

**Sant Gadge Baba Amravati University, Amravati**

**Faculty: Science & Technology**

**Programme:- B.Sc. with Petrochemical Science**

**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 socio-technological changes

**PSOs**

By the end of this program, the learner 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
3. Petrochemical Science field.
4. Plan and conduct scientific experiments and record the results of such experiments.
5. Get acquainted with safety of chemicals, transfer, and measurements of chemicals, preparation of solutions, and using physical properties to identify compounds and chemical reactions.
6. Describe how Petrochemical Science is useful to solve social, economic and environmental problem and issues facing our society in energy, medicine, and health.
7. 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.

**Syllabus Prescribed for B.Sc. First Year UG Programme**

**Programme: B.Sc.**

**Semester -1**

Code of the Course/Subject	Title of the Course/Subject	(Total Number of Periods)
PCH(1S) –T	Petrochemical Science 1S	84

**COs**

By the end of the course, the student would be able to:

1. Know basic principles and concepts of petro-chemistry
2. get in-depth knowledge of fuels and petroleum industries
3. Apply basic concepts in formation, exploration and drilling for petroleum
4. Recognize composition and classification of petroleum
5. Classify various operations & processes carried out in petroleum refinery
6. Use basic quality monitoring and laboratory test

Unit	Content
<b>Unit I</b>	Basic concept in Petro-chemistry: P <sup>H</sup> , 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, 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. <b>(14 Periods)</b>
<b>Unit II</b>	<b>Fuel and Petroleum Industry</b> Definition of Petroleum and Petrochemicals. Fuels: Conventional and nonconventional fuels. Type of Petroleum fuel: Primary and secondary. 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. 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. Commonly used crude oil terms like WTI, Brent and OPEC. <b>(14 Periods)</b>
<b>Unit III</b>	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. 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. Type of drill bits, casings, well control systems. <b>(14 Periods)</b>
<b>Unit IV</b>	<b>Chemistry and Composition of Petroleum:</b> 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. <b>(14 Periods)</b>
<b>Unit V</b>	<b>Refinery Operation</b> 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, preflashing of crude oil. Introduction to Atmospheric distillation (ADU), side stream strippers, vacuum distillation (VDU). Fractions from ADU and VDU, carbon number of the hydrocarbons present in various fractions, boiling range, and details of composition of various fractions.

	<b>(14 Periods)</b>
<b>Unit VI</b>	<b>Quality Monitoring of petroleum product</b> Classification of Laboratory tests. Distillation, Vapor pressure, Flash point, Fire point, Octane number, Cetane number, Aniline point, Diesel index, Calorific value, Smoke Point, Viscosity, Viscosity index, 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, Conradson carbon residue(CCR). <b>(14 Periods)</b>
<b>*SEM-</b> <b>1. Calculations involved in basic chemistry</b> , Solve numerical problems based on normality, molality, molarity etc. <b>2. Unit conversions associated with stoichiometry</b> <b>3. Uses of energy, sources and advantages &amp;disadvantages of petroleum.</b> <b>4. Visualization of formation of petroleum, and technology-methodology involved in petroleum production.</b> <b>5. Compare the physical and chemical properties of various hydrocarbons, understand the principle involved in classification of petroleum based on its composition.</b> <b>6. Different identification tests of petroleum products and their significances involved.</b>	
<b>COs:</b> By the end of this module , student would be able to: 1. Solve the numerical associated petro-chemistry, unit conversions, hydrocarbons, properties of hydrocarbons, formation and production of petroleum, objective of refining, refining operations, quality control of petroleum products. 2. Prepare the theoretical background of tests for various petroleum products and their significances.	
<b>**Activities</b>	Refinery location maps, Class tests, assignments, Project, Survey, Group discussion, Industrial visit, or any other innovative pedagogical method. Any two activities be conducted from above. Class tests are compulsory. Equal weightage for each activity.

### Course Material/Learning Resources

#### 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) Chemistry of petrochemical processes 2<sup>nd</sup> edition by Sami Matar , Lewis F. Hatch Gulf publishing company
- 2) Fundamentals of Petroleum and Petrochemical Engineering by Uttam Ray Chaudhuri CRC press
- 3) Hand book of petroleum Processing Edited by David S. J. “Stan” Jones and Peter R. Pujado Springer
- 4) The Chemistry and technology of Petroleum 4<sup>th</sup> edition by James G. Speight CRC Press
- 5) Catalyst and chemical process, Ronald Pearcc and William R. Patreson ,Leonard Hill, Glasgow
- 6) Systematic Experimental Physical Chemistry, S. W. Rajbhoj, Dr. T. K. Chondhekar, Anjali Publication, Aurangbad

- 7) Advance Petroleum Refining, Dr. G. N. Sarkar, Khanna Publication, Delhi
- 8) Petroleum Refining technology, Dr. Ram Prasad, Khanna Publication, Delhi
- 9) Unit Operation II, K. A. Gavhane. Nirali Publication, Pune
- 10) Basic Organic Chemistry, Part 5, Industrial Product, J.M. Tedder, A. Nechvatal, and A.H. Jubb, John Wiley, London
- 11) Industrial Organic Chemistry, K. Weissmermel, and H. J. Arpe, Veriagchemie, New York
- 12) Chemical From Petroleum, A.L. Waddms, Murry, London
- 13) An Introduction to industrial organic chemistry, P. Wiseman, Applied Science, London
- 14) Modern Petroleum Technology, G. D. Hobson, John Wily, Chichester
- 15) Chemical from Synthesis Gas, R. A. Sheldon, B. Reidel publication company, Dordrecht

Weblink to Equivalent MOOC on SWAYAM if relevant:--

Weblink to Equivalent Virtual Lab if relevant:--

Any pertinent media (recorded lectures, YouTube, etc.) if relevant:--

**Sant Gadge Baba Amravati University, Amravati**

**Faculty: Science & Technology**

**Programme:- B.Sc. with Petrochemical Science**

**Syllabus Prescribed for B.Sc. First Year UG Programme**

**Programme: B.Sc. in Petrochemical Science**

**Semester -2**

Code of the Course/Subject	Title of the Course/Subject	(Total Number of Periods)
PCH (2S)-T	Petrochemical Science 2S	84

**COs**

By the end of course, student would be able to:

1. Apply the knowledge of petrochemical industries.
2. Understand the basic feed stocks and gas purification techniques utilized in petrochemical Industries.
3. Recognize the primary raw materials for various Petrochemicals.
4. Apply separation and purification processes of petroleum gases in to individual constituents.
5. Identify steam reforming processes with their definition, reactions, reactivity, to know the synthesis gas production through various processes.
6. use various applications of synthesis gas with the processes involved.

Unit	Content
<b>Unit I</b>	Overview of Petrochemical industry Definition of Petrochemical, World Petrochemical industry, History and Development of petrochemical industry in India, Role of MGCC, IPCL, HBJ gas line, TNC, Fertilizer in India. <b>(14 Periods)</b>
<b>Unit II</b>	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, how to remove them. <b>(14 Periods)</b>
<b>Unit III</b>	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. <b>(14 Periods)</b>
<b>Unit IV</b>	Separation of gases (From Natural gas and Petroleum) in to individual constituents Various process:- Absorption Desorption, Compression Liquefaction, Low temperature fractionation, Adsorption, and special technique. Introduction to separation techniques of Aromatic:- azeotropic separation, Extractive Distillation, Crystallization. <b>(14 Periods)</b>
<b>Unit V</b>	Steam reforming Definition of reforming, Types of reforming,(Thermal and catalytic only introduction) Steam reforming, various steam reforming reaction, Reactivity of hydrocarbons, Role of steam hydrocarbon ratio. Production of synthesis gas Various processes:- Natural gas steam reforming, Naphtha steam reforming, Partial oxidation hydrocarbon process, Coal gasification process, Lurgi process <b>(14 Periods)</b>
<b>Unit VI</b>	Uses of synthesis gas Various uses of synthesis gas, Methanol production with physical properties, Chemical reaction, Process flow and uses. Oxo synthesis process, Production of propionaldehyde and propanol, Chemicals based on carbon monoxide <b>(14 Periods)</b>
<b>*SEM- II</b>	
<ol style="list-style-type: none"> <li>1. Identify the petrochemicals and petrochemical industry.</li> <li>2. Use of hydrocarbons and how these can be converted into building blocks for various petrochemicals and consumer commodities.</li> </ol>	

3. Comparison of the hydrocarbons and their physical or chemical properties. 4. Understand the various separation processes that are applied in petroleum and petrochemical industry. 5. Choose the various processes to convert basic hydrocarbons into petrochemicals as a feedstock for petrochemicals. 6. Study the composition of synthesis gas and processes available.	
COs: By the end of this module student would be able to: 1. Use different hydrocarbons as a starting material for various petro-chemicals. 2. Apply various processes available to convert hydrocarbons in the building blocks for petrochemicals.	
<b>**Activities</b>	Class tests, assignments, Project, Survey, Group discussion, Industrial visit or any other innovative pedagogical method. Any two activities be conducted from above. Class tests are compulsory. Equal weightage for each activity.

### Course Material/Learning Resources

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- 2) Fundamentals of Petroleum and Petrochemical Engineering by Uttam Ray Chaudhuri CRC press
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- 4) The Chemistry and technology of Petroleum 4<sup>th</sup> edition by James G. Speight CRC Press
- 5) Fuels and combustion, Samir Sarkar,, Orient Longman Ltd. Hyderabad
- 6) Catalyst and chemical process, Ronald Pearcc and William R. Patreson ,Leonard Hill, Glasgow
- 7) Systematic Experimental Physical Chemistry, S. W. Rajbhoj, Dr. T. K. Chondhekar, Anjali Publication, Aurangbad
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- 12) Industrial Organic Chemistry, K. Weissermel, and H. J. Arpe, Veriagchemie, New York
- 13) Chemical From Petroleum, A.L. Waddms, Murry, London
- 14) An Introduction to industrial organic chemistry, P. Wiseman, Applied Science, London

15) Modern Petroleum Technology, G. D. Hobson, John Wiley, Chichester

16) Chemical from Synthesis Gas, R. A. Sheldon, B. Reidel publication company, Dordrecht

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**Sant Gadge Baba Amravati University, Amravati**

**Syllabus Prescribed for First Year UG Programme**

**Programme: B.Sc.**

**Semester 1**

Code of the Course/Subject	Title of the Course/Subject (Laboratory/Practical/practicum/hands-on/Activity)	(No. of Periods/Week)
PCH (1S) Pr	Petrochemical Science	26

**COs:**

At the end of the Lab/Practical course, the student would be able to:

1. Prepare standard chemical solutions and standardize them.
2. Identify and calculate the viscosity of a lubricant.
3. Measure flash and fire point of petroleum samples.
4. Determine melting point of petroleum wax and other solid petroleum.
5. Magnify specific gravity of petroleum samples.
6. Calculate acid value and saponification value of petroleum samples.

**\* List of Practical/Laboratory Experiments/Activities etc.**

1	Determination of API gravity of given sample
2	Determination of acid value of given Petroleum sample
3	Determination of drop point and melting of wax
4	Determination of viscosity by U-tube Viscometer
5	Determination of Congealing point of wax
6	Determination of Saponification value of petroleum sample
7	Determination of Flash point and Fire point of petroleum sample by Cleveland open cup apparatus
8	Numerical problems on unit conversion
9	Preparation of standard solution

**Distribution of Marks for Practical Examination.**

<b>Time: 4 hours</b>	<b>(One Day Examination)</b>	<b>Marks: 50</b>
<b>Exercise No. 1 (Practical Expt.)</b>		<b>15 Marks</b>
<b>Exercise No. 2 (Practical Expt.)</b>		<b>15 Marks</b>
<b>Viva-Voce</b>		<b>10 Marks</b>
<b>Practical Record</b>		<b>10 Marks</b>
<b>Total</b>		<b>50 Marks</b>

**Sant Gadge Baba Amravati University, Amravati**  
**Syllabus Prescribed for First Year UG Programme**  
**Programme: B.Sc.**  
**Semester 2**

<b>Code of the Course/Subject</b>	<b>Title of the Course/Subject</b> (Laboratory/Practical/practicum/hands-on/Activity)	<b>(No. of Periods/Week)</b>
<b>PCH (2S) Pr</b>	<b>Petrochemical Science 2S</b>	<b>26</b>

**COs:**

At the end of Lab/Practical course, students would be able to -

1. Identify flash point of petroleum samples
2. Calculate density and specific gravity of petroleum samples for API gravity
3. Identify smoke point of various petroleum samples
4. Estimate diesel index by using aniline point of given petroleum samples
5. Determine viscosity of petroleum samples by using slandered Redwood viscometer apparatus
6. Melting point of various solid petroleum and chemicals

**\* List of Practical/Laboratory Experiments/Activities etc.**

- 1 Determination of flash point of petroleum sample by Abels closed cup apparatus
- 2 Determination of flash point of petroleum sample by Pensky Martin apparatus
- 3 Determination of density and specific gravity of given petroleum sample
- 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

**Distribution of Marks for Practical Examination.**

<b>Time: 4 hours</b>	<b>(One Day Examination)</b>	<b>Marks: 50</b>
<b>Exercise No. 1 (Practical Expt.)</b>		<b>15 Marks</b>
<b>Exercise No. 2 (Practical Expt.)</b>		<b>15 Marks</b>
	<b>Viva-Voce</b>	<b>10 Marks</b>
	<b>Practical Record</b>	<b>10 Marks</b>
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	<b>Total</b>	<b>50 Marks</b>

## GIC SEM I

### Semester-I

**Course Title:** Petroleum Refining, Petro chemistry, Petroleum Products

Total Credits: 01

Total Lectures: 15

#### **Objectives:**

- To make students to understand composition of petroleum.
- To make students acquaint the importance of petroleum in modern society.
- To aware students about the fact that energy is critical to economic and social development.
- To make students to understand that a clean environment, increased economic growth and improvement in lifestyles are all important goals.
- To make students to understand basic refinery operations and their roles.

#### **COs (Learning Outcome):**

By the end of this course, students would be able to:

1. Gain knowledge about hydrocarbons, their sources and potential uses.
2. Recognize the importance of petroleum in modern society.
3. Have in-depth knowledge of refinery and refinery operations.
4. Have idea about commercial use of petroleum products and their impact on environment.
5. Understand the importance of role of conservation of natural resources in achieving the sustainable growth.

**Unit 01:**Composition and characteristics, types of crude oil. Types of hydrocarbons, impurities present in petroleum. Formation theories of petroleum, availability of petroleum. Advantages and disadvantages of petroleum, importance of petroleum in the petrochemical sector.(05 Lectures)

**Unit 02:**Introduction to prospecting of petroleum. Drilling for petroleum. Objective of refining, basic refining operations and their role. Various petroleum products and their applications, Production and consumption of petroleum and petroleum products in India. Natural gas and its uses in various sectors. Role of ADU and VDU. Composition of various petroleum fractions, boiling ranges of petroleum products. Quality control of petroleum products, various tests and specifications prescribed for petroleum fuels such as LPG, gasoline, kerosene, ATF, diesel, lubricants, greases, bitumen etc. Importance of conservation of petroleum to achieve sustainable growth in energy and petrochemical sector. (10 Lectures)

#### **Reference**

1. Modern Petroleum Refining Processes, B.K. Bhaskara Rao, Oxford and IBH Publication, New Delhi
2. Fundamentals of Petroleum and Petrochemical Engineering by Uttam Ray Chaudhuri CRC press
3. Hand book of petroleum Processing Edited by David S. J. "Stan" Jones and Peter R. Pujado Springer
4. Advance Petroleum Refining, Dr. G. N. Sarkar, Khanna Publication, Delhi
5. Petroleum Refining technology, Dr. Ram Prasad, Khanna Publication, Delhi

**GIC SEM II****Semester-II****Course Title:** Petrochemical and their Importance

Total Credits: 01

Total Lectures: 15

**Objectives:**

- 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.
- To make them skilled for various processes that converts basic hydrocarbon molecules in a feedstock for manufacture of consumer commodities.

**COs (Learning Outcome):**

By the end of this course, students would be able to:

1. understand about Indian Petrochemical Industry.
2. classify basic Petrochemical Feedstocks their compositions.
3. skillfully use various separation processes that are useful in Petrochemical Industry.
4. use the basic conversion processes as steam reforming- partial oxidation etc., kinetics and reactions involved in the manufacture of synthesis gas.

Unit 01: Introduction to Petrochemicals, Indian Petrochemical Industry, Role of Petrochemical Industry in India, basic raw materials for Petrochemical Industry, impurities present in the feedstocks and techniques for their removal. (05 Lectures)

Unit 02: Various separation processes-principle involved in these processes, steam reforming process, partial oxidation process, coal gasification: reactions involved-kinetics involved, uses of synthesis gas. Introduction to basic petrochemicals that acts as building blocks for various petrochemicals. (10 Lectures)

**Reference**

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