LAXMINARAYAN INSTITUTE OF TECHNOLOGY
Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur

GUIDELINES FOR ADD-ON COURSES

2020-21

The rapid changes in the Engineering and Technology fields requires additional set of knowledge and skills beyond prescribed curriculum to meet the industrial requirement. This can also enhance the lateral thinking and the spirit of innovation and start up to cope up with the schemes launched by Government. To meet the rapid technological development, several times, students need to be imparted with new skills and professionalism in order to achieve the Programme Specific Objectives. The university curriculum clearly defines the program specific courses. However, students may need specialised aptitude of their own interest to become industry ready. In view of this, Laxminarayan Institute of Technology decided to offer range of Add-On courses in the field of Chemical Engineering and Technology ranging from foundation to more specialised areas. These courses are conducted by experts for academia and industries which help students to stand apart from the rest in the job market by adding further value to their resume.

1. Objectives

The main objectives of the Add-On Course are:

- To enhance the knowledge and skills in more specialised areas of Chemical Engineering and Technology beyond Curriculum.
- To bridge the skill gaps and make students industry ready.
- To provide an opportunity to students to seek the knowledge and the more job opportunities in the specialised area of interest.

2. Course Designing

The Institute has designed a range of Add-On courses in discussion with the Heads and Faculty members after taking into consideration the current

advancements in relevant fields and industrial demands. The detail of Add-On courses and their content is shown in **Annexure I**.

3. Guidelines for conducting Add-On courses

Add-On Course is over and above the prescribed curriculum. The students should opt and choose the Add-On courses of their choice to gain additional knowledge in the area of his/her interest from the pool of the Add-On courses being offered by the Institute. The student may choose not to opt for any Add-On course as these courses are not mandatory to qualify or award of B. Tech degree. **Therefore, registration for Add-On course is not mandatory.** After successful completion and evaluation, the certificate will be awarded to student by the Institute. It is a teacher assisted learning course open to all students without any additional fee. The following are the guidelines for the conduct of the Add-On course.

- Students studying in second semester to seventh semester are eligible for registration of Add-On course one per semester. Students studying in second, third and fourth semester can opt for Add-On course of his/her interest offered in the area of Science and General Engineering. Whereas students studying in fifth, sixth and seventh semester can opt for any of the Add-On course offered in the area of Chemical Engineering and Technology (Annexure I).
- Classes for an Add-On Course are conducted during the **RESERVED** Time Slot in a week or beyond the regular class hours.
- An Add-On courses may be also conducted during weekends/ vacation period.
- A student will be permitted to register **only one Add-On Course in a Semester**.
- Student can decide the **track of the course** to earn specialised knowledge of the selected area.
    - e.g. Chemical Engineering student can earn specialised knowledge in any of the areas from Polymer Technology, Petrochemical Technology, Oil Technology, Surface Coating Technology, Food Technology, Pulp and Paper Technology to have better understating in the specialised

field of his/her interest and can continue till completion of all Add-On courses in that field. He/She will have specialised knowledge in that field to have good placement opportunities.

- OR the student of Food Technology can register for the Add-On courses offered by Oil Technology and vice a versa. OR they can opt for Chemical Engineering Courses.

- The student shall opt for the Add-On courses offered by the Department other than his/her parent Department.
- Some course content may be delivered by the Industry experts and eminent academicians from other Institutes.
- The Add-On course can be offered only if there are at least 15 students opting for it. Otherwise based on the choice given by the students, the other Add-On course shall be allotted on the merit (average of SGPA till last semester) basis.
- The duration of the Add-On course will be 30 hours and as stated in the course content.
- The attendance and evaluation record of the students and the marks obtained will be maintained by the respective course co-ordinator.
- The test will be conducted for 50 marks (or as per the need of course) after the completion of the course and shall be internal.
- The marks distribution shall be **20% for attendance and 80% evaluation at the completion of the course**. Minimum 75% attendance and 50% marks are mandatory for award of certificate.

5. Procedure for registration

The list of Add-On Courses shall be made available on the Institute Website along with the syllabus. A student shall register for an Add-On Course offered during the semester by submitting the duly filled-in registration form. The segregation of Add-On course according to the choice opted will be done at institute level and final allotment list will displayed after the approval of Director, LIT. The time table for the classes of Add-On courses will be notified to the students.

6. Grading

The passing requirement for Add-On courses shall be 50% of the marks prescribed for the course. A candidate who has NOT secured a minimum of 50% of marks in a course shall not be awarded certificate. The Grades will be awarded to the students depending on the percentage of marks obtained by a candidate in a course as below.

Grade	**Marks %**
A+	90 and above
A	80-89
B+	70-79
B	60-69
C	50-59

7. Awarding Certificate

Students will get a certificate after they have registered for, appeared the exam and successfully passed. The students who have successfully completed the Add-On Course shall be issued with a Certificate duly signed by the Authorized signatories. This information will also be made available to the companies visiting for Campus Placements along with their academic record.

Registration Form

College ID	Name of Student	E-mail ID	Mobile Number	Branch/ Technology	Semester of Study	Average of SGPA of all previous semesters	Preference wise Add-On Course Code and title			
							Pref-1	Pref-2	Pref-3	Pref-4

ANNEXURE I

LAXMINARAYAN INSTITUTE OF TECHNOLOGY

Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur.

SCHEME FOR ADD-ON COURSES (AOC)

Sem II	Course Title	Course Coordinator	Sem III	Course Title	Course Coordinator	Sem IV	Course Title	Course Coordinator
AOCP201	Photovoltaic Engineering and Technology	Dr N.Thejo Kalyani	AOCC301	Good Laboratory Practices	Dr S U Meshram	AOCG401	AUTOCAD	Dr P J Giri
AOCM202	Getting Started with MATLAB	Dr S P Dautpure	AOCM302	Operation Research	Dr S D Warbhe	AOCC402	Electrospectrochemistry	Dr Asar Ahmed
						AOCG403	Total Quality Management	Dr. P. N. Belkhode
						AOCPP404	Personnel Management for Technologist	Dr S S Sen
						AOCPT405	Biomass, Biofuels and Renewable Energy Sources	Mr. A J Agrawal
Sem V	**Course Title**	**Course Coordinator**	**Sem VI**	**Course Title**	**Course Coordinator**	**Sem VII**	**Course Title**	**Course Coordinator**
AOCCE501	Wastewater treatment with Industrial Case Studies	Dr. R. P. Birmod	AOCCE601	Scale up: Lab to Commercial Scale	Dr. V. G. Lade	AOCCE701	Piping Engineering	Dr. R. P. Ugwekar
AOCCE502	Sustainable Engineering	Dr. S. N. Joglekar	AOCCE602	Intensification-Introduction with Case Studies	Dr. S. P. Sirsat	AOCCE702	Artificial Neural Network and Evolutionary Algorithm	Prof. S. L. Pandharipande
AOCPL501	Polymer Materials	J B Modak	AOCPP601	Chemical Process Optimization	Dr J B Bhasarkar	AOCPP701	Printing of Paper, Boards and Laminates	Dr S S Sen
AOCFT501	Food Safety and Hygiene Management	Dr S D Deshmukh	AOCPL601	Polymer Processing	M M Yenkie	AOCPL701	Polymer Testing	M M Yenkie
AOCPT501	Facets of Petroleum Road Transportation Fuels	Dr V N Ganvir	AOCFT601	Dairy and Dairy product Processing	Dr S D Deshmukh	AOCFT701	Post-Harvest Management of Fruits and Vegetables	Dr S V Karadbhajne
AOCOT501	Basics of Oil, Fats and Oleo chemicals	Dr. V. Y. Karadbhajne	AOCPT601	LNG Technology	Mr. A C Shende	AOCPT701	Petroleum Refinery Engineering Design	Dr G M Deshmukh
AOCSC501	Materials and Manufacture of Coatings	Dr. P. G. Shende	AOCOT601	Technology of Oils and Oil-Bearing materials	Mr. V. M. Gawande	AOCOT701	Technology of Soaps, Surfactants and Glycerin	Mr. V. M. Gawande
			AOCSC601	Classification of Coatings	Dr. G. P. Lakhawat	AOCSC701	Application Techniques in Coatings	Dr. G. P. Lakhawat

ADD ON COURSES

B.TECH. CHEMICAL ENGINEERING

AND

B.TECH. CHEMICAL TECHNOLOGY

(2ND TO 4TH SEMESTER)

SYLLABUS

Abbreviations used in course code

1. AOC: Add-On Course
2. Fourth and fifth (if any) alphabet in course code indicates name of department offering the course, P- Physics, C- Chemistry, M- Mathematics, G- General Engineering, CE- Chemical Engg, PP- Pulp and Paper Tech, PL- Polymer Tech, PT-Petrochemical Tech, FT- Food Technology, OT- Oil Tech, SC- Surface Coating Tech
3. First digit in the course code indicates semester for which course is offered
4. Last two digits indicate course number

Course: AOCP201: Photovoltaic Engineering and Technology

Course Duration: 30 Hrs **Course Coordinator:** Dr.(Mrs.) N.Thejo Kalyani

Course Objective: This course is designed to provide comprehensive knowledge on solar photovoltaics materials and devices with following learning objectives: **1.** To induce awareness on the real-world concerns in the direction of acquiring electricity from solar energy. **2.** To develop a comprehensive technological understanding on photovoltaic (PV) system components and key contributions in the development of PV technology. **3.** To ensure in-depth understanding of design parameters that helps in designing highly efficient and stable solar cells. **4.** To assess performance degradation factors and mechanisms in solar cells. **5.** To motivate intense research hot spot activity in next-generation photovoltaics (PVs) in quest of novel solar cells.

Course Contents:

I: Introduction to Solar energy and Photovoltaics: Energy and its sources, overview of solar energy conversion devices, principle of solar energy conversion. Review of semiconductor physics, device physics of solar cells, solar cell design, various factors affecting conversion efficiency, I-V characteristics. **[5L]**

II: Evolution of Photovoltaics: Basic classification of solar cell technologies, Silicon based solar cells: Single crystalline and poly crystalline solar cells, hydrogenated amorphous solar cells, basic comparison, limitations and applications. Chalcogenides based solar cells: Cadmium Telluride (CdTe), Copper Zinc Tin Sulphide (CZTS), Copper Indium Gallium Diselenide (CIGS) based solar cells. Group III-V materials based solar cells: Gallium Arsenide (GaAs) Gallium Indium Phosphide (GaInP) material based solar cells**.** **[10L]**

III: Emerging solar cell Technologies: Dye sensitized solar cell (DSSC): Anatomy, working principle, materials requirement for electrodes, synthesis procedure of electrode materials, performance of DSSCs, advanced colourful approach and applications of DSSCs. Perovskites solar cells: Introduction to perovskites, device anatomy, requirements of each layer, working principle. Organic Solar cells: small molecule based solar cells and polymeric solar cells, fabrication approaches, device evaluation, key challenges and future outlook**.** **[10L]**

IV: Photovoltaic system engineering and future prospective: Photovoltaic system engineering, Thermo- Photovoltaic generation of electricity, Concentration and storage of electrical energy, Photovoltaics modules, system and application**.** **[5L]**

Books Recommended-

1. S.J. Dhoble, N. ThejoKalyani, Venkadaesvaran, BalakrishnanAbdulKariemArof, Energy materials: Fundamentals to Applications (Elsevier publication, 2021).
2. Learning Handbook of photovoltaic science and engineering, ed. A. Luque and S. Hegedus (John Wiley and Sons, 2010).
3. Solar Photovoltaics – Fundamentals, Technologies and Applications, C. S. Solanki, 2nd ed. (PHI Learning, 2011).
4. Renewable Energy Engineering and Technology – A Knowledge Compendium, ed. V.V.N. Kishore (TERI Press, 2008).
5. Photovoltaic system engineering, R. A. Messenger and A. Abtahi, 3rd ed. (CRC Press, 2010) Grid connected PV systems design and installation, GSES (GSES India Sustainable Energy, 2013).

Course (Expected) Outcomes: After completion of this course the students will be able to

1. Comprehend how a solar cell converts sunlight into electrical power and distinguish between PV cells, modules, panels and arrays.
2. Outline the technologies that are used to harness the power of solar energy.
3. Discuss the positive and negative aspects of solar energy in relation to natural and human aspects of the environment.
4. Highlight the importance of conservation and energy efficiency as they relate to PV system applications.

Course: AOCM202: Getting Started with MATLAB

Course Duration: 30 Hrs **Course Coordinator:** Dr. Shubha P. Dautpure

Course Objective:

1. Introduction of Matlab.
2. Explanation of Matrix Operations using Matlab.
3. Explanation of Solving Linear Systems.
4. Introduction to the Graphics.

Course Contents:

1. **Introduction to Matlab**: Basic commands, Built in functions, Manipulating functions, scripts, files, function files, Symbolic computations, saving MATLAB session. [6L]
2. **Matrices using MATLAB**: Vectors and Matrices, creating vectors, Matrix operations like Addition, subtraction, multiplication, inverse of Matrix, Determinant of Matrix, Eigen values and Eigen vectors, solving and Loading data, import data files [9L]
3. **Linear Systems Using MATLAB:** Solving linear systems as linier operator equations, Models in one dimension; Heat flow in a bar, Fourier's law, solving simple boundary value problems, existence and uniqueness of solution to Ax=b [6L]
4. **Graphics**: Curve fitting, Simple Graphics: One D plotting, labelling etc [4L]
5. Lab1: Hands on Session on Matrix Operations [2Hr]
6. Lab2: Hands on Session on Linear Systems [2Hr]
7. Lab3: Hands on Session on Simple Graphics [1Hr]

Books Recommended:

1. Getting Started with Matlab by Rudra Pratap
2. Matlab for Beginners by Peter Issa Kattan, Petra Books Publication
3. Matlab for Beginners and Experienced Users by Brian R. Hunt, Jonathan Rosenberg and Ronald L Lipsman.

Course (Expected) Outcomes: Upon completion of this course student will be able to

1. Understand the basic commands in Matlab and inbuilt functions.
2. They will develop a skill to perform Matrix operations using MATLAB
3. They will model one dimensional Systems Using MatLab.
4. Understand plotting of simple Graphics Using Matlab

Course: AOCC301: Good Laboratory Practices

Course Duration: 30 Hrs **Course Coordinator:** Dr. S. U. Meshram

Course Objective:

1. To minimize the risk of injury or illness among the students working in the Laboratory.
2. To ensure training, information, and support to handle toxic and hazardous chemicals using safety precautions
3. To get acquainted with the various unit operations involved in synthesis of organic and inorganic compounds.
4. To induce the insight of green catalyst and methods to reduce the pollution load and health hazard in chemical laboratories
5. To impart methods for safe disposal of unused/used chemicals in the laboratory

Course Contents:

1. **Handling of Chemicals and Glassware:** Introduction, safety aspects involved in handling flammable, reactive and explosive chemicals, safe disposal of used/unused chemicals (06L)
2. **Acquaintance of Unit Operations:** Demonstration of various unit operations namely, reflux, precipitation, filtration, drying, crystallization, and purification of crude organic compounds (06L)
3. **Green Chemistry and Catalysis:** Fostering culture of green chemistry and catalyst, Industrial significance, experimental and operating skills in organic Process Technology laboratory with SOP, safety precautions (08L)
4. **Glassware Calibration, Data and Error Analysis:** Introduction, handling of glassware, calibration of volumetric apparatus, preparation and standardizations of solutions, Plotting of graphs, % yield, error, precision and standard deviations in results (10L)

Books Recommended:

1. Chemical Laboratory Safety and Security: A Guide to Prudent Chemical Management, Lisa Moran, and Tina Masciangioli
2. Textbook of Environmental chemistry by Balram Pani, second addition distributed by Wiley
3. Monograms on green chemistry, Task Force Committee, DST
4. Basic Concepts of Data and Error Analysis, Kaloyerou by Springer

Course (Expected) Outcomes: After completion of this course the students will be able to

1. Learn recent advancement in green chemistry and chemical processes
2. Acquaint knowledge of handling chemicals and glassware with safety measurements
3. Develop practical skills towards smooth conduct of experimental task with accuracy
4. Understand the significance of disposal of chemicals suitably
5. Adopt methods to minimize the risk of pollution and health hazards in laboratory

Course: AOCM302: Operation Research

Course Duration: 30 Hrs **Course Coordinator:** Dr. Shrikant D. Warbhe

This course aims to introduce students to use quantitive methods and techniques for effective decisions–making; model formulation and applications that are used in solving business decision problems.

Course Objectives:

1. To impart knowledge in concepts and tools of Linear Programming Problems and Transportation Problems.
2. To understand mathematical models used in Linear Programming Problems and Transportation Problems.
3. To apply these techniques constructively to make effective business decisions**.**

Contents:

1. **Standard form of Linear Programming Problems [6 Hr]**
   Introduction, Standard problem of Linear programming problems, Linear dependence and Independence, Convex Combination convex set and extreme points of a convex set, Basic feasible solution of a linear programming problems.
2. **Linear Programming : The Simplex Method [10 Hr]**
   Introduction, Computational procedure of the simplex method, Modified Simplex Methods of Linear programs with artificial Variables: Two Phase and Big-M (or Penalty) Methods.
3. **Linear Programming : Duality [6 Hr]**
   Dual – Formulation, Relationship between Primal, Dual, Solution of Dual. Duality in Linear Programming Duality theorems and Dual Solution, Dual-Simplex method

Transportation Problems [8 Hr]
Introduction, Mathematical model for transportation problem-Initial Solution, Solution of transportation problem [uv method] and Degeneracy case.

Course Outcomes:

Upon completion of this course student will be able to

1. Describe the basic concepts of convex analysis and explain the theoretical foundations of various issues related to linear programming modelling
2. Formulate real-world problems as a linear programming model and describe the theoretical workings of the simplex method, demonstrate the solution process by hand and solver.
3. Formulate the transportation problems and describe theoretical workings of the solution methods for transportation problems and demonstrate solution process by hand and solver.
4. The students will be able to identify the problems in business and prepare a mathematical model.

Books Recommended:

1. Operations Research, by Kanti Swarup, Sultan chand and Sons
2. Linear Programming: Methods and Applications by S.I. Gauss
3. Linear Programming and theory of Games by P.K. Gupta
4. Hillier, F. S., & Lieberman, G. J. (2010). Introduction to operations research- concepts and cases (9th ed.). New Delhi: Tata McGraw Hill (Indian print)

Course : AOCG401: AUTOCAD

Course Duration : 30 hours **Course Coordinator :** Dr. (Mrs.) Pallavi J. Giri

Pre –requisites :

1. Fundamental working knowledge of the Windows environment
2. A working knowledge of Engineering drawings, basic design or drafting procedures and terminology.

Course Objectives :

1. The goal of this course is to make students familiar with the basic AutoCAD commands and menu systems.
2. Create drafting symbols, plans and integrate all information into one deliverable sheet file.
3. The students will be shown how to create a new drawing, edit an existing drawing and also how to plot a drawing to a suitable printer or plotter
3. The students will be shown how to draw Isometric drawing and setup drawing environment and Customize screen layout to suit their own preferences.

Course Contents:

Module 1 : Introduction to AutoCAD **8 hrs**

Getting Started with AutoCAD - Setting up a drawing starting from scratch, Setting up a drawing using a Wizard, Using and creating a template file, Opening an existing drawing , Screen layout, Function Keys

Coordinate System - Cartesian Coordinate System, Absolute Coordinate System, Relative Coordinate System

Basic Drawing & Editing Commands - Drawing Lines, Erasing Objects, Drawing Lines with Polar Tracking, Drawing Rectangles, Drawing Circles, Undo and Redo Actions

Module 2 : Creating a Simple Drawing **8 hrs**

Creating a Simple Drawing – Create a simple drawing, Create a simple shapes

Making Changes in Your Drawing - Selecting Objects for Editing, Moving Objects, Copying Objects, Rotating Objects, Scaling Objects, Mirroring Objects, Editing with Grips

Drawing Precision in AutoCAD - Using Running Object Snaps, Using Object Snap Overrides, Polar Tracking at Angles, Object Snap Tracking

Advanced Object Types - Drawing Arcs, Drawing Polylines, Editing Polylines, Drawing Polygons, Drawing Ellipses

Module3 : Dimensions and Styles **8 hrs**

Organizing Your Drawing with Layers - Creating New Drawings With Templates, What are Layers?, Layer States, Changing an Object's Layer

Advanced Editing Commands - Trimming and Extending Objects, Stretching Objects, Creating Fillets and Chamfers, Offsetting Objects, Creating Arrays of Objects,

Text Working with Annotations - Adding Text in a Drawing, Modifying Multiline Text, Formatting Multiline Text, Adding Notes with Leaders to Your Drawing

Hatching – Hatching, Editing Hatches,

Adding Dimensions - Dimensioning Concepts, Adding Linear Dimensions, Adding Radial and Angular Dimensions, Editing Dimensions

Parametric Drawing - Working with Constraints, Geometric Constraints, Dimensional Constraints

Annotation Styles - Creating Text Styles, Creating Dimension Styles, Creating Multileader Styles

Module IV : Isometric Drawings and Printing drawings **6 hrs**

Isometric views - Isometric top, left, right , Isometric diagrams, Isometric drawings exercise

Setting Up a Layout - Printing Concepts, Working in Layouts, Copying Layouts, Creating Viewports, Guidelines for Layouts

Printing Your Drawing - Printing Layouts, Printing from the Model Tab,

Course Outcome :

1. After completion of this course the students will develop an understanding the AutoCAD workspace and user interface.
2. The students will be able to use AutoCAD as a drafting tool to produce 2D working Drawings

Books Recommended :

1. AutoCAD For Dummies - Bill Fane

2. AutoCAD Exercises for Beginners: Designers WorkBook for Practice - Shameer S.A

3. AUTOCAD EXERCISES – 400 Practice Drawings for AUTOCAD and Other Feature- Based CAD Software - Sachidanand Jha

4. Modeling and Visualization with AutoCAD - Suining Ding

5. Exercise Autocad 2D - Ahu Bahar Tanacar

Course: AOCC402: Electrospectrochemistry

Course Duration: 30 Hrs **Course Coordinator:** Dr Asar Ahmed

Course Objectives: In this course work, undergraduate students will have the opportunity to learn about the basics related to characterization techniques used for different materials. Students will also get knowledge about applications of different characterization techniques in their projects and future research endeavours. This course will help students to gain practical knowledge, develop analytical thinking and improve their scientific skills. Once they have basic knowledge about different characterization techniques, students will have better understanding and prospects in future and will have the opportunity to propose and conduct their own experiments in future advanced laboratories making use of reported necessary instruments.

Course Contents-

1. **Basic Instrumentation:** Introduction, pH metre, conductometry, potentiometry: Electrodes, Cell, calibrations, handling, Precautions (6L)
2. **Electronic Spectra of metal complexes:** Russel-Saunders or L-S coupling scheme, Term Symbols, microstates, Selection rules, Strong ligand field configurations, splitting Pattern, Tanabe sugano diagrams for d2 and d8 configurations, Jahn Teller effect – Spectrochemical Series, Racah parameters (B), charge transfer spectra. (8L)
3. **IR Spectroscopy:** Introduction, Principles of IR Spectroscopy, mode of vibrations, IR absorption frequencies, functional groups and their identification, Analysis of IR Spectra (8L)
4. **Mass Spectrometry:** Introduction, Principles of mass spectrometry, Mass spectral fragmentation of organic compounds, Molecular-ion peak, base peak, Metastable peak, Nitrogen rule - Isotope labeling - High resolution mass spectrometry McLafferty rearrangement, Examples of mass spectral fragmentation of organic compounds with respect to their structure determination. (8L)

Books Recommended:

1. Atomic and Molecular Spectroscopy, M C Gupta, new Age publications
2. Elementary Organic Spectroscopy (Multicolor) Book by Y R Sharma, S Chand Publications
3. Spectroelectrochemistry, RSC Publications

Course (Expected) Outcomes: Students will be able to understand the underlying theoretical principles behind the different characterization techniques. They will be able to understand the basics related to instrumentation, sample handling and working of these instruments. They will have preliminary idea about analysis of spectra/ graphs obtained after characterization. They will develop laboratory skills, and knowledge of usage of modern instrumentation.

Course: AOCC403: Total Quality Management

Course Duration: 30 Hrs **Course Coordinator:** Dr Pramod Belkhode

Course Objective-

To provide comprehensive knowledge of quality management principles followed in industries.

Course Contents-

INTRODUCTION TO QUALITY CONCEPTS:

Various definitions of quality, Importance of quality, Quality control : Objectives, importance, Functions of quality control, Quality assurance : Organization for Quality assurance, Functions of Quality assurance. [4L]

PHILOSOPHY OF TQM:

Introduction to TQM, Overview of TQM, Implementing TQM, Benefits of TQM, Five 'S' practice [4L]

SEVEN TOOLS FOR QUALITY IMPROVEMENT :

Check sheet, Flow diagram, Pareto chart, Cause & Effect Diagram, Control charts, Histograms and Scatter diagram [7L]

TOOLS FOR QUALITY & PRODUCTIVITY IMPROVEMENT :

Vision & Mission Statement, Goals, Objectives & plan, Kaizen, Zero defect programme (POKA-YOKE), Just in time production system, Quality circles, Six Sigma, Deming cycle, PDCA cycle, Benchmarking [9L]

QUALITY STANDARDS:

ISO–9001:2000 purpose, applications and importance of certification. ISO- 14000 Purpose & importance. Quality Management and Audit [6L]

Books Recommended

1. Dale H. Besterfiled, et at., "Total Quality Management", Pearson Education Asia, Third Edition, Indian Reprint (2006).
2. James R. Evans and William M. Lindsay, "The Management and Control of Quality", 6th Edition, South-Western (Thomson Learning), 2005.
3. Oakland, J.S. "TQM – Text with Cases", Butterworth – Heinemann Ltd., Oxford, 3rd Edition, 2003.
4. B. Jankiraman, Total Quality Management, Prentice Hall Of India Ltd. New Delhi

Course Outcomes: After completion of this course the students will be able to

1. To find out the new decision of principle in real time projects.
2. Analyze the various types of techniques are used to measure quality.
3. Apply the various quality systems in implementation of total quality management.
4. Apply different tools for quality and productivity enhancement

Course: AOCPP404: Personnel Management for Technologist

Course Duration: 30 Hrs **Course Coordinator:** Dr S S Sen

Course Objective

Follow the principles of personnel management while working on the shop floor of industry.

Unit 1 - Management Concepts **7 Lectures**

Important Concepts in Management, Co-Operation and co-Ordination, Managerial Authority and Responsibility, Delegation and Decentralization, Line and Staff concepts, Committees, Policies and Strategies, Performance Appraisal.

Unit 2 - Organizational Behaviour **7 Lectures**

Understanding Organisation, Significance of Scientific Study of Human Behaviour, Hawthorn Studies it's importance & implication, Approaches-Cognitive, Behaviourstic& Social learning framework Human Need, theory, Maslow & Herzberg, Motivation Process.

Unit 3 - Business Legislations **16 Lectures**

The Indian Contract Act 1872, The Sale of Goods Act 1930, The Negotiable Instrument Act 1881, The Companies Act 1956 (amended 2018), Consumer Protection Act 1986, Indian Partnership Act 1932.

References:

1) Avtar Singh :Mercantile Law, Eastern Book Company.
2) Chandra Bose :Business Laws, PHI.
3) Bulchandani, :Business Law for Management, Himalaya Publishing.
4) Tripathy, Reddy: Principles of Management.
5) Mrityanjay Banerjee Business Administration.
6) Koontz &O;Donnel Management A contingency and Systems.

Course: AOCPT405: Biomass, Biofuels and Renewable Energy Sources

Course Duration: 30 Hrs **Course Coordinator:** Mr. A J Agrawal

Course Objectives: After completion of this course, the students are expected to learn about:

1. The basic understanding of biomass, biofuels and renewable energy sources.
2. The current energy challenges and the importance biofuels in future.
3. The overview of available renewable and alternative energy sources.
4. Biomass resources, types and production processes of biofuels.
5. The concept of 1st generation, 2nd generation, and advance biofuels.

Course Contents:

1. Introduction to Biofuels, terminologies, energy security, and renewable energy sources.(2 L)
2. Biodiesel Process, vegetable oil sources and production, current technologies and challenges. (5 L)
3. Algae to biofuels and challenges. (2 L)
4. Types of biomass and available resources. (3 L)
5. Lignocellulosic biomass composition and characterizations. (3 L)
6. Pyrolysis, bio-oil upgradation, and biochar. (3 L)
7. Biomass gasification followed by Fischer-Tropsch synthesis for liquid fuels. (3 L)
8. Biochemical Conversion Process, bioethanol production from 1st and 2nd generation biomass feedstock, biohydrogen, and methane. (5 L)
9. Biobased products quality analysis and life cycle assessment. (2 L)
10. Biofuel's economics, policies, and future R&D. (2 L)

Books Recommended:

1. Fundamentals of Renewable Energy Sources by G. N. Tiwari and M. K. Ghoshal, Narosa Publishing House.
2. Renewable Energy Engineering and Technology, Principles and Practice by V V N Kishore, The Energy and Resources Institute (TERI).
3. Biorenewable Resources: Engineering New Products from Agriculture by Robert C. Brown, Wiley-Blackwell.
4. Biomass for Renewable Energy, Fuels, and Chemicals by Donald Klass, Academic Press Publications.
5. Gasoline, Diesel and Ethanol Biofuels from Grasses and Plants by Ram B. Gupta and Ayhan Demirbas, Cambridge University Press.
6. Biofuels Engineering Process Technology by Cave Drapcho, John Nghiem, and Terry Walker, McGraw Hill Publications.

Course (Expected) Outcomes: This course will enhance the student's

(a) Learning on multidisciplinary subjects and current issues related to energy and biofuels.

(b) Understanding of renewable energy and their impact on societal and global context.

(c) Awareness of emerging technologies on biofuel production.

(d) Ability to identify and formulate various biofuel types.

ADD ON COURSES

B.TECH. CHEMICAL ENGINEERING

AND

B.TECH. CHEMICAL TECHNOLOGY

(5TH TO 7TH SEMESTER)

SYLLABUS

Abbreviations used in course code

1. AOC: Add-On Course.
2. Fourth and fifth (if any) alphabet in course code indicates name of department offering the course, P- Physics, C- Chemistry, M- Mathematics, G- General Engineering, CE- Chemical Engg, PP- Pulp and Paper Tech, PL- Polymer Tech, PT-Petrochemical Tech, FT- Food Technology, OT- Oil Tech, SC- Surface Coating Tech.
3. First digit in the course code indicates semester for which course is offered.
4. Last two digits indicate course number.

Course: AOCCE501: Wastewater treatment with Industrial Case Studies

Course Duration: 30 Hrs **Course Coordinator:** Dr. R. P. Birmod

Course Objectives:

- This course will provide insight in the current treatment approaches for wastewater treatment.
- This course will provide insight of the various reactor configurations used in the wastewater treatment.

Course Contents:

- Introduction to wastewater, Water quality parameters and standards.
- Sludge Management
- Current Treatment Approaches: Conventional systems; Integrated treatment systems; Advanced reactor configurations; SBR, MBR and MBBR; Application and case studies.
- Technology Selection and Decision Making: Research trends in wastewater treatment and recycling
- Risks and challenges and Socio-economic perspectives with Case studies

Books Recommended:

1. Waste water Engineering Treatment and Reuse: McGraw Hill, G. Tchobanoglous, FI Biston, 2002.
2. Industrial Waste Water Management Treatment and Disposal by Waste Water McGraw Hill III Edition 2008.

Course Outcomes: At the end of the course, the student will be able to

- understand various wastewater treatment plants.
- Apply various advanced treatment processes for the wastewater with use of various reactor configurations.

Course: AOCCE502: Sustainable Engineering

Course Duration: 30 Hrs **Course Coordinator:** Dr. S. N. Joglekar

Course Objectives: The students completing this course will learn about the principles, indicators and general concept of sustainability. Student shall be able to apprehend the local, regional and global impacts of unsustainable designs, products and processes. Student shall be able to apply the sustainability concepts in engineering

Course Contents:

Unit 1: Introduction to sustainable Engineering, Theoretical background of green chemistry/ engineering. Various global initiatives on achieving sustainable development (Protocols). Sustainable development Goals

Unit 2: Life cycle assessment – Introduction, ISO 14044:2006 framework, Impact assessment methods

Unit 3: Introduction to Life cycle assessment software (Open LCA & GaBi), Case studies

Unit 4: Multi-criteria decision-making methods for sustainability assessment such as MIVES, AHP etc. Application/ case studies

Books Recommended:

- Gnansounou, Edgard, and Ashok Pandey, eds. Life-cycle assessment of biorefineries. Elsevier, 2016.
- de Bruijn, Hans, Robbert van Duin, and Mark AJ Huijbregts. Handbook on life cycle assessment: operational guide to the ISO standards. Springer Netherlands, 2002.
- Hauschild, Michael Z., Ralph K. Rosenbaum, and Stig Irvin Olsen. Life cycle assessment. Vol. 2018. Springer International Publishing, Cham. https://doi. org/10.1007/978-3-319-56475-3, 2018.
- Saaty, Thomas L. "Decision making—the analytic hierarchy and network processes (AHP/ANP)." Journal of systems science and systems engineering 13, no. 1 (2004): 1-35.
- O. Pons and A. De la Fuente, “Integrated sustainability assessment method applied to structural concrete columns,” Construction and Building Materials, vol. 49, pp. 882–893, 2013.
- Shibata, Akiho. "The Basel Compliance Mechanism." Rev. Eur. Comp. & Int'l Envtl. L. 12 (2003): 183.
- Fitzmaurice, Malgosia. "The Kyoto protocol compliance regime and treaty law." SYBIL 8 (2004): 23.

Course Outcomes: After completion of this course, student would:

- learn the sustainability concepts; be able to quantify sustainability, and resource availability;
- to able to rationalize the sustainability based on scientific merits;

- understand and apply sustainability concepts in designs, product developments and processes across various engineering disciplines;
- be able to make a decision in applying green engineering concepts;
- understand the role and responsibility of engineers in sustainable development;
- become a lifelong advocate of sustainability in society.

Course: AOCCE601: Scale up: Lab to Commercial

Course Duration: 30 Hrs **Course Coordinator:** Dr. V. G. Lade

Course Objectives: The objective of the course is to give to the students the basis of the scale-up through various case studies. Moreover, part of the course will be dedicated to the deepening of the two most important field in the chemical industry.

Course Contents:

Unit I: Introduction to scale-up methods: Important Aspects concerning Scale-up, Principals of Similarity, Pilot Plants and Models, Dimensional Analysis, Experimental Techniques for Scale-up

Unit II: Scale-Up of Mixing and Heat Transfer Equipment: Determination of stirrer Power, Typical problems in scale up of mixing equipment and heat transfer equipment. Scale-up of mixers for mixing Solids, Optimization of Stirrers for maximum removal of reaction Heat

Unit III: Scale-Up of Chemical Reactors: Kinetics, reactor development and scale-up techniques for chemical reactors. Mass & heat transfer in catalysed reaction, Continuous Chemical Process in Tubular Reactor, Factors affecting choice of reactor

Unit IV: Selected Examples of the Industrial Applications: Mass transfer and reaction in G/L, G-L-S system, Scale-up of the dryers, Scale-up of the reactors for the catalytic processes in the petrochemical Industry, Scale up of the processes in Speciality and pharmaceutical Industry, Scale-up of distillation columns and packed towers for continuous and batch processes.

Books Recommended:

1. Johnstone and Thring, Pilot Plants Models and Scale-up methods in Chemical Engg., McGraw Hill, New York, 1962.
2. W. Hoyle, Pilot Plants and Scale-Up, Royal Society of Chemistry, 1st Edition, 1999.
3. E. Bruce Nauman, Chemical Reactor Design, Optimization and Scale-up, McGraw Hill, New York, 2002.
4. M. Zlokarnik, Scale-up in Chemical Engineering, Wiley-VCH, VErlag GmbH & Co., 2002
5. Attilio Bisio, Robert L. Kabel, Scale up of Chemical Processes, John Wiley & Sons, 1985
6. D. G. Jordan, "Chemical Process Development" (Part 1 & 2), Interscience Publishers, 1988.

Course Outcomes: At the end of the course, the student will be able to

- Understand scale up fundamentals and its application in the chemical process.

Course: AOCCE602: Intensification- Introduction with Case Studies

Course Duration: 30 Hrs **Course Coordinator:** Dr. S. P. Shirsat

Course Objectives: The course will enable the students to

1. Understand the concept of Process Intensification.
2. Apply the techniques of intensification to a range of chemical processes.
3. Develop various process equipment used for intensifying the processes.

Course Contents:

Introduction to Process Intensification, Case Studies in Process Intensification, Reactive Distillation, Reactive Crystallization, Hybrid Processes, Pinch Technology for heat integration and analysis

Books Recommended:

1. Stankiewicz, A. and Moulijn, (Eds.), Reengineering the Chemical Process Plants, Process Intensification, Marcel Dekker, 2003.
2. Reay D., Ramshaw C., Harvey A., Process Intensification, Butterworth Heinemann, 2008.
3. Robin Smith, Chemical Process: Design and Integration, Wiley–Blackwell; Subsequent edition (7 January 2005)

Course Outcomes: At the end of the course, the student will be able to

- Apply and implement methodologies for process intensification in industrial processes.
- Gain the scientific background, techniques and applications of intensification in the process industries.
- Identify and solve process challenges using intensification technologies

Course: AOCCE701: Piping Engineering

Course Duration: 30 Hrs **Course Coordinator:** Dr. R. P. Ugwekar

Course Objectives: The course will enable the students to

- To understand basics and purpose of Piping Engineering.
- To understand project requirements & Methodology
- To learn types of calculations involved in piping engineering project

Course Contents:

Piping fundamentals

1. Introduction to Piping: Pipe, classification of pipe, Piping
2. Size of pipe, Pipe wall thickness., Schedule number
3. Pipe Fittings: Diagram and application of – Bends, Elbow, Tees, Reducers, Stub ends, Cross
4. Joints: Principal and application of Expansion, threaded joints, Bolted, Flange type

Materials for Piping:

i. Selection of material for piping
ii. Desirable properties of piping materials, materials for various temperature and pressure conditions, materials for corrosion resistance.
iii. Materials for valves -Ball, Gate Globe, Butterfly
iv. Gaskets: Functions and properties, types of gaskets and their selection

DESIGN CODES AND STANDARDS: Generating piping codes and material specifications. Various ASME pressure piping codes such as B31.1 Power Piping, B31.3 Process Piping, B31.4 Pipeline Transportation Systems for Liquid Hydrocarbons, B31.5 Refrigeration Piping and Heat Transfer Components, B31.8 Gas Transmission and Distribution Piping Systems, B31.9 Building Services Piping and B31.11 Slurry Transportation Piping Systems. Material specifications such as API - American Petroleum Institute Standards, ASTM – American Society of Testing Materials, ASME Piping Components Standards, American Welding Society (AWS), American Water Works Association (AWWA) and EN – European Standards

Piping Drawings:

1. Introduction to P & I Diagrams, Process flow diagrams, standard symbols and notations.
2. Guidelines for Plot Plan / Plant Layout design.
3. Equipment layout, piping layout and piping isometrics.
4. Typical piping system layout considerations for following systems:
   i. Distillation column and heat exchanger
   ii. Reactor,
   iii. Pipe rack,
   iv. Storage tank,
   v. Pump

Case study: Piping for Petroleum products, Under the sea piping, piping for slurries

Books Recommended:

1. Peter Smith, The Fundamentals of Piping Design: 01 (Process Piping Design Handbook), Gulf Publishing Company, 2007

2. Peter Smith, Piping Materials Guide, Elsevier ,2005

Course Outcomes:

At the end of this course students are able to

- Describe the responsibilities of piping field engineer
- Use pipe's standard tables for different calculations.
- Describe the functions and features of various piping components/Element.
- Interpret and use various simple piping drawings in a given situation.

Course: AOCCE702: Artificial Neural Network and Evolutionary Algorithm

Course Duration: 30 Hrs **Course Coordinator:** Prof. S.L. Pandharipande

Course Objectives: The course will enable the students to understand the mechanism and working of the neural network and to apply ANN in chemical engineering processes.

Course Contents:

- Mechanism/ working principle of biological neuron and biological neural network
- Phases in development of artificial neurons and learning rules
- Feed forward error back propagation neural network: Flow chart and algorithm
- Application of ANN in Chemical Engineering Processes
- Fuzzy logic: Flow chart, algorithm and application
- Genetic algorithm: Flow chart, algorithm and application
- Introduction to ANT algorithm, Bee Algorithm, Particle Swarm Optimization & Case Base reasoning systems

Books Recommended:

- Principles of soft computing- Sivanandam & Deep, Wiley India

Course Outcomes:

At the end of this course students are able to

Apply ANN modeling for optimization of various chemical processes.

Course: AOCPP601: Chemical Process Optimization

Course Duration: 30 Hrs **Course Coordinator:** Dr. J. B. Bhasarkar

Course Objective:

To apply mathematical models of optimization in various chemical processes.

Unit:1	**Formulation of optimization problems**	**5 hours**
Nature and Organization of Optimization problem, Mathematical concepts of optimization, Developing model for optimization, Taylor expansion, Gradient, Hessian etc. Quadratic functions. Convex functions and sets. Gaussian elimination method.		
Unit:2	**Models for optimization**	**5 hours**
Selection of function, degrees of freedom, factorial experimental design, constraints in model, Optimality conditions for a single-variable and multi-variable functions, classification of models		
Unit:3	**Linear and nonlinear Least square problems**	**5 hours**
One-dimensional search - Methods requiring derivatives (Newton, Secant etc) Region elimination methods (Interval halving, Fibonacci search, Golden section) Polynomial approximations (Lagrange's, quadratic & Cubic).		
Unit:4	**Multivariable Optimization**	**5 hours**
Unconstrained multivariable optimization - Graphical visualization (contour plots, 3D plots) - Gradient based methods (Steepest descent, conjugate direction, and Newton methods), Linear programming (LP) - Graphical solution - Simplex Method - Test for optimality – Barrier methods - Sensitivity analysis		
Unit:5	**Nonlinear Programming**	**5 hours**
Nonlinear programming (NLP) with constraints - Lagrange multipliers - Graphical illustration of NLP problems - KKT necessary and sufficient conditions - Quadratic programming - Successive linear and quadratic programming, penalty function method -. Integer and mixed integer programming. (IP and MIP) - Graphical solution - Branch and bound methods.		
Unit:6	**Dynamic programming**	**5 hours**
Dynamic programming - Minimum cost routing problems - Solution of separable nonlinear programming problems. Global optimization problems. - Introduction to multi objective optimization problems- Pareto optimal solutions (graphical illustration)		
Text Book(s)		
1.	T. F. Edger, D. M. Himmelblau, and L. S. Lasdon, Optimization of chemical processes by McGraw-Hill, Second edition, 2015.	
Reference Books		
1.	F. S. Hillier, and G. J. Lieberman, Introduction to operations research by McGraw-Hill, Seventh edition 2001.	
2	Singiresu S Rao, 'Engineering Optimization: Theory and Practice, 4th Edition, John Wiley & Sons Ltd., 2009	
3.	Mohan C. Joshi and Kannan M. Moudgalya , 'Optimization: Theory and Practice', Alpha Science International Limited, 2004	

Course: AOCPP701: Printing of Paper, Boards and Laminates

Course Duration: 30 Hrs **Course Coordinator:** Dr S S Sen

Course Objective:

To select and apply requisite printing method for paper and boards.

Unit 1 - Basic Printing Fundamentals **10 Lectures**

History of Printing, Image signals, Image metrics, Visual image measures, Imaging systems, Measurement of color, Reproduction of color, Basic principles of printing, Color separation and correction, Text processing and page make up.

Unit 2 - Printing Inks **10 lectures**

Ink in the press, Composition, Pigments, Binders, Solvents, Additives, Optical properties, Rheological properties, Measuring rheological properties of ink, Tack of ink, surface and colloid chemical properties, drying characteristics of printing inks.

Unit 3 - Printing Methods **10 lectures**

Printing methods and printing plates, Lithographic plates, Gravure cylinders, Flexographic plates, Printing nip phenomena, Ink transfer to the plate, Ink transfer to the paper, Drying of prints, Mechanism of solvent evaporation, Mechanism of chemical drying, Printing presses.

References:

1) Pirkko Oittinen : Printing, Tappi Press, 1998.
2) Lan Faux, Modern Lithography, SITA Limited
3) Thompson Bob, Printing Materials- Science and Technology, PIRA
4) Leach, R. H., The Printing Ink Manual, Springer.

Course: AOCPL501: Polymer Materials

Course Duration: 30 Hrs **Course Coordinator:** Dr J B Modak

Course Objective: To introduce basic concepts related to polymeric materials, engineering estimations about their properties and various applications.

Course Content:

Unit 1: Polymer Classification (10 Hrs)

Introduction to Monomer, Oligomer, Polymer, Polymerization, Degree of polymerization, Monomer functionality and its importance, Classification of polymers, on the basis of- Source, thermal behaviour, structure, Tacticity and C-C Linkages, Configuration and conformation, Co-polymers- random, alternating, block and graft. Amorphous and crystalline polymers.

Unit 2: Thermoplastics and Thermosetting Polymers (10 Hrs)

Structure, properties and applications of- Polyethylene, Polypropylene, Polyvinyl chloride, Polystyrene, Polymethyl methacrylate, Polycarbonate, Acrylonitrile-Butadiene-Styrene, Polyamide, Polyethylene terephthalate, Phenol formaldehyde, Urea formaldehyde, Unsaturated polyester, Epoxy, Polyurethane, Introduction to biopolymers and biodegradable polymers.

Unit 3: Modification of Polymers (10 Hrs)

Function and example of Additives- filler, plasticizer, stabilizer, lubricant, colorant, flame retardant, coupling agent, blowing agent, Concept and significance of polymer blend and composites, important commercial blends, Fundamentals of Composites- elements, curing, layup techniques.

Books Recommended:

1. V.R. Gowariker, N.V. Viswanathan, Jayadev Sreedhar, Polymer Science, New Age International Publishers Pvt. Ltd. 2005
2. M. L. Berins, SPI Plastics Engineering Handbook of the Society of the Plastics Industry Inc., 1991.
3. J. R. Fried, Polymer Science and Technology, Prentice Hall of India, 2nd Ed., 2009.

Course Outcome:

Student will be able to select and modify polymer for specified application.

Course: AOCPL601: Polymer Processing

Course Duration: 30 Hrs **Course Coordinator:** M M Yenkie

Course Objective: To acquaint with basic processes for conversion of polymer material into finished products.

Course Content:

Unit 1: Continuous Processes (10 Hrs)

Principle, plant layout and application of Pipe extrusion, Blown and Flat film extrusion, Sheet extrusion, Calendaring, Lamination, Thermoforming.

Unit 2: Moulding Processes (10 Hrs)

Principle, machines, moulds, and application of Injection moulding, Compression moulding, Transfer moulding, Injection moulding, Blow moulding, Rotational moulding.

Unit 3: Plant Operations and Economics (10 Hrs)

Materials and parts handling- vacuum loaders, coloring loaders, on-the-machine blenders, bulk vacuum flow system, plastics materials drying, granulators and shredders. Decorating plastics- Surface pretreatment, Printing, Metalizing.

Plant Economics- Fixed capital, Raw materials, Total working capital/month, Total capital investment, Turn over/ Annum, Product cost economics with respect to Plasticizer, Storage tank, Injection moulded chair and Wood Plastic Composite.

Books Recommended:

1. M. L. Berins, SPI Plastics Engineering Handbook of the Society of the Plastics Industry Inc., 1991.
2. J. M. Margolis, Decorating Plastics, Hanser Publication Inc., 1987.
3. J. Dym, Product Design with Plastics, Industrial Press Inc. 1983.

Course Outcome:

Student will be able to select suitable processing technique for polymer product manufacture.

Course: AOCPL701: Polymer Testing

Course Duration: 30 Hrs **Course Coordinator:** Mr. M M Yenkie

Course Objective: To introduce basic testing of polymer materials carried out in industries.

Course Content:

Unit 1: Standards, Physical and Chemical Properties (10 Hrs)

Concept of Quality Management System, Importance and need of Testing, Specifications and Standards- ASTM, DIN, ISO, Sample preparation and conditioning, Density, Specific Gravity-Methods of determination, Bulk Density, Bulk Factor, Immersion test, Stain resistance test.

Unit 2: Mechanical and Electrical Properties (10 Hrs)

Mechanical Properties: Tensile Properties and Test Methods, Flexural Properties and Test Methods, Compression Properties and Test Methods, Impact Properties and Test Methods-Izod, Charpy, Dart, Falling weight, Hardness test-Shore, Rockwell, Abrasion Resistance,
Electrical Properties: Introduction, Dielectric Strength, Dielectric Constant, Volume resistivity, Surface resistivity.

Unit 3: Thermal, Flow and Optical Properties (10 Hrs)

Thermal Properties: Thermal Conductivity, Coefficient of Thermal Expansion and Contraction, Brittleness Temperature, Heat Deflection Temperature, (HDT), Vicat Softening Point (VSP).
Flow Properties: Melt Flow Index for Thermoplastics, k-value for PVC, Cup method for Thermosets, Rheological concept of polymer melt and solution, types of fluid, viscoelasticity, rheometer.
Optical Properties: Refractive Index, Gloss, Haze and Luminous Transmittance.

Books Recommended:

1. Nayak, Fundamentals of Plastics Testing, Springer.
2. Vishu Shah, Plastics Testing Technology Handbook, Wiley Interscience.
3. Brown, Handbook of Polymer Testing, Marcel Dekker.

Course Outcome:

Student will be able to evaluate various properties of polymer according to standard.

Course: AOCFT501: Food Safety and Hygiene Management

Course Duration: 30 Hrs **Course Coordinator:** Dr S D Deshmukh

Course Objective:

1. This course provides basic understanding about food hazards & safety assurance in food sector.
2. To spread awareness in the community about the Food Safety and Hygiene Management for use in the food processing industries.

Course Contents:

1. Introduction to Food Safety, Types of Hazards: Physical, Chemical and Microbiological, food spoilage, Microorganisms involve in food spoilage, factors responsible for food spoilage, spoilage in different foods (07 L)
2. Food Contamination, Toxicants in Animal foods, Toxicants in Plant food, Anti-nutritional factors in foods, Biological contaminants, Pesticide Residues, Drug Residues, Heavy Metals (07 L)
3. Food Adulteration, Foods commonly Adulterated, classification of adulterants, Harmful effects of adulterants, Detection Methods for some adulterants, Risk analysis, Risk assessment, Risk Management, Risk Communication. (06 L)
4. Food Safety in food service establishments: Food Safety measures, Street foods- Food Safety measures, Sanitation in food Service: Waste disposal, cleaning agents, Pest & Rodent control, Hygiene & sanitation in food service: Health status of food handlers, personal Hygiene, HACCP: Need, Benefits & principles. (08 L)

Books Recommended:

1. Fundamentals of Food Hygiene, Safety and Quality by Alok Kumar, New Delhi, 2019.
2. Principles of Hygiene and Food Safety Management, PIP c/o COLEACP, International network, European Union.
3. Food Safety, Sanitation and Personal Hygiene, The BC Cook Articulation

Course Outcomes: Upon completion of this course student will

1. gain knowledge about food hazards, and contaminants.
2. learn skills of good hygiene practices and sanitation in food service
3. understand the process of hazard analysis and critical control point and its benefits to food process industry.

Course: AOCFT601: Dairy and Dairy Product Processing

Course Duration: 30 Hrs **Course Coordinator:** Dr S D Deshmukh

Course Objective: This course provides basic understanding about Dairy and Dairy Product processing. Upgrade the technical proficiency in clean milk handling and processing. Provide knowledge about fluid milk processing, production of value-added products and quality control aspects in dairy industry.

Course Content:

1. Fundamental of Dairy Technology, Dairy development in India, Milk composition, its constituents and nutritional importance, Physico-chemical properties of Milk, control of microbial spoilage in milk (06 L)
2. Processing of Milk, Thermal processing of Milk, Pasteurization, Homogenization, sterilization, UHT processing of Milk, chilling of Milk and Packaging (08 L)
3. Definition of cream, butter, ghee, method of manufacturing of butter, packaging and storage of ghee & butter (05 L)
4. Types of Dairy Product, Manufacturing method of paneer & Chhana, concentrated milk, sweetened condensed milk, Khoa manufacturing of curd, starter culture in curd, manufacturing of cheese, types of cheese: cheddar cheese, mozzarella cheese (11 L)

Books Recommended:

1. Dairy Science: Petersen (W.E.) Publisher – Lippincott & Company
2. Outlines of Dairy Technology – Sukumar (De) – Oxford University press
3. Indian Dairy Products – Rangappa (K.S.) & Acharya (KT) – Asia Publishing House.
4. The technology of milk Proceesing – Ananthakrishnan, C.P., Khan, A.Q. and Padmanabhan, P.N. – Shri Lakshmi Publications.
5. Dairy India 2007, Sixth edititon

Course Outcomes: After learning this course student will be able to

1. have basic knowledge about dairy technology
2. have ability to use acquired knowledge during milk processing
3. understand the various dairy product processing and preservation techniques.

Course: AOCFT701: Post-Harvest Management of Fruits and Vegetables

Course Duration: 30 Hrs **Course Coordinator:** Dr S V Karadbhajne

Course Objective: Now a days Food Processing Industry is identified as high profit industry due to the scope offers for value addition, processing and preservation to wholesome and nutritious food. This course provides basic understanding about post-harvest management and processing of fruits and vegetable. Know Quality characteristics & assurance of fruits & vegetables

Course Contents:

1. Introduction to Food Processing Technology, Food Production in India and world, Processing and Value addition, Trends in consumption of Processed food, Status of food processing in India, Major Food processing Sectors. (06 L)
2. Types of Edible agricultural Products, Types of fruits and vegetables, Physiology of fruits and vegetables, Nutritional importance of fruits and vegetable, post-harvest treatment & Management of fruits and vegetable, Anti-nutritional factors, Toxic compounds of fruits & vegetable. (08 L)
3. Factors causing food spoilage, assessment of losses of perishable Commodities, Deterioration factors & their controls: Chemical reactions, Biochemical reactions, and Microbiological reactions. Quality characteristics & assurance of fruits & vegetable (06L)
4. Processing of Fruits & Vegetables: Processing of Fruit Juice, Jam, Jelly, Squash, Preserve, Tutti-fruity, Tomato Sauce, Ketchup and Puree, Amla candy. (10 L)

Books Recommended:

1. Preservation of fruits & vegetables by Girdharilal & Sidappa G.S.,ICAR. New Delhi.
2. Fruits & vegetables juice processing technology edited by Tressler D.K. & Joslyn M.A., AVI publishing Co. Westport, Connecticut 1971

Course Outcomes: After learning this course student will

1. have acknowledge about food and food processing sectors
2. learn skills in post-harvest management of fruits & vegetable
3. understand the process technology in development of value-added products from fresh produced

Course: AOCPT501: Facets of Petroleum Road Transportation Fuels

Course Duration: 30 Hrs **Course Coordinator:** Dr. V. N. Ganvir

Course objectives: Students will be

- familiarize about hydrocarbons present in Petroleum.
- able to evaluate petroleum & petroleum transportation products.
- introduce to various operations & processes practised in the petroleum refining.

Course Contents:

1. Introduction of Petroleum / crude oil, Classification of crude oil based on hydrocarbons, Types of Non hydrocarbons present in crude oil, Petroleum Refineries in India and their capacities and locations Petroleum products obtained from petroleum refineries.
2. Thermal Processes practiced in petroleum refineries to convert cuts into road transportation fuels, Mechanism involved in Pyrolysis, Visbreaking and coking, Catalytic process employed in petroleum refineries to produce petroleum transportation fuels, Catalytic cracking and Catalytic reforming
3. Processing of Catalytic hydrocracking, Catalytic isomerization, and Catalytic alkylation, BIS for Gasoline, Important test for motor gasoline.
4. Physio-chemical properties of Gasoline, like API gravity, Octane number, Gum residue, Oxidation stability, Sensitivity, posted octane number, Reformulated Gasoline
5. BIS for HSD, Important test for HSD, Physio-chemical properties of HSD, like Viscosity API gravity, Pour point and cloud point, Flash point (Abel, Pensky Marten, COC), Aniline point, Diesel index, Cetane index and Cetane number and Carbon residue
6. Additives added to gasoline to improve oxidation stability and engine performance, additives added in HSD to reduce emissions and pour point depressants.

Books Recommended:

1. J.H. Gary and G.E. Handwerk “Petroleum Refinery Technologies and Economics.
2. Surinder Prakash “Petroleum fuels Manufacturing Handbook”
3. G.D. Hobson “Modern Petroleum Technology”.
4. B.K. Bhaskar Rao “Modern Petroleum Refining process”.
5. Ram Prasad “Petroleum Refining Technology”.

Course Outcome: Upon successful completion of this course, the students will be able to **identify** various petroleum transportations products obtained from the petroleum refinery and their end uses.

Course: AOCPT601: LNG Technology

Course Duration: 30 Hrs **Course Coordinator:** Mr. A C Shende

Course Objective:

- To introduce the basic concept of LNG.
- Explain the various technologies for the production of LNG.
- Gain knowledge about determination of various properties of natural gas.

Course Contents:

1. Introduction to natural gas, brief history of natural gas industry, importance & sources of natural gas, utilization of natural gas.
2. Composition & classification of natural gas, phase behaviour of natural gas.
3. Different important thermophysical properties of natural gas & their estimation.
4. Various surface operations for natural gas processing, pre-treatment of natural gas such as sulphur removal, acid gas removal etc.
5. Liquefaction of natural gas & their various methods, technologies.

Books recommended:

1. Donald L. Katz and Robert L.Lee, Natural Gas Engineering, McGraw – Hill Publishing Company, NY.
2. William C. Lyons, Gary J. Plisga. Standard Handbook of Petroleum & Natural Gas Engineering, Gulf Professional Publishing.
3. G.V. Chilingarian, J.O. Robertson, Sanjay Kumar, Surface Operations in Petroleum Production, Vol.1, Elsevier Science Publishers B.V.

Course: AOCCTPT701: Petroleum Refinery Engineering Design

Course Duration: 30 Hrs **Course Coordinator:** Dr G M Deshmukh

Course Objective: To get acquainted with process design of distillation columns involving multicomponent and complex mixtures. To learn methodologies practiced in rating and designing heat transfer equipment used in refining and process industry.

Course Contents:

Unit-I (06 Lecture)

Overview of Refinery: - Global and Indian Refining Industry, Refinery configurations, ASTM Distillation, TBP Distillation, EFV distillation. Analysis of crude petroleum and its fractions.

Different types of Boiling point: VABP, WABP, MABP, MeBP, CABP. Computation of the curves, Calculation of ASTM Temperature to TBP and EFV Temperature, Average boiling points, Separation criteria in crude oil fractionation. Calculation for characterizing crude oil.

Unit-II (06 Lecture)

Atmospheric distillation: Atmospheric distillation tower, Types of refluxes, Pump around reflux, Pump back reflux and Top tray reflux, Converting crude TBP to product TBP curves, Concept of Overflash.

Energy balance in a topping tower and Calculations involve, Estimation of Top, Side, Bottom draw tray temperatures. Calculation of side steam strippers.

Unit-III (06 Lecture)

Vacuum distillation: Vacuum Distillation Tower, Type of operations, Lube Type Vacuum tower with Pump back and Pump around reflux heat removal.

Lube or special vacuum distillation operation, Economic consideration in Vacuum Tower.

Unit-IV (06 Lecture)

Fired Heater: Types of fired heaters, Horizontal Types, Vertical Types, Codes and standards Burner, Gas burner Oil burner combination burners.

Preparing refractories for operation stacks emissions Basic constructional features of furnace, Different furnace types.

Unit-V (06 Lecture)

Heat exchanger in refinery and operational problems, General considerations, Choice of tube side versus shell side.

Fluid mechanics and refinery applications, Types of heat exchangers used in refinery, Heat exchanger analysis.

Books:

1. R.N. Watkin, Petroleum Refinery Distillation, 2/e Gulf Publishing Co, Houstan, Texas, USA, 1981.
2. B.K Bhaskar Rao, Modern Petroleum Refining Processes, 3/e, Oxford n& IBH Publishing Co Pvt. Ltd., 1997.

3. Wayne C. Edmister, Applied Hydrocarbon Thermodynamics, 2/e, Gulf Publishing Co., 1988.
4. Van Winkle M., "Distillation", McGraw Hill, 1967
5. Sinnott R. K., "Coulson and Richardson's Chemical engineering", Vol. 6, Third Edition, Butter Worth-Heinemann, 1999.
6. Kern D. Q., "Process Heat Transfer", McGraw Hill, 1965.

Course Outcome:

Students learn process design aspects related to distillation column, Fired Heaters and Heat exchangers

Course: AOCOT501: Basics of Oil, Fats and Oleo chemicals

Course Duration: 30 Hrs **Course Coordinator:** Dr. V. Y. Karadbhajne

Course Objectives: After final completion of the course, students will be able to:

1. Thoroughly understands the basic knowledge about sources of Oils & Fats.
2. They are able to classify oils & fats in detail, structure & composition of oil seeds.
3. Capable to differ oils & fats from its constituents.
4. Knowledge of physical & chemical characteristics their determination processes as well as Indian standards & finding adulteration becomes clear after completion of this course.
5. This course gives knowledge of various aspects in the field of waxes also it includes sources, manufacturing process, refining of wax & highly applicable Chemical reaction and Bio-chemical reactions of fats and their fatty acids in industry.

Course Contents:

Sr. No.	Topic	Hours
1	Natural Fats and Oils: Their sources and classification. Constituents of natural fats Glycerides.	3
2	Phospholipids, fatty acids, non-glyceride constituents, toxic constituents and detoxification.	4
3	Physical and Chemical characteristics of Oils and Fats. Elementary methods of analysis of oils, fats and fatty acids	2
4	Glycerides and fatty acids: Nomenclature, structure, occurrence in oils and fats.	3
5	Physical properties of fats and fatty acids their properties, solution properties and spectral properties	3
6	Chemical reaction of fats and their fatty acids	3
7	Dehydration, sulphation and sulphonation of oils and fats	3
8	Esterification, inter esterification and hydrolysis.	4
9	Identification of fats and oils. Detection of adulteration in fats. Indian Standards for fats and oils	3
10	Nutritional functions of fats	2

Course Outcomes:

This course will enhance the student's

1. To apply knowledge on different methodologies in this field. This Program provides to completely illustrate knowledge on natural oils & fats in addition with natural & synthetic waxes.
2. To Categorize Various chemical and via chemical reactions related to Oil Technology.
3. The learners get a required knowledge to discriminate between the classification oil, fats & wax processing industries.
4. The Oil Technologist will be capable of designing reactions required during processing of Oil, Fats & Waxes.

Course: AOCOT601: Technology of Oils and Oil-Bearing Materials

Course Duration: 30 Hrs **Course Coordinator:** Mr. V. M. Gawande

Course Objectives:

1. Understand importance of pre-treatment of oil seeds prior to oil extraction, domestic & world production of oil seeds & oils.
2. Differentiate between mechanical & solvent extraction process mainly used to get crude oil from vegetable source.
3. Explain stage wise refining of crude oil, application & importance of valuable by-products getting in every stage of refining. Understand batch & continuous plants & processes, recent trends in refining.
4. Calculate economics of Hydrogenation unit by analyzing different method of hydrogenation & designing process engineering aspects of it.
5. Describe & explain products derived from milk fat group like butter, margarine, salad oil, plastic shortening agents, confectionary fats etc.

Course Contents:

Sr. No.	Topic	Hours
1	Production of oil seeds and oils, handling, drying, storage, sampling and grading, pretreatment of oil seeds prior to oil extraction.	2
2	Mechanical extraction of oil seeds, newer methods in extraction of oil seeds.	3
3	Plants and processes employed for recovery of oils and fats by solvent extraction, solvents, their availability and selection, advantages and limitations	4
4	Refining, bleaching and deodorization of oils and fats.	4
5	Hydrogenation oils and fats, pretreatment prior to hydrogenation	3
6	Designing and processes engineering aspects of hydrogenation.	4
7	Manufacture of butter, ghee, margarine and Transesterified oils and fats	3
8	General methods of upgrading and utilization of oils and fats, Oil Seed Proteins and Byproduct Utilization, oil cakes and allied products.	2
9	Lipid Associates and Applications of non-traditional oils such as Karanja, Neem, Mahua etc…	3
10	Membrane Processing of Fats and Oils.	2

Course Outcomes: This course make student capable to:

1. Completely illustrate knowledge on overall sources of natural oils & fats in addition with its processing.
2. Implement various chemical reactions related to Oil Technology in technical fields.
3. Differ easily vegetable, animal & mineral oils with its different sources & part of application in society & industries.
4. Modify reactions with processing parameters & able to derive new products according to need to customer & special application in food industries.

Course: AOCOT701: Technology of Soaps, Surfactants and Glycerin

Course Duration: 30 Hrs **Course Coordinator:** Mr. V. M. Gawande

Course Objectives: After final completion of the course, students will be able to:

1. Thoroughly understands the basic knowledge about soaps & surfactants.
2. They are able to classify soaps, surfactants & detergent in detail according to specific application.
3. Knowledge of physical & chemical characteristics their determination processes as well as Indian standards to accomplish quality standards.
4. This course gives knowledge of various aspects in the field of surfactants also it includes sources, manufacturing process, natural surfactants & highly applicable Chemical reactions for soap manufacturing and Bio-chemical reactions of fats and their fatty acids in industry.
5. Develop bio-surfactants which are need of today's generation.

Course Contents:

Sr. No.	Topic	Hours
1	Concept and Theory of Surface action, structure of surfactant molecule, Hydrophilic – lipophilic balance	4
2	Mechanism of detergency, Classification of surfactants manufacture, evaluation and industrial applications.	3
3	Raw materials used in the manufacture of synthetic detergents and their functions. Plants and processes employed for powders, liquids and cake detergents.	4
4	Raw materials for soaps, their Classification and selection of oils and fat.	2
5	Continuous processes of soap manufacture. Modern process and plants for the production of house hold and toilet soaps	3
6	Selection of builders and their functions, fillers and other auxiliary raw materials in soap.	3
7	Details of machinery employed and quality specifications in soap making.	2
8	BIS methods of testing, Properties of soaps and soap solutions, phase separation in soap boiling, various types of soaps & cleaning Preparations.	3
9	Sources, properties, grades, and types of glycerol, Synthetic glycerin.	3
10	Recovery and purification of glycerin from fat splitting	3

Course Outcomes: This course will enhance the student's

1. The learners get a required knowledge to discriminate between the classification of surfactants & soaps.
2. This Program provides to completely illustrate knowledge on soaps & surfactants addition with detergents & glycerin as by product. To apply knowledge on different methodologies in this field.
3. To Categorize Various chemical and via chemical reactions related to Oil Technology.
4. As they are able to transfer the technology to entrepreneur with very nominal economics.
5. The Oil Technologist will be capable of designing reactions required during processing of soap manufacturing & polymeric surfactants.

Course: AOCSC501: Materials and Manufacture of Coatings

Course Duration: 30 Hrs **Course Coordinator:** Dr. P. G. Shende

Course Objective:

The objective of this course is to enable the students to identify the various raw materials and their roles in the formulation of coatings. Also, understand the steps and their importance in the processing of the paint/coatings.

Course Contents:

1) Film-former/Vehicles/Binders/resins/polymers in coatings

   Drying Oil, Alkyd Resin, Epoxy Resin, Polyurethane, Polyester, Amino Resin, Phenolic Resin, Acrylic Resin,

2) Pigments (Inorganic)

3) Pigments (Organic)

4) Solvents

5) Additives in coatings

5) Manufacture of coatings

Course: AOCSC601: Classification of Coatings

Course Duration: 30 Hrs **Course Coordinator:** Dr. G. P. Lakhawat

Course Objective:

The objective of this course is to enable the students to classify the various types of coatings and on the basis of this, student must able to select the coatings as per the area of applications.

Course Contents:

1) General classification of coating system.

2) Oleoresinous varnishes

3) Synthetic enamels

4) Architectural coatings

5) Industrial coatings

6) Power Coatings

7) High-solid coatings

8) Marine coatings

9) Anti-corrosive coatings

Course: AOCSC701: Application Techniques in Coatings

Course Duration: 30 Hrs **Course Coordinator:** Dr. G. P. Lakhawat

Course Objective:

The objective of this course is to enable the students to understand the of various techniques used in application of coatings.

Course Contents:

1) Various types of substrates

2) Pre-treatments of substrates

3) Brush and roller coatings

4) Spray coatings

5) Curtain coatings

6) Flow coatings

7) Cathodic electrodeposition of coatings

8) Electrostatic-fluidized bed coatings

9) Electrostatic spray coatings