EDTA Solution Using Zinc Sulfate D. Precipitation Titrations 18. Mohr’s Method – Determination of Chloride Ion Using AgNO₃ 19. Volhard’s Method – Back Titration of Chloride Ions Using Fe³⁺ Indicator			Chalk & Board, Power Point Presentation, Videos, Group Discussion, Assign ments, surprise quizzes, question and answering sessions Assessment through Reflective Learning Encourage students to maintain lab journals for recording observations and interpretations. Conduct oral presentations and report writing to develop scientific communication skills.		

References	1. Vogel's Textbook of Quantitative Chemical Analysis – G.H. Jeffery et al. 2. A Textbook of Practical Chemistry – V.S. Kulkarni, G.H. Hegde 3. Laboratory Manual in Organic and Inorganic Chemistry – R.K. Bansal 4. Practical Chemistry for Class 12 (NCERT) – NCERT (India) 5. Comprehensive Practical Chemistry (Laxmi Publications) – Dr. J.N. Gurtu & Dr. R. Kapoor 6. Practical Chemistry Lab Manual – O.P. Agarwal 7. Introductory Practical Chemistry – G.S. Sodhi 8. Analytical Chemistry: A Modern Approach to Analytical Science – David Harvey 9. Practical Analytical Chemistry – M. Satake, Y. Sugiura et al. 10. Experiments in General Chemistry – C. H. Sorum Web resources: 1. Acid-Base Titration Procedure https://alameda.edu/wp-content/uploads/2024/08/Titration-short-version-of-Lab-11.pdf 2. Redox Titration Lab Guide https://study.com/academy/lesson/redox-titration-lab.html 3. Complexometric Titration with EDTA https://chem.libretexts.org/Ancillary_Materials/Demos_Techniques_and_Experiments/General_Lab_Techniques/Titration/Complexation_Titration 4. Precipitation Titration: Determination of Chloride by the Mohr Method https://www.uobabylon.edu.iq/eprints/publication_3_16276_250.pdf 5. Iodometric Titration Procedure https://usptechnologies.com/iodometric-titration/
Model Questions:	NA

Distribution of Marks and the scheme of (SEC) Practical Examination is as follows:

Section I: Continuous Internal Assessment

- | | |
|--|-----------------|
| • Continuous Assessment Tests (CAT) (At least three tests) * | 15 Marks |
| • Submission of duly certified practical record | 10 Marks |
| Total | 25 Marks |

Section II: End Semester Examination (Internal only)

- | | |
|------------------------|-----------------|
| • Exercise 1 | 20 Marks |
| • Viva-Voce (internal) | 05 Marks |
| Total | 25 Marks |

Total (Section I And II)	50 Marks
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*Note: Total Performance in CAT (i.e. 40 %) shall be based on the best two out of three in CAT examinations

128242 Petrochemical Science Lab- 20 (FP/ CES in Petrochemical Science - III)

Level	Semester	Course Code	Course Name	Credits	Teaching Hours	Exam Duration	Max Marks
5.5	V	128242	Petrochemical Science Lab 20 (FP/ CEP - III)	2	60	--	50
Course Objectives:	The intended objectives are: • To develop an appreciation of rural culture, lifestyle and wisdom amongst students. • To learn about the status of various agricultural and development programmes. • To understand the causes of distress and poverty faced by vulnerable households and explore solutions for the same. • To apply classroom knowledge of courses to field realities and thereby improve the quality of learning.						
Course Outcomes:	Upon successful completion of this course, students will be able to: 1. Gain an understanding of rural life, Indian culture and ethos and social realities 2. Develop a sense of empathy and bonds of mutuality with the local community 3. Appreciate significant contributions of local communities to Indian society and Economy 4. Learn to value the local knowledge and wisdom of the community 5. Identify opportunities for contributing to community's socio-economic improvements						
Guidelines/ SOP for FP/CEP							
For understanding key principles of CE, forms of CE, operational guidelines and implementation strategy please refer https://www.ugc.gov.in/pdfnews/4187860_Revised-Final-Guidelines.pdf							
As per NEP 2020, students of B Sc. III of Semester V need to perform a Field Project (FP) for TWO (2) credits i.e. 50 Marks. The guidelines regarding the field project are as follows:							
1 The total time allocation for the student to carry out field project is 60 hours. 2 Students should participate in field-based projects under the supervision of faculty. 3 Assignment of project topics to individual students or groups of students (max 4 students in one group) and one faculty member from the department will act as Guide for the student or group of students. 4 For a SURVEY based project related questionnaire (15 or more questions) should be prepared. 5 The departmental coordinator/guide should check the questions and finalize the questionnaire. The question that may create unnecessary complications should be avoided. The questions should be qualitative as well as quantitative. 6 If the project is related to work that does not involve survey work, then the questionnaire part can be replaced accordingly (e.g. Sample collection/Data collection/ Experimental base etc). 7 The student should compile all the relevant data and carry out its analysis. 8 A project report should be written individually in the standard format (2 Copies): Index, Introduction, Materials, Methods, Result, Conclusion/output, References (Numeric citation type) etc. 9 The project report should be of minimum 6 pages (excluding Title page, Certificate, Index, Acknowledgement etc.). Submit the project report with the Guide's signature to the department. 10 The oral /poster presentation for all the projects should be arranged in the department. To evaluate the project, examiner should be appointed by HoD. 11 The total project work including preparation of questionnaire to presentation should be evaluated for 2 credits (50 Marks).							
Some suggested forms of FP/ CEP are:							
1. Linking learning with community service: For example, students of Petrochemical science can conduct petrol (Gasoline) diesel, kerosene and lube oil testing in local areas and share the results with the local community. 2. Linking research with community knowledge: Community-based Participatory Research (CBPR) approaches are gaining recognition in this regard. For example, students of chemistry can undertake research in partnership with the community on solid and liquid waste disposal. 3. Knowledge sharing and knowledge mobilization: These can take the forms of enumerations, surveys, awareness camps and campaigns, training, learning manuals/films, maps, study reports, public hearings, policy briefs, cleanliness and hygiene teachings, legal aid clinics, etc. For example, students can undertake a 'swachhta survekshana' and/or nutrition survey for mothers and children, and educate them about hygiene and nutrition. 4. Social innovations by students: The students can be encouraged to initiate learning projects with a social impact and supported by HEIs. Incubation of such social innovation projects by students can also have meaningful links to existing curriculum and courses							

A few suggested (not exclusive) areas which not only provide practical applications of Petrochemical science concepts but also foster collaboration, education, and sustainable practices within the community. are:

1. Understanding the chemical footprints of household products such as toothpaste, haircare, facecare food products etc
2. Enhance science literacy among school students through interactive chemistry demonstrations.
3. Managing organic waste to composting and improve soil health.
4. Explore the extraction and application of natural dyes as alternatives to synthetic dyes.
5. Identify and mitigate lead exposure risks in the community.
6. Implement a community-wide recycling initiative focusing on chemical waste and recyclable materials.
7. Introduce and demonstrate the principles of renewable energy sources, such as biofuels or solar energy.
8. Assess local air quality and raise awareness about pollution sources and mitigation strategies.
9. Educate community members on the safe use, storage, and disposal of household chemicals.
10. Assist local farmers in understanding soil nutrient content and composition to optimize crop production.
11. Evaluate local water sources for contaminants such as heavy metals, nitrates, and pH levels.

References	1. https://www.ugc.gov.in/pdfnews/4187860_Revised-Final-Guidelines.pdf 2. https://en.wikipedia.org/wiki/OU_Citizen_Science_Soil_Collection_Program 3. https://www.immerse.education/study-tips/100-ideas-for-research-projects-in-chemistry/ 4. https://pubs.rsc.org/en/content/articlelanding/2021/rp/d0rp00374c 5. https://www.acs.org/education/student-communities/activities.html 6. https://www.nettercenter.upenn.edu/academically-based-community-service-chemistry-outreach
Model Questions:	NA

Distribution of Marks and the scheme of FP/CEP Examination is as follows:

- | | |
|--|----------|
| • Students’ performance | 20 Marks |
| • Submission of duly certified FP/CEP report | 20 Marks |
| • Presentation (PPT or Poster) | 10 Marks |

Total	50 Marks
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Course Category: **Non Credit**
Foundation of Artificial Intelligence

Level	Semester	Course Code	Course Name	Credits	Teaching Hours	Exam Duration	Max Marks
5.5	V		Foundation of Artificial Intelligence	Non credit	30	2 Hrs	30+20=50

Introduction :

The National Education Policy (NEP) 2020 emphasizes the integration of Artificial Intelligence (AI) across all undergraduate levels and disciplines to foster digital literacy and problem-solving skills. 'It can enhance the employability of the youth and prepare professionals in cutting-edge areas.' (pg. 46, R.D Kulkarni Report)

The Foundations of Artificial Intelligence course offers an overview of the key concepts, structures, applications, and ethical aspects of AI. It helps learners understand how intelligent systems work and shape modern life. The course covers AI's definition, evolution, types, and practical uses, along with its basic architectures like rule-based systems, machine learning, and neural networks. Learners will explore AI's role in education, healthcare, and commerce while reflecting on ethical and social concerns such as privacy, bias, and automation. In line with NEP 2020, it fosters digital literacy and responsible AI awareness for all disciplines.

A) Objective

- i) Introduce all undergraduate students of all the faculties to the basic concepts, uses, and importance of AI.
- ii) Enable learners to understand AI's principles, applications, limitations, and effectively use AI tools.
- iii) Encourage students to recognize AI's role in enhancing life and engage with its social and ethical implications.

B) Outcomes

- i) Understand the fundamental concepts, types, and evolution of Artificial Intelligence.
- ii) Apply basic AI techniques and tools to real-world problems across different domains.
- iv) Evaluate the social, ethical, and professional implications of AI in everyday life.

C) Implementation of Syllabus, Scheme of Examination and Teaching.

- 1) Curriculum, Teaching and Examination Scheme Given in Appendix A
- 2) This course given in Appendix A shall be compulsory course in **fifth semester** of all undergraduate programs of all faculties in Sant Gadge Baba Amravati University, Amravati.
- 2) Medium of instruction, paper setting and writing of Answer paper shall be in English, Marathi and Hindi.
- 3) Question paper shall be set and valued by the College/ Department.
- 4) Duration of external examination shall be of 2 hours and paper shall be of 30 marks.
- 5) Internal 20 marks shall be distributed, 5 to attendance, 15 marks to assignment/class test/viva voce/presentation.
- 6) Distribution of 30 external marks shall be based on 4 units, 15 marks to short and 15 marks to long answer type questions.
- 7) It shall be obligatory on part of the college/department to conduct examination on prescribed date by the university and submit the candidate wise information as follows on university portal on due date after valuation answer books.
 Grade A -- mark secured 30 to 50,
 Grade B -- 25 to 29,
 Grade C -- 20 to 24,
 FAIL 19 and below
- 8) The final Grade shall be determined by the combined performance in internal and external assessments. A student must secure a minimum of 30% in the internal assessment, 30% in the external assessment, and at least 40% overall to pass. Failure to meet any of these criteria will result in a grade of "Fail."
- 9) In case of failure, student need to appeared in backlog examination by paying prescribed fees.
- 10) Valuated answer book shall be kept in college custody for one academic year and random verification may be done by the University if required.

- 11) Result of final year of respective degree shall not be declared of an examination unless secured any of the grades out of A to C in Foundation of Artificial intelligence.
- 12) Grade secured by an examinee in examination of said course shall be shown on fifth and last semester marksheet.
- 13) The candidates shall have to pay Rs 150 /- in 5th semester to the college to meet out the expenses by the college on teaching of course, question paper setting and printing, paper valuation, providing answer sheet, and filling grade on University portal. In case of failure student need to pay Rs 20 /- for conduction of examination. There shall not have any facility of revaluation of answer book.
- 14) For teaching of the subject person having PG degree in any faculty with second class shall be considered eligible, provided priority shall be given to Ph.D., NET, SET, regular teacher.

15) Format of question paper

Distribution of 30 external marks shall be based on 4 units, 15 marks to short and 15 marks to long answer type questions with internal choice.

1a) Long or short answer questions based on unit number 1 having 8 marks

Or

1b) Long or short answer questions based on unit number 1 having 8 marks

2a) Long or short answer questions based on unit number 2 having 7 marks

Or

2b) Long or short answer questions based on unit number 2 having 7 marks

3a) Long or short answer questions based on unit number 3 having 8 marks

Or

3b) Long or short answer questions based on unit number 3 having 7 marks

4a) Long or short answer questions based on unit number 4 having 8 marks

Or

4b) Long or short answer questions based on unit number 4 having 8 marks

Program:				Semester:	V	
Course: Foundation of Artificial Intelligence				Code:		
Teaching Scheme				Evaluation Scheme		
Level	Lecture	Hours	Credit	Internal	External	Total
5.5	2	2	2	20	30	50
Methods of Internal Assessment: 15 Marks to Class Tests, /Assignments/ Viva voce/ Presentation & 5 Marks to Attendance						
Course Objectives: To introduce AI concepts in a simple, real-life way with focus on understanding applications, ethics, and future opportunities.						
Course Outcomes: After completion of the course, the students will be able to:						
CO	Course Outcomes				BT Level	
CO-1	Explain the basic concepts, history, and types of AI with real-life examples.				L1 – Knowledge, L2 – Understanding	
CO-2	Describe AI structures and architectures using simple real-world analogies.				L2 – Understanding, L3 – Application	
CO-3	Identify and analyze applications of AI in the area of arts, commerce, humanities, and daily life.				L3 – Application, L4 – Analysis	
CO-4	Evaluate ethical, social issues and predict future opportunities of AI in their own fields.				L4 – Analysis, L5 – Evaluation	

Unit 1: Introduction to Artificial Intelligence (8 Hours)

Definition of AI: What is Intelligence? Natural vs. Artificial, Simple definition of AI; History & Evolution of AI: From early computers to modern AI; Types of AI: Narrow AI vs. General AI vs. Super AI; AI in Everyday Life: Google Maps, E-commerce suggestions, Chatbots, Social Media feeds; Key Components: Data, Algorithms, Computing Power

Unit 2: AI Structures, Architectures & Techniques (7 Hours)

Basic Structure of an AI System; AI Architectures (Simplified): Rule Based System, Machine Learning, Neural Networks; Key Concepts: Knowledge Representation (using symbols, facts), Search & Problem Solving (maze example, finding shortest route), Natural Language Understanding (Google Translate, chatbots)

Unit 3: Applications of AI in Society (7 Hours)

AI in Different Fields: Education (Personalized learning apps, plagiarism checkers), Healthcare (Disease prediction, medical chatbots), Commerce (Fraud detection in banking, stock market predictions, customer support), Daily Life (Smart home devices, language translation, travel assistants); AI & Decision Making: Hiring, Loan Approval, Court Decisions; Advantages of AI, Limitations of AI

Unit 4: Ethical, Social & Future Aspects of AI (8 Hours)

Ethical Concerns in AI: Privacy issues (CCTV, online data), Bias & Fairness (AI preferring certain groups), Job Displacement (automation replacing humans); Responsible AI: Transparency, Accountability, Human oversight; Future Trends in AI: Self-driving cars, AI in governance, creative industries; AI and You (Career Perspective): Opportunities in Digital Marketing, Content Creation, Business Analytics, HR Tech, Creative Industries (non-programming roles)

Textbook:

Melanie Mitchell – *Artificial Intelligence: A Guide for Thinking Humans*

Reference Books:

1. Boden, Margaret A., *Artificial Intelligence: A Very Short Introduction*
2. Elaine Rich – *Artificial Intelligence* (3rd Edition)
3. Godbole, Achyut, *Artificial Intelligence* (आर्टिफिशियल इंटेलिजन्स), Bookganga Publication.
4. Kulkarni, Dr Anand, आर्टिफिशियल इंटेलिजन्सचा वाटेवर, Sakal Media Pvt. Ltd.
5. Stuart Russell – *Human Compatible* (2019)
6. Thorpe, Josh, *AI for Students: Creative Hacks for Academic Success*, Promply Books

Course: B.Sc. III Semester VI (Petrochemical Science)

Course Category: Major Theory -T

128243: Petroleum Specialty Products and Catalyst in Petroleum and Petrochemical industries							
Level	Semester	Course code	Course Name	Credits	Teaching Hours	Exam Duration	Max marks
5.5	VI	128243	Petroleum Specialty Products and Catalyst in Petroleum and Petrochemical industries	2	30	2Hrs	30 + 20 = 50

Course Objectives	- Know the various Uses and Application of various Lubricant. - Basic Knowledge of Lube oil, Grease, Wax, Bitumen and Carbon black production. - Understand Various catalyst used in different processes			
Course Outcomes	Upon completion of this course successfully, students would be able to - Understand the Importance of catalyst in various petroleum and petrochemical processes. - Apply the skill utilization of Lubricant and Bitumrn - Recognizes of process parameters involved in the Production of wax, Lube oil, Grease, Bitumen, and Carbon black - To multiple uses of wax, Lube oil, Grease, Bitumen, and Carbon black.			
Unit System	Contents	Workload Allotted	Weightage of Marks Allotted	Incorporation of Pedagogies
Unit I	Lubricating Oil Introduction, Definition (Lube base stocks) Lube base, Natural lube, Bright stock lube, Virgin base lube, Re-refined lube, Finished lube, Paraffinic lube oil, Naphthenic lube oil) Specification:- Quality & Performance. Composition, test property of lube oil. Types of Lube oil (Automotive oil, Industrial Lubricants:- bearing, hydraulic, compressor, pump. Aviation Lubricants, Marin Lubricant.) Process for production of Lubricating oil. (Process diagram & Process Parameter)	8 Hrs	8 Marks	Chalk & Board, Power Point Presentation, Videos, Group Discussion, Assignments, surprise quizzes, question and answering sessions
Unit II	Grease and Bitumen (Asphalt) Grease:- Introduction, Types of grease Lime soap, Soda soap, Lithium & Barium soap Aluminum soap, and Cold Sett grease, Production process, Process diagram, Process Parameter and Application. Bitumen:- Introduction, Source of bitumen, Chemical structure, Properties, Production process, Process diagram, Process Parameter and Application.	7 Hrs	7 Marks	
Unit III	Wax and Carbon Black Wax:- Introduction, Types & Sources of wax, Properties Production process, Process diagram, Process Parameter and Application. Carbon Black:- Introduction Production process, Process diagram, Process Parameter and Application.	8 Hrs	8 Marks	
Unit IV	Catalyst Introduction, Homogeneous and heterogeneous catalysts. Catalysts morphology and activity Catalysts for petroleum refining:- Cracking catalysts, Reforming catalysts, Hydro-treating catalysts. Catalysts for petrochemical Industry:- Catalysts for synthesis gas, Hydrogenation catalysts, Hydrocarbon oxidation catalysts, Polymerization catalysts. Recent advances in industrial catalysis	7 Hrs	7 Marks	
References	Text books: 1. Petroleum refining and Petrochemical. N. K. Sinha, Umesh Publication Delhi 2.Advance Petrochemical, Dr. G. N. Sarkar, Khanna Publication, Delhi			

	3. text on Petrochemical, Dr. B. K. Bhaskararao, Khanna Publication, Delhi 4. Introduction to petrochemical, Sukumar Maiti 5. Fuels and combustion, Samir Sarkar,, Orient Longman Ltd. Hyderabad 6. Modern Petroleum Refining Processes, B.K. Bhaskara Rao, Oxford and IBH Publication, New Delhi Reference Books: 1. Fundamentals of Petroleum and Petrochemical Engineering by Uttam Ray Chaudhuri CRC press 2. The Chemistry and technology of Petroleum 4th edition by James G. Speight CRC Press 3. Systematic Experimental Physical Chemistry, S. W. Rajbhoj, Dr. T. K. Chondhekar, Anjali Publication, Aurangbad 4. Petroleum Refining technology, Dr. Ram Prasad, Khanna Publication, Delhi 5. Industrial Organic Chemistry, K. Weissmermel, and H. J. Arpe, Veriagchemie, New York 6. Chemical From Petroleum, A.L. Waddms, Murry, London 7. An Introduction to industrial organic chemistry, P. Wiseman, Applied Science, London
Model Questions	Short Type 1. Define lubricating oil and explain different types of lube base stocks such as natural lube, bright stock lube, virgin base lube and re-refined lube. 2. Differentiate between Paraffinic Lubricating Oil and Naphthenic Lubricating Oil with respect to properties and applications. 3. Discuss the composition, quality specifications and performance characteristics of lubricating oils. 4. Explain various test properties of lubricating oils and their industrial importance. 5. Describe the types of lubricating oils such as automotive oils, industrial lubricants, aviation lubricants and marine lubricants along with the production process, process flow diagram and important process parameters. 6. Define grease and explain different types of grease such as lime soap, soda soap, lithium soap, barium soap, aluminum soap and cold set grease with their applications. 7. Discuss the production process, process flow diagram and important process parameters involved in grease manufacture. 8. Define Bitumen and explain its sources, chemical structure and important physical properties. 9. List the homogeneous catalyst 8. List part involved in catalyst Morphology. Long Type 1. Differentiate between Paraffinic Lubricating Oil and Naphthenic Lubricating Oil with respect to composition, properties, performance and industrial applications. 2. Explain the introduction, classification, types and sources of wax with suitable examples and industrial applications. 3.. Discuss the physical and chemical properties of Grease along with its industrial importance. 4. . Describe the Cracking catalyst with example 5. Explain the introduction, manufacture and industrial importance of Carbon Black. M.C.Q. 1. The primary function of lubricating oil is to: a) Increase friction b) Reduce friction and wear c) Increase corrosion d) Produce heat 2. Paraffinic Lubricating Oil is mainly characterized by: a) High wax content and good viscosity index b) High acidity c) Low thermal stability d) High volatility 3. Which test property is used to determine the flow characteristics of lubricating oil? a) Flash point b) Pour point c) Carbon residue d) Ash content 4. Hydraulic oils are mainly used in: a) Cooling towers b) Hydraulic systems and machinery c) Food processing d) Distillation columns 5. Re-refined lubricating oil is produced by: a) Fermentation process b) Recycling and refining used oil c) Coal gasification d) Polymerization 6. 6.Which type of grease is known for high water resistance? a) Soda soap grease b) Lime soap grease c) Aluminum soap grease d) Cold set grease 7. Lithium Soap Grease is widely used because of its: a) Poor thermal stability b) High temperature resistance c) Low lubricating property d) High acidity 8. Bitumen is mainly obtained from: a) Natural gas b) Petroleum refining residue c) Coal combustion d) Fermentation 9. The main application of Bitumen is in: a) Fertilizer production b) Road construction c) Food preservation d) Textile bleaching 10. In grease production, temperature and mixing conditions are important: a) Catalysts b) Process parameters c) Fillers d) Solvents

Course: B.Sc. III Semester VI (Petrochemical Science)

Course Category: Major Theory -T

128244: Pollution and Future Fuels							
Level	Semester	Course code	Course Name	Credits	Teaching Hours	Exam Duration	Max marks
5.5	VI	128244	Pollution and Future Fuels	2	30	2Hrs	30 + 20 = 50

Course Objectives	- Know the various process for identify west water analysis - Effect of Various Pollution on Earth and Human being - Recognizes refineries waste and their Impact. - Understand importance of Future fuels.			
Course Outcomes	Upon completion of this course successfully, students would be able to - Understand the Various type of pollution conducted due to chemical processes. - To know various tests for water analysis. - Recognizes of process parameters involved in the Bio-diesel production - To control the refinery waste. .			
Unit System	Contents	Workload Allotted	Weightage of Marks Allotted	Incorporation of Pedagogies
Unit I	Pollution Introduction, Definition Air Pollution, Water Pollution, Noise Pollution. Air pollution in India, Air Quality Index (AQI), greenhouse gases:- Methane, Water vapor, Global warming potential.	8 Hrs	8 Marks	Chalk & Board, Power Point Presentation, Videos, Group Discussion, Assignments, surprise quizzes, question and answering sessions
Unit II	Water Pollution Control of Water pollution, Indian standards for liquid effluents and Inland surface water, (Most considerable characters like TSS, pH, TDS, BOD, COD, DO, Temperature, sulphates, chlorides, sodium.) Soil pollution:- Sources of soil pollution in refineries and petrochemicals manufacturing units Soil pollution control techniques	7 Hrs	7 Marks	
Unit III	Refinery Wastes Introduction, Emission of waste from refinery processes (Desalting, Distillation, Thermal cracking & Vis-breaking, coking, FCC, Hydrocracking, Reforming, Alkylolation, Isomerization, Polymerization, etc.) Solid waste	8 Hrs	8 Marks	
Unit IV	Bio-Fuel and Hydrogen Fuels Bio-fuels:-Introduction, History, Significance and Importance. Algal biofuels, Green diesel, Processing of Biofuel (Process flow and process parameter) specification of Bio-diesel and Advantages. Bio-Ethanol, Importance of Biofuel for energy demand in India. Hydrogen:- Introduction, Processes, Feedstock, Chemistry, Hydrogen purification (Process flow and process parameter)	7 Hrs	7 Marks	
References	Text books: 1. Petroleum refining and Petrochemical. N. K. Sinha, Umesh Publication Delhi 2.Advance Petrochemical, Dr. G. N. Sarkar, Khanna Publication, Delhi 3. text on Petrochemical, Dr. B. K. Bhaskararao, Khanna Publication, Delhi 4. Introduction to petrochemical, Sukumar Maiti 5. Fuels and combustion, Samir Sarkar,, Orient Longman Ltd. Hyderabad 6. Modern Petroleum Refining Processes, B.K. Bhaskara Rao, Oxford and IBH Publication, New Delhi Reference Books: 1. Fundamentals of Petroleum and Petrochemical Engineering by Uttam Ray Chaudhuri CRC press 2. The Chemistry and technology of Petroleum 4 th edition by James G. Speight CRC Press 3. Systematic Experimental Physical Chemistry, S. W. Rajbhoj, Dr. T. K. Chondhekar, Anjali Publication, Aurangbad 4. Petroleum Refining technology, Dr. Ram Prasad, Khanna Publication, Delhi 5. Industrial Organic Chemistry, K. Weissermel, and H. J. Arpe, Veriagchemie, New York 6.Chemical From Petroleum, A.L. Waddms, Murry, London 7. An Introduction to industrial organic chemistry, P. Wiseman, Applied Science, London			

Model Questions	Short Type 1. Define and explain important water quality parameters such as TSS, pH, TDS, BOD, COD, DO, temperature, sulphates, chlorides and sodium. 2. Discuss the significance of Biochemical Oxygen Demand and Chemical Oxygen Demand in water pollution analysis. 3. Explain the major sources of soil pollution in petroleum refineries and petrochemical manufacturing industries. 4. Discuss various soil pollution control techniques used in refinery and petrochemical industries. 5. Explain the introduction, history, significance and importance of Biofuel with special reference to India's energy demand. 6. Discuss algal biofuels, green diesel and the processing of biofuels including process flow diagram and important process parameters. 7. . Explain the specifications, advantages and industrial applications of Biodiesel and Bioethanol 8. Define Hydrogen and explain various hydrogen production processes, feedstocks and reaction chemistry. Long Type 1. Explain the introduction, definition and different types of pollution such as air pollution, water pollution and noise pollution with suitable examples. 2. Discuss the causes, effects and control measures of Air Pollution in India. 3. Explain the concept of Air Quality Index and discuss its importance in monitoring environmental health. 4. Describe greenhouse gases with special reference to Methane and water vapor, including their sources and environmental impacts. 5. Explain the concept of global warming potential and discuss the role of greenhouse gases in climate change and global warming. Explain importance hydrocracking operation in petroleum field 6. Discuss algal biofuels and green diesel including their production methods, properties, advantages and industrial applications. 7. Explain the processing of biofuels with suitable process flow diagram, important process parameters, specifications and advantages of Biodiesel. 8. Describe the production, properties and applications of Bioethanol and discuss the importance of biofuels in reducing dependence on fossil fuels in India. M.C.Q. 1. Which of the following is mainly responsible for air pollution in urban areas? a) Photosynthesis b) Vehicular emissions c) Rainwater d) Soil erosion 2. Air Quality Index is used to indicate: a) Water hardness b) Soil fertility c) Level of air pollution d) Noise intensity only 3. Which of the following is considered a greenhouse gas? a) Oxygen b) Nitrogen c) Methane d) Helium 4. Excessive sound causing discomfort to humans is called: a) Water pollution b) Soil pollution c) Noise pollution d) Thermal pollution 5. Global warming potential of a gas indicates its: a) Density b) Ability to absorb heat in the atmosphere c) Solubility in water d) Electrical conductivity 6. Biofuel is mainly produced from: a) Fossil fuels b) Biomass and biological materials c) Nuclear waste d) Metallic ores 7. Biodiesel is commonly prepared by the process of: a) Cracking b) Polymerization c) Transesterification d) Distillation 8. Which of the following is considered an important advantage of biofuels? a) High sulfur emission b) Renewable and eco-friendly nature c) Non-biodegradability d) High ash formation 9. Hydrogen is commonly produced industrially by: a) Steam reforming of natural gas b) Sedimentation c) Filtration d) Crystallization 10. The purification of Hydrogen is commonly carried out by: a) Pressure swing adsorption b) Simple filtration c) Evaporation d) Centrifugation
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Course: B.Sc. III Semester VI (Petrochemical Science)

Course Category: Major Theory -T

128245: Operations and Future in Petro-Chemical Industries							
Level	Semester	Course code	Course Name	Credits	Teaching Hours	Exam Duration	Max marks
5.5	VI	128245	Operations and Future in Petro-Chemical Industries	2	30	2Hrs	30 + 20 = 50

Course Objectives	- Know the various safety measures applicable in petrochemical complexes. - Basic Knowledge of measurement quantity of petroleum products - Study future of petrochemical products.			
Course Outcomes	Upon completion of this course successfully, students would be able to - Understand the handling of hazardous chemical. - Apply the concepts, plant management and Economics - Understand support system used in refinery. - Study after petroleum crises what is the future of petrochemical. .			
Unit System	Contents	Workload Allotted	Weightage of Marks Allotted	Incorporation of Pedagogies
Unit I	Safety in petrochemicals industries Handling of hazardous Material:- Anhydrous hydrofluoric acid, Amines, Furfural, Hydrogen Sulfide, MEK, Etc. Fire Prevention and fire-fighting, (Class A & B Foam) Personal safety, Cleaning spills. Classification and symbols used for substance dangerous for conveyance.	8 Hrs	8 Marks	Chalk & Board, Power Point Presentation, Videos, Group Discussion, Assignments, surprise quizzes, question and answering sessions
Unit II	Measurement of Quantity of petroleum products Tank dipping:-Volume correction , Density correction Plant management and Economics of petroleum industries:- Cost of equipment, Cost of plant, Operating cost, Product cost, Profit and product price, Taxes and duties. Energy Audit of petroleum industries:- Electricity audit, Thermal audit	7 Hrs	7 Marks	
Unit III	Support system common to refinery Control System:- Introduction, Types, Definition. Offsite System:- Introduction, Storage facilities (Atmospheric, Pressure & Heated Storage) Road and rail loading facilities. Utility system:- Introduction, Fuel System, Water system. Safety System:- Introduction, Determination of risk Definitions.	8 Hrs	8 Marks	
Unit IV	Future of Petrochemical Integrated petrochemical complexes, Energy crises and the petrochemical industry, Natural gas as petrochemical feedstock, Impact of heavy feedstock's on petrochemicals Ecology and energy crisis Coal as an alternative to oil Energy crisis and the industrial fuels Natural fuels, Synthetic fuels, Hydrogen: Fuel of tomorrow, Trends in petrochemical industries	7 Hrs	7 Marks	
References	Text books: 1. Petroleum refining and Petrochemical. N. K. Sinha, Umesh Publication Delhi 2.Advance Petrochemical, Dr. G. N. Sarkar, Khanna Publication, Delhi 3. text on Petrochemical, Dr. B. K. Bhaskararao, Khanna Publication, Delhi 4. Introduction to petrochemical, Sukumar Maiti 5. Fuels and combustion, Samir Sarkar,, Orient Longman Ltd. Hyderabad 6. Modern Petroleum Refining Processes, B.K. Bhaskara Rao, Oxford and IBH Publication, New Delhi Reference Books: 1. Fundamentals of Petroleum and Petrochemical Engineering by Uttam Ray Chaudhuri CRC press			

	2. The Chemistry and technology of Petroleum 4th edition by James G. Speight CRC Press 3. Systematic Experimental Physical Chemistry, S. W. Rajbhoj, Dr. T. K. Chondhekar, Anjali Publication, Aurangbad 4. Petroleum Refining technology, Dr. Ram Prasad, Khanna Publication, Delhi 5. Industrial Organic Chemistry, K. Weissmehl, and H. J. Arpe, Veriagchemie, New York 6. Chemical From Petroleum, A.L. Waddms, Murry, London 7. An Introduction to industrial organic chemistry, P. Wiseman, Applied Science, London
Model Questions	Short Type 1. Define refinery control system and mention its types. 2. What are atmospheric, pressure and heated storage facilities in refinery offsite systems? 3. Define utility system and explain the functions of fuel and water systems in a refinery. 4. What is meant by road and rail loading facilities in refinery operations? 5. Define risk determination and explain the importance of safety systems in refineries. 6. What is tank dipping and why is it important in petroleum industries? 7. Define volume correction and density correction in petroleum product measurement. 8. What are the major components of plant management and economics in petroleum industries? 9. Define operating cost, product cost and profit in petroleum refinery operations. 10. What is meant by electricity audit and thermal audit in energy auditing of petroleum industries? Long Type 1. Explain the safety practices followed in petrochemical industries for handling hazardous materials such as Hydrofluoric Acid, amines, furfural, hydrogen sulfide and MEK. 2. Discuss the hazards, storage, handling precautions and emergency control measures for Hydrogen Sulfide and Methyl Ethyl Ketone in petrochemical industries. 3. Explain fire prevention methods and firefighting techniques used in petrochemical plants with special reference to Class A and Class B foam systems. 4. Describe personal safety measures, use of personal protective equipment (PPE) and spill cleaning procedures in petrochemical industries 5. Discuss the classification, labeling and symbols used for dangerous substances during transportation and conveyance of hazardous chemicals. 6. Explain the introduction, definition and different types of refinery control systems used in petroleum and petrochemical industries. 7.. Discuss the importance of support systems common to refineries and 8. explain how control, offsite, utility and safety systems contribute to efficient refinery operation. M.C.Q. 1. Hydrogen Fluoride is highly dangerous mainly because it is: a) Non-toxic gas b) Highly corrosive and toxic c) Inert gas d) Radioactive material 2. Hydrogen Sulphide is commonly recognized by its: a) Sweet smell b) Rotten egg odour c) No odour d) Fruity smell 3. MEK (Methyl Ethyl Ketone) is mainly classified as a: a) Strong acid b) Organic solvent and flammable liquid c) Metal alloy d) Salt compound 4. Class A and Class B foam are mainly used for: a) Electrical insulation b) Fire fighting of solid and liquid fires c) Water purification d) Gas compression 5. Hazard symbols used in chemical transport are mainly used to indicate: a) Color of material b) Dangerous nature of substances c) Market price d) Production cost 6. The main purpose of a refinery control system is to: a) Increase crude oil price b) Monitor and regulate process variables c) Store petroleum products d) Reduce refinery size 7. Offsite System mainly deals with: a) Chemical reactions b) Storage and transportation of products c) Catalyst preparation d) Distillation only 8. Atmospheric storage tanks in refineries are used for storing: a) High-pressure gases b) Liquids at normal pressure c) Solids only d) Plasma materials 9. Utility systems in refineries include: a) Fuel and water systems b) Only control systems c) Only storage systems d) Only safety systems 10. In refinery safety systems, risk determination refers to: a) Product pricing b) Identification and evaluation of hazards c) Equipment painting d) Fuel combustion

Course Category: Major Lab-21

128246: Lab21 Tests for Lube oil, Bitumen, Grease and Wax/ Water Analysis							
Level	Semester	Course code	Course Name	Credits	Teaching Hours	Exam Duration	Max marks
5.5	VI	128246	Lab. 21 Tests for Lube oil, Bitumen, Grease and Wax/ Water Analysis	2	60	4 Hrs	25+25

Course Objectives	- To train the students for basic techniques in petroleum tests. - To introduce the students with handling and working of common IP equipment's used in laboratory.
Course Outcomes	After completion of this course students will be able to - Identify Ash & Penetration of Lube oil and Grease - Estimate COD, BOD, DO, & Hardness of waste water sample - To know Viscosity of Bitumen - Identify Drop and Dropping of Grease sample
List of Practical	
- Determination of P^H of soil sample - Determination of DO of given water sample - Determination of BOD of given water sample - Determination of COD of given water sample - Determination of Hardness of given water sample - Determination of Cone Penetration index of Grease - Determination of Needle Penetration index of Bitumen and Wax - Determination of Ash content in given Grease sample - Determination of Softening point of Bitumen sample - Determination of Viscosity of bitumen - Determination of Drop and Dropping point of Grease sample	

Distribution of Marks and the scheme of Practical Examination is as follows:

Section 1: Internal Assessment

• Active participation in activities	10 Marks
• Continuous Assessment Tests (CAT) (At least three tests) *	10 Marks
• Submission of duly certified practical record	05 Marks
Total	25 Marks

*Note: Total Performance in CAT (i.e. 40 %) shall be based on the best two out of three in CAT examinations

Section 2: External Assessment

• Exercise 1	10 Marks
• Exercise 2	10 Marks
• Viva-Voce (external)	05 Marks
Total	25 Marks

Course Category: Major Theory Elective

128247: Production of Polymer (Plastic, Rubber, Fiber and Resin)							
Level	Semester	Course code	Course Name	Credits	Teaching Hours	Exam Duration	Max marks
5.5	VI	128247	Production of Polymer (Plastic, Rubber, Fiber and Resin)	2	30	2Hrs	30 + 20 = 50

Course Objectives	- Understand the various basic Polymerization process that can be used as basic building blocks to manufacture the various Polymer as per the market requirement. - Identify the characteristics of basic raw materials that may act as a basic building block in the manufacture of Polymers. - Understand the various chemicals and catalysts that may play the important role in conversion of basic raw materials into various Polymers			
Course Outcomes	Upon completion of this course successfully, students would be able to - Use Basic chemical like Caprolactam, Hexamethylenediamine, Adipic Acid, Sebacic Acid, Lauryl Lactum a building block in the manufacture of various Nylon - Apply the knowledge of these basic raw materials in manufacturing various Polymer like Nylon, Polyester, and Rubber etc. - Recognize and optimize the various processes and process designs to manufacture the various Polymer - Study the market and demand of Polymer			
Unit System	Contents	Workload Allotted	Weightage of Marks Allotted	Incorporation of Pedagogies
Unit I	Ethylene and Propylene polymer:- Chemistry (Reaction Mechanism), Catalyst or Initiator properties, Manufacture processes (Well-lable flow diagram) Operating condition and Application of Polyethylene (HDPE, LDPE, LLDPE), Polypropylene, Ethylene-Propylene co-polymer (EPM Rubber)	8 Hrs	8 Marks	Chalk & Board, Power Point Presentation, Videos, Group Discussion, Assignments, surprise quizzes, question and answering sessions
Unit II	C ₄ Based Polymer:- Chemistry (Reaction Mechanism), Catalyst or Initiator properties, Manufacture processes (Well-label flow diagram) Operating condition and Application of Poly-butylene (Butyl Rubber), Di-Isobutylene, Poly-butadiene, Poly-isoprene, Poly-chloroprene (Neoprene) Butadiene-Styrene co-polymer (SBR), Butadiene-Acrylonitrile co-polymer (ABN)	7 Hrs	7 Marks	
Unit III	Vinyl and Styrene polymer:- Chemistry (Reaction Mechanism), Catalyst or Initiator properties, Manufacture processes (Well-label flow diagram) Operating condition and Application of Poly-vinyl chloride (PVC) Poly-vinyl acetate (PVA), Poly-styrene. Copolymers of Styrene Acrylonitrile-Butadiene-Styrene (ABS) Styrene-Acrylonitrile (SAN)	8 Hrs	8 Marks	
Unit IV	Condensation polymer:- Chemistry (Reaction Mechanism), Catalyst or Initiator properties, Manufacture processes (Well-label flow diagram) Operating condition and Application of Nylon-6, Nylon-6,6, Nylon-6,10 Nylon-12, Nylon-11, Urea-Formaldehyde resin, Phenol-Formaldehyde resin, Saturated polyester, Unsaturated polyester.	7 Hrs	7 Marks	
References	Text books: - Petroleum refining and Petrochemical. N. K. Sinha, Umesh Publication Delhi - Advance Petrochemical, Dr. G. N. Sarkar, Khanna Publication, Delhi - text on Petrochemical, Dr. B. K. Bhaskararao, Khanna Publication, Delhi - Introduction to petrochemical, Sukumar Maiti - Fuels and combustion, Samir Sarkar, Orient Longman Ltd. Hyderabad - Modern Petroleum Refining Processes, B.K. Bhaskara Rao, Oxford and IBH Publication, New Delhi Reference Books:			

	1. Fundamentals of Petroleum and Petrochemical Engineering by Uttam Ray Chaudhuri CRC press 2. The Chemistry and technology of Petroleum 4th edition by James G. Speight CRC Press 3. Systematic Experimental Physical Chemistry, S. W. Rajbhoj, Dr. T. K. Chondhekar, Anjali Publication, Aurangbad 4. Petroleum Refining technology, Dr. Ram Prasad, Khanna Publication, Delhi 5. Industrial Organic Chemistry, K. Weissmermel, and H. J. Arpe, Veriagchemie, New York 6. Chemical From Petroleum, A.L. Waddms, Murry, London 7. An Introduction to industrial organic chemistry, P. Wiseman, Applied Science, London 8. A Textbook of Polymer Volume I, II, III M. S. Bhatnagar, S. Chand & Company Ltd.
Model Questions	Short Type 1. Explain the basic reaction mechanism involved in the polymerization of ethylene to form polyethylene. 2. What are the catalysts or initiators used in the production of High-Density Polyethylene and Low-Density Polyethylene? 3. Mention the manufacturing process and operating conditions for Linear Low-Density Polyethylene. 4. What are the important properties and applications of Polypropylene? 5. Define Ethylene-Propylene Rubber and mention its major applications. 6. What is the basic reaction mechanism involved in the formation of condensation polymers like Nylon-6,6? 7. Which monomers are used for the production of Nylon-6,10 and what type of reaction is involved? 8. Mention the catalyst or reaction conditions required in the manufacture of Urea-Formaldehyde Resin. 9. State the main properties and applications of Phenol-Formaldehyde Resin. 10. What are the industrial applications of saturated and unsaturated polyester resins in polymer industries? Long Type 1. Explain in detail the chemistry and reaction mechanism of polymerization of ethylene to produce polyethylene. Describe the catalysts/initiators used, operating conditions, manufacturing process with well-labeled flow diagram, and applications of High-Density Polyethylene and Low-Density Polyethylene. 2. Explain the manufacture of Polypropylene with detailed chemistry, catalyst or initiator properties, process technology (bulk/slurry/gas phase), operating conditions and applications in industry. 3. Describe the production process of ethylene-propylene co-polymer (EPM rubber) including reaction mechanism, catalyst system, process flow diagram, operating parameters, properties and applications. 4. Discuss the production of Polyvinyl Acetate including reaction mechanism, initiator system, process flow diagram, operating parameters, properties and industrial applications. 5. Explain the polymerization of styrene monomer with detailed chemistry, catalyst/initiator system, manufacturing process, operating conditions, properties and applications of Polystyrene. 6. Describe the production, chemistry, reaction mechanism, process flow diagram, operating conditions and applications of Acrylonitrile Butadiene Styrene. 6. Explain the synthesis, structure, properties, manufacturing process and applications of Styrene Acrylonitrile including comparison with other styrene-based copolymers. M.C.Q. 1. The polymer formed from Hexamethylenediamine and adipic acid is: a) Nylon-6 b) Nylon-6,6 c) Nylon-11 d) Polyester 2. Urea-Formaldehyde Resin is mainly used for: a) Fibres b) Adhesives and moulding materials c) Fuel additives d) Lubricants 3. Phenol-Formaldehyde Resin is also known as: a) Nylon b) Bakelite c) Teflon d) PVC 4. Unsaturated polyester resins are mainly used in: a) Rubber tires only b) Fiber reinforced plastics (FRP) c) Fuel production d) Lubrication oils 5. Nylon polymers are generally formed by which type of polymerization? a) Addition polymerization b) Condensation polymerization c) Combustion reaction d) Electrolysis 6. The polymerization mechanism of Polyvinyl Chloride is mainly: a) Condensation polymerization b) Free radical addition polymerization c) Fermentation d) Hydrolysis 7. Polyvinyl Acetate is mainly used in: a) Adhesives and paints b) Fuel production c) Metal extraction d) Glass making 8. Polystyrene is produced by polymerization of: a) Ethylene b) Styrene c) Vinyl chloride d) Propylene 9. Acrylonitrile Butadiene Styrene is mainly known for: a) High fragility b) High impact resistance c) High solubility in water d) Low strength 10. Styrene-Acrylonitrile (SAN) copolymer is mainly used for: a) Insulation and structural applications b) Fuel additives c) Lubricating oils d) Fertilizers

Course Category: Major Elective Lab-22 A

128248: Lab 22A Preparation of Some Polymer							
Level	Semester	Course code	Course Name	Credits	Teaching Hours	Exam Duration	Max marks
5.5	VI	128248	Preparation of Some Polymer	2	60	4 Hrs	25+25

Course Objectives	- To train the students for basic techniques for production of polymer. - To introduce the students with handling and working of common chemicals
Course Outcomes	After completion of this course students will be able to - Identify melting point of polymer. - Preparation of various resins - Determine Acid value and bromine no. of polymer
List of Practical 10. –Preparation of Urea-Formaldehyde resin 11. - Preparation of Phenol-Formaldehyde resin 12. - Preparation of Nylon-6 13. – Determination of melting point of various polymer 14. – Determination of saponification value of polymer 15. - Determination of Acid value of polymer 16. – Determination of Bromine number of polymer	

Distribution of Marks and the scheme of Practical Examination is as follows:

Section 1: Internal Assessment

• Active participation in activities	10 Marks
• Continuous Assessment Tests (CAT) (At least three tests) *	10 Marks
• Submission of duly certified practical record	05 Marks
Total	25 Marks

*Note: Total Performance in CAT (i.e. 40 %) shall be based on the best two out of three in CAT examinations

Section 2: External Assessment

• Exercise 1	10 Marks
• Exercise 2	10 Marks
• Viva-Voce (external)	05 Marks
Total	25 Marks

Course Category: Major Theory Elective

128249: Petroleum and Petrochemical Products Characterization Methods							
Level	Semester	Course code	Course Name	Credits	Teaching Hours	Exam Duration	Max marks
5.5	VI	128249	Petroleum and Petrochemical Products Characterization Methods	2	30	2Hrs	30 + 20 = 50

Course Objectives	- Understand the various basic Characterization method - Identify the characteristics of UV, IR , NMR, Mass spectroscopy. - Understand the working of HPLC GC			
Course Outcomes	Upon completion of this course successfully, students would be able to - Understand various testing's and characterization techniques to analyze the properties of polymers, by using spectroscopy, NMR, UV, IR, GLC, HOLC etc. - Understand the working of HPLC and GC - Understand the concepts Chromatographic technique - Understand the multicomponent separation of petroleum			
Unit System	Contents	Workload Allotted	Weightage of Marks Allotted	Incorporation of Pedagogies
Unit I	Spectroscopy:- Introduction, Definition, Electromagnetic radiation, Units, Electromagnetic spectrum, absorption radiation. Ultra-Violet Spectroscopy:- Introduction, Absorption laws (Lamberts Law & Beers Law) Formation of absorption bands, Instrumentation, Theory of electronic spectroscopy, Type of electronic transition, Type of absorption bands, Application of UV- Spectroscopy	8 Hrs	8 Marks	Chalk & Board, Power Point Presentation, Videos, Group Discussion, Assignments, surprise quizzes, question and answering sessions
Unit II	Infra Red Spectroscopy:- Introduction, Theory, Instrumentation, Finger Point Region, Importance and Application. NMR [Nuclear Magnetic Resonance Spectroscopy] Introduction, Theory, Instrumentation, and Application. Mass Spectroscopy:- Introduction, Principles, Theory, Instrumentation, Mass spectrum and Application.	7 Hrs	7 Marks	
Unit III	Chromatography:- Introduction, Definition, Theory, Classification Techniques:- Partition Chromatography (Introduction, Solvent system, Theory, Advantages and Disadvantages of plate theory, Liquid-Liquid Partition chromatography and Application) Paper Chromatography:- (Introduction, Principles, Theory, Technique and Applications)	8 Hrs	8 Marks	
Unit IV	HPLC [High Performance Liquid Chromatography] Introduction, Characteristic feature of HPLC, Principles, Instrumentation and Application. TLC [Thin Layer Chromatography] Introduction, Advantages of TLC, Theory, Techniques, Types of TLC and Application GC [Gas Chromatography] Introduction, Principles, Theory, Instrumentation and Application	7 Hrs	7 Marks	
References	Text books:			

	1. Petroleum refining and Petrochemical. N. K. Sinha, Umesh Publication Delhi 2. Advance Petrochemical, Dr. G. N. Sarkar, Khanna Publication, Delhi 3. text on Petrochemical, Dr. B. K. Bhaskararao, Khanna Publication, Delhi 4. Introduction to petrochemical, Sukumar Maiti 5. Fuels and combustion, Samir Sarkar, Orient Longman Ltd. Hyderabad 6. Modern Petroleum Refining Processes, B.K. Bhaskara Rao, Oxford and IBH Publication, New Delhi Reference Books: 1. Fundamentals of Petroleum and Petrochemical Engineering by Uttam Ray Chaudhuri CRC press 2. The Chemistry and technology of Petroleum 4th edition by James G. Speight CRC Press 3. Systematic Experimental Physical Chemistry, S. W. Rajbhoj, Dr. T. K. Chondhekar, Anjali Publication, Aurangbad 4. Petroleum Refining technology, Dr. Ram Prasad, Khanna Publication, Delhi 5. Industrial Organic Chemistry, K. Weissmermel, and H. J. Arpe, Veriagchemie, New York 6. Chemical From Petroleum, A.L. Waddms, Murry, London 7. An Introduction to industrial organic chemistry, P. Wiseman, Applied Science, London 8. Elementary Organic Spectroscopy, Y. R. Sharma, S, Chand Publication 9. Spectroscopy of organic compound, P. S. Kalsi, New Age International Pub. 10. Chromatography, H. Kaur, Pragati Prakashan Meerut 11. Chromatography Kamlesh Bansal, Campus Books International New Delhi
Model Questions	Short Type 1. Define spectroscopy and explain the role of electromagnetic radiation in spectroscopic analysis. 2. What are the basic units used in spectroscopy for measuring wavelength and frequency? 3. Define Electromagnetic Spectrum and mention its importance in spectroscopy. 4. State Beer-Lambert Law used in UV spectroscopy. 5. Mention any two applications of ultraviolet (UV) spectroscopy in chemical analysis. 6. Define chromatography and explain its basic principle of separation. 7. What is the theory of chromatography and how is it used for separation of mixtures? 8. Define Partition Chromatography and mention its solvent system. 9. What is paper chromatography and state its basic principle? 10. Mention any two applications of paper chromatography in chemical analysis. Long Type 1. Explain the introduction and definition of spectroscopy. Describe electromagnetic radiation, its properties, units of measurement and the electromagnetic spectrum in detail. 2. Explain Beer-Lambert Law and Lambert's Law. Discuss their mathematical expressions, limitations and applications in UV spectroscopy. 3. Explain the theory of electronic spectroscopy. Discuss types of electronic transitions, formation of absorption bands and applications of UV spectroscopy in qualitative and quantitative analysis. 4. Explain the introduction, definition and theory of chromatography. Discuss the basic principles involved in separation techniques. 5. Describe the classification of chromatography techniques in detail. Explain different types based on mobile phase and stationary phase with suitable examples. 6. Explain Partition Chromatography in detail. Discuss its principle, solvent system, theory and application in analytical chemistry. 7. Explain paper chromatography in detail including its introduction, principle, theory, experimental technique and applications in qualitative and quantitative analysis. M.C.Q. 1. Spectroscopy is mainly the study of interaction between: a) Matter and heat b) Matter and electromagnetic radiation c) Solids and liquids d) Gases and pressure 2. The unit commonly used for wavelength in UV spectroscopy is: a) Pascal b) Kelvin c) Nanometre (nm) d) Joule

	3. Beer-Lambert Law relates absorbance to: a) Temperature b) Concentration and path length c) Pressure only d) Volume only 4. In UV spectroscopy, $\pi \rightarrow \pi^*$ transition is an example of: a) Nuclear transition b) Electronic transition c) Thermal transition d) Magnetic transition 5. UV spectroscopy is mainly used for: a) Determination of atomic mass b) Qualitative and quantitative analysis of compounds c) Measurement of density d) Determination of melting point 6. Chromatography is mainly a technique used for: a) Heating substances b) Separation of components in a mixture c) Measuring density d) Measuring melting point 7. Partition Chromatography is based on the distribution of solute between: a) Solid and gas b) Two liquid phases c) Solid and solid d) Gas and solid only 8. In paper chromatography, the stationary phase is: a) Water in cellulose paper b) Organic solvent c) Gas phase d) Acid solution 9. The mobile phase in chromatography is usually: a) Solid b) Liquid or gas c) Metal d) Polymer 10. Paper chromatography is mainly used for: a) Industrial synthesis b) Separation and identification of small quantities of compounds c) Measuring pressure d) Distillation of crude oil
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Course Category: Major Elective P

128250: Lab 22B: Identification of various Petroleum products tests							
Level	Semester	Course code	Course Name	Credits	Teaching Hours	Exam Duration	Max marks
5.5	VI	128250	Experiment based on Spectroscopy	2	60	4 Hrs	25+25

Course Objectives	- To train the students for basic techniques in chemical tests. - To introduce the students with handling and working of common equipment's used in laboratory.
Course Outcomes	After completion of this course students will be able to - Compare estimation of various chemical - Comparison of IR spectra - Determine equivalent weight - Analysis of reference spectra
List of Practical - Estimation of glucose by Fehling's method - Estimation of phenol by bromination method - Estimation of ester by hydrolysis method - Verification of Beer–Lambert law using potassium permanganate or potassium dichromate solution. - Estimation of copper using colorimetric/UV-visible method. - Determination of concentration of unknown solution using UV–Visible spectrophotometer. - Identification of functional groups in alcohols, aldehydes, ketones, acids, esters, and amines using IR spectra. - Distinction between aldehydes and ketones (Benzaldehyde and Acetophenone) using IR spectra. - Estimation of vitamin C in fruit juice/tablets - Determination of equivalent weight of an organic acid (Reference spectra may be obtained from literature) a] Determination of chemical shift values using standard PMR spectra (Chloroform, Acetaldehyde, Benzaldehyde and Anisole) b] Proton counting using integrated peak areas. (Acetone, Toluene, Acetic acid) - Distinction between structural isomers using ¹H NMR spectra. (o-Xylene, m-Xylene, p-Xylene and 1-propanol and 2-propanol) - Identification of molecular ion peak and base peak in: Toluene, Acetophenone, Cyclohexanone - Study of isotopic patterns in: Chlorobenzene and Bromobenzene	

Distribution of Marks and the scheme of Practical Examination is as follows:

Section 1: Internal Assessment

• Active participation in activities	10 Marks
• Continuous Assessment Tests (CAT) (At least three tests) *	10 Marks
• Submission of duly certified practical record	05 Marks
Total	25 Marks

*Note: Total Performance in CAT (i.e. 40 %) shall be based on the best two out of three in CAT examinations

Section 2: External Assessment

• Exercise 1	10 Marks
• Exercise 2	10 Marks
• Viva-Voce (external)	05 Marks
Total	25 Marks

Course Category: Minor Theory

28251: Non energy Petroleum/ Pollution/ Future fuels							
Level	Semester	Course code	Course Name	Credits	Teaching Hours	Exam Duration	Max marks
5.5	VI	128251	Non energy Petroleum/ Pollution/ Future fuels	2	30	2Hrs	30 + 20 =50

Course Objectives	- Understand the various basic lubricants used in Industries. - Identify the characteristics of pollutant - Understand the various Safety, transport and storage of petroleum			
Course Outcomes	Upon completion of this course successfully, students would be able to - Use of Lube oil, Grease, and Bitumen in various sector. - Apply the knowledge of water analysis. - Understand importance of Bio-diesel in future fuels. - Study the production processes for Lube-oil, Grease, Bitumen, and Bio-diesel			
Unit System	Contents	Workload Allotted	Weightage of Marks Allotted	Incorporation of Pedagogies
Unit I	Lube Oil:- Introduction, Definition, Specification, Type of Lube oil, Production process and Application. Grease:- Introduction, Type of Grease, Specification and Application. Bitumen:- Introduction, Sources, Structures, Properties, Types of Bitumen, Production Processes and Application.	8 Hrs	8 Marks	Chalk & Board, Power Point Presentation, Videos, Group Discussion, Assignments, surprise quizzes, question and answering sessions
Unit II	Pollution in integrated chemical industries, Definition, Kinds of Pollution (Air, Water & Soil) Air Quality Index (AQI), water analysis (DO, COD, BOD, Hardness, P ^H) Impact of Pollution on Human being, Land & Water. Green house gases.	7 Hrs	7 Marks	
Unit III	Safety, Transportation & Storage for petroleum and chemical Products, Symbols used for handling of hazardous material, Personal protective equipment selection, Use and handling. Transportation (Pipeline, Road, and Rail) Storage.	8 Hrs	8 Marks	
Unit IV	Future Fuel:- Bio-diesel, History, Significance, Processing (Flow diagram & Process parameter) Specification of Bio-diesel, Advantages, Bio-ethanol, Importance of Bio-Diesel in India (For Energy Demand)	7 Hrs	7 Marks	
References	Text Books: 1. Petroleum refining and Petrochemical. N. K. Sinha, Umesh Publication Delhi 2. Advance Petrochemical, Dr. G. N. Sarkar, Khanna Publication, Delhi 3. text on Petrochemical, Dr. B. K. Bhaskararao, Khanna Publication, Delhi 4. Introduction to petrochemical, Sukumar Maiti 5. Fuels and combustion, Samir Sarkar,, Orient Longman Ltd. Hyderabad Reference Books: 1. Fundamentals of Petroleum and Petrochemical Engineering by Uttam Ray Chaudhuri CRC press 2. The Chemistry and technology of Petroleum 4th edition by James G. Speight CRC Press 3. Systematic Experimental Physical Chemistry, S. W. Rajbhoj, Dr. T. K. Chondhekar, Anjali			

	Publication, Aurangbad 4. Petroleum Refining technology, Dr. Ram Prasad, Khanna Publication, Delhi 5. Industrial Organic Chemistry, K. Weissmerl, and H. J. Arpe, Veriagchemie, New York 6. Chemical From Petroleum, A.L. Waddms, Murry, London 7. An Introduction to industrial organic chemistry, P. Wiseman, Applied Science, London
Model Question	Short Type 1. Define lubricating oil and mention its main functions in machinery. 2. What are the different types of lubricating oils and where are they used? 3. Define grease and mention any two types of grease used in industries. 4. State any two important properties of Bitumen. 5. Mention one application each of lube oil, grease and bitumen in industry 6. Define pollution in the context of integrated chemical industries. 7. List the different kinds of pollution found in chemical industries. 8. What is Air Quality Index and why is it important? 9. Name any two parameters used in wastewater analysis (e.g., DO, BOD, COD, pH). 10. What are greenhouse gases and mention any one example. Long Type 1. Explain the introduction and definition of lubricating oil. Discuss its specifications, quality requirements, types, production process and industrial applications in detail. 2. Describe different types of lubricating oils such as automotive oils, industrial lubricants and aviation lubricants. Explain their properties, functions and applications in various industries. 3. Discuss in detail the introduction, sources, chemical structure, properties and types of Bitumen. Explain its industrial significance. 4. Explain in detail the safety measures required in petroleum and chemical industries during handling, storage and processing of hazardous materials. Discuss common industrial hazards and their control methods. 5. Describe the classification and meaning of symbols used for handling hazardous materials. 6.. Explain different modes of transportation of petroleum and chemical products including pipeline, road and rail transport. Discuss their advantages, limitations and safety precautions. M.C.Q. 1. The main function of Lubricating Oil is to: a) Increase friction b) Reduce wear and friction c) Increase corrosion d) Produce ash - Grease is generally a: a) Solid lubricant formed by thickening oil with soap b) Gas mixture c) Pure solvent d) Acid solution - Bitumen is mainly obtained from: a) Coal distillation b) Petroleum refining residue c) Natural gas cracking d) Water treatment - Which property of lubricating oil indicates resistance to flow? a) Density b) Viscosity c) Melting point d) Hardness - Bitumen is mainly used in: a) Fertilizer industry b) Road construction and waterproofing c) Textile industry d) Food industry - Pollution in integrated chemical industries mainly refers to: a) Increase in production only b) Undesirable changes in environment due to industrial activities c) Improvement in air quality d) Increase in biodiversity - Air Quality Index is used to measure: a) Water hardness b) Level of air pollution c) Soil fertility d) Noise frequency - Which of the following is used to measure organic pollution in wastewater? a) DO b) COD c) pH only d) Hardness - Which of the following is a greenhouse gas? a) Oxygen b) Nitrogen c) Carbon dioxide d) Argon - High Biological Oxygen Demand (BOD) in water indicates: a) Clean water b) Low microbial activity c) High organic pollution d) High salinity only

Course Category: Minor Lab

128252: Lab23 Waste Water and non-energy Petroleum Analysis							
Level	Semester	Course code	Course Name	Credits	Teaching Hours	Exam Duration	Max marks
5.5	VI	128252	Lab 23 Waste Water and non-energy Petroleum Analysis	2	60	4 Hrs	25+25

Course Objectives	- To train the students for basic techniques in waste water analysis. - To introduce the students with handling and working of common IP equipments used in laboratory.
Course Outcomes	After completion of this course students will be able to - Identify Ash content of Lube oil and grease samples - Calculate DO and PH of Water sample - Identify smoke point of various petroleum samples - Estimate Drop and Dropping point of given petroleum samples
List of Practical	
- Determination of P^H of soil sample - Determination of DO of given water sample - Determination of Hardness of given water sample - Determination of Cone Penetration index of Grease - Determination of Ash content in given Grease sample - Determination of Softening point of Bitumen sample - Determination of Drop and Dropping point of Grease sample	

Distribution of Marks and the scheme of Practical Examination is as follows:

Section 1: Internal Assessment

• Active participation in activities	10 Marks
• Continuous Assessment Tests (CAT) (At least three tests) *	10 Marks
• Submission of duly certified practical record	05 Marks
Total	25 Marks

*Note: Total Performance in CAT (i.e. 40 %) shall be based on the best two out of three in CAT examinations

Section 2: External Assessment

• Exercise 1	10 Marks
• Exercise 2	10 Marks
• Viva-Voce (external)	05 Marks
Total	25 Marks

Course Category: Vocational Skill Course (VSC) Lab 24 PCH Lab

128253: Lab 24 PCH Lab							
Level	Semester	Course Code	Course Name	Credits	Teaching Hours	Exam Duration	Max Marks
5.5	VI	128253	VSC Lab 24 PCH Lab	2	60	--	50

Course Objectives:	- Develop practical skills in paper and pulp processing, recycling techniques, and testing of paper materials. - Gain hands-on experience in simple chromatographic techniques for separation and identification of components in natural and synthetic samples.	
Course Outcomes:	- Carry out simple chromatographic separations (paper chromatography/TLC) and interpret results using Rf values. - Analyze environmental impact of chemical processes and suggest green alternatives for industrial applications. - Develop vocational skills such as observation, reporting, teamwork, and basic analytical thinking. - Connect laboratory experiments with real-life industrial and environmental applications	
Unit System	Content	Incorporation of Pedagogies
Experiments	- Preparation of Handmade Paper from Waste Paper - Preparation of plate for TLC and separation of plant pigments. - Comparison of Different Paper Types with respect to thickness, texture and absorbency test. - Preparation of Activated Charcoal from Coconut Shell - Preparation of biodegradable Plastic from Starch and glycerol - Measurement of capillary action of various paper samples. - Measurement of pH of Paper Pulp Slurry - Separation of Oil–Water Using Natural Adsorbents like Coconut husk or sawdust filtration. - Determination of Moisture Content in Paper - Preparation of Natural Dye using turmeric, hibiscus, beetroot extracts. - Estimation of total alkali content in soap - Preparation of phenolphthalein Indicator dye. - To determine the acidity or alkalinity of a paper sample by measuring the pH.	Lab Reports: Students prepare detailed lab reports on their findings. Discussion Sessions: Group discussions. Group Projects: Assign group projects on Mass Transfer Operations. Class Debates: Discuss the findings amongst the students.
References:	- Green Chemistry: Theory and Practice by Paul T. Anastas & John C. Warner by Oxford University Press - Practical Green Chemistry for Undergraduate Students by M. Lancaster, Royal Society of Chemistry (RSC) - Handbook of Pulp and Paper Technology by H. Sixta, Wiley-VCH - Chromatographic Methods by Braithwaite & Smith, Springer - Green Chromatographic Technique edited by Inamuddin & Ali Mohammad, Springer Web Resources: https://nptel.ac.in https://www.vlab.co.in https://epgp.inflibnet.ac.in https://ncert.nic.in	
Model Questions:	NA	

Distribution of Marks and the scheme of (VSC) Practical Examination is as follows:

Section I: Continuous Internal Assessment

- Continuous Assessment Tests (CAT) (At least three tests) * 15 Marks
 - Submission of duly certified practical record 10 Marks
- Total 25 Marks**

Section II: End Semester Examination (Internal only)

- Exercise 1 20 Marks
 - Viva-Voce (internal) 05 Marks
- Total 25 Marks**

Total (Section I and II) 50 Marks

***Note: Total Performance in CAT (i.e. 40 %) shall be based on the best two out of three in CAT examinations**
Course Category: Internship / Apprenticeship/ OJT

128254 Internship / Apprenticeship/ OJT (On the Job Training)

Level	Semester	Course Code	Course Name	Credits	Teaching Hours	Exam Duration	Max Marks
5.5	VI	128254	Internship / Apprenticeship/ OJT	4	80	--	100

Course Objectives:	- To provide hands-on training in Petrochemical -related industries, laboratories, and research organizations. - To expose students to industrial practices, instrumentation, quality control, and safety procedures. - To enhance problem-solving, teamwork, communication, and technical skills. - To create awareness regarding entrepreneurship and employment opportunities in Industries.
Course Outcomes:	Upon successful completion of this course, students will be able to: - Apply theoretical chemistry concepts in practical and industrial environments. - Operate and understand basic analytical instruments and laboratory techniques. - Demonstrate professional ethics, laboratory safety, and teamwork. - Analyze chemical processes, observations, and experimental data effectively. - Prepare technical reports and communicate scientific findings professionally. - Explore employability and entrepreneurship skills in petrochemical-related sectors.

Guidelines/ SOP for Internship / Apprenticeship/ OJT

For understanding key principles of Internship/Apprenticeship/OJT operational guidelines and implementation strategy please refer

1. https://www.ugc.gov.in/pdfnews/2051511_Internship-Research-Internship-Guidelines.pdf
2. <https://www.sgbau.ac.in/pdf/1092Internship%20Policy.pdf>

As per NEP 2020, students of B Sc. III need to undertake Internship / Apprenticeship/ OJT for FOUR (4) credits i.e. 100 Marks.

The guidelines for Internship / Apprenticeship/ OJT are as follows:

Credit: 04

Duration: 120 Hrs

Internship Period: Ideally, the internship should be completed during the summer break between the second and third year. Students who are unable to complete the internship during this period must ensure its completion by the end of the VI semester, either in a part-time manner during Semester V, or during the Diwali break, or winter break or through an alternative arrangement subject to prior approval by the parent institution (University School/College).

Internship Categories:

- Internship for enhancing the employability:** Employability is a set of skills and attributes developed through a range of experiences at workshops and workplaces.
- Internship for developing the research aptitude:** Research internship aims at providing hands-on training to work on research tools, techniques, methodologies, equipment, policy framework and various other aspects in pursuing quality research.

Implementation and assessment: For implementation and assessment of this vertical a separate SoP or relevant document that shall be provided by the University will be applicable.

These can be implemented through:

1. Industries

2. Research labs
3. Government testing laboratories
4. Colleges/departments
5. MSMEs and startups
6. Online/virtual internships with report and viva evaluation

Some suggested forms of Internship / Apprenticeship/ OJT are:

Laboratory and Analytical Training:

1. Water quality testing laboratory internship
2. Soil and fertilizer analysis training
3. Food and dairy testing laboratory apprenticeship
4. Edible oil analysis and quality control training
5. Pharmaceutical quality control laboratory training
6. Clinical pathology and diagnostic laboratory exposure
7. Environmental monitoring and pollution analysis internship
8. Industrial analytical chemistry laboratory training

Chemical Industry-Based OJT

- 1.Internship in chemical manufacturing units
- 2.Paint, dye, pigment, and polymer industry training
- 3.Soap, detergent, and cosmetic industry apprenticeship
- 4.Agrochemical and pesticide formulation training
- 5.Distillery, sugar, or fermentation industry exposure
- 6.Cement, ceramic, or glass industry laboratory training
- 7.Electroplating and metal finishing industry training

Research and Academic Exposure

- 1.Internship in university or research laboratories or premier institutes like IITs/IISERs etc.
- 2.Spectroscopy and instrumentation laboratory training
- 3.Computational chemistry or chemoinformatics training
- 4.Nanochemistry and material characterization exposure
- 5.Scientific documentation and laboratory management training

Entrepreneurship and Skill-Based OJT

- 1.Small-scale chemical product preparation: Oil, Soap, Sanitizer, Phenyl, Detergent, Herbal products etc.
- 2.Food preservation and quality analysis training
- 3.Entrepreneurship in chemical products and formulations
- 4.Laboratory chemical preparation and packaging training

References	https://www.ugc.gov.in/pdfnews/2051511_Internship-Research-Internship-Guidelines.pdf https://www.sgbau.ac.in/pdf/1092Internship%20Policy.pdf
Model Questions:	NA