

UNIVERSITY OF MUMBAI



Syllabus for Certificate Course in Chemistry

UNIVERSITY OF MUMBAI
BOS (Chem)

DRAFT SYALLBUS FOR

CERTIFICATE COURSE IN
Polymers : Chemistry and Processing

Duration	:	One Year(30 Credits = 450 Hrs)	
Theory	:	10 Credits = 150 Hrs (Paper I + Paper II of 75 Hrs Each)	
Practical	:	10 Credits = 150 Hrs	
Project	:	10 Credits = 150 Hrs	
Examination	:	Theory Paper I	: 75 Marks
		Paper II	: 75 Marks
		Practical – I & II	: 100 Marks
		Project Report	: <u>50 Marks</u>
		Total	: 300 Marks

THERORY :

Paper I:

Unit 1 (15L)

1) Introduction :

Development in polymers and petrochemicals industries with reference to plastics.

Historical development of plastic materials, natural plastics.

Importance of plastics materials, market of plastics and future Of Plastics

Unit 2 (15L)

Sources of plastics raw materials from petroleum and others- With flow diagrams. Crude oils, natural gas, Petroleum HC, types and sources of crude oils, refining, fractionation, cracking, Knock and octane rating, Petrochemicals as building blocks. Acetylene, etylene, propylene and their derivatives, butane, butene and buta diene fractions,

Unit 3 (15 L)

Processing :

Introduction to making of plastic products through processes such as compounding, colouring, extrusion, molding (injection and compression, Rotatiobnal), printing, welding, etc.

Unit 4

(15 L)

Reactants and monomers :

Synthesis and properties of following reactants and monomers such as :-

- Polyfunctional acids- phthalic acid and isomers, dicarboxylic Acids - Aliphatic and aromatic
- Polyols- Various aliphatic and aromatic polyols, eg. Ethylene Glycol, glycerol etc.
- Phenols.
- Aromatic and aliphatic polyamines- e.g. Ethylene diamine.

Unit 5

(15 L)

- Vinyl monomers such as ethylene, propylene, styrene, vinyl chloride, acrylics etc.

Analysis of raw material and Reactants:

Analysis and testing of various reactants and raw materials as mentioned in Units 4&5 , understanding & detailing their procedures.

Paper II

Unit 6

(15L)

Chemical Nature of Plastics :

Definition of monomers, polymers, degree of polymerization etc.

Concept and importance of functionality- Carothers relations.

Classification of Polymers:

Thermoplastics and thermosetting behavior.

Linear, branched, and cross-linked polymers.

Concept of molecular weight and its distribution, polydispersity.

Unit 7

(15L)

Types of Polymerisation :

Addition or radical-chain polymerization: Steps involved and illustrations

Condensation or step growth polymerization: mechanism and illustrations.

Introduction to ionic polymerization.

Thermal properties of polymers. Crystalline and amorphous states.
Glass transition temperature.

Unit 8

(15L)

Various types of molecular weight averages in polymers and their methods of determination. – number average, weight average, Viscosity-average, membrane osmometry, vapour pressure osmometry, Light scattering viscometry, ultra centrifugation and GPC.

Techniques of Polymerisation :

Following methods with their detailed description and with examples are to be considered.

- a) Mass/bulk polymerization
- b) Solution polymerization
- c) Suspension polymerization
- d) Emulsion polymerization

Unit 9

(15L)

Introduction to important polymers :

The following polymers with brief method of preparation, properties and important applications.

Polyolefin: Polyethylene, polypropylene,

Poly(vinyl chloride), poly(vinyl acetate) and its derivatives, polystyrene and its copolymers, polyamides, cellulose plastics, phenolic resins, amino resins, polyester resins, epoxy resins,

Unit 10

(15L)

Contd.:

Amino resins, polyester resins, epoxy resins, polyurethane, silicone resins, acrylic polymers, polycarbonates, nylons etc engineering polymers.

Copolymerisation :

Concept of co-polymerization, various types and properties, with illustrations.

Practicals

1. Analysis of water.	2 Nos.
2. Determination of purity of phenols and substituted phenols by bromination.	2 Nos.
3. Determination of purity and analysis of formaldehyde.	2 Nos.
4. Determination of purity of phthalic anhydride.	1 No.
5. Determination of purity hexamine	1 No.
6. Determination of purity epichlorohydrin.	1 No.
7. Analysis of calcium chloride.	1 No.
8. Analysis of sodium / potassium dichromate.	1 No.
9. Analysis of hydrogen peroxide.	1 No.
10. Estimation of zinc oxide.	2 No.
11. Analysis of melamine.	1 No.
12. Analysis of glycerine.	1 No.
Analysis of solvents	
13. Specific gravity, refractive index, distillation range, boiling points, aniline point, etc.	3 Nos
14. Analysis of methyl methacrylate	1 No.
15. Analysis of acrylic acid	1 No.
16. Determination of functional groups in resins and polymers	
1) Determination of acid value	1 No.
2) Determination of saponification value	1 No.
3) Determination of hydroxyl value	1 No.
4) Determination of carbonyl value	1 No.
5) Determination of peroxide value	1 No.
6) Determination of iodine value	1 No.
17. Determination of melting range and softening point of resins	1 No.
18. Determination of molecular weight by viscometry.	1 No.

Project:

Each student will have a project on field work/survey/experience in industry etc of 10 credits (150 Hrs.) during the year. The candidate will prepare a report on the same. The report, duly signed by the candidate and the supervisor under whom the work was carried out, will be submitted for evaluation by the examiners during the examination, during which the candidate will also make a presentation on the same.

Practical Examination:

Students will be examined in practicals for seven hours in one day as follows:

Follows:

1. One short experiment	30 Marks
2. One long experiment	35 Marks
3. Journal	20 Marks
4. Viva-voce	15 Marks

Total 100 Marks

Project Report:

1) Project Report	40 Marks
2) Presentation of P Report	10 Marks

Total	50 Marks
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Recommended Readings :

1. Polymer science : V R Govarikar, N V Vishwanathan et al. Pub New age international
2. Plastic technology : Robert V, Milby McGraw hill
3. Analysis of polymers: An introduction ; Crompton T R , Pergaman Press , 1989
4. Principles of polymerization, Godion, Wiley- Interscience 1981
5. Physical chemistry of macromolecules, D D Deshpande, Vishal Pub
6. Organic polymer chemistry, K J saunders, Chapman and Hall , London, 1973
7. Principles of polymer chemistry, P J Flory
8. Engineering chemistry , P C Jain, Manik Jain, Dhanpatrai & Sons;
9. Molecular weight distribution in polymers, L H Peebles jr, Wiley I Sc
10. Polymer Chemistry, Basic concepts; Hiemenz, PC Marcel Dekkar
11. Thermal Characterisation of polymeric material, Turil EA, Acad Press
12. Thermal methods of polymer analysis, shellaby S W, The Franklein Insti Press
13. Plastic technology, Pattern W J
14. Polymer-Plastic technology and engineering, Naturman, L M Dekkar, 1979
15. Principles of polymer processing, Fenner R t , Chemi Publi, NY 1979
16. Physical chemistry of polymers, Sokolev D & Borov N Belevy,
17. Charecterisation of plastics by physical methods, G Kumf, Hansu Publi
18. Applied polymer science, ACS symposium series no 285 ; 1985
19. Introduction to organic chemistry of high polymers, Carl Marvel, john Wiley & sons,
20. fundamentals of Petroleum chemistry, R

UNIVERSITY OF MUMBAI
(BOS- Chem)
Draft Syllabus for

Certificate Course in Industrial Chemistry (U.G.)

Eligibility	: XII (science) pass
Duration	: Minimum one year; 30 credits (450Hrs. total)
Theory	: 10 credits (150 Hrs: Pap I and II each 75 Hrs)
Practical	: 10 credits (150 Hrs)
Project	: 10 credits (150 Hrs)
Examination :	
Total marks	: 300
Theory	: 150 (Pap I and II each 75 marks)
Practical	: 100
Project & Presentation	: 50

THEORY

Paper - I : Chemical Industry and Unit Operations.

Unit I **15 L**

- Chemical Industry in India (5 L)
 - Introduction
 - Historical Background
 - Classification of Chemical Industries
- Non-renewable Sources (10 L)
 - Coal
 - Petroleum

Unit II **15 L**

- Utilities: Water, steam (15 L)

Unit III **15 L**

- Renewable Sources (8 L)
 - Cellulose
 - Starch
 - Alcohol and Alcohol Based Chemicals

- Unit Operations
 - i. Centrifugation (5 L)
 - ii Extraction (2 L)

15 L

Unit IV

- iii Filtration (5 L)
- iv Distillation (5 L)
- v Crystallization (5 L)

15 L

Unit V

- vi Drying (5 L)
- vii Evaporation (5 L)
- viii Cooling (5 L)

Paper - II Unit Processes :

15 L

Unit VI

- Introduction to Unit Process (3 L)
- Symbols Used in Flow-charts (2 L)
- Classification of Unit Processes (3 L)
- Flow of fluid, Mixing, Pressure drop, energy requirement (7 L)

15 L

Unit VII

- Heat transfer : Conductive; Convective, Radiative (5 L)
- Mass Transfer : Absorption; Adsorption (5 L)

Unit Processes

- Oxidation (5 L)

15 L

Unit VIII

Contd.

- i. Nitration
- ii. Sulphonation
- iii. Alkylation

Unit IX

15 L

- Manufacture of three bulk chemicals involving each of the unit processes and principles. (including mass transfer, thermodynamics, cost and effluent treatment method used)

Oxidation : 1) Isopropyl benzene 2) o,m,p_xylenes 3) Naphthalene

Nitration: 1) Benzene 2) Acetanilide 3) Nitrobenzene

Contd.

Unit X

15 L

- Sulphonatin : 1) Benzene 2) Acetanilide 3) Naphthalene
- Alkylation : 1) Phenol 2) Toluene 3) Chloro benzene

PRACTICALS

1. pH metry:

- i) Standardization of pH meter and Determination of pH of various water samples (dist. Water, tap water. River water, etc.)
- ii) Determination of pKa value of given organic acid by pH measurement
- iii) Determination of pH values of various mixtures of Na-acetate and CH_3COOH in aq. Solution and find dissociation constant of the acid.

2. Conductometry:

- i) Investigate conductometric titration of weak acid and strong base at various concentrations.
- ii) Estimate % composition of CH_3COOH and HCl .
- iii) Estimate concentration of CH_3COOH , H_2SO_4 and CuSO_4

3. Potentiometry :

- i) Determine basicity and p Ka value of organic acids
- ii) Calculate pKa value of H_3PO_4

4. Colorimetry:
 - i) Standardization of colorimeter / spectrophotometer by Determination of λ_{max} of KMnO_4 solution.
 - ii) Determination of Cu ion in given solution using EDTA
 - iii) Determination of concentration of $\text{K}_2\text{Cr}_2\text{O}_7$ by plotting calibration curve.
5. Refractometry :
 - i) To measure refractive indices of various solutions (eg Acetone, benzene, Alcohol, Xylene)
 - ii) To determine % composition of given two liquids by..
6. Surface tension :
 - i) Determination of surface tension by Stalagmeter
(H_2O , alcohol, ethyl acetate etc)
 - ii) Determination of % composition of mixture using stalagmeter ..
7. Viscosity :
 - i) Determination of viscosity of given liquid by Oswald's viscometer
 - ii) Determination of % composition of given mixture by Oswald's viscometer .
8. Determine the value of COD of given sample of industrial waste.
9. Determine the value of BOD of given sample of Industrial waste.
10. Determine the value of DO of given sample of industrial waste.
11. Ore analysis.:

Determine amount of Nickel from given ore. (Monel metal)
12. Separation and Mass Balance of given liquid mixture by fractional distillation.

Preparation of following compounds (Use of TLC is expected)

1. Nitrobenzene to m-dinitrobenzene
2. Nitration of Acetanilide
3. Benzaldehyde to Benzoic Acid
4. Anthracene to Anthraquinone
5. Sulphonation of Benzene, Naphthalene
6. Prep of Diphenyl methane from benzyl chloride.

Practical Examination :

Student will be examined in practical for seven hours in one day as follows :

- | | |
|---------------------------|----------|
| 1) One Long experiment : | 40 marks |
| 2) One short experiment : | 25 marks |
| 3) Journal : | 15 marks |
| 4) Viva-voce: | 20 marks |

Total	100 marks
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Project :

Each student will have a project on field work/ survey/ experience in industry etc of 10 credits (150 hours) during the course/year. The candidate will prepare a report on the same. The report, duly signed by the candidate and the supervisor under whom the work was carried out, will be submitted for evaluation by the examiner during the examination, during which the candidate will also make a presentation on the same.

- | | |
|-------------------------------------|----------|
| 1) Project report : | 40 marks |
| 2) Presentation of Project report : | 10 marks |

Total	50 marks
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Recommended reading .:

1. E Stoch : " Industrial Chemistry "
2. E Hinnawi and A K Biswas : " Renewable sources of Energy and the environment "
3. Shrieve's: " Chemical Process Industries "
4. Wiseman and Peter: " an Introduction to Industrial Organic Chemistry "
5. Sharma : " Industrial Chemistry " God publications 1998
6. Badger, walter, bancher Julius.: "Introduction to Chemical engineering"
7. Coal and Combustion : Dr Kale
8. Chemical process- Principles : O. A. Hougen – Asia Pub Hse
9. Unit operations in chemical engineering – W L McCabe and J Smith -Mc Grow hill
10. Unit Operations I and II – P P kale- Pune Vidyarthi gruh Prakashan
11. Introduction to Petroleum Chemicals – H Steiner – Pergamon Press
12. Chemistry of Cellulose- E Houser –
13. Chemistry and Industry of starch - RW Kerr –
14. Modified starches- properties and uses – wurzburg O B
15. Catalysis -heterogenous and homogenous – Delmol and Janner-
16. Unit operations and processes – Groggins
17. Phase transfer catalysis – Principles and techniques – Starley C
18. Stocheiometry – Bhatt and Vora – Tata Mc Grow Hill
19. Industrial Chemistry – B K Sharma -

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DRAFT SYALLBUS FOR

CERTIFICATE COURSE IN ENVIRONMENT & INDUSTRY

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Each)			
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		Paper II	: 75 Marks
		Practical – I & II	: 100 Marks
		Project Report	: <u>50 Marks</u>
		Total	: 300 Marks

THERORY :

Paper I

ENVIRONMENT & ENVIRONMENNTAL POLLUTION

Unit I. Components of Environment

15L

- Introduction to Environmental Science. General perspectives: global environmental problems, environmental priorities in India, environmental ethics, man and environment, earth's carrying capacity.
- Components of Environment: Introduction. Atmosphere, hydrosphere, lithosphere and biosphere.
- Ecosystem. Introduction, components of ecosystem: biotic and abiotic. Productivity and energy flow. Food chain and food webs. Ecosystem diversity.
- Biogeochemical cycles (hydrological cycle and nutrient cycles).
- Consequences of population growth

Unit II. Natural Resources:

15L

- Natural Resources: Introduction. Concept of resources, types of resources.
- Current status of Major Resources: Water, land, biological resources including wood. Minerals, energy, wild life, ocean, human resources.
- Energy Management: Solar energy input. Conventional fuels: wood, oil, coal, natural gas, nuclear energy. Non-conventional sources: photovoltaic, solar heating, wind and tidal energy. Biological energy, use of wastes. Energy use pattern in India.

Unit III. Environmental Pollution: Air Pollution: 15L

- Environmental pollution: Types: Air, water, soil(land) and noise.
- Air pollution: Classification and properties of air pollutants.
- Sources of air pollutants.
- Effects of Air pollutants (on health, vegetation and material damage).
- Air pollution laws and air quality standards.

Unit IV. Water Pollution: 15L

- Introduction. Ground and surface water pollution.
- Types of water pollutants and their effects.
- Water quality monitoring.
- Water quality parameters and permissible limits.
- Water pollution laws and standards for drinking water

Unit V. Land/soil Pollution and Noise Pollution: 15L

- Land/soil Pollution:
 - Concept of land/soil pollution.
 - Causes.
 - Types: acidification, salinisation and sodification, agrochemical pollution. Urban and industrial pollution.
- Noise Pollution:
 - Introduction. Concept of sound, noise and hearing problems.
 - Measurement of noise.
 - Sources of noise: transport, industrial, domestic.
 - Effects of noise pollution.
 - Noise mapping.

Paper II

ENIRONMENT AND CHEMICAL INDUSTRIES

Unit VI Chemical Industries: 15L

- Chemical industries in India: Introduction. Historical background.
- Classification of chemical industries.
- An overview of petrochemical, agrochemical, pharmaceutical, soap & detergents, polymer, thermal & nuclear power industries in India.

Unit VII. Methods of Analysis: 15L

- Introduction. Qualitative and quantitative analysis. Chemical and instrumental methods of analysis.
- Types of analysis: proximate, partial, trace constituent and complete analysis. Macro and micro analysis. Sampling. Methods of sampling, sampling devices, preservation, storage and processing of air and liquid samples.

- Common techniques of analysis: Classical methods: gravimetric and volumetric analysis. Instrumental methods: Electrical methods, optical methods, atomic absorption spectroscopy. Emission methods.
- Application of various methods of analysis in environmental and industrial pollutants analysis.
- Time and money, accuracy and range.

Unit VIII. Treatment, Control and Prevention of Pollution: 15L

- Methods of treatment, control and prevention of :
 - Air pollution
 - Water pollution
 - Land/soil pollution
 - Noise pollution

Unit IX. Chemical Toxicology: 15L

- Introduction. Essential and non-essential elements. Trace elements, physiological role of trace elements.
- Heavy metals, industrial uses and pollution sources, environmental pathways.
- Biochemical effects of heavy metals.
- Toxic elements in water and their environmental fate.
- Control and treatment of some trace elements.

Unit X. Environmental Management: 15L

- Introduction, objectives of Environmental Management.
- Components of Environmental Management.
- Legal Aspects: Some important environmental laws.
- Concept of sustainable development.

Practical - I : Non-instrumental:

2. Determination of total solids/dissolved solids in the given sample of water.
3. Determination of alkalinity of the given sample of water/waste water.
4. Determination of acidity of the given sample of water/waste water.
5. Determination of carbonates and bicarbonates.
6. Determination of calcium and magnesium.
7. Determination of chloride content of the given sample.
8. Determination of sulphate content of the given sample.
9. Determination of temporary, total and permanent hardness.
10. Determination of total organic matter of a given sample.

Practical – II : Instrumental:

1. Standardization of a pH meter.
2. Measurements of pH of various samples.
3. Determination of redox potential of a given sample.
4. Determination of Cell Constant of a conductivity cell of a conductometer.
5. Measurement of electrical conductivity of given sample/s.
6. Measurement of color index of the given sample using Nessler tubes.
7. Determination of turbidity of given sample using turbidimeter.
8. Measurement of temperature of soil/water samples.
9. Measurement and classification of noise pollution.

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2. One Instrumental Experiment	35 Marks
3. Journal	20 Marks
4. Viva-voce	15 Marks
Total	100 Marks

Project Report:

3) Project Report	40 Marks
4) Presentation of P Report	10 Marks
Total	50 Marks

References:

1. Fundamental concepts of Environmental Chemistry, G. S. Sodhi.
 2. Environmental Pollution Analysis, S. M. Khopkar.
 3. Elements of Environmental Chemistry, H. V. Jadhav, Himalaya Publishing House.
 4. Environmental Science, S. C. Santra, New Central Book Agency, Calcutta. 2001.
 5. Environmental Pollution, H. V. Jadhav, Himalaya Publishing House.
 6. Environmental Chemistry, P. S. Sindhu, New Age International, Mumbai, 2002.
 7. Environmental Chemistry, A. K. De, New Age Int., 4th Edn., 2000.
 8. Environmental Chemistry and Pollution Control, S. S. Dara, S. Chand & Co., 2000.
 9. Vogel's Textbook of Quantitative Chemical Analysis, G. H. Jeffery, G. H. Bawwett, Menham and R. C. Denny, 5th Edn., ELBS Publication.
- Chemical Methods for Environmental Analysis-Water and Sediment, R. Ramesh & Anbu, Macmillan India Ltd., 1996.