Y1

P. R. GOVERNMENT COLLEGE
(AUTONOMOUS)
KAKINADA

(Affiliated to Adikavi Nannaya University, Rajamahendravaram)

DEPARTMENT OF CHEMISTRY

B.Sc. Petrochemicals Syllabus under CBCS

BOARD OF STUDIES

2021-2022

P. R. Govt. College (A), Kakinada

Recommended Composition of the Board of Studies of Petrochemicals

And it's Functions of an Autonomous College

(AY 2021-22)

I Composition

i. **Head of the Department concerned (Chairman):**

Sri. Rambabu Vasamsetti, M.Sc.B.Ed,SET

ii. **The entire faculty of each specialization.**

1. Dr. D. Rama Rao, M.Sc., B. Ed., M.Phil. Ph.D.
2. Dr. D. Chenna Rao M.Sc., Ph.D.
3. Sri. V.Sanjeeva Kumar M.Sc, NET
4. Sri. T.V.V. Satyanarayna M.Sc.B.Ed,SET
5. Sri. P. Vijaya Kumar M.Sc., NET
6. Sri. G. Pavani, M.Sc.B.Ed,SET
7. Dr. T. Uma Maheswara Rao MSc, Ph.D.
8. Dr. N. Bujjibabu MSc., Ph. D
9. Dr. Ch. Praveen MSc., Ph.D
10. Sri. G. Sai Subrahmanyam, M.Sc.,

iii. **One expert to be nominated by the Vice-Chancellor from a panel of six recommended by the College Principal**

Dr. M. Trinadh, Lecturer in Chemistry, GDC (A), Rajahmundry

iv. **One expert in the subject from outside the college to be nominated by the Academic Council**

Dr.V. Narayana Rao, Lecturer in Chemistry, GDC Perumallapuram.

v. **One representative from industry/ Corporate Sector/ allied area relating to Placement.**

Dr. B. Ramesh Babu, Founder & M. D., BogaR Laboratories, Peddapuram.

vi. **One postgraduate meritorious alumnus to be nominated by the Principal**

The chairman, Board of Studies, may with the approval of the Principal of the College, Co-opt.

Dr. K. Raghava Chari, M.Sc., M.Phil., Ph.D

II. Term.

The term of the nominated members shall be two years.

III. Meeting

The Principal of the College shall draw the schedule for meeting of the Board of Studies for different Departments. The meeting may be scheduled as and when necessary but at least once a year.

IV. Functions

The Board of Studies of a Department in the College shall:

a) Prepare syllabus and various courses keeping in view the objectives of the College interest of the stakeholders and national requirement for consideration and approval of the Academic Council.
b) Suggest methodologies for innovative teaching and evaluation techniques.
c) Suggest panel of names to the Academic Council for appointment of examiners.
d) Coordinate research, Teaching, Extension and other academic activities in the Department/College.

P.R. GOVT.COLLEGE (A), KAKINADA

Department of Petro chemicals

Minutes of board of studies (BOS) meeting 2021-22 on 02. 12. 2021 at 3.00 PM

Meeting of Board of Studies in Petro Chemicals is convened on 02 December 2021 through offline at P.R. Govt. College (A), Kakinada, at 3.00 PM.

Venue: Conference Hall, Dt: 02-12-2021, Thursday – 3.00 PM.

The Principal Dr. B.V. Tirupanyam, Chairman, Sri V. Rambabu, University Nominee, Dr. M. Trinadh, Lecturer in Chemistry, Govt. College (Autonomous), Rajamahendravaram, Industrialist Dr. B. Ramesh Babu, Founder & M.D., BogaR laboratories, Peddapuram, Subject Expert Dr.V. Narayana Rao, Lecturer in Chemistry, Government Degree College Perumallapuram, all the faculty members of Chemistry Department and student alumni attended the meeting.

Agenda:

- To discuss the Semester System and Choice Based Credit System (CBCS) being implemented for the past 06 years, i.e., w.e.f. 2015-16.
- To discuss and approve the Continuation/Modifications of the syllabus for the Odd & Even Semesters of I, II & III Years for 2021-22.
- Grant of Extra credits for Online SWAYAM MOOCs etc.
- Syllabus, Model Question Papers and Model Blue Prints for I, II, III, IV, V and VI Semesters.
- Teaching learning methodology by 60:40 (External: Internal) ratio for the present II- and III-Year Students and 50:50 (External: Internal) ratio I Year Students w.e.f. 2021-22.
- Panel of paper setters and examiners.
- Proposals for Community Service Projects/Extension activities for the benefit of the society.
- Department action plan for 2021-22.
- To discuss and resolve the minor modifications/refinement if any, in the Chemistry cluster electives CI, CII & CIII as majority of the students opting this cluster as their choice.

Any Other Proposal with the Permission of the Chairman.

Resolutions:

The following agenda items are discussed and resolutions are made.

1. It is resolved to continue choice based credit system in the chemistry combination programmes as per the directions of the CCE, Vijayawada to the first year and second year and final year student's w.e.f. 2018-19.

2. It is resolved to approve the Continuation/Modifications of the syllabus for the Odd & Even Semesters of I, II & III Years for 2021-22.

3.It is resolved to encourage students to active participation in various activities and give extra credits for students after successful completion of a particular activity such as SWAYAM, MOOCS etc., (Annexure –II)

4.It is Resolved to follow 60%-40% external and internal w.e.f. 2017-2018 admitted batches and it continued in present second and third year students.

5. It is resolved to follow 50%-50% external and internal for first year w.e.f 2021-22 admitted batch.

6. It is resolved to allot 50 marks project work for final year students in chemistry preferably in cluster paper C - 3 practical's, w.e.f 2019-20 in accordance with APSCHE.

7. It is resolved to conduct departmental activities such as OZONE DAY, CHEM FEST, CHEMISTRY DAY and SCIENCE DAY. (Annexure-I)

8.It is resolved to implement the recommended andragogy for the first semester 2021-22

9.Resolved to conduct practical examinations semester wise.

10.It is resolved to organize guest lectures by eminent professors.

11.Resolved to implement pass minimum for internal assessment for CBSE pattern students as the pattern is learner oriented.

12.It is resolved to maintain status quo for same question paper pattern in II, III years.

The following paper setters are recommended

1. Sri. U. Sai Krishna, Govt. College(A), Rajamahendravaram.
2. Dr. M. Trinadh, Govt. College(A), Rajamahendravaram
3. Dr. V. Narayana Rao, GDC, Perumallpuram.
4. Sri. M. Sudhakar, Govt. College(A), Rajamahendravaram.
5. Sri. K. Anand, GDC, Pithapuram.
6. Dr. CH. Vijay Vardhan, GDC, Perumallpuram.
7. Sri B. Surendra, GDC, Tadepaliigudem.

Signatures of the members who attended the

Board of studies in Petrochemicals on 02.12.2021 at 3: 00 PM

S.No.	Name of the member	Designation	Signature
1	Sri. Rambabu Vasamsetti	Chairman, Board of Studies, Lecturer in charge	
2	Dr. M.Trinadh	University Nominee Lecturer in Chemistry, GDC(A),Rajahmundry	02/12/2021
3	Dr.V. Narayana Rao	Subject Expert Lecturer in Chemistry, GDC Perumallapuram	02/12/21
4	Dr. B. Ramesh Babu	Industry expert Founder & M. D., BogaR Laboratories, Peddapuram.	
5	Dr. K. Raghava Chari	Alumnus, Retd. Principal,	
6	Dr.D.RamaRao	Member Lecturer I/c- Dept. of Chemistry	
7	Dr.D. ChennaRao	Member Lecturer in Chemistry	
8	Sri. V. Sanjeeva Kumar	Member Lecturer in Chemistry	
9	Sri. T. V. V. Satyanarayna	Member Lecturer in Chemistry	
10	Sri. P. Vijaya Kumar	Member Lecturer in Chemistry	
11	Sri.G. Pavani	Member Lecturer in Chemistry	2/12/21
12	Dr.T. Uma Maheswara Rao	Member Lecturer in Chemistry	
13	Dr. N. Bujji Babu	Member Lecturer in Chemistry	
14	Dr. Ch. Praveen	Member Lecturer in Chemistry	2/12/201
15	Sri. G. Sai Subrahmanyam	Member Guest Faculty in Petrochemicals	

ACTION PLAN BOS MEETING – PETROCHEMICALS HELD ON 02 - 12 - 2021.

Department activities for 2021-22 Academic year.

Annexure I

S.No.	Month	Activity Proposed	Faculty Member of In charge
1.	**NOV-21**	Departmental staff meeting to review admissions and faculty recruitment	All Faculty members
2.	**NOV-21**	Preparation of curricular plans, time-tables etc.,	All Faculty members
3.	**DEC-21**	Bridge classes	All Faculty members
4.	**DEC-21**	Student awareness programs on ragging & eve teasing - consequences, self-discipline.	All Faculty members
5.	**DEC – 21**	World AIDS Day	All Faculty members
6.	**JAN-22**	Career guidance, higher education opportunities etc.,	All Faculty members
7.	**JAN-22**	Chemistry day & Chem. Fest	All Faculty members
8.	**FEB – 22**	Study tour / Field trips	All Faculty members
9.	**FEB – 22**	NATIONAL SCIENCE DAY	All Faculty members
10.	**MAR-22**	Guest Lecture	All Faculty members

1. Organizing National/ State level seminars/Workshops/ Conferences/ Training programs etc. With topics and other details.

i). Staff development programs
ii) Awareness on OZONE protection
iii) National Chemistry day
iv) National Science day 2020
v) Guest lectures / Invited Talks
vi) Training on Soil analysis
vii) Training on water analysis

2. Change of modules in the syllabus content.

3. Plan for utilization of funds for Autonomous /CPE / Other grants available for arranging guest lectures, faculty improvement programs, study tours, equipping laboratories, reference books & other necessary teaching-learning material with ICT enabled teaching.

I. Study visits/ Field tours to Final year students: **Rs. 20,000**

1. National Institute of Hydrology, Kakinada.

2. SAR Chandra Environ Solutions, Kakinada.

3. ONGC mini refinery, Tatipaka.

4. Soil analysis laboratory, Samalkot.

5. Venky parenteral, Yanam

6. Any other relevant field visits

II. Lab equipment's: **Rs. 2, 00,000**

Lab equipment's required to conduct Practical's and to give hands on training to the students in order to build skill and confidence in the area of Petrochemicals and petroleum products.

III. Reference books & other necessary teaching – learning material: **Rs. 10,000**

IV. Guest Lectures / Invited talks: **Rs. 15,000**

4. Plan for organizing subject oriented community outreach programs & allocation of necessary funds. (Mandatory for each Department)

i) Awareness programs on various social / Health issue Rs. 10,000

5. Introduction of new programs - Certificate courses. Rs. 10,000

6. Any other program that enhances the learning capacity of students and their employable & knowledge skills

7. Examination reforms if any,

8. Suggest panel of examiners/paper setters & other experts/nominees for BOS deliberations.
   1. Sri. U. Sai Krishna, Govt. College(A), Rajamahendravaram.
   2. Dr. M. Trinadh, Govt. College(A), Rajamahendravaram
   3. Dr. V. Narayana Rao, GDC, Perumallpuram.
   4. Sri. M. Sudhakar, Govt. College(A), Rajamahendravaram.
   5. Sri. K. Anand, GDC, Pithapuram.
   6. Dr. CH. Vijay Vardhan, GDC, Perumallpuram.
   7. Sri B. Surendra, GDC, Tadepaliigudem.

Semester wise/ Paper wise Marks / Credits allotted.

YEAR	SEMESTER	PAPER	TITLE	MARKS	CREDITS
I	I	I	Fundamentals of Petroleum Production	100	04
			Practical – I	50	01
	II	II	Modern Petroleum Refining Processes	100	04
			Practical – II	50	01
II	III	III	Introduction to Chemical Engineering	100	04
			Practical – III	50	01
	IV	IV	Heat Transfer and Polymers	100	04
			Practical – IV	50	01
		V	Mass Transfer operations	100	04
			Practical – V	50	01
III	V	V	Mass Transfer operations	100	03
			Practical – V	50	02
		VI	Petrochemicals-I	100	03
			Practical – VI	50	02
		VII	Petrochemicals II (Elective)	100	03
			Practical - VII	50	02
Cluster	VIII(C)		VIII-C -1: Petrochemicals -III	100	03
			VIII-C-2 : Manufacturing Processes of Polymrs, Flow of fluids	100	03
			VIII-C-3:Testing and processing Techniques of Polymers	100	03
			Practical –VIII	50	02
			Practical –IX	50	02
			Practical –X: Project Work	50	02

GUIDELINES FOR ALLOTMENT OF EXTRA CREDITS

S.No.	Activity	Details of achievement	Credits
1	MOOC Course	**III**	Total credits achieved will be considered
2	NCC	B CERTIFICATE	2
		Participation in National Camp after 'B' certificate	3
		C certificate	4
		Adventure camp/RD parade along with 'B'	5
		Failed in B certificate Examination	1
3	Sports	Intercollegiate selection	2
		South zone selection	3
		All India participation	4
		Winning medals in all India competitions	5
4	NSS	40% attendance in regular NSS activities	1
		50% attendance with Community Service	2
		Conduct of survey/Youth exchange/RD	3
5	JKC	Enrollment and training	1
		Campus recruitment local level	2
		MNCs/reputed companies	3
6	Community service	Participation in community service by departments (outreach programmes)	2
7	Cultural activity	Winning medals at state level-2, District level-1	2 1
8	COP/Add on Course	Pass in Certificate Exam-1, Diploma-2	1 2

Course Structure:

All theory papers will have 4 hours per week and practical's will have 2 hours per week up to Semester IV (Second year). In final year all theory papers will have 3 hours per week and practical's will have 2 hours per week in Semester V and V I (Final year).

Each Theory Paper shall be of 100 marks and Practical Paper shall be of 50 marks.

Total Number of Papers: 21

Mathematics	: 7Papers
Chemistry	: 7Papers
Petrochemicals	: 7 Papers

Objectives and outcome of the course Petrochemicals

To give basic knowledge and awareness on petroleum and petrochemical products to the undergraduate level students, so that maintains linkages with Industries and research laboratories to expose the students to higher levels of knowledge and application of chemistry and then to provide job opportunities to the students in different industries.

With this impression the department of chemistry, P R Govt. College (A), introduced Mathematics, Chemistry and petrochemicals (MCPC) group in 1998-99. The objective of this course

The objective of B.Sc. Petrochemicals course is to teach students the basics about petroleum, petrochemicals and their processes. This subject gives student detailed information about petroleum and its formation.

In this three-year course spread over six semesters, there are 10 papers of Petrochemicals 7 papers of chemistry and 7 papers of Mathematics.

After graduating in Petrochemicals the students can pursue academics in Chemistry, Petroleum engineering, Petrochemicals and other disciplines of inter- disciplinary sciences. They can also use it as a stepping stone to different chemical, petrochemical and fertilizer in industries

Program Outcomes B.Sc. (Chemistry):

Undergraduate students upon graduation with a B.Sc. degree in chemistry:

PO : 1	Have firm foundations in the fundamentals and application of current chemical and scientific theories.
PO : 2	An understanding of major concepts, theoretical principles and experimental findings in chemistry.
PO : 3	Are able to design, carry out, record and analyze the results of chemical experiments
PO : 4	Are able to use modern instrumentation and classical techniques, to design experiments, and to properly record the results of their experiment.
PO : 5	Are skilled in problems solving, critical thinking and analytical reasoning.
PO : 6	Are able to identify and solve chemical problems and explore new areas of research.
PO : 7	Are able to use modern library searching and retrieval methods to obtain information about a topic, chemical, chemical technique, or an issue relating to chemistry.
PO : 8	Knows the proper procedures and regulations for safe handling and use of chemicals and can follow the proper procedures and regulations for safe handling when using chemicals
PO : 9	Are able to communicate the results of their work to chemists and non-chemists.
PO : 10	Understand the ethical, historic, philosophical, and environmental dimensions of problems and issues facing chemists.
PO : 11	Find gainful employment in industry or government, be accepted at graduate or professional schools (law, medicine, etc.), or find employment in school systems as instructors or administrators.
PO : 12	Are able to pursue Higher education in Chemistry and other disciplines of inter disciplinary

Course outcomes

Petrochemicals

CO: 1	To gains basic knowledge on Petroleum and petroleum products.
CO: 2	. To explain the market drivers for the refining industry.
CO: 3	To indicate what crude oils consist of and how crude oils are characterized based on their physical properties.
CO: 4	To express the objectives of petroleum refining and classify the processes used in petroleum.
CO: 5	To demonstrate how a petroleum refinery works and sketch a flow diagram that integrates all refining processes and the resulting refinery products
CO: 6	To examine how each refinery process works and how physical and chemical principles are applied to achieve the objectives of each refinery process
CO: 7	To assess implications of changing crude oil feed stocks on refinery configuration and propose strategies to resolve conflicts with degrading crude oil quality and increasingly stringent environmental regulations on petroleum fuels.
CO: 8	To discuss different sources of natural gas and explain how natural gas is processed at well sites and in processing plants with application of selected refinery processes and their physical operations

Specific Program Out comes

Petrochemicals

SEMESTER –I	SPO : 1	Gains knowledge Petroleum reservoirs, their characteristics and mechanisms
	SPO : 2	Understands the types of drillings
	SPO : 3	Gains knowledge on reservoir evaluation
	SPO : 4	Gains knowledge on composition, properties and uses of natural gas and LPG
SEMESTER –II	SPO : 1	Gains knowledge on Petroleum Processing Data and crude oil classification
	SPO : 2	Gains knowledge on crude oil distillation
	SPO : 3	Gains knowledge on different types of cracking processes
	SPO : 4	Gains knowledge on petroleum fractions
SEMESTER –III	SPO : 1	Gains basic knowledge on Unit operations and unit processes
	SPO : 2	Gains knowledge on measuring devices, flow meters and chemical reactors
SEMESTER - IV	SPO : 1	Gains knowledge on conduction, radiation and convection
	SPO : 2	Gains knowledge on evaporation and evaporation process
	SPO : 3	Gains basic knowledge on flow fluids
SEMESTER - V	SPO : 1	Gains basic knowledge about adsorption, absorption and distillation.
	SPO : 2	Gains some basic knowledge about extraction, crystallization and drying.
	SPO : 3	Gains some basic knowledge on purification of gases and natural gas.
	SPO : 4	Gains some basic knowledge about synthesis gas, its applications and synthetic detergents.
SEMESTER - VI	SPO : 1	Gains knowledge and awareness about some applied industrial products of C1, C2, C3 and C4 compounds and petroleum aromatics
	SPO : 2	Gains knowledge about chemicals produced from coal, coke, cellulose plastics and corrosion and prevention in industry.
	SPO : 3	Gains some knowledge about polymers, synthetic rubbers and plastics
	SPO : 4	Gains knowledge on moulding and different types of mouldings

Syllabus II B.Sc., - (Petroleum & Petrochemicals)

Semester - IV

Paper - IV: Heat Transfer and Polymers

Unit – 1: Heat Transfer:

Conduction – Fourier's Law, conduction through plane wall and through resistances in series, Heat flow through thick walled cylinder, Heat flow through a sphere. Thermal Insulation

Radiation: Laws of Black – Body radiation, Kirchhoff's law, Stefan-Boltzmann law, Planck's law, concept of Black Body.

Unit – 2: Heat Transfer:

Convection: Natural and forced convection – Heat Transfer with change in Phase – Mechanism of Condensation Heat Transfer and Boiling Heat Transfer, Over all Heat Transfer coefficients, Logarithmic Mean Temperature difference.

Flow arrangements in Heat exchangers, Variation of Fluid Temperatures in Heat exchangers, Heat Transfer Equipment. Double pipe heat exchanger and shell and tube heat exchanger.

Unit – 3: Evaporation: Material and Enthalpy balances for single effect – Evaporator – Types of Evaporators-Common methods of feeding multiple evaporation system – Multiple effect Evaporation, Vapour Recompression, capacity and economy of evaporator

Unit –4: Polymers of Olefins:

Polymers of Ethylene: High Pressure Polyethylene (LDPE) – conventional and slurry processes, Low pressure Poly Ethylene (HDPE) – Zeigler process and Solvay process.

Polymers of Propylene – different forms of polypropylene – manufacture of Isotactic polypropylene.

Polymers of Olefins:

Unit –5: Poly Vinyl Chloride: Manufacture of PVC by suspension polymerization process and emulsion polymerization process.

Polystyrene: Manufacture of Polystyrene by mass polymerization and emulsion polymerization.

Manufacture of Polybutadiene and Poly Tetrafluoro ethylene (PTFE)

II B.Sc., Petroleum & Petrochemicals

MODEL QUESTION PAPER

Paper IV- Heat Transfer and Polymers

Time: $2\frac{1}{2}$ Hrs. Semester - IV Max. Marks 60

Section - I

Answer any three questions from the following
All questions carry equal marks. 3x6=48 Marks

1. a. State and explain Fourier's law of Heat conduction. Derive the steady – State heat transfer equation through a flat wall of three layers which are in perfect thermal contact.
   b. Derive the heat transfer equation for Heat flow through a sphere.

2. a. Explain the mechanism of condensation heat transfer.
   b. Explain about the variation of fluid temperature in Heat Exchanges.

3. a. What do you mean by Evaporation? Describe the Design and functioning of Forced circulation type Evaporator.
   b. With a neat sketch, explain Thermal Vapour Recompression process.

4. a. With a neat flow diagram describe the process of Production of HDPE by Zeigler process.
   b. With a neat flow diagram describe the process of production of Isotactic polypropylene

5. a. With a neat flow diagram describe the production of Polyvinyl chloride by emulsion polymerization.
   b. With a neat flow diagram describe the process of production of Polybutadiene.

Section – II

Write short notes on ANY FIVE of the following. 4x3=12 Marks

6. Write the laws of Radiation.

7. Write short notes on double pipe heat exchanger.

8. Multiple effects Evaporation.

9. LDPE

10. Poly Tetra fluoro ethylene (PTFE)

Note to Proper setter:
In section I, one essay question is to be set from each of the 5 units.
Similarly, in section II, one short Answer question is to be set from each of the 5 units.

II B.Sc., - Petroleum & Petrochemicals
Paper –IV: SEMESTER - IV
Heat Transfer and Flow of Fluids
QUESTION BANK

Essay Questions: 16 M

UNIT –I:

1. a. Derive the steady state heat transfer equation through a plane wall
   b. Derive the steady state heat transfer equation through a flat wall of three layers which are I perfect thermal contact.

2. a. Derive the steady state heat transfer equation through a thick walled cylinder
   b. Derive the steady state heat transfer equation through a sphere

3. a. State and explain Kirchhoff's law
   b. Explain about the laws of Black body radiation

UNIT –II:

1. a. Explain the mechanism of condensation heat transfer.
   b. Derive the expression for overall heat transfer coefficient based on inside area

2. a. Explain about the variation of fluid temperature in Heat Exchanges.
   b. With a neat sketch describe about the design and functioning of shell and heat exchanger

3. a. Explain in detail about heat transfer equipment
   b. Write about the design and functioning of double pipe heat exchanger.

UNIT –III:

1. a. Write about the material and enthalpy balance calculations for single effect evaporator.
   b. With a neat diagram explain he design and functioning of long tube vertical evaporator

2. a. With a neat diagram describe the Design and functioning of Forced circulation type Evaporator.
   b. With a neat sketch, explain Thermal Vapour Recompression process.

3. a. With a neat diagrams explain Common methods of feeding multiple evaporation system
   b. With neat sketches explain about multiple effect evaporation

UNIT –IV:

1. a. With a neat flow diagram describe the manufacturing of LDPE by conventional process

   b. With a neat flow diagram describe the manufacturing of LDPE by slurry process

2. a. With a neat flow diagram describe the manufacturing of HDPE by Ziegler process

   b. With a neat flow diagram describe the manufacturing of HDPE by Solvay process.

UNIT –V:

1. a. With a neat flow diagram describe the manufacturing of Poly vinyl chloride by suspension process

   b. With a neat flow diagram describe the manufacturing of Poly vinyl chloride by emulsion polymerization process

2. a. With a neat flow diagram describe the manufacturing of poly styrene by bulk polymerization process

   b. With a neat flow diagram describe the manufacturing of poly styrene by emulsion by polymerization process.

Short answer questions: 03 M

UNIT - I:

1. Explain about Fourier's law of conduction
2. Write about thermal insulation
3. Explain the concept of black body
4. Write about Planck's law
5. Explain about Stefan Boltzmann's law

UNIT - II:

1. Write about types of convections
2. Explain about Logarithmic mean temperature difference
3. Write a note on flow arrangements in heat exchangers
4. Write the mechanism of boiling heat transfer

UNIT - III:

1. Write briefly about Capacity and economy of an evaporator
2. Write about the process of evaporation
3. Explain the types of evaporators

UNIT - IV:

1. Manufacturing of isotactic poly propylene
2. Ziegler Natta catalyst
3. Different types of poly propylene

UNIT - V:

1. Manufacturing of poly butadiene
2. Manufacturing of Poly tetrafluoro ethylene

IMPORTANT NOTE TO PAPER SETTER:

In section - I, one essay question is to be set from each of the five units. Similarly in

Section - II, one short answer question is to be set from each of the five units. Questions should be given from QUESTION BANK.

II B.SC., Petroleum & Petrochemicals

PRACTICAL SYLLABUS

Semester - IV

PRACTICAL IV (At the end of Fourth Semester)

1) Determination of Viscosity Index.
2) Redwood Viscometer.
3) Engler Viscometer.
4) Ostwald viscometer
5) Determination of Iodine Value.

SCHEME OF VALUATION

Max. Marks: 50

1)	Procedure to be written in the first 15 minutes	10 Marks
2)	Recording of data and reporting the value up to 2% error	20 Marks
	Error up to 5%	10 Marks
	Error greater than 5%	5 Marks
3)	Viva – Voice	10 Marks
4)	Record	10 Marks

B.Sc., - Petroleum & Petrochemicals

Semester - IV

Paper - V: **Mass Transfer operations**

Unit -1: Absorption (Gas Absorption) -Selection criteria for solvent in Gas absorption - material balances for a packed column – Pressure drop in packed columns Gas Absorption equipment – Tower packing's.
Adsorption: Types of Adsorption - Adsorption equipment.

Unit – 2: Distillation (I):
Concept of distillation – vapour – liquid equilibrium – relative volatility – Boiling point diagram -
Various methods of distillation – differential distillation, Flash distillation, Fractionating column - Analysis of Fractionating columns – calculations of number of theoretical stages by McCabe – Thiele method –

Unit -3: Distillation (II):
Derivation of equation of q-line, effect of feed condition on slope of q-line, calculation-of number of plates and location of feed plate, Importance of reflux ratio-concept of total reflux and minimum reflux ratio-optimum reflux ratio. – Equipment for Gas-liquid operations.

Unit -4: Extraction:
Liquid – liquid extraction – extraction schemes – distribution coefficient – triangular diagram – selection of solvent for extraction – single stage equilibrium extraction – multistage extraction process – Industrial liquid – liquid extraction equipment's.

Unit -5: Crystallization & Drying -
Solubility and solubility curves, saturation and super-saturation – methods of achieving super saturation – The Mier's super saturation theory – mechanism of crystallization process – material and Heat balances in crystallization – classification and construction of crystallization equipment. Drying: Material and Heat balance equations in Continuous drying operation
- Drying equipment - Tray dryer, rotary dryer & Spray dryer.

Suggested Reading:

1) Introduction to Chemical Engineering by Salil K Ghosal and others Tata Mc. Graw – Hill Publishing Company.
2) Unit operations – I and II by K.A. Gavhane. Nirali Prakashan – Pune,

II B.Sc., - Petroleum & Petrochemicals

MODEL QUESTION PAPER

Paper –V: MASS TRANSFER OPERATIONS

Time: 2 $^{1}/_{2}$ Hrs. Semester - IV Max. Marks 60

Section - I

Answer any three questions from the following
All questions carry equal marks. 3x16=48 Marks

1. a. Define gas absorption. Give suitable examples.
   What factors should be considered while selecting solvent for gas absorption.
   b. Draw a neat sketch of packed column and write its construction and functioning.

2. a. What is differential distillation? Derive Rayleigh equation.
   b. Explain briefly McCabe – Thiele method used for obtaining theoretical plates required for a given degree of separation.

3. a. Explain the flow through feed plate for various thermal conditions of feed.
   b. Explain the concepts of minimum and optimum Reflux Ratios.

4. a. Define the following terms with respect to extraction.
   i) feed ii) solvent iii) raffinate iv) Extract
   Explain briefly the selection criteria for solvents to be used for liquid – liquid extraction.
   b. with a neat sketch explain briefly the mixer – settler assembly and its functioning.

5. a. With a neat sketch explain the construction and working of continuous vacuum crystallizer.
   b. Carry out material and energy balance calculations in a continuous drying operation.

Section II

Write short notes on ANY FOUR of the following 4 x 3 = 12 Marks

6. Adsorption equipment.
7. Boiling Point Diagram.
8. Optimum Reflux Ratio.
9. Triangular Diagram.
10. Rotary Dryer.

Note to paper setter:
In Section I one essay question is to be set from each of the Five (5) units.
Similarly, in Section II one short answer question is to be set from each of the Five (5) units.

II B.Sc., - Petroleum & Petrochemicals

Paper –V: SEMESTER - IV

Mass transfer Operations

QUESTION BANK

Essay Questions: 16 M

UNIT –I:

1. a. Define gas absorption. Give suitable examples.
   What factors should be considered while selecting solvent for gas absorption
   b. Explain about the material balances for packed columns

2. a. Draw a neat sketch of packed column and write its construction and functioning.
   b. Write about the pressure drop in packed columns.

3. a. State and derive Longmuir's adsorption isotherm
   b. Explain in detail about adsorption equipment

UNIT –II:

1. a. What is differential distillation? Derive Rayleigh equation
   b. Describe the details of constructing boiling point diagrams

2. a. Explain about the Flash distillation and derive the expression for operating material balance of flash distillation.
   b. Explain in detail about the method of carrying out analysis of fractionating columns.
3. a. Explain briefly McCabe – Thiele method used for obtaining theoretical plates required for a given degree of separation.
   b. With a neat diagram describe the design and functioning of a fractionating column.

UNIT –III:

1. a. Explain the flow through feed plate for various thermal conditions of feed.
   b. What is q – factor? Derive the expression for q – factor and write about the effect of feed conditions on feed line.
2. a. Explain the method of calculating the total number of plates and location of feed plate in a fractionating column.
   b. Explain the concepts of minimum and total Reflux Ratios.

3. a. Write in detail about the equipment for Gas – liquid Operations
   b. Write a detailed note on the design of plate columns used to carry out fractionation

UNIT –IV:

1. a. Explain the principles of Liquid – liquid extractions and Explain briefly the selection criteria for solvents to be used for liquid – liquid extraction
   b. Explain about single stage equilibrium extraction

2. a. Explain about the extraction schemes used in Liquid – liquid extraction.
   b. Write about multi stage extraction process

3. a. With a neat sketch explains briefly the mixer – settler assembly and its functioning.
   b. With a neat sketch explain briefly about pulse column extraction technique

UNIT –V:

1. a. Define solubility and write in detail about solubility curves
   b. Write in detail about the Miers super saturation theory

2. a. Explain in detail about the mechanism of crystallization
   b. Carry out the material balance calculations for crystallization process.

3. a. With a neat sketch explain the construction and working of continuous vacuum crystallizer.
   b. With a neat sketch explain the construction and working of agitated tank crystallizer.

4. a. Carry out material and heat balance calculations in a continuous drying operation.
   b. With the help of a neat diagram describe the design and working of rotary dryer.

Short answer questions: 03 M

UNIT - I:

1. Write about types of adsorption
2. Explain about Freundlisch adsorption isotherm
3. What factors should be considered while selecting solvent for gas absorption
4. What is gas absorption? Give example
5.

UNIT - II:

1. Explain briefly the concept of Distillation
2. Write a short note on Vapour – Liquid equilibria
3. Write a short note on relative volatility
4. Explain briefly about differential distillation
5. Explain briefly about Flash distillation

UNIT - III:

1. Explain the terms Reflux and Reflux ratios
2. Write about Optimum reflex ratio
3. Write about q – line
4. Explain the effect of feed condition on slope of q – line.

UNIT - IV:

1. Write about triangular diagrams.
2. Explain about the classification of industrial extraction equipment
3. Write about distribution coefficient
4. Explain briefly about Solvent extraction.

UNIT - V:

1. Explain the terms saturation and super saturation
2. Write briefly about the methods of super saturation
3. Write a note on classification of crystallization equipment
4. Write a short note on drying process
5. Write about the classification of industrial dryers

IMPORTANT NOTE TO PAPER SETTER:

In section - I, one essay question is to be set from each of the five units. Similarly in Section - II, one short answer question is to be set from each of the five units. Questions should be given from QUESTION BANK.

II B.SC., - (Petroleum & Petrochemicals)

Practical Syllabus

Semester - IV

Practical -V (At the end of Fouth semester)

a. Determination of Specific gravity by Specific gravity bottle.

b. Determination of Specific gravity by Pyknometer.

c. Simple Distillation

d. Steam distillation.

SCHEME OF VALUATION

Max. Marks: 50

1)	Procedure to be written in the first 15 minutes	10 Marks
2)	Recording of data and reporting the value Up to 2% error	20 Marks
	Error up to 5%	10 Marks
	Error greater than 5%	5 Marks
3)	Viva – Voice	10 Marks
4)	Record	10 Marks