]PAAVAI ENGINEERING COLLEGE, NAMAKKAL – 637 018

(AUTONOMOUS)

B.Tech. CHEMICAL ENGINEERING

REGULATIONS 2015

CURRICULUM

SEMESTER VII

S.No	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1	CM15701	Transport Phenomena	3	2	0	4
2	CM15702	Process Dynamics and Control	3	0	0	3
3	CM15703	Process Plant Utilities	3	0	0	3
4	CM15704	Energy Management	3	0	0	3
5	CM1535*	Programme Elective III	3	0	0	3
6	CM1545*	Programme Elective IV	3	0	0	3
PRACTICAL						
1	CM15705	Process Control and Simulation Laboratory	0	0	4	2
2	CM15706	Chemical Process Equipment Design II	0	0	4	2
3	CM15707	Mass Transfer Laboratory	0	0	4	2
		TOTAL	18	2	12	25

SEMESTER VIII

S.No	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1	CM1555*	Programme Elective V	3	0	0	3
2	CM1565*	Programme Elective VI	3	0	0	3
PRACTICAL						
1	CM15801	Project Work	0	0	12	6
		TOTAL	6	0	12	12

LIST OF ELECTIVES

PROGRAMME ELECTIVE III

S.No	COURSE CODE	COURSE TITLE	L	T	P	C
1	CM15351	Oil and Natural Gas Engineering	3	0	0	3
2	CM15352	Electrochemical Engineering	3	0	0	3
3	CM15353	Fertilizer Technology	3	0	0	3
4	CM15354	Polymer Technology	3	0	0	3

PROGRAMME ELECTIVE IV

S.No	COURSE CODE	COURSE TITLE	L	T	P	C
1	CM15451	Pulp and Paper Technology	3	0	0	3
2	CM15452	Corrosion Engineering	3	0	0	3
3	BA 15253	Total Quality Management	3	0	0	3
4	CM15453	Enzyme Engineering	3	0	0	3

PROGRAMME ELECTIVE V

S.No	COURSE CODE	COURSE TITLE	L	T	P	C
1	CM15551	Air Pollution and Control	3	0	0	3
2	CM15552	Process Optimization	3	0	0	3
3	CM15553	Computational Fluid Dynamics	3	0	0	3
4	CM15554	Piping Engineering	3	0	0	3

PROGRAMME ELECTIVE VI

S.No	COURSE CODE	COURSE TITLE	L	T	P	C
1	CM15651	Process Modelling and Simulation	3	0	0	3
2	CM15652	Solid Waste Management	3	0	0	3
3	CM15653	Petroleum Refining Engineering	3	0	0	3
4	CM15654	Chemical Process Design	3	0	0	3

SEMESTER VII

CM15701 TRANSPORT PHENOMENA 3 2 0 4

COURSE OBJECTIVES

To enable the students to

- understand the fundamentals in transport processes
- study fundamentals to solve real life problems involving transports of momentum
- do energy and mass balance analysis.
- develop steady and time dependent solutions along with their limitations.
- analyse industrial problems along with appropriate boundary conditions.

UNIT I TRANSPORT PHENOMENA – FUNDAMENTALS 9+6

Importance of transport phenomena - analogous nature of transfer process - basic concepts - conservation laws - Newtonian and non - Newtonian fluids - rheological models - theories of transport properties of gases and liquids effect of pressure and temperature

UNIT II SHELL MOMENTUM TRANSPORT IN LAMINAR FLOW 9+6

General method of shell balance approach to transfer problems - boundary conditions - momentum flux and velocity distribution in falling film - circular tube - annulus and two adjacent immiscible fluids - creeping flow around a Sphere - Equations of Continuity and Motion - solutions to flow problems.

UNIT III SHELL ENERGY AND MASS BALANCE DISTRIBUTION IN LAMINAR FLOW 9+6

Flow of Newtonian fluids in planes - slits and annulus heat flux and temperature distribution for heat sources such as electrical - nuclear viscous and chemical - forced and free convection - mass flux and concentration profile for diffusion in stagnant gas - Falling Liquid Film (Gas Absorption) - Diffusion and Chemical Reaction inside a Porous Catalyst.

UNIT IV TRANSPORT IN TURBULENT AND BOUNDARY LAYER FLOW 9+6

Turbulent phenomena - phenomenological relations for transfer fluxes - time smoothed equations of change and their applications for turbulent flow in pipes - boundary layer theory – laminar - turbulent Hydrodynamics - Thermal and concentration boundary layer and their thicknesses - analysis of flow over flat Surface.

UNIT V ANALOGIES BETWEEN TRANSPORT PROCESSES 9+6

Importance of analogy - development and applications of analogies between momentum and mass transfer – Reynolds – Prandtl - Von Karman and Colburn analogies

TOTAL PERIODS 75

COURSE OUTCOMES

On completion of the course the students will be able to

- understand the principles of momentum, heat and mass transport by developing mathematical models to determine respective fluxes
- apply the shell momentum balance and velocity distribution in laminar flow and understand equation of continuity and motion
- determine the shell mass balance and concentration distributions in systems involving diffusion and reactions
- develop steady and time dependent solutions along with their boundary conditions
- analyze the analogy between the transports processes of heat- momentum and mass transfer

TEXT BOOKS

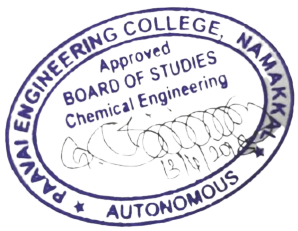
1. R.B. Bird- W.E. Stewart and E.W. Lightfoot, "Transport Phenomena", John Wiley II Edition 2006.
2. Robert- S Brodkey- Harry C. Hershey, "Transport Phenomena A Unified Approach ", Brodkey Publishing 2003

REFERENCES

1. L.S.Sissom and D.R.Pitts "Elements of Transport Phenomena", McGraw- Hill, New York- 1972.
2. R.W.Fahien "Elementary Transport Phenomena", McGraw-Hill- New York- 1983.
3. J.R. Welty- R.W. Wilson- and C.W.Wicks Rorer G.E- Wilson R.W. "Fundamentals of Momentum
4. "Heat and Mass Transfer" V Edition. John Wiley- New York- 2007.
5. Geankoplis Christie J. "Mass transport phenomena". Holt- Rinehart and Winston- 1972.

CO/PO MAPPING

Mapping of course outcomes with programme outcomes (1/2/3 indicates strength of correlation)3-Strong, 2-Medium, 1- Weak														
	Programme Outcome (POs)													
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	2	1	1	1	1	1	-	-	-	-	1	2	3
CO2	2	2	2	1	1	-	-	-	1	-	-	2	2	3
CO3	3	2	1	2	1	-	-	-	1	1	-	2	2	3
CO4	3	2	2	2	1	-	-	-	-	1	-	2	2	3
CO5	2	2	1	1	1	-	-	-	-	-	1	2	2	3



CM15702 PROCESS INSTRUMENTATION DYNAMICS AND CONTROL 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- introduce about various instrument and their principle.
- have knowledge about first order system and their dynamics in open loop system.
- design various control schemes
- convert the model to a form amenable to solution and analysis
- apply the control system in various processes.

UNIT I INSTRUMENTATION 9

Principles of measurements and classification of process instruments - measurement of temperature – pressure - fluid flow - liquid weight and weight flow rate – viscosity - pH - concentration - electrical and thermal conductivity humidity of gases.

UNIT II OPEN LOOP SYSTEMS 9

Laplace transformation and its application in process control. First order systems and their transient response for standard input functions- first order systems in series - linearization and its application in systems and their dynamics - transportation lag.

UNIT III CLOSED LOOP SYSTEMS 10

Closed loop control systems - development of block diagram for feed - back control systems - servo and regulatory problems - transfer function for controllers and final control element - principles of pneumatic and electronic controllers - transient response of closed-loop control systems and their stability.

UNIT IV FREQUENCY RESPONSE 9

Introduction to frequency response of closed-loop systems - control system design by frequency response techniques - Bode diagram - stability criterion - tuning of controllers Z-N tuning rules - C-C tuning rules.

UNIT V ADVANCED CONTROL SYSTEMS 8

Introduction to advanced control systems - cascade control - feed forward control - Smith predictor - control of distillation towers and heat exchangers - introduction to computer control of chemical processes.

TOTAL PERIODS 45

COURSE OUTCOMES

Upon the completion of the course- students will be able to

- Understand the working principle of various instruments.
- Apply the Laplace transforms for different systems
- Model and study the system behavior
- Check the stability criterion and follow the tuning rules
- Design the controllers

TEXT BOOKS

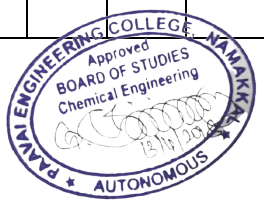
1. Stephanopoulos. G. “Chemical Process Control”, Prentice Hall of India- 2003
2. Donald R Coughnowr “Process Systems Analysis and Control”, 3rd Edition. McGraw Hill- New York- 2008

REFERENCES

1. Marlin- T. E.- “Process Control”- 2nd Edition- McGraw Hill- New York- 2000.
2. Jason L. Speyer- Walter H.Chung- “Stochastic Processes- Estimation- and Control”- PHI Ltd (2013).
3. Peter Harriott- “Process Control” Tata McGraw-Hill Education-1964

CO/PO MAPPING

Mapping of course outcomes with programme outcomes (1/2/3 indicates strength of correlation)3-Strong, 2-Medium, 1- Weak														
Programme Outcome (POs)														
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	1	1	3							3	2	2
CO2	2	2	2	1	3							3	2	2
CO3	2	3	2	1	3							3	2	2
CO4	3	3	2	1	3							3	2	2
CO5	2	2	2	1	3							3	2	2



CM15703 PROCESS PLANT UTILITIES 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- understand effective use of chemical industry utilities.
- know various trouble shooting in industries
- study various optimization techniques in refrigeration industry
- optimize various parameters in cooling industries to improve efficiency
- gain knowledge on different techniques utilized in waste disposal

UNIT I IMPORTANT OF UTILITIES 9

Hard and Soft water - Requisites of Industrial Water and its uses. Methods of water Treatment such as Chemical Softening and Demineralization - Resins used for Water Softening and Reverse Osmosis. Effects of impure Boiler Feed Water.

UNIT II STEAM AND STEAM GENERATION 9

Properties of Steam - problems based on Steam - Types of Steam Generator such as Solid Fuel Fired Boiler - Waste Gas Fired Boiler and Fluidized Bed Boiler. Scaling and Trouble Shooting. Steam Traps and Accessories.

UNIT III REFRIGERATION 9

Refrigeration Cycles - Methods of Refrigeration used in Industry and Different Types of Refrigerants such as Mono chlorodifluro Methane - Chlorofluro Carbons and Brins. Refrigerating Effects and Liquefaction Processes.

UNIT IV COMPRESSED AIR 9

Classification of compressor - reciprocating compressor - single stage and two stage compressor - velocity Diagram for Centrifugal Compressor - Slip Factor - Impeller Blade Shape. Properties of Air Water Vapors and use of Humidity Chart. Equipments used for Humidification - Dehumidification and cooling towers.

UNIT V FUEL AND WASTE DISPOSAL 9

Types of Fuel used in Chemical Process Industries for Power Generation such as Natural Gas - Liquid Petroleum Fuels - Coal and Coke. Internal Combustion Engine - Petrol and Diesel Engine. Waste Disposal.

TOTAL PERIODS 45

COURSE OUTCOMES

Upon the completion of the course- students will be able to

- understand effective use of chemical industries utilities
- knowledge about Steam- power- water- air are extensively used in process industries
- understand its efficient operation methods in refrigeration industries.
- safe operation for the survival of industries
- understand the importance of health- safety and the environment during waste disposal.

TEXT BOOKS

1. D.B.Dhone- "Plant Utilities" - Nirali Prakashan Publication
2. Sathiyamoorthy Manickkam "Chemical Plant Utilities**"** LAMBERT Academic Publishing

REFERENCES

1. P. N. Ananthanarayan- "Basic Refrigeration & Air conditioning"- Tata McGraw Hill- New Delhi- 2007.
2. P. L. Ballaney- "Thermal Engineering"- Khanna Publisher New Delhi- 1986.
3. Perry R. H. Green D. W. "Perry's chemical Engineer's Handbook"- McGraw Hill- New York- 2007.
4. Eckenfelder- W. W- Jr. "Industrial Water Pollution Control" McGraw-Hill: New York- 1966.

CO/PO MAPPING

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Programme Outcome (POs)														
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	2	1	1	1	1	1	-	-	-	2	1	2	3
CO2	2	2	2	1	1	2	2	-	1	-	-	2	2	3
CO3	3	1	1	2	1	2	2	-	1	1	2	2	2	3
CO4	3	2	2	2	1	1	1	-	-	1	-	2	2	3
CO5	2	2	1	1	1	2	2	-	-	-	1	2	2	3

CM15704 ENERGY MANAGEMENT 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- know the basic fundamentals of energy conversion.
- understand the interaction between different energy system.
- gain knowledge on the relevance and applications of nuclear and biomass energy.
- comprehend the principles of power generation using hydro, wind and solar energy.
- understand about energy management and conducting energy audit in chemical industries.

UNIT I ENERGY 9

Introduction to energy – Global energy scene – Indian energy scene - Units of energy - conversion factors – general classification of energy - energy crisis - energy alternatives

UNIT II NUCLEAR ENERGY & FOSSIL FUELS 9

Nuclear energy - Fission and fusion - Types of nuclear reactors. Coal - types and classification – Conversion. Technologies – Petroleum - products and properties - shale oil and gas - Oil - tar sand - Natural gas-CNG and LNG

UNIT III RENEWABLE ENERY SOURCES 9

Fundamentals of Power generation systems – Hydro – Wind – solar - Geothermal and ocean energy - fuel cells.

UNIT IV BIOMASS ENERGY 9

Biomass origin – Resources - Biomass estimation - Thermochemical conversion - Biological conversion - Chemical Conversion - Hydrolysis & hydrogenation – solvolysis - bio crude - biodiesel power generation gasifier – biogas - Integrated gasification.

UNIT V ENERGY CONSERVATION & MANAGEMENT 9

Energy forecasting and planning - Energy conservation - Waste heat recovery and heat pipes - Energy Audit in Chemical process industries - Cogeneration practices in industries

TOTAL PERIODS 45

COURSE OUTCOMES

Upon the completion of the course- students will be able to

- apply the fundamentals of energy conversion in applications.
- understand the sources- applications and conversion technologies for nuclear and fossil fuels
- grasp the principles of power generation using hydro- wind and solar energy
- gain knowledge on the relevance and applications of biomass energy
- understand the importance on the necessary of conservation and audit

TEXT BOOKS

1. Rao- S. and Parulekar- B.B - "Energy Technology"- Khanna Publishers- 2005.
2. Rai- G.D - "Non-conventional Energy Sources"- Khanna Publishers- New Delhi- 1984.

REFERENCES

1. Nejat Vezirog- "Alternate Energy Sources"- IT- McGraw Hill- New York
2. El. Wakil- "Power Plant Technology"- Tata McGraw Hill- New York- 2002.
3. Sukhatme. S.P.- "Solar Enery - Thermal Collection and Storage"- Tata McGraw hill- New Delhi- 1981.
4. Albert Thumann- P.E.- C.E.M & William J Younger C.E.M- "Handbook of Energy Audit by 7th edition" Faiment Press 2008
5. Nagpal- G.R.- "Power Plant Engineering"- Khanna Publishers- 2008

CO/PO MAPPING

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Programme Outcome (POs)														
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	2	1	1	1	1	1	-	-	-	-	1	2	3
CO2	2	2	2	1	1	-	-	-	1	-	-	2	2	3
CO3	3	2	1	2	1	-	-	-	1	1	-	2	2	3
CO4	3	2	2	2	1	-	-	-	-	1	-	2	2	3
CO5	2	2	1	1	1	-	-	-	-	-	1	2	2	3

CM15705 PROCESS CONTROL LABORATORY 0 0 4 2

(All Tables/Chemical Engineers' Handbook/Data Books/Graph Sheets are permitted during the Examination.)

COURSE OBJECTIVES

To determine experimentally the response and controlling methods

- For first and second order system
- For Open and closed loop on level- flow and thermal system
- For control valve with different characteristics
- Tuning of pressure system with loop study

LIST OF EXPERIMENTS

1. Response to the first order system
2. Response to the second order system
3. Response of Non-Interacting level System
4. Response of Interacting level System
5. Open loop study on a thermal system
6. Closed loop study on a level system
7. Closed loop study on a flow system
8. Closed loop study on a thermal system
9. Tuning of a pressure system
10. Characteristics of different types of control valves
11. Flow co-efficient of control valves
12. Closed loop study on a pressure system

TOTAL PERIODS 60

COURSE OUTCOMES

Upon the completion of the course- students will be able to

- have knowledge on the development and use of right type of control dynamics for level and thermal
- have knowledge on the development and use of right type of control dynamics for flow and pressure
- have knowledge on controlling processes under different operative conditions
- have knowledge on different characteristic of control valve

TEXT BOOKS

1. Stephanopoulos- G. "Chemical Process Control"- Prentice Hall of India, 2003.
2. Coughnowr. D "Process Systems Analysis and Control", 3rd Edn.- McGraw Hill- New York- 2008

REFERENCES

1. Marlin- T. E.- " Process Control "- 2nd Edition- McGraw Hill- New York- 2000

CO/PO MAPPING

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COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
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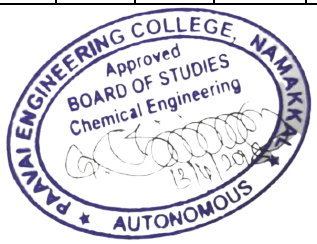
CO2	3	2	2	2	1	-	-	-	1	-	-	2	2	3
CO3	3	2	1	2	2	-	-	1	1	1	-	2	2	3
CO4	2	3	2	2	2	-	-	-	1	1	-	2	2	3
CO5	2	2	1	1	1	-	-	-	-	-	1	2	2	3



CM15706 CHEMICAL PROCESS EQUIPMENT DESIGN II 0 0 4 2

(All Tables/Chemical Engineers' Handbook/Data Books/Graph Sheets are permitted during the Examination.)

COURSE OBJECTIVES

To develop skill for design and install process equipment's like

- Basic drawing for cooling tower- drier – evaporator
- Basic drawing for heat exchanger
- Basic drawing for distillation
- Basic drawing for extraction and absorption

LIST OF EXPERIMENTS

1. Basic design and drawing considerations of cooling tower
2. Basic design and drawing considerations of evaporator
3. Basic design and drawing considerations of drier
4. Basic design and drawing considerations of heat exchanger
5. Basic design and drawing considerations of reboiler
6. Basic design and drawing considerations of sieve tray distillation
7. Basic design and drawing considerations of bubble cap distillation
8. Basic design and drawing considerations of packed column distillation
9. General design and drawing considerations of absorption column
10. General design and drawing considerations of extraction equipment

TOTAL PERIODS 60

COURSE OUTCOMES

Upon the completion of the course- students will be able to

- have skill to design and install process equipments like cooling tower- drier - evaporator
- have skill in design and drawing of heat exchanger
- have skill in design and drawing of different types of distillation
- have skill in design and drawing for extractor and absorption

TEXT BOOKS

1. McCabe- W.L- Smith J.C and Harriott- P.- "Unit Operations in Chemical Engineering"- McGraw-Hill Fourth Edition- 1984.
2. J.M. Coulson and J.Richardson- "Chemical Engineering"- vol. 6- Asian Books Printers Ltd.

REFERENCES

1. R.H. Perry- "Chemical Engineers' Handbook"- McGraw-Hill
2. Robert Treybal- "Mass Transfer Operations"- McGraw-Hill.
3. S.D.Dawande "Process Design of Equipments" Central Techno Publications- Nagpur- 2000.
4. M.V.Joshi and V.V. Mahajan- "Process Equipment Design"- MacMillan India Ltd.

CO/PO MAPPING

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COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
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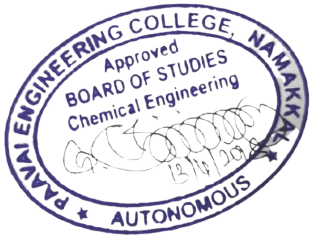
CO2	3	2	2	2	1	-	-	-	1	-	-	2	2	3
CO3	3	2	1	2	2	-	-	1	1	1	-	2	2	3
CO4	2	3	2	2	2	-	-	-	1	1	-	2	2	3
CO5	2	2	1	1	1	-	-	-	-	-	1	2	2	3



CM15707 MASS TRANSFER LABORATORY 0 0 4 2

COURSE OBJECTIVES

To train the students to develop sound working knowledge on different types of equipment's

- for separation using distillation
- for characteristics study of different dryers
- estimation of coefficients in cooling tower
- studies on Ion-exchange- RDC and Gas-Liquid absorption

LIST OF EXPERIMENTS

1. Separation of binary mixture using Simple distillation
2. Separation of binary mixture using Steam distillation
3. Separation of binary mixture using Packed column distillation
4. Measurement of diffusivity
5. Liquid-liquid extraction
6. Drying characteristics of Vacuum Dryer
7. Drying characteristics of Tray dryer
8. Demonstration of Rotary dryer
9. Water purification using ion exchange columns
10. Mass transfer characteristics of Rotating disc contactor
11. Estimation of mass/heat transfer coefficient for cooling tower
12. Demonstration of Gas – Liquid absorption

TOTAL PERIODS 60

COURSE OUTCOMES

Upon the completion of the course- students will be able to

- determine important data for the design of process equipment like distillation
- determine important data for operation of extractor
- evaluate the data for diffusivity and drying
- understand the mass transfer principles which are having wide applications in various industries

TEXT BOOKS

1. McCabe- W.L- Smith J.C and Harriott- P.- "Unit Operations in Chemical Engineering"- McGraw-Hill, Fourth Edition- 1984.
2. Geankoplis- Christie J. "Mass transport phenomena". Holt- Rinehart and Winston- 1972.
3. Robert Treybal- "Mass Transfer Operations"- McGraw-Hill.

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Programme Outcome (POs)														
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
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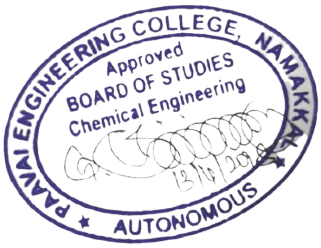
CO2	2	2	2	2	1	-	-	-	1	-	-	2	2	3
CO3	3	2	1	2	2	-	-	1	1	1	-	2	2	3
CO4	3	3	2	2	2	-	-	-	1	1	-	2	2	3
CO5	2	2	1	1	2	1	1	-	1	-	-	1	2	3



SEMESTER VIII

CM15801	**PROJECT WORK**	**0**	**0**	**12**	**6**

COURSE OBJECTIVES

The objective of the project is

- To make use of the knowledge gained by the student at various stages of the degree course.
- To make students to prepare a report individually on the project assigned to him and submit it to the department.
- To prepare report based on the information available in the literature or data obtained in the laboratory/ industry.
- Students- in addition will be permitted to undertake industrial/ consultancy project
- Student can work- outside the department- in industries/Research labs for which proportional weightage will be given in the final assessment.

GUIDELINES

1. The students are expected to get formed into a team of convenient groups of not more than 4 members for a project.
2. Every project team shall have a guide who is the member of the faculty of the institution.
3. The group has to identify and select the problem to be addressed as their project work through literature survey and finalize a comprehensive aim and scope of their work.
4. Reviews of the progress of the project work have to be conducted by a team of faculty (minimum 3 and a maximum of 5) along with their faculty guide as a member the review team.
5. Progress of project work has to be monitored by the project guide and committee periodically.
6. Attendance for review is mandatory. If a student fails to attend review for some valid reasons, one more chance may be given
7. The project report should be submitted by the students around the first week of April.

COURSE OUTCOME

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

- take up any challenging practical problems and find solution by formulating proper methodology
- collect literature through research journals and identify the gap in selected area
- Devise the methodology to find solution through gathering complete knowledge on materials/design procedure/analysis and optimisation techniques/ availability of experimental setup/ company permission and other documentation procedures to execute the project.
- prepare project report as per format and confidently face viva voce with proper PPT for presentation

TOTAL PERIODS 180

CO\PO MAPPING

Mapping of course outcomes with programme outcomes (1/2/3 indicates strength of correlation)3-Strong, 2-Medium, 1- Weak														
Programme Outcome (POs)														
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	3	2	3	-	-	1	3	-	1	2	2	2
CO2	3	3	3	2	3	-	-	1	3	-	1	2	2	2
CO3	3	3	2	2	3	-	-	1	2	-	-	1	2	2
CO4	3	3	2	2	3	-	-	1	2	-	-	1	2	2
CO5	3	3	3	2	3	-	-	1	3	-	1	2	2	2

PROGRAMME ELECTIVE III

CM15351 OIL AND NATURAL GAS ENGINEERING 3 0 0 3

COURSE OBJECTIVES

To enable students to

- understand the occurrence of petroleum- exploration techniques- types of rigs and platforms
- examine the composition of natural gas- compression- purification- liquefaction.
- understand the shale oil occurrence- extraction and purification
- understand the storage- transportation of natural gas and power generation in industrial needs
- examine the hydrodynamic equations for flow- PVT properties and multiphase flow correlations

UNIT I OCCURRENCE AND EXPLORATION 9

Occurrence of petroleum - types of reservoirs - Exploration Methods. Drilling and Production of crude and natural Gas - types of rigs and platforms.

UNIT II NATURAL GAS 9

Composition and properties - compression and liquefaction of natural gas - purification methods - Shale gas: Occurrence - extraction and purification.

UNIT III STORAGE AND TRANSPORT 9

Storage and transportation of Natural gas- application in Chemical Process- Power generation- domestic - Industrial and transportation sectors.

UNIT IV APPLIED HYDRODYNAMICS IN OIL WELLS 9

Hydrodynamic equations for flow of fluids through porous media - PVT properties for oil gas systems - Multiphase flow correlations to determine flow ratio and pressure traverse in flowing oil wells

UNIT V REGULATORY PROBLEMS 9

Safety - environmental and economic aspects of oil and gas exploration - Oil Spill Management Alaska and Gulf of Mexico case studies.

TOTAL PERIODS 45

COURSE OUTCOMES

Upon the completion of the course- students will be able to

- understand the occurrence of petroleum- exploration techniques- types of rigs and platforms
- examine the composition of natural gas- compression- purification- liquefaction and understand the shale oil occurrence- extraction and purification
- understand the storage- transportation of natural gas and power generation in industrial needs
- examine the hydrodynamic equations for flow- PVT properties of gas and multiphase flow correlations.
- recognize legal aspects governing gas oil exploration- oil spill management and case studies

TEXT BOOKS

1. Katz Donald L. and Lee Robert L. "Natural Gas Engineering" McGraw Hill Publishing Company- New York- 1990.
2. Medici M. "The Natural Gas Industry"- Newnes-Butterworths- London- 1974.

REFERENCES

1. Econonides M.J. And Daniel A. "Petroleum Production Systems"- Prentice Hall Petroleum Engineering Series- 2012.
2. William C Lyons- Gary C Plisga- "Standard Hand Book of Petroleum and Natural Gas Engineering"- 2nd Edition- Gulf Professional Publishing- 2004.
3. Boyun Guo- Ali Ghalambor- "Natural Gas Engineering Handbook"-2nd Edition- Gulf Publishing Company-2014
4. G.G.Nasr- N.E.Connor- "Natural Gas Engineering and safety challenges"- Springer Publishing- 2014

CO/PO MAPPING

Mapping of course outcomes with programme outcomes (1/2/3 indicates strength of correlation)3-Strong, 2-Medium, 1- Weak														
Programme Outcome (POs)														
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	2	1	1	1	1	1	-	-	-	2	1	2	3
CO2	2	2	2	1	1	2	2	-	1	-	-	2	2	3
CO3	3	1	1	2	1	2	2	-	1	1	2	2	2	3
CO4	3	2	2	2	1	1	1	-	-	1	-	2	2	3
CO5	2	2	1	1	1	2	2	-	-	-	1	2	2	3

CM15352 ELECTROCHEMICAL ENGINEERING 3 0 0 3

COURSE OBJECTIVES

To enable students to

- obtain the principles of electrochemical cells
- solve problems related to the production- storage- distribution of electrochemical energy
- understand utilization of electrochemical energy and the associated environmental issues
- understand the impact of these factors on global energy issues
- integrate professional- ethical and environmental factors in electrochemical engineering design

UNIT I REVIEW BASICS OF ELECTROCHEMISTRY 9

Review basics of electrochemistry - Faraday's law - Nernst potential - Galvanic cells - Polarography - The electrical double layer - It's role in electrochemical processes - Electro capillary curve Helmoltz layer – Guoy - Steven's layer - fields at the interface.

UNIT II MASS TRANSFER IN ELECTROCHEMICAL SYSTEMS: 9

Mass transfer in electrochemical systems: diffusion controlled electrochemical reaction the importance of convention and the concept of limiting current. over potential - primary secondary current distribution rotating disc electrode.

UNIT III INTRODUCTION TO CORROSION 10

Introduction to corrosion - series - corrosion theories derivation of potential - current relations of activities controlled and diffusion controlled corrosion process. Potential - pH diagram - Forms of corrosion - definition - factors and control methods of various forms of corrosion - corrosion control measures - industrial boiler water corrosion Control protective coatings Vapor phase inhibitors - cathodic protection - sacrificial anodes - paint removers.

UNIT IV ELECTROCHEMICAL CELLS 8

Electro deposition - electro refining - electroforming - electro polishing - anodizing Selective solar coatings - Primary and secondary batteries - types of batteries - Fuel cells.

UNIT V ELECTRODES USED IN ELECTROCHEMICAL INDUSTRIES 9

Electrodes used in different electrochemical industries: Metals - Graphite - Lead dioxide Titanium substrate Insoluble electrodes - Iron oxide - semi conducting type - Metal finishing - cell design. types of electrochemical reactors - batch cell - fluidized bed electrochemical reactor - filter press cell - Swiss roll cell - plug flow cell - design Equation figures of merits of different type of electrochemical reactors.

TOTAL PERIODS 45

COURSE OUTCOMES

Upon the completion of the course- students would be able to

- obtain the principles of electrochemical cells
- solve problems related to the production- storage- distribution of electrochemical energy
- understand utilization of electrochemical energy and the associated environmental issues
- understand the impact of these factors on global energy issues
- integrate professional- ethical and environmental factors in electrochemical engineering design

TEXT BOOKS

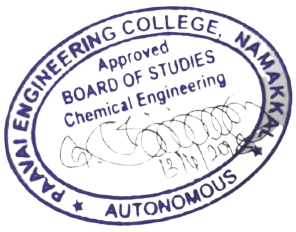
1. Picket “Electrochemical Engineering” Prentice Hall-1977
2. Newman. J. S. “ Electrochemical systems” Prentice Hall-1973

REFERENCES

1. Barak M. and Stevenge U. K. “ Electrochemical Power Sources - Primary and Secondary Batteries” 1980
2. Mantell C. “Electrochemical Engineering” McGraw Hill-1972.
3. H.Wendt, G.Kreysa “ Electrochemical Engineering Science and Technology in chemical and other industries”, Springer-1999
4. Fumio Hine “Electrode Processes and Electrochemical Engineering” Plenum Press- New York-1985

CO/PO MAPPING

Mapping of course outcomes with programme outcomes (1/2/3 indicates strength of correlation)3-Strong, 2-Medium, 1- Weak														
Programme Outcome (POs)														
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	2	1	1	1	1	1	-	-	-	2	1	2	3
CO2	2	2	2	1	1	2	2	-	1	-	-	2	2	3
CO3	3	1	1	2	1	2	2	-	1	1	2	2	2	3
CO4	3	2	2	2	1	1	1	-	-	1	-	2	2	3
CO5	2	2	1	1	1	2	2	-	-	-	1	2	2	3



CM15353 FERTILIZER TECHNOLOGY 3 0 0 3

COURSE OBJECTIVES

To enable students to

- develop an understanding of the basic concepts of fertilizer technology
- study about various types of fertilizers
- learn about the manufacturing techniques of fertilizer.
- understand the design of the equipments in fertilizer industry
- apply the methodology in real life.

UNIT I NITROGENOUS FERTILISERS 9

Methods of production of nitrogenous fertilizer - ammonium sulphate - nitrate - urea and calcium ammonium nitrate; Ammonium chloride and their methods of production - characteristics and specifications - storage and handling.

UNIT II PHOSPHATIC FERTILISERS 9

Raw materials; phosphate rock - sulphur; pyrites etc. - processes for the production of sulphuric and phosphoric acids; phosphates fertilizers - ground rock phosphate; bone meal - single superphosphate - triple superphosphate - triple superphosphate - thermal phosphates and their methods of production - characteristics and specifications

UNIT III POTASSIC FERTILISERS 9

Methods of production of potassium chloride - potassium schoenite - their characteristics and specifications.

UNIT IV COMPLEX AND NPK FERTILISERS 9

Methods of production of ammonium phosphate - sulphate diamSmonium phosphate - nitro phosphates - urea - ammonium phosphate - mono - ammonium phosphate and various grades of NPK fertilizers produced in country

UNIT V MISCELLANEOUS FERTILISERS 9

Mixed fertilizers and granulated mixtures; biofertilisers - nutrients - secondary nutrients and micro nutrients; fluid fertilizers - controlled release fertilizers - controlled release fertilizers.

TOTAL PERIODS 45

COURSE OUTCOMES

Upon the completion of the course students would be able to

- develop an understanding of the basic concepts of fertilizer technology
- study about various types of fertilizers
- learn about the manufacturing techniques of fertilizer.
- understand the design of the equipments in fertilizer industry
- apply the methodology and techniques in real life.

TEXT BOOKS

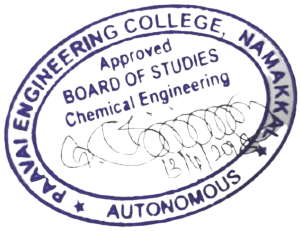
1. GopalaRao M. and Marshall Sittig "Dryden's Outlines of Chemical Technology", 3rd Edition East- West Press, New Delhi- 2008.
2. Menno- M.G.; "Fertilizer Industry - An Introductory Survey" Higginbotham's Pvt. Ltd.- 1973.

REFERENCES

1. "Handbook of fertilizer technology" Association of India, New Delhi- 1977.
2. Sauchelli- V.; "The Chemistry and Technology of Fertilizers" ACS MONOGRAPH No. 148- Reinhold Publishing Cor. New York- 1980.
3. Fertilizer Manual- "United Nations Industrial Development Organization" United Nations, New York- 1967.
4. Slack- A.V.; "Chemistry and Technology of Fertilizers" Interscience, New York- 1966.

CO/PO MAPPING

Mapping of course outcomes with programme outcomes (1/2/3 indicates strength of correlation)3-Strong, 2-Medium, 1- Weak														
Programme Outcome (POs)														
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	2	-	-	2	2	1	-	1	2	2	2	2
CO2	3	2	2	-	-	2	1	-	-	1	1	2	2	2
CO3	3	2	2	-	-	2	1	-	-	1	1	2	2	2
CO4	3	2	2	-	-	2	1	-	-	1	1	2	2	2
CO5	3	2	2	-	-	2	1	-	-	1	1	2	2	2



CM15354 POLYMER TECHNOLOGY 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- develop an understanding of the basic concepts of polymer technology
- study the molecular weight distribution, Condensation polymerization and transition in polymers.
- understand the principles related to the synthesis and characterization of polymers.
- comprehend the properties and manufacturing processes of polymers
- grasp the methods of preparation and moulding of plastics

UNIT I INTRODUCTION 6

History of Macromolecules - structure of natural products like cellulose rubber - proteins - concepts of macromolecules - Staudinger's theory of macromolecules - difference between simple organic molecules and Macromolecules.

UNIT II ADDITION POLYMERIZATION 12

Chemistry of Olefins and Dienes - double bonds - Chemistry of free radicals - monomers – functionality - Polymerization: Initiation - types of initiation - free radical polymerization - cationic polymerization - anionic polymerization - coordination polymerization - industrial polymerization – bulk - emulsion - suspension and solution polymerization techniques - Kinetics – Copolymerization concepts.

UNIT III CONDENSATION POLYMERIZATION 9

Simple condensation reactions - Extension of condensation reactions to polymer synthesis - functional group reactivity - poly condensation - kinetics of poly condensation - Carother's equation - Linear polymers by poly condensation - Interfacial polymerization - cross linked polymers by condensation - gel point.

UNIT IV MOLECULAR WEIGHTS OF POLYMERS 9

Difference in molecular weights between simple molecules and polymers - number average and weight average molecular weights - degree of polymerization and molecular weight - molecular weight distribution - poly dispersity - molecular weight determination. Different methods – Gel Permeation Chromatography

UNIT V TRANSITIONS IN POLYMERS 9

First and second order transitions - Glass transition - Tg - multiple transitions in polymers - experimental study - significance of transition temperatures - crystallinity in polymers - effect of crystallization in polymers - factors affecting crystallization crystal nucleation and growth - relationship between T_g and T_m - Relationship between properties and crystalline structure.

TOTAL PERIODS 45

COURSE OUTCOMES

At the end of this course- the student would be able to

- Understand the principles related to the synthesis and characterization of polymers.
- Develop the knowledge to characterize the plastics by using different instruments
- Gain insight into the structure and properties of polymers
- Comprehend the properties and manufacturing processes of polymers
- Grasp the methods of preparation and moulding of plastics

TEXT BOOKS

1. Billmeyer.F.W.-Jr "Text Book of Polymer Science"- Ed. Wiley, Interscience- 1984
2. Gowariker.V.T, Viswanathan.N.V and Sreedar.J. "Polymer Science", 9th Reprint- New Age International Pvt. Ltd, India- 1996.

REFERENCES

1. Joel-R.F; "Polymer Science and Technology"- Eastern Economy Edition- 1999
2. Rodriguez- F.- Cohen.C.- Oberic.K and Arches- L.A.- "Principles of Polymer Systems"- 5th edition- Taylor and Francis- Great Britain- London- 2003
3. Arora M.G. and Singh M. "Polymer Chemistry"- Anmol Publications Pvt. Limited- 2003.
4. Seymour.R.B. and Carraher.C.E.- Jr.- "Polymer Chemistry", 2nd Ed.- Marcel Dekker- 1988.

CO/PO MAPPING

Mapping of course outcomes with programme outcomes (1/2/3 indicates strength of correlation)3-Strong, 2-Medium, 1- Weak														
Programme Outcome (POs)														
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	2	1	1	1	1	1	-	-	-	2	1	2	3
CO2	2	2	2	1	1	2	2	-	1	-	-	2	2	3
CO3	3	1	1	2	1	2	2	-	1	1	2	2	2	3
CO4	3	2	2	2	1	1	1	-	-	1	-	2	2	3
CO5	2	2	1	1	1	2	2	-	-	-	1	2	2	3

PROGRAMME ELECTIVE IV

CM15451 PULP AND PAPER TECHNOLOGY 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- focus on papermaking science and technology and is
- understand various methods for wood preparation and pulping
- become familiar with the processing and bleaching of pulp
- understand the finishing and surface treatment of various grades of paper
- demonstrate various methods for testing of pulp and paper

UNIT I INTRODUCTION 9

Introduction Basic pulp and paper technology - Wood haves dry - Wood as a raw material

UNIT II WOODYARD OPERATION 9

Wood yard operation - Mechanical pulping - Chemical pulping - Secondary fiber pulp processing.

UNIT III PAPER MACHINE 9

Paper Machine wet and addition paper machine dry and Paper machine - Wet and operation

UNIT IV PAPER AND PAPERBOARD 9

Paper and paperboard frames and products - Surface treatments - Finishing operation - End uses

UNIT V PROPERTIES AND TESTING OF PULP AND PAPER 9

Properties and Testing of pulp and paper Process control - Quality assurance - Water and air pollution control

TOTAL PERIODS 45

COURSE OUTCOMES

At the end of this course the student would be able to

- understand various methods for wood preparation and pulping
- familiar with the processing and bleaching of pulp
- understand the finishing and surface treatment of various grades of paper
- demonstrate various methods for testing of pulp and paper
- demonstrate control measures relevant to solid - liquid and gaseous pollution from pulp and paper industry

TEXT BOOKS

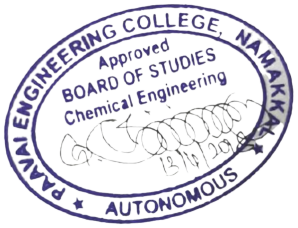
1. Kenneth W. Brittt, "Handbook of Pulp and Paper Technology", 2nd Revised Edition- John Wiley & Sons- 1971.
2. Smook G.A. "Handbook for Pulp & Paper Technologists", 3rd Edition- Angus Wilde Publications Incorporation- 2003.

REFERENCES

1. Austin- G.T. "Shreve's Chemical Process Industries"- 5th Edition- McGraw-Hill International Book Company- Singapore- 1984.
2. Kent J.A.- Riggel's Hand Book of Industrial Chemistry‖- Van Nostrant Reinhold- 1974.
3. Monica ER Monica- Goran Gellerstcdt- "Pulp and paper chemistry and Technology"- Gneyter 2009.
4. Pratima Bajpai- "Pulp and Paper Industry-Energy Conservation"- Elsevier 2016

CO/PO MAPPING

Mapping of course outcomes with programme outcomes (1/2/3 indicates strength of correlation)3-Strong, 2-Medium, 1- Weak														
Programme Outcome (POs)														
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	2	1	1	1	1	1	-	-	-	2	1	2	3
CO2	2	2	2	1	1	2	2	-	1	-	-	2	2	3
CO3	3	1	2	2	1	2	2	-	1	1	2	2	2	3
CO4	2	2	2	2	1	1	1	-	-	1	-	2	2	3
CO5	2	2	1	1	1	2	2	-	-	-	1	2	2	3



CM15452 **CORROSION ENGINEERING** **3 0 0 3**

COURSE OBJECTIVES

To enable the students to

- have an insight into all aspects of corrosion and testing methods
- apply the principles of corrosion inhibition for protection of process equipments
- develop knowledge of corrosion inspection and management in chemical industries
- control corrosion and select materials for different applications
- comprehend the impact of corrosion on nations economy

UNIT I TYPES OF CORROSION AND TESTING METHODS 9

Basic principles of corrosion and its control – Forms of corrosion – uniform – Galvanic – Crevis – pitting - selective leaching – erosion - stress – corrosion - cracking Cavitation phenomena and their effects – corrosion testing – field – testing – Electrochemical techniques for measurement of corrosion rates - corrosion detection and components Examination Accelerated salt - spray testing.

UNIT II CORROSION PROTECTION METHODS 9

Corrosion inhibitors - electroplated coatings - conversion coatings – anodizing - hot dipping - spray metal coatings - zinc coating by alloying – electro photeric coatings and electro painting - powder coating - electrical methods of corrosion protection - composite materials in corrosion minimization – Cathodic and Anodic protections.

UNIT III CORROSION IN SPECIFIC ENVIRONMENTS 9

Corrosion damage to concrete in industrial and marine environments and its protection; biological corrosion halogen corrosion of metals - environmental degradation of materials - corrosion and inspection managements in chemical processing and petrochemical industries.

UNIT IV CORROSION IN SPECIFIC CASES AND CONTROL 9

Corrosion in structure – corrosion of stainless steels – corrosion in power equipments - corrosion in electrical and electronic industry – corrosion and selection of materials of pulp and paper plants – corrosion aspects in nuclear power plants – corrosion of surgical implants and prosthetic devices

UNIT V CORROSION AND COUNTRY'S ECONOMY 9

Corrosion protection management – process maintenance procedures under corrosion Environments.

TOTAL PERIODS 45

COURSE OUTCOMES

At the end of this course- the student would be able to

- have an insight into all aspects of corrosion and testing methods
- apply the principles of corrosion inhibition for protection of process equipments
- develop knowledge of corrosion inspection and management in chemical industries
- control corrosion and select materials for different applications
- comprehend the impact of corrosion on nations economy

TEXT BOOKS

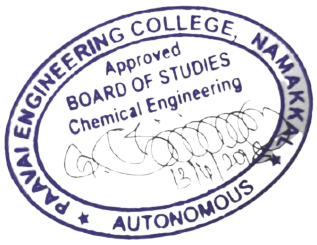
1. Fontana M.G, "Corrosion Engineering", Tata McGraw Hill- 2005.
2. Jones D.A. "Principal and Protection of Corrosion", Prentice-Hall- 1996

REFERENCES

1. Pierre R. Roberge, "Corrosion Engineering: Principles and Practice", McGraw-Hill- 2008.
2. Sastri V.S. Ghali E. And Elboujdaini M."Corrosion Prevention and Protection: Practical Solutions", John Wiley and Sons- 2007.
3. Pierre R. Roberge "Handbook of Corrosion Engineering" 2nd edition, McGraw-Hill- 2012.
4. Zaki Ahmad " Principles of Corrosion Engineering and corrosion control" Butterworth- 2006

CO/PO MAPPING

Mapping of course outcomes with programme outcomes (1/2/3 indicates strength of correlation)3-Strong, 2-Medium, 1- Weak														
Programme Outcome (POs)														
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	2	1	1	1	1	1	-	-	-	2	1	2	3
CO2	2	2	2	1	1	2	2	-	1	-	-	2	2	3
CO3	3	1	1	2	1	2	2	-	1	1	2	2	2	3
CO4	3	2	2	2	1	1	1	-	-	1	-	2	2	3
CO5	2	2	1	1	1	2	2	-	-	-	1	2	2	3



BA 15253 TOTAL QUALITY MANAGEMENT 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- describe the basic concepts in Quality Management- Customer orientation and retention.
- facilitate the understanding of Quality Management principles and process.
- discuss the techniques in Six Sigma- Bench marking and FMEA.
- understand the basic concepts in Quality Function Development and TPM.
- become familiar with Quality System- Quality Auditing and HR practices.

UNIT I INTRODUCTION 9

Introduction - Need for quality - Evolution of quality - Definitions of quality - Dimensions of product and service quality - basic concepts of TQM - TQM Framework - Contributions of Deming - Juran and crosby - barriers to TQM - Quality statements - Customer focus - Customer orientation - customer satisfaction customer complaints- Customer retention - Costs of quality

UNIT II TQM PRINCIPLES 9

Leadership - strategic quality planning- quality councils - employee involvement – motivation – empowerment - team and teamwork - quality circles recognition and reward - performance appraisal - continuous process improvement - PDCA cycle - 5S- kaizen - supplier partnership - partnering- supplier selection- supplier rating.

UNIT III TQM TOOLS AND TECHNIQUES I 9

The seven traditional tools of quality - new management tools - six sigma: concepts – methodology - applications to manufacturing - service sector including IT - bench marking - reason to bench mark - bench marking process - FMEA – stages - types.

UNIT IV TQM TOOLS AND TECHNIQUES II 9

Control charts - process capability - concepts of six sigma - quality function development (QFD) - taguchi quality loss function - TPM – concepts - improvement needs - performance measures.

UNIT V QUALITY SYSTEMS 9

Need for ISO 9000 - ISO 9001-2008 Quality System - Elements- Documentation- Quality Auditing - QS 9000 - ISO 14000 – Concepts - Requirements and Benefits - TQM Implementation in manufacturing and service Return on Investment - Personnel management. Recruitment - selection and training - Technology in Agri sectors.

TOTAL PERIODS 45

COURSE OUTCOMES

Upon the completion of the course- students will be able to

- discuss the basic concepts in Quality Management- Customer orientation and retention.
- describe the principles and process of Quality Management.
- implement the quality control techniques in Six Sigma- Bench marking and FMEA.
- explain the basic concepts in Quality Function Development and TPM.
- understand the elements in Quality System- Quality Auditing and HR practices.

TEXT BOOKS

1. Dale H. Besterfiled- et al. "Total quality Management"- Pearson Education Asia- Third Edition, Indian Reprint (2006).
2. Jones D.A, “Principal and Protection of Corrosion”, Prentice-Hall- 1996

REFERENCES

1. James R. Evans and William M. Lindsay- "The Management and Control of Quality"- 8th Edition- First Indian Edition- Cengage Learning, 2012.
2. Suganthi.L and Anand Samuel- "Total Quality Management"- Prentice Hall (India) Pvt. Ltd. 2006.
3. Janakiraman. B and Gopal .R.K.- "Total Quality Management - Text and Cases"- PHI (India)- 2006
4. Dennis AuBuchon- “Understanding the Concept of Quality”, Pronoun- 2017.
5. Donna C. S. Summers- “Quality”- Pearson- 5th edition- 2009.

CO/PO MAPPING

Mapping of course outcomes with programme outcomes (1/2/3 indicates strength of correlation)3-Strong, 2-Medium, 1- Weak														
Programme Outcome (POs)														
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	2	1	1	1	1	1	-	-	-	-	1	2	3
CO2	2	2	1	2	1	-	-	-	1	-	-	2	2	1
CO3	1	2	1	2	1	-	-	-	1	1	-	2	2	2
CO4	2	1	2	2	1	-	-	-	-	1	-	2	2	2
CO5	2	2	1	1	1	-	-	-	-	-	1	2	2	3

CM15453 ENZYME ENGINEERING 3 0 0 3

COURSE OBJECTIVES

To enable students to

- gain knowledge on microorganism and culture growth of enzyme
- learn about different classification of enzymes
- study about the enzyme kinetics using gas-liquid transports
- know the purifying techniques in enzyme production and its application
- study about different types of bioreactor operation and design.

UNIT I INTRODUCTION 9

Types of Microorganism: Structure and function of microbial cells - Fundamentals of microbial growth - Batch and continuous culture. Isolation and purification of enzymes from cells. Cell and Enzyme Immobilization.

UNIT II ENZYME KINETICS 9

Fermentation - Types of mechanisms- Continuous fermentation - aeration and agitation- kinetics of fermentation - Processes

UNIT III TRANSPORT PHENOMENA 9

Introduction of Bioreactor design: Continuously stirred aerated tank bioreactors. Mixing power correlation determination of volumetric mass transfer rate of oxygen from air bubbles and effect of mechanical mixing and aeration on oxygen transfer rate- heat transfer and power.

UNIT IV PURIFICATION OF ENZYMES 9

Introduction to Biochemistry- Function and applications. Nature and function of enzyme. Coenzyme / Cofactor. Classification of enzymes. Assay methods and units. Examples of applications of enzymes in industry- analytical technique medicine and Pharmaceuticals

UNIT V ENZYME BIOREACTORS 9

Industrial Bioreactors Utilizing Isolated enzymes and biosensors development and applications. designs of Reactor- Batch and continue type; analysis for immobilized enzyme reactors. Sterile and non-sterile Operations; reactors in series with and without recycle.

TOTAL PERIODS 45

COURSE OUTCOMES

Upon the completion of the course- students will be able to

- classify enzymes and gain knowledge on immobilization- extraction and purification of enzymes and biosensors
- determine the Enzyme rate for the reaction with kinetics
- emphasis on reactor operation and design with respect to transfer rate
- purify the enzymes and the analytical techniques employed for it
- understand the function of industrial bio reactors and can study the effect of sterilization.

TEXT BOOKS

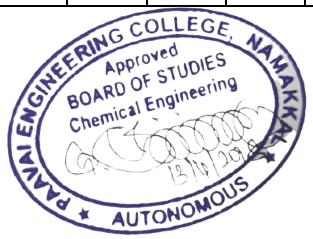
1. "Technological Applications of Bio-catalysts"- BIOTOL series- Butter worth- 1995.
2. Cornish. A -Bowden- "Analysis of Enzyme Kinetic Data"- Oxford University Press- 1996.

REFERENCES

1. Wiseman. A and Blake borough N and Dunnill P "Enzymic and nonenzymic catalysis"- Vol.5 Ellis and Harwood- U.K. (1981).
2. Wiseman A (Ed.) "Topics in enzyme and fermentation Bio-technology"- Ellis and Harwood- U.K. Vol-5.
3. James C. Samuelson "Enzyme Engineering**:** Methods and Protocols"- Humana Press- 2016
4. Peter Gemeiner,"Enzyme engineering**:** immobilized bio systems", E. Horwood- 1992

CO/PO MAPPING

Mapping of course outcomes with programme outcomes (1/2/3 indicates strength of correlation)3-Strong, 2-Medium, 1- Weak														
Programme Outcome (POs)														
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	1	3			1	2					2	2	2
CO2	2	2	2			1	1					2	2	2
CO3	2	2	3			1	1					2	2	2
CO4	3	2	2			1	1					2	2	2
CO5	3	3	3			2	2					2	2	2



PROGRAMME ELECTIVE V

CM15551 AIR POLLUTION AND CONTROL 3 0 0 3

COURSE OBJECTIVES

To enable students to

- learn about Air Pollution regulations
- make the students aware of effects of air pollution- Global effects-
- learn the of Sampling of pollutants-
- control pollution with technological achievement and economic viability.
- study the Meteorology and air pollution- Atmospheric stability- and Prediction of air quality.

UNIT I INTRODUCTION 9

Air Pollution Regulatory Framework History - Air Pollution Regulatory - Framework - Regulatory System - Laws and Regulations - Clean air Act - Provisions for Recent Developments.

UNIT II AIR POLLUTION GASES 9

Measurement fundamentals - chemicals and physical properties – Phase - Incinerators - Design and Performance - Operation and Maintenance - Absorbers - Design operation and improving performances

UNIT III PARTICULATE AIR POLLUTION 9

Particle collection mechanism - fluid particle - dynamic - particle size - Distribution - Efficiency - Gravity Settling chambers Cyclones - Electrostatic precipitators

UNIT IV HYBRID SYSTEM 9

Heat electrostatic precipitation - Genizing Heat Scrubbers - Dry Scrubbers - Electrostatically Augmented Fabric Filtration

UNIT V AIR POLLUTION CONTROL EQUIPMENT 9

Introduction - Installation - Cost Model.

TOTAL PERIODS 45

COURSE OUTCOMES

Upon the completion of the course- students will be able to

- understand the evolution of air pollution regulation and different laws related to air pollution and control
- know the effects of air pollution and its adverse impact on Global scenario
- assess the performance of absorbers and understand the different particle collection mechanisms
- understand the concepts involved in hybrid systems and its cost Modelling
- learn to control the pollution with technological equipment and attain economic viability.

TEXT BOOKS

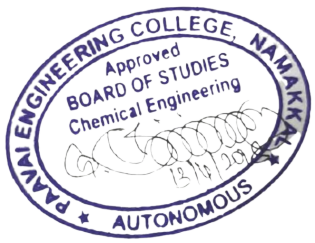
1. Louis Theodore, "Air Pollution Control Equipment", Springer- 2011
2. Cooper C.D. and Alley F.C. "Air Pollution Control-A Design Approach"- 4th Edition- Waveland Pr Inc. 2010.

REFERENCES

1. Noel de Nevers, "Air Pollution Control Engineering"- 2nd Edition- Waveland Pr Inc.- 2010.
2. Rao M.N. and Rao H.V.N. "Air Pollution"- 1st Edition- McGraw Hill India Pvt. Ltd.- 2001.
3. Norman C.Pereira, "Air Pollution control Engineering", Springer science- 2004
4. Paul N. Cheremisinoff, "Air Pollution Control and Design for Industry", Marcel Dekker INC- New york- 1993

CO/PO MAPPING

Mapping of course outcomes with programme outcomes (1/2/3 indicates strength of correlation)3-Strong, 2-Medium, 1- Weak														
	Programme Outcome (POs)													
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	1	1	-	-	-	2	2	-	-	1	-	1	1	1
CO2	2	2	2	-	-	2	2	-	-	-	-	2	2	2
CO3	3	2	2	-	-	1	2	-	-	-	-	2	2	2
CO4	2	2	2	-	-	1	2	-	-	-	-	1	2	2
CO5	2	1	1	-	-	1	2	-	-	-	-	1	2	2



CM15552 PROCESSES OPTIMIZATION 3 0 0 3

COURSE OBJECTIVE

To enable students to

- study the systems of equations for attaining optimum
- expose the students with basic function and interpretation of quadratic
- perform functional concepts using various mathematical methods
- study about unconstrained multivariable optimization methods
- expose the students in linear programming

UNIT I DEVELOPING MODELS FOR OPTIMIZATION 9

Scope and hierarchy of optimization - Essential features of Optimization problems - Classification of Models - building a model - Factorial experimental designs- Degree of freedom

UNIT II BASIC CONCEPTS 9

Formation of objective function - continuity of functions - NLP problem statement- convexity and applications - Interpretation of objective function based on its Quadratic approximation

UNIT III OPTIMIZATION OF UNCONSTRAINED FUNCTIONS 9

Methods for one dimensional search- Newton‘s method and Quasi - Newton methods for uni-dimensional search. Polynomial approximation methods

UNIT IV UNCONSTRAINED MULTIVARIABLE OPTIMIZATION 9

Methods using function value only - methods using first derivative - Newton‘s method- Quasi - Newton methods.

UNIT V LINEAR PROGRAMMING 9

Simplex method - Barrier method - sensitivity analysis - Linear mixed integer programs - Examples

TOTAL PERIODS 45

COURSE OUTCOMES

Through this course- the students would have learnt about

- designing experiments and formulate optimization models of chemical processes/equipment
- knowledge on the basic concepts of process optimization techniques
- solving different uni-dimensional search methods and polynomial approximations
- understanding the principles of unconstrained multivariable Optimization techniques
- familiarizing the methods of linear programming

TEXT BOOKS

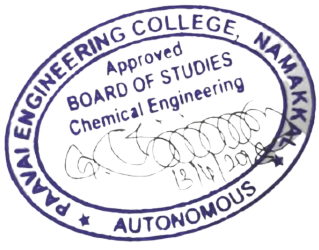
1. Edgar- T.F, Himmelblau, D.M. "Optimization of Chemical Processes", McGraw-Hill- 2001.
2. Kalyanmoy Deb "Optimization for Engineering Design: Algorithms and Examples", Prentice Hall of India- New Delhi- 2005.

REFERENCES

1. Biles- W.E.- Swain- J.J, "Optimization and Industrial Experimentation", Inter Science- New York- 19
2. Seinfeld- J.H.; Lapidus- L; "Process Modelling- Estimation and Identification", Prentice Hall- Englewood Cliffs- New Jersey- 1974.
3. Beveridge- C.S.; Schechter- R.S.; "Optimization: Theory and Practice", McGraw-Hill.- New York.
4. Enrique del Castillo, "Process Optimization: A Statistical Approach", springer-2007

CO/PO MAPPING

Mapping of course outcomes with programme outcomes (1/2/3 indicates strength of correlation)3-Strong, 2-Medium, 1- Weak														
Programme Outcome (POs)														
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	2	1	1	1	1	1	-	-	-	-	1	2	3
CO2	1	2	1	2	1	-	-	-	1	-	-	2	2	1
CO3	1	2	1	2	1	-	-	-	1	1	-	2	2	2
CO4	2	1	2	2	1	-	-	-	-	1	-	2	2	2
CO5	2	2	1	1	1	-	-	-	-	-	1	2	2	3



CM15553 COMPUTATIONAL FLUID DYNAMICS 3 0 0 3

COURSE OBJECTIVE

To enable students to

- make the students to demonstrate competence in setting up computational fluid dynamics models.
- understand the computational fluid models
- enable technical competence in building and conducting CFD simulations.
- understand the basic fluid operation analogies.
- perform grid generation for models

UNIT I CONSERVATION LAWS AND TURBULENCE MODELS 9

Governing equations of fluid flow and heat transfer – mass conservation - momentum and energy equation - Differential and integral forms - conservation and non-conservation form. Characteristics of turbulent flows - time averaged Navier Strokes equations - turbulence models - one and two equation- Reynolds stress - LES and DNS

UNIT II FINITE DIFFERNCE APPROXIMATION 9

Mathematical behavior of PDE - finite difference operators - basic aspects of discretization by FDM - explicit and implicit methods - error and stability analysis.

UNIT III FINITE VOLUME METHOD 15

Diffusion problems - explicit and implicit time integration; Convection-diffusion problems - properties of discretization schemes- central- upwind- hybrid- QUICK schemes; Solution of discretised equations.

UNIT IV FLOW FIELD COMPUTATION 6

Pressure velocity coupling - staggered grid - SIMPLE algorithm - PISO algorithm for steady and unsteady flows

UNIT V GRID GENERATION 6

Physical aspects - simple and multiple connected regions - grid generation by PDE solution - grid generation by algebraic mapping. Growth and growth coefficients - Calculations involving material and energy balances - Methods based on super saturation and industrial equipment.

TOTAL PERIODS 45

COURSE OUTCOME

Upon completing the course, the students would have learnt about

- hands-on experience with a commercial CFD program.
- understand the computational fluid models
- enable technical competence in building and conducting CFD simulations.
- understand the basic fluid operation analogies.
- perform grid generation for models

TEXT BOOKS

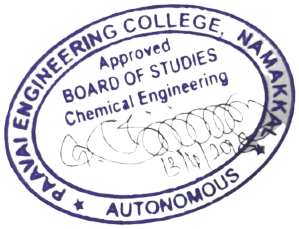
1. Anderson- J. D., "Computational Fluid Dynamics: The Basics with Applications"- McGraw-Hill- 1995.
2. Fletcher- C. A. J., "Computational Techniques for Fluid Dynamics"- Springer Verlag- 1997.

REFERENCES

1. Chung T.J "Computational Fluid Dynamics" Cambridge University Press- 2003.
2. Muralidhar. K. and Sundararajan. T., "Computational Fluid Flow and Heat Transfer", Narosa Publishing House- New Delhi- 2001.
3. Subas- V. Patankar "Numerical heat transfer fluid flow"- Hemisphere Publishing Corporation- 1980.
4. Taylor. C and Hughes. J.B. "Finite Element Programming of the Navier Stock Equation", Pineridge Press Limited- U.K. 1981.

CO/PO MAPPING

Mapping of course outcomes with programme outcomes (1/2/3 indicates strength of correlation)3-Strong, 2-Medium, 1- Weak														
Programme Outcome (POs)														
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	2	1	1	1	1	1	-	-	-	2	1	2	3
CO2	3	2	2	1	1	-	2	1	1	-	3	2	2	3
CO3	3	3	1	2	1	-	-	-	1	1	2	2	2	3
CO4	3	2	3	2	1	-	1	1	-	1	2	2	2	3
CO5	2	2	1	1	1	-	-	-	-	-	1	2	2	3



CM15554 PIPING ENGINEERING 3 0 0 3

COURSE OBJECTIVES

To enable students to

- understand the concept of piping generic design
- learn the fundamental principles of fluid flow phenomena
- perform the design of pipeline systems for air and water systems
- perform the design of pipeline system for refrigeration and slurry systems
- apply operation and maintenance techniques to ensure safety operations

UNIT I PIPING FUNDAMENTALS 9

Equations of flow for Newtonian and Non-Newtonian fluids - losses in pipes and fittings - Types of pipes and Fittings. Piping standards and codes.

UNIT II PIPING GENERIC DESIGN 9

Piping layout - series and parallel pipes - Pipe network. Stress analysis and design of pipe supports.

UNIT III PIPING DESIGN-I 9

Design of pipeline system - Air- Water - Steam and Oil.

UNIT IV PIPING DESIGN- II 9

Design of pipeline system - Gases - Refrigeration and Slurry. Continuous drying - Drying equipment: tray - Rotary drum - spray dryer and their applications.

UNIT V OPERATION AND MAINTENANCE 9

Coating- cleaning; freeze prevention- leak detection- corrosion and protection. Pipeline failures - Piping insulation and heat tracing- repair techniques; Pipeline economics.

TOTAL PERIODS 45

COURSE OUTCOMES

On completion of the course the students will be able to

- understand the concept of piping generic design
- familiarize the fundamental principles of fluid flow phenomena
- perform the design of pipeline systems for air and water systems
- perform the design of pipeline system for refrigeration and slurry systems
- apply operation and maintenance techniques to ensure safety operations

TEXT BOOKS

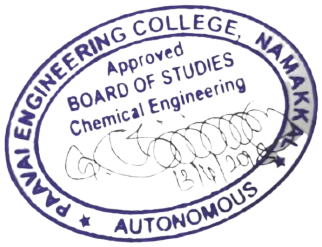
1. John J Mcketta, "Piping Handbook", 3rd Edition, Marcel Dekker Publication- 1992.
2. Henry Liu, "Pipeline Engineering", 2nd Edition- Lewis Publishers- 2003.

REFERENCES

1. Mohinder L. Nayyar, "Piping Handbook", 7th Edition- McGraw Hill- 2000.
2. George A. Antaki- "Piping and Pipeline Engineering: Design- Construction- Maintenance- Integrity and Repair", Marcel Dekker Publications- 2003.

CO/PO MAPPING

Mapping of course outcomes with programme outcomes (1/2/3 indicates strength of correlation)3-Strong, 2-Medium, 1- Weak														
	Programme Outcome (POs)													
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	2	1	1	1	1	1	-	-	-	-	1	2	3
CO2	2	2	2	1	1	-	-	-	1	-	-	2	2	3
CO3	3	2	1	2	1	-	-	-	1	1	-	2	2	3
CO4	3	2	2	2	1	-	-	-	-	1	-	2	2	3
CO5	2	2	1	1	1	1	1	-	-	-	-	1	2	3



PROGRAMME ELECTIVE VI

CM15651 PROCESS MODELLING AND SIMULATION 3 0 0 3

COURSE OBJECTIVES

To enable students to

- give an overview of various method of process modeling
- understood the development of process models based on conservation principles
- learn Process data and computational techniques to solve the process models.
- study different computational techniques for simulation.
- learn the fundamental principles of steady and unsteady state models.

UNIT I INTRODUCTION 7

Introduction to modeling and simulation- classification of mathematical models-conservation equations and auxiliary relations.

UNIT II STEADY STATE LUMPED SYSTEMS 9

Degree of freedom analysis- single and network of process units- systems yielding linear and non-linear algebraic equations- flow sheeting – sequential modular and equation oriented approach- tearing-partitioning and precedence ordering- solution of linear and non-linear algebraic equations.

UNIT III UNSTEADY STATE LUMPED SYSTEMS 9

Analysis of liquid level tank- gravity flow tank- jacketed stirred tank heater- reactors- flash and distillation column- solution of ODE initial value problems- matrix differential equations- simulation of closed loop systems.

UNIT IV STEADY STATE DISTRIBUTED SYSTEM 7

Analysis of compressible flow- heat exchanger- packed columns- plug flow reactor -solution of ODE boundary value problems.

UNIT V CRYSTALLIZATION 13

Analysis laminar flow in pipe-sedimentation - boundary layer flow - conduction - heat exchanger - heat transfer in packed bed – diffusion - packed bed adsorption - plug flow reactor - hierarchy in model development - Classification and solution of partial differential equations. Empirical modeling-parameter estimation - Population balance and stochastic modeling.

TOTAL PERIODS 45

COURSE OUTCOMES

Upon completing the course

- The student should have understood the development of process models based on conservation principles
- Process data and computational techniques to solve the process models.
- overview of various method of Process modeling
- Different computational techniques for simulation.
- The fundamental principles of steady and unsteady state models.

TEXT BOOKS

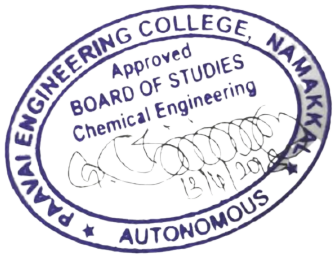
1. Ramirez- W.; "Computational Methods in Process Simulation "- 2nd Edn. Butterworths Publishers - New York- 2000.
2. Luyben- W.L. " Process Modelling Simulation and Control", 2nd Edn- McGraw-Hill Book Co.- 1990

REFERENCES

1. Felder R. M. and Rousseau R. W. "Elementary Principles of Chemical Processes", John Wiley- 2000.
2. Franks- R. G. E.- " Mathematical Modelling in Chemical Engineering", John Wiley- 1967
3. Amiya K. Jana "Process Simulation and Control Using ASPEN", PHI Learning Ltd (2012).
4. Amiya K. Jana "Chemical Process Modelling and Computer Simulation", PHI Learning Ltd- (2012).

CO/PO MAPPING

Mapping of course outcomes with programme outcomes (1/2/3 indicates strength of correlation)3-Strong, 2-Medium, 1- Weak														
	Programme Outcome (POs)													
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	2	1	1	1	1	1	-	-	-	-	1	2	3
CO2	2	1	2	1	2	-	-	-	1	-	-	2	2	3
CO3	2	2	1	2	1	-	-	-	1	1	-	2	2	3
CO4	3	2	2	2	1	-	-	-	-	1	-	2	2	3
CO5	2	2	1	1	1	-	-	-	-	-	1	2	2	3



CM15652 SOLID WASTE MANAGEMENT 3 0 0 3

COURSE OBJECTIVES

To enable students to

- learn the sources- generation- storage- processing and disposal of municipal solid waste.
- understand the nature and characteristics of municipal solid wastes
- Ability to plan waste minimization and design storage
- make the students conversant with different aspects of the types
- process waste and utilize it in energy forms.

UNIT I SOURCES AND TYPES 8

Sources and types of municipal solid wastes - waste generation rates - factors affecting generation- Characteristics - methods of sampling and characterization; Effects of improper disposal of solid wastes- Public health and environmental effects. Elements of solid waste management - Social and Financial aspects - Municipal solid waste (M&H) rules – integrated management - Public awareness; Role of NGO's.

UNIT II ON-SITE STORAGE AND PROCESSING 8

On-site storage methods - Effect of storage - materials used for containers - segregation of solid wastes - Public health and economic aspects of open storage - waste segregation and storage – case studies under Indian conditions – source reduction of waste - Reduction- Reuse and Recycling.

UNIT III COLLECTION AND TRANSFER 8

Methods of Residential and commercial waste collection - Collection vehicles - Manpower - Collection routes - Analysis of collection systems; Transfer stations - Selection of location - operation & maintenance; options under Indian conditions - Field problems - solving.

UNIT IV OFF-SITE PROCESSING 12

Objectives of waste processing – Physical Processing techniques- Equipments; Resource recovery from solid waste composting and biomethanation; Thermal processing options – case studies under Indian conditions.

UNIT V DISPOSAL 9

Land disposal of solid waste; Sanitary landfills – site selection- design and operation of sanitary landfills – Landfill liners – Management of leachate and landfill gas- Landfill bioreactor– Dumpsite Rehabilitation

TOTAL PERIODS 45

COURSE OUTCOMES

On completion of the course the students will be able to

- understand of the nature and characteristics of municipal solid wastes
- understood the regulatory requirements regarding municipal solid waste management
- ability to plan waste minimization and design storage
- process waste and utilize it in energy forms.
- sound knowledge on collection- transport- processing and disposal of solid waste

TEXTBOOKS:

1. Tchobanoglous- G. Theisen H. M. and Eliassen- R. "Solid. Wastes: Engineering Principles and Management Issues", McGraw Hill- New York- 1993.
2. Paul T Willams, "Waste Treatment and Disposal"- John Wiley and Sons-2000

REFERENCES:

1. Bhide A.D. and Sundaresan. B.B. "Solid Waste Management Collection Processing and Disposal", Indian National Scientific Documentation Centre - 1983
2. George Tchobanoglous and Frank Kreith, "Handbook of Solid waste Management", McGraw Hill, New York- 2002
3. Marc J. Rogoff, "Solid Waste Recycling and Processing", Elsevier-2014
4. Sunil Kumar, "Municipal Solid Waste Management in Developing Countries", CRC press-2016

CO/PO MAPPING

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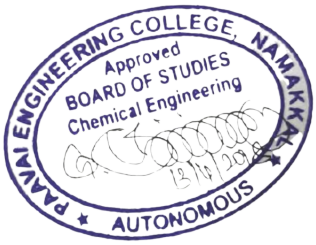
Programme Outcome (POs)														
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	2	1	1	1	1	1	-	-	-	2	1	2	3
CO2	2	2	2	1	1	2	2	-	1	-	-	2	2	3
CO3	3	1	1	2	1	2	2	-	1	1	2	2	2	3
CO4	3	2	2	2	1	1	1	-	-	1	-	2	2	3
CO5	2	2	1	1	1	2	2	-	-	-	1	2	2	3



CM15653 PETROLEUM REFINING ENGINEERING 3 0 0 3

COURSE OBJECTIVES

On completion of the course the students will be able to

- study the formation and composition of petroleum
- learn with properties and testing methods for crude and petroleum products
- learn the various treatment techniques of petroleum
- familiarize with upgrading process of petroleum products
- understand the material and energy balance

UNIT I FORMATION AND COMPOSITION OF PETROLEUM 9

Origin and formation of petroleum; composition; types and classification; Petroleum reserves.

UNIT II PROPERTIES AND TESTING METHODS 9

Physical properties and testing methods - crude and petroleum products;

UNIT III TREATMENT TECHNIQUES 9

Desalting of crudes- dehydration and fractionation methods; Thermal and catalytic cracking processes vis- Breaking - Dubbs two coil process - coking- FCC- Hydro cracking processes.

UNIT IV UPGRADING PROCESSES 9

Solvent extraction; hydro treatment processes; Reforming and Alkylation; Isomerization; polymerization; Finishing and purification processes.

UNIT V MATERIAL AND ENERGY BALANCES 9

Material and Energy balances calculation; controlling hydrocarbon losses in refinery; application of pollution Control techniques.

TOTAL PERIODS 45

COURSE OUTCOMES

On completion of the course the students will be able to

- understand the formation and composition of petroleum
- familiarize with properties and testing methods for crude and petroleum products
- understand the various treatment techniques of petroleum
- familiarize with upgrading process of petroleum products
- demonstrate the material and energy balance

TEXT BOOKS

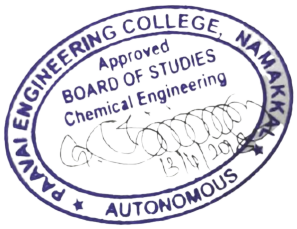
1. Bhaskara Rao B.K. "Modern Petroleum Refining Processes", 5th Edition- Oxford and IBH Publishing Company- New Delhi- 2008.
2. Nelson W.L. “Petroleum Refinery Engineering”, 4th Edition- McGraw Hill Publishing Company Limited- 1958.

REFERENCES

1. Watkins R.N. “Petroleum Refinery Distillation”- 2nd Edition- Gulf Publishing Company- Texas- 1979.
2. Hobson G. D. “Modern Petroleum Technology"- Part 1&2 5th Edition- Wiley Publishers- 1984.
3. Mohamed A. Fahim- Taher A. Al-Sahhaf- Amal Elkilani “Fundamentals of Petroleum Refining” Elsevier-2010
4. Surinder Parkash “Refining Processes Handbook”- Gulf Professional publishing-2003

CO/PO MAPPING

Mapping of course outcomes with programme outcomes (1/2/3 indicates strength of correlation)3-Strong, 2-Medium, 1- Weak														
Programme Outcome (POs)														
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	2	1	1	1	1	1	-	-	-	2	1	1	3
CO2	2	2	2	1	1	2	2	-	1	-	-	2	2	3
CO3	2	1	1	2	1	2	2	-	1	1	2	2	1	3
CO4	3	1	2	2	1	1	1	-	-	1	-	2	2	3
CO5	2	2	1	1	1	2	2	-	-	-	1	2	2	3



CM15654 CHEMICAL PROCESS DESIGN 3 0 0 3

COURSOBJECTIVES

On completion of the course the students will be able to

- apply the skill in thermal design of heat transfer equipments like condensers and reboilers
- understand the design parameters of reactors
- perform the process design of distillation column
- apply the skill in design of absorption column
- study the concepts involved in design of dryers

UNIT I INTRODUCTION 9

The Hierarchy of Chemical process Design - Overall process Design - approaches to design

UNIT II CHOICE OF REACTORS AND SEPARATOR 9

Reaction path - reactor performance - practical reactors - Separation of Heterogeneous and homogeneous fluid mixtures.

UNIT III SYNTHESIS OF REACTION - SEPARATION SYSTEMS 9

Process recycle - Batch processes - process yield

UNIT IV DISTILLATION SEQUENCING 9

Using simple columns - using columns with more than two products - Distillation Sequencing Using thermal coupling.

UNIT V HEAT EXCHANGER NETWORK UTILITIES - ENERGY TARGETS 9

Heat recovery pinch - The Problem table Algorithm - Utilities Selection - Energy targets capital total Cost targets - Number of Heat Exchanger Units - Area Targets - Number of Shells Targets - Capital Cost Targets

TOTAL PERIODS 45

COURSE OUTCOMES

On completion of the course the students will be able to

- apply the skill in thermal design of heat transfer equipments like condensers and reboilers
- estimate the design parameters of reactors
- perform the process design of distillation column
- apply the skill in design of absorption column
- understand the concepts involved in design of dryers

TEXT BOOKS

1. Walas- Stanley M. "Chemical Process Equipment Selection and Design" Butterworth - Heinemann
2. Lloyd E. Brownell and Edwin H. Young "Process Equipment Design" John Wiley and Sons

REFERENCES

1. Smith- R. "Chemical Process Design"- McGraw Hill, New York- 1995.
2. Douglas- J.M. "Conceptual Design of Chemical Process" McGraw Hill- New York- 1988.

CO/PO MAPPING

Mapping of course outcomes with programme outcomes (1/2/3 indicates strength of correlation)3-Strong, 2-Medium, 1- Weak														
	Programme Outcome (POs)													
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	2	1	1	2	1	1	-	-	-	-	1	2	3
CO2	2	2	2	1	2	-	-	-	1	-	-	2	2	3
CO3	3	2	1	2	2	-	-	-	1	1	-	1	2	3
CO4	3	2	2	2	2	-	-	-	-	1	-	2	2	3
CO5	2	2	1	1	3	-	-	-	-	-	1	1	2	3