

CIRCULAR :-

UNIVERSITY OF MUMBAI
No.UG. 455 of 2004

The Head, University Department of Chemistry and the Principals of the affiliated colleges in Faculty of Science are hereby informed that syllabus of new Post-Graduate Diploma Course in Techniques in Chemical Industry (PGDTICI) introduced from the academic year 2003-2004 in the University Department of Chemistry vide this office Circular No.UG/246 of 2004 dated 11th June, 2004 is forwarded for their information and record.

MUMBAI-400 032

21st October, 2004

To,

AC/4.18/13.6.03

MC/15/17.4.04

for L.c. REGISTRAR

No.UG/ 455-A of 2004, MUMBAI-400 032

21st October, 2004

1. Copy to the Dean, Faculty of Science

for L.c. REGISTRAR

Copy to :-

The Director, Board of College and University Development, the Controller of Examinations, the Deputy Registrar (Eligibility and Migration Section), the Director of Students Welfare, the Personal Assistants to the Vice-Chancellor, the Pro-Vice-Chancellor, the Registrar and the Assistant Registrar, Administrative sub-center, Ratnagiri information.

The Controller of Examinations (10 copies), the Finance and Accounts Officer (2 copies), Record Section (5 copies), Publications Section (5 copies), the Deputy Registrar, Enrolment, Eligibility and Migration Section (3 copies), Deputy Registrar, Statistical Unit (2 copies), the Deputy Registrar (Accounts Section), Vidyanagari (2 copies), Deputy Registrar, Affiliation Section (2 copies), the Director University Computer Center (IDE Building), Vidyanagari, (2 copies) the Assistant Registrar, Academic Authorities Unit (2 copies) and the Assistant Registrar, Management Council (2 copies). They are requested to treat this as action taken report of concerned resolution adopted by the Academic Council referred to in the above Circular and that no separate Action Taken Report will be sent in this connection. the Assistant Registrar Constituent Colleges Unit (2 copies), BUCTI (1 copy), the Deputy Account, Unit VI (1 copy), the In-charge Director, Centralize Computing Facility (1 copy), the Receptionist (1 copy), the Telephone Operator (1 copy), the Secretary MUASA (1 copy), the Superintendent Post-Graduate Section (2 copies), the Deputy Registrar (Special Cell), the Deputy Registrar (PRO).

UNIVERSITY OF MUMBAI



**ORDINANCES, REGULATIONS,
AND
SYLLABUS RELATING TO
THE POST GRADUATE DIPLOMA
IN TECHNIQUES
IN
CHEMICAL INDUSTRY
(PGDTICI)**

Justification for starting Post Graduate Diploma in Techniques In Chemical Industry (PGDTICI) in the Department of Chemistry.

The present course is an attempt to bridge the gap that exists between the requirements of industry and the students passing out with B. Sc or M. Sc degree in the branches of organic, inorganic, physical and analytical chemistry.

This course would be very useful for these students and will enable them to get employment opportunity in industry. The fee is reasonable and is also being charged by other departments (PGDIT for example in Physics department) of the university.

The intake capacity of 30 students has been arrived at by considering the infrastructure facilities like Laboratory space, lecture room etc that are presently available in the Department of Chemistry. Most of the workload of this course will be taken care by the faculty of the department and minor inputs would be required (especially for Paper VI) from the visiting faculty. Conducting such a professional course would require constant monitoring and hence these responsibilities would be assigned to Course Director and Course Coördinator, which is also a prevalent practice, in the Department of Physics of the university.

The admission would be by conducting common entrance test (CET), which will be conducted immediately after the B. Sc result and before M. Sc admission. This will enable the course to attract meritorious students.

UNIVERSITY OF MUMBAI

ORDINANCES, REGULATION AND SYLLABUS RELATING TO THE POST GRADUATE DIPLOMA IN TECHNIQUES IN CHEMICAL INDUSTRY (PGDTICI)

Title of the Course:

Post Graduate Diploma in Techniques in Chemical Industry (PGDTICI)

Eligibility:

- O. 5345 (1) A candidate for being eligible for admission to the course for the Post Graduate Diploma in Techniques in Chemical Industry (PGDTICI) must have passed Bachelor of Science (B.Sc.) in Chemistry
(2) He/ She will have to qualify an Entrance Test (ET) conducted by the University Department of Chemistry.
- O. 5346 Every candidate admitted to the Post Graduate Diploma in Techniques in Chemical Industry (PGDTICI) in the University Department of Chemistry, shall have to register himself / herself with the University.

Duration:

- R. 4618 The course of study for the Post Graduate Diploma in Techniques in Chemical Industry (PGDTICI) shall be a full time course in Theory, Practicals and Project work. The total duration of the course will be One Academic Year consisting of two semesters.
- R. 4619 The course is conducted by the Department of Chemistry. No. of Students - A maximum of 25 students should be enrolled.
- R. 4620 Course- The course will consist of Six Theory papers and Six Practicals based on theory papers and One Project Work.

R. 4621

The scheme of the Course be as follows:

Semester- I

Paper	Theory		Practicals	
	Duration	Marks	Duration	Marks
Paper-I	50 Hrs.	50	80 Hrs.	100
Paper-II	50 Hrs.	50	80 Hrs.	100
Paper – III	50 Hrs.	50	80 Hrs.	100

Semester- II

Paper	Theory		Practicals	
	Duration	Marks	Duration	Marks
Paper-IV	50 Hrs.	50	80 Hrs.	100
Paper-V	50 Hrs.	50	80 Hrs.	100
Paper – VI	50 Hrs.	50	80 Hrs.	100
Project				100

R. 4622

(a) First Semester- Duration Six months.(i) Work load per day-

Theory papers – 2 lectures (each of 1hr duration.)

Practicals – 3 hrs.

(i) Work load per week-

Theory papers – 12 lectures (12hrs/ week)

Practicals – 18 hrs/ week.

(b) Second Semester- Duration Six months.(i) Work load per day-

Theory papers – 2 lectures (each of 1hr duration.)

Practicals – 3 hrs.

(ii) Work load per week-

Theory papers – 12 lectures (12hrs/ week)

Practicals – 18 hrs/ week.

R. 4623

Conduct of Examination:

- I. The examination (Theory & Practicals) shall be conducted at the end of each Semester and also for the Project work i.e. Dissertation at the end of the Second Semester.
- II. The candidates shall appear for the 3 Theory papers each carrying 50 marks of 3 hours duration and 3 Practicals each carrying 100 marks of 7 hours duration at the end of each semester. The candidate shall be examined for the project work i.e. Dissertation for 100 marks at the end of the Second Semester.
- III. The candidates shall prepare and submit for examination a Dissertation, based on the short-term project work carried out under the guidance of an expert / faculty member. This dissertation will carry 100 marks and will be assessed by examiners / experts appointed for this purpose.

R. 4624

Passing Standards:

- I. A candidate will be placed in the First Class with distinction if he/she secures 70% aggregate marks with a minimum of 40% marks in each of the Theory Papers I to VI and Practicals I to VI and the Dissertation considered separately.
- II. A candidate will be placed in the First Class if he/she secures 60% aggregate marks with a minimum of 40% marks in each of the Theory Papers I to VI and Practicals I to VI and the Dissertation considered separately.
- III. A candidate will be placed in the Second Class if he/ she secures 50% aggregate marks with a minimum of 40% marks in each of the

Theory Papers I to VI and Practicals I to VI and the Dissertation considered separately.

IV. A candidate shall have to secure at least a Second class to pass the examination.

V. A candidate who fails in any particular Theory paper/s, Practical/s, will be allowed to appear again for that Theory paper/s, Practical/s, and will be entitled to the Second or the First Class as the case may be, on passing and he/she need not appear for the entire examination again.

VI. A candidate who fails in any of the Theory papers at the First Semester Examination will be allowed to keep terms for the Second Semester. However his/her results will be declared only after he/she clears all the papers.

R. 4625

The course contents shall be updated to keep in tune with the latest developments in the field to the extent of 20%.

The University Department of Chemistry established in the year 1967, conducts two year post-graduate courses in Analytical Chemistry, Inorganic Chemistry, Organic Chemistry and Physical Chemistry leading to the award of M. Sc. (By Papers) degree of the University of Mumbai. In addition, it also conducts programmes for M. Sc. (By Research), M. Phil and Ph. D. degrees. On behalf of the University, the Department also acts as a centralized admission centre for admission to M. Sc. (by Papers) course under different zones for the benefit of the students registering at the various affiliated colleges. The Department is actively engaged in organizing Refresher Courses for college teachers sponsored by U. G. C. and the State Government. It also conducts workshops for teachers for effective, smooth teaching and uniformity in the implementation of the revised syllabui from time to time. In addition, the Department also organizes, jointly with other reputed institutes and registered societies, lectures, workshops and Research Scholars Meet etc. for the benefit of teachers and students. The Department also offers consultancy services to the industry whenever solicited. Every year, the Department organizes lectures under Dr. R. C. Shah Memorial Lectureship Endowment and Dr. A. B. Kulkarni Lectureship Endowment, which are delivered by eminent chemists of the country. While the University of Mumbai finances the research programmes, additional finance required for research work is sought by individual faculty members from various national funding agencies such as UGC, DST, CSIR etc. and also from industries.

Since inception of the department, over 1300 students have taken their Master's degree by papers, more than 140 students have been awarded doctorates while a greater number of students have taken their M.Sc. degree by research. Under the M.Phil. programme, 50 teachers from affiliated colleges have received their degrees. It is indeed a pleasure to report that the Alumni of the department are holding key positions in the industry and academic institutions.

A University department is judged not only by maintenance of high teaching standards but also by its focus on research activity. Though plagued by problems of infrastructure and senior academic positions, the Department has consistently endeavored to raise its standards. It is heartening to point out that members of the faculty have published over 1000 research papers / reviews in foreign and Indian journals of repute.

Besides they also have presented their research work at several prestigious international and national conferences. Two teachers of the department have already been awarded the 'Best Teacher Award' by the Maharashtra State.

With such a history of achievements and availability of the state-of-the-art instrumental facilities along with the expertise available with the departmental faculty it was but natural for the department to start **Post Graduate Diploma in Techniques in Chemical Industry (PGDTICI)**. This is also a step towards making the department self-reliant.

Aims and Objectives of the Post Graduate Diploma in Techniques in Chemical Industry (PGDTICI).

- a) To induce life long learning skills, attitudes for social and personal development.
- b) To provide trained manpower.
- c) To provide leadership qualities.
- d) To seek gainful employment in any chemical industry.
- e) To impart systematic knowledge of basic and applied aspects of the techniques used in chemical industries.
- f) To offer an opportunity for the candidate to develop
- g) An appreciation of quality standards
- h) Knowledge of the organisation and operation of manufacturing unit
- i) Personal and professional attitudes
- j) Management ability
- k) To develop entrepreneurship skills to run a unit of operation / production unit
- l) To develop innovation and entrepreneurship in production / research and development / quality control
- m) To develop marketing / sale skills

DRAFT SYLLABUS FOR
POST GRADUATE DIPLOMA IN
TECHNIQUES IN CHEMICAL INDUSTRY
(PGDTICI)

- Duration : 1 Year (Full Time, 2 Semesters)
- Workload : 13 Weeks per semester
- Theory : $13 \times 12 = 156$ (Say 150)
- Practicals : $13 \times 18 = 234$ (Say 240)
- Per Week : Theory :- 12 Lectures per Week
Practicals :- 3 x 6 Hrs. sessions per week
- Students Intake : 30
- Tuition Fees : Rs. 25,000/- p.a. (Rs.12,500/- per semester)
- Eligibility Criteria : A) Graduation in Science.
B) He/ She will have to qualify an Entrance
Test (ET) conducted by University
Department of Chemistry.

Course Structure

Semester- I

Paper	Theory		Practicals	
	Duration	Marks	Duration	Marks
Paper-I	50 Hrs.	50	80 Hrs.	100
Paper-II	50 Hrs.	50	80 Hrs.	100
Paper – III	50 Hrs.	50	80 Hrs.	100

Semester- II

Paper	Theory		Practicals	
	Duration	Marks	Duration	Marks
Paper-IV	50 Hrs.	50	80 Hrs.	100
Paper-V	50 Hrs.	50	80 Hrs.	100
Paper – VI	50 Hrs.	50	80 Hrs.	100
Project				100

➤ Total Marks of Semester- I + Semester- II + Project = 1000 marks

SEMISTER – I

PAPER – I

THEORY

Introduction, Principles, Theory, Instrumentation, Qualitative and Quantitative applications of –

Topic	Hrs.
1 X-ray Absorption Spectroscopy	4
2 Ultra Violet – Visible Spectroscopy (UV-Vis)	8
3 Infra Red, Fourier-Transform Infra Red, Raman spectroscopy (IR)	9
4 Nuclear Magnetic Resonance Spectroscopy (^1H -, FT-, ^{13}C - & 2D-NMR)	15
5 Electron Spin Resonance Spectroscopy (ESR)	4
6 Mass Spectroscopy (MS)	6
7 Circular Dichroism and Optical Rotatory Dichroism Spectroscopy (CD, ORD)	4

PRACTICALS :

A minimum of **any ten** of the following experiments including analysis / interpretation of data is to be carried out.

1. Determination of the Composition and Stability Constant of a Complex Formed between Fe(III) Ion and Salicylic Acid by Job's Method of Continuous Variations.
2. Estimation of Iron in Pyrolusite Ore by Colorimetry Using 1,10-Phenanthroline.
3. Estimation of Titanium Using Hydrogen Peroxide by Colorimetry.
4. Determination of Chromium and Manganese by Simultaneous Spectrophotometry.
5. Simultaneous Determination of Fe(II) and Fe(III) Using 1,10-Phenanthroline.
6. Determination of Fe(III) and a Mixture of Cu(II) and Fe(III) with EDTA by Photometric Titration.
7. Determination of Glucose by Folin-Wu Method.
8. Extractive Photometric Determination of Nickel Using DMG.
9. Colorimetric Determination of Proteins.

10. Estimation of Sugar by Lane-Eynon's Polarimetric Method and from Honey Willstatter's Method.

11. Colorimetric Determination of :

- i) Iron from Tablets.
- ii) Fluoride from Toothpaste.
- iii) Phosphorous from Milk Powder.
- iv) Titanium in Steel / Stainless Steel.

14. Interpretation of Data :

- b) Analysis of UV Spectra.
- c) Analysis of IR Spectra.
- d) Analysis of NMR Spectra.
- e) Analysis of Mass Spectra.
- f) Use of a, b, c, d above for assignment of Structure.
- g) Analysis of ESR Spectra.
- h) Analysis of Circular Dichroism and Optical Rotatory Dichroism Spectra.

PAPER – II

THEORY

Introduction, Principles, Theory, Instrumentation, Qualitative and Quantitative applications of –

Topic	Hrs.
1 Flame Photometry	5
2 Fluorimetry	5
3 Atomic Absorption Spectroscopy	5
4 Titrimetric Methods	5
5 Gravimetric Methods	5
6 X-ray Diffraction	5
7 Neutron Diffraction	3
8 X-ray Fluorescence	3
9 Turbidimetry / Nephelometry	4
10 Radioanalytical Methods	5
11 Microbiological Methods	5

PRACTICALS :

A minimum of **any ten** of the following experiments including analysis / interpretation of data is to be carried out.

1. Flame Photometric Determination of Li / Na / K by Calibration Curve and Standard Addition Method.
2. Estimation of Vitamin B₁₂ by Microbiological Assay Method.
3. Assay of Streptomycin by Microbiological Method.
4. Sterility Testing of Water for Injection.
5. Determination of Microbial Count of Sample of Sugar / Starch / Kaolin / Paste / Cream.
6. Determination of Hardness of Water (Permanent / Temporary / Total).
7. Determination of Dissolved Oxygen in Water by Winkeler's Method.
8. Determination of BOD of Water.
9. Estimation of Sodium Lauryl Sulphate and Cetrimide by Complexation with Orange II and Methylene Blue.
10. Determination of Carbonate and Bicarbonate Alkalinity of Water.
11. Limit Tests for Chloride, Sulphate, Arsenic, Iron and Lead Ions.
12. Determination of Sodium from Electral / Fasting Salt by Flame Photometry.
13. Determination of Uric Acid / Sugar / Cholesterol from Serum / Blood.
14. Statistics of Radioactive Countings.
15. Determination of Plateau of a GM Tube.
16. Determination of Half-Life of a Radioactive Isotope.
17. Gamma-Ray Spectroscopy.
18. Determination of Copper and Nickel by Electrogravimetry from Monel Metal.
19. Determination of Aluminium in Bauxite Ore by Gravimetry.
20. Determination of Titanium from Ilmenite by Volumetry.
21. Determination of Nickel from Steel / Stainless Steel by Homogeneous Precipitation.
22. Acid, Saponification and Iodine Value of Oils and Fats.
23. Non-Aqueous Titration :
 - a. Sodium Benzoate
 - b. Dizepam tablets

24. Interpretation of Data :

Analysis of X-Ray Powder Diffraction (Cubic Spectrum).

PAPER – III

THEORY

Introduction, Principles, Theory, Instrumentation, Qualitative and Quantitative applications of

Topic	Hrs.
1 Solvent Extraction	3
2 Super Critical Fluid Extraction	3
3 Paper Chromatography (PC)	3
4 Thin Layer Chromatography (TLC), High Performance–Thin Layer Chromatography (HPTLC), Column Chromatography (CC)	6
5 Gas Chromatography (GC)	6
6 High Performance Liquid Chromatography (HPLC)	5
7 Gas Paper Chromatography (GPC)	5
8 Ion Exchange Chromatography (IEC)	8
9 Chemometrics	5
10 Electrophoresis	

PRACTICALS :

A minimum of **any ten** of the following experiments including analysis / interpretation of data is to be carried out.

1. Separation of Proteins by Electrophoresis.
2. Separation and Determination of Sugar by Paper Chromatography.
3. Separation and Determination of Components of a Given Mixture by TLC :
 - Co and Mn.
 - Ni and Zn.
 - Co, Cu and Ni.

4. Separation and Analysis by Reverse Phase TLC.
5. Separation and Analysis by Column Chromatography. $\text{Cr}_2\text{O}_7^{2-}$, MnO_4^{-1} , Using Al_2O_3 Column, Mixture of Organic Compounds Using Silica Gel Column.
6. Analysis of a Mixture of Alcohols by GC.
7. Analysis of Analgesics by HPLC.
8. Analysis of Analgesics by HP-TLC.
9. Separation / Purification Using Fractional Distillation / Vacuum Distillation / Sublimation / Natural Product Extraction / Crystallization.
10. Separation of a ternary Mixture of Organic Compounds and Identification of Compounds on a Microscale.
11. Determination of Exchange Capacity and Exchange Efficiency of a Cation Exchange Resin.
12. Separation and Estimation of Co and Ni from a Mixture Using Ion Exchange Chromatography.
13. Complex Elution of Fe and Cu Using a Cation Exchange Resin.
14. Determination of Fats in Milk Powder by Soxhlet Extraction.
15. PC Separation of Food Colours and their Estimation.
16. Determination of Antioxidants by GLC-Butylated Hydroxy Anisole, Butylated Hydroxy Toluene.

SEMISTER – II

PAPER – IV

THEORY

Introduction, Principles, Theory, Instrumentation, Qualitative and Quantitative applications of

Topic	Hrs.
1 Thermo-Gravimetric Analysis (TGA)	3
2 Differential Thermal Analysis (DTA)	3
3 Differential Scanning Calorimetry (DSC)	5
4 Electro-Gravimetric Analysis (EGA)	3
5 Electron Spectroscopy for Chemical Analysis (ESCA)	3
6 Auger	3

7	PH-metry	3
8	Conductometry	3
9	Coulometry	3
10	Potentiometry	3
11	Polarography / Amperometry	7
12	Electron Microscopy (SEM, STM & TEM)	5
13	Electroplating Techniques	3
14	Magnetic Susceptibility Methods	3

PRACTICALS :

A minimum of **any ten** of the following experiments including analysis / interpretation of data is to be carried out.

1. Verification of Ostwald's Dilution Law and Determination of the Dissociation Constant of a Weak Monobasic Acid Conductometrically.
2. Titration of a Mixture of Trichloro Acetic Acid, Monochloro Acetic Acid and Acetic Acid with Sodium Hydroxide Conductometrically.
3. Determination of Concentrations / Amounts of Chloride, Bromide and Iodide from a Mixture by Potentiometric Titration with Silver Nitrate.
4. Determination of the Stability Constant of Silver Chloride Potentiometrically Using Chemical / Concentration Cell.
5. Determination of pK_a Value of Maleic Acid by Potentiometric Titration with Sodium Hydroxide Using Glass Electrode.
6. Determination of pK_a Value of Phosphoric Acid by Potentiometric Titration with Sodium Hydroxide Using Glass Electrode.
7. Estimation of Copper Potentiometrically Using Iodometric Method.
8. pHmetric Titration of Malonic Acid against a Base.
9. Determination of Magnetic Susceptibility of Fe(II) Ammonium Sulphate (Mohr's Salt) / $K_3Fe(CN)_6$ by Gouy's Method / Faraday Method.
10. Determination of Half-Wave Potential of Cd, Cu and Zn Ions in 0.1 Mole dm^{-3} KCl Solution.
11. Determination of Concentration of Lead in Solution by Amperometric Titration with $K_2Cr_2O_7$.

12. To Study the Redox Behavior of $K_3Fe(CN)_6$, $K_4Fe(CN)_6$ by Cyclic Voltammetry.
13. Gas Analysis Using Orsat Apparatus.
14. Conductometric Determination of Acetic Acid from Vinegar.
15. Determination of Sulphur from Coal and Coke by ESCA Method.
16. Analysis of Lindane in BHC by Polarography.
17. Determination of Moisture by Karl-Fischer.
18. Estimation of C, H and N by dry combustion method.
19. Estimation of Cl, Br and S by Schrodinger oxygen flask method.
20. Interpretation of Data : Analysis of DTA, TGA, DSC Curves.

PAPER – V

THEORY

Introduction, Principles, Theory and Instrumentation of

Topic	Hrs.
I Methods for Determination of Molecular Weight of Polymers	15
A Physical Methods:	
1 Vapour Pressure Change	
2 Cryoscopic Change	
3 Ebullioscopic Change	
4 Osmotic Pressure	
5 Light Scattering	
6 Sedimentation Measurements / Ultra Centrifugation	
B Chemical Methods:	
End Group Analysis	
C Indirect Measurements:	
Viscosity Measurements	
II Moulding Methods for Plastics	8
III Casting Methods for Plastics	2
IV Fabrication Techniques in Plastics	4
V Testing of Plastics	15
VI Calendering / Thermoforming / Foaming Process / Laminates	6

PRACTICALS :

A minimum of **any ten** of the following experiments including analysis / interpretation of data is to be carried out.

1. Determination of tensile strength and % elongation at break for given plastic and rubber samples.
2. To evaluate scratch hardness of polymeric films using automatic scratch hardness tester.
3. Determination of scratch hardness of elastomeric films using Shore A and Shore D hardness testers.
4. Determination of Impact resistance of plastic specimens and polymeric films using falling ball type impact tester.
5. Determination of gloss / sheen of polymeric coating films at 30° , 60° , 80° angles by using gloss-o-meter.
6. Evaluation of flexibility of coating films using conical / cylindrical mandrel bend test.
7. Determination of % adhesion of polymeric films on different substrates by cross hatch adhesion test.
8. Determination of density of polymer sample (solid granules) using Pyknometer.
9. Determination of % swelling or crosslink index of given specimen by solvent swelling study in different solvents.
10. Determination of viscosity of given polymer solution using Brookfield Viscometer.
11. Determination of viscosity of given polymer solution using Ostwald Viscometer and hence determination of molecular weight of the polymer.
12. Determination of molecular weight of given polymer by end group analysis from acid value determination of sample.
13. Determination of molecular weight of given polymer by end group analysis from hydroxyl value determination of sample.
14. Determination of radius of a molecule by viscosity measurements.
15. Determination of unsaturation present in a given polymer / oil sample using iodine value (Wij Solution Method).
16. Determination of -NCO value of given polyurethane sample.
17. Determination of carbonyl value of given polyester sample.

18. Determination of amine value of given polyamide sample.
19. Identification of functional groups present in given polymers by chemical spot test.
20. Interpretation of spectra of polymers to identify the chemical type of polymer- IR, NMR.

PAPER – VI

THEORY

Introduction, Principles and Practice of

Topic	Hrs.
1 Management Information System : Structural system analysis and design. i) Tools and techniques. ii) Documentation. iii) Detailed SAD procedures. iv) Information system concepts and Information Technology, Quality Assurance i) Basic principles of quality management, designing principles, etc. ii) Maintainability iii) ISO iv) CMM	8
2 Cost Accounting, Financial Accounting and Taxation : Basic concepts, Profit and Loss Account and related concepts, balance sheet and related concepts, inventory accounting, understanding networth, reserves, provisions, intangible assets, fictitious assets, revenue vs capital fixed assets, prime cost, work cost, etc., material, labour, overhead expenses, costing methods, working capital management, cost of capital and financial analysis and interpretation. a) Direct taxes i) Heads of income and computation thereunder. ii) Salaries. iii) Business income. iv) Capital gains. v) Other sources. vi) Exclusion and deductions from total income. b) Sales tax. i) Central sales tax and its scope. ii) Tax on work contract.	15

- iii) Purchase tax.
 - 1. Implication of branch transfers and consignment.
 - 2. Bombay sales tax
 - c) Excise duty.
 - i) Definition and valuation principles.
 - ii) MODVAT / job work.
 - iii) Self removal procedure.
 - iv) Classification list / price list.
 - v) Small scale industries – concessions / exemptions.
- 3 Sales and Distribution Management 8

Sales organisation and role of sales management in organisation, selling functions, sales management planning, sales budgeting and planning for quota, manpower planning, time and territory management, roles of channels and distribution, sales incentives, sales force, its performance, evaluation and control.
- 4 Marketing Finance : 4
 - a) Management of Sales Revenue
 - i) Sales Revenue as an integral element of cost – revenue – investment.
 - ii) Marketing cost by function, management of sales revenue analysis.
 - b) Marketing Investment :
 - i) Management of accounts receivables and inventories.
 - ii) Export marketing and finance.
 - iii) Export costs and pricing.
 - iv) Export credit tax concession.
 - c) Application and forecasting techniques for developing, marketing, budgeting.
 - d) Warehousing, transportation decisions. The concept of marketing cost and value measuring.
- 5 Operation Research 4

Inventory management, transportation problems, sequencing problem, linear programming problem, PERT-CPM analysis.
- 6 Patenting and Intellectual Property Rights 3
- 7 Innovation and Enterprenuership 8
 - i) Concept of enterprenuership and emergence of entrepreneurial class, theories of enterprenuership, characteristics of entrepreneurial leadership.
 - ii) Risk taking, decision taking and business planning.
 - iii) Analysis of business opportunities.
 - iv) Techno-economic feasibility studies and developing detailed project report for implementation.
 - v) Financial incentives and sources of finance.

PRACTICALS :

A minimum of **any ten** of the following experiments including analysis / interpretation of data is to be carried out.

1. Group Discussion.
2. Molecular Orbital Calculations for Simple Molecules Using Computer Program.
3. Preparing a Balance Sheet / Feasibility Report.
4. Preparation of
 - a) Organic Compounds –
 - Acetanilide → p-Nitroacetanilide → p- Nitroaniline → p-Iodonitrobenzene.
 - m-Dinitrobenzene → m-Nitroaniline → m-Nitrochlorobenzene → m-Nitrophenol.
 - p-Nitrotoluene → p-Nitrobenzoic Acid → p-Aminobenzoic Acid.
 - Maleic Anhydride → N-Phenylmaleimide → Anthracene Adduct.
 - Phthalic Anhydride → Phthalimide → Anthranilic Acid.
 - Aldehyde → Nitrostyrene → 1-Phenylacetone.
 - Benzoylchloride → Benzophenone → Benzhydrol.
 - Hydroquinone Diacetate → 2-Acetyl-1,4-dihydroxybenzene.
 - Benzophenone → Benzophenone oxime → Benzanilide.
 - b) Inorganic Compounds –
 - Ni-DMG.
 - Hexamine Cobaltic Chloride.
 - Copper Acetylacacetate.
 - Potassium Permanganate.
 - Sodium Dioxalato Ferrate Trihydrate.
 - Aluminium Chloride Hexahydrate.
 - Tri (Thiourea) Cuprous Chloride.
 - Sodium Thioisulphate Pentahydrate.

REFERENCES :

THEORY

PAPER - I

1. **Principles of Instrumental Analysis**; D. S. Skoog, F. J. Holler and J. A. Nieman *Saunders* (1998).
2. **Fundamentals of Analytical Chemistry**; D. S. Skoog, D. M. West and F. J. Holler., *Holt-Saunders* (1992).
3. **Analytical Chemistry**; G. D. Christian., *John Wiley* (1986).
4. **Instrumental Methods of Analysis**; H. H. Willard, L. L. Meritt Jr. J. A. Dean and F. A. Settler Jr., *CBS* (1986).
5. **Introduction to Instrumental Analysis**; R. D. Brown., *McGraw Hill* (1987).
6. **Spectrometric Identification of Organic Compounds**; T. C. Morrill, R. M. Silvester and G. C. Bassler., *Wiley* (1981).
7. **Organic Spectroscopy**; V. R. Dani., *Tata-McGraw Hill* (1995).
8. **Physical Methods in Inorganic Chemistry**; R. S. Drago.,
9. **Instrumental Methods of Analysis**; G. W. Ewing., *McGraw Hill*
10. **Principles and Practice of X-Ray Spectrometric Analysis**; E. D. Bertin., *Plenum Press* (1975).
11. **Fundamentals of Molecular Spectroscopy**; C. N. Bamwell., *Tata-McGraw Hill* (1991).
12. **Molecular Spectroscopy**; P. S. Sadhu., *Tata McGraw-Hill*
13. **NMR**; P. J. Horne., *Oxford Univ. Press* (1995).
14. **Spectroscopy**; B. P. Stutgham and S. Walker., *Chapman & Hall* (1992).
15. **Spectroscopy in Inorganic Compounds**; C. N. R. Rao and G. R. Eerrane., *Academic Press* (1970).
16. **Basic Principles of Spectroscopy**; R. Handey., *McGraw Hill*.
17. **Elements of Magnetochemistry**; A. Syamal and R. L. Dutta., *S. Chand & Co.* (1983).
18. **Molecular and Atomic Spectroscopy**; J. M. Hollas., *Wiley*
19. **NMR**; R. K. Harris., *Pitman*

20. **Theory and Practice of IR Spectroscopy**; (1970).
21. **Symmetry and Spectroscopy**; D. C. Harris and M. D. Bertolucci., *Oxford Univ. Press* (1978).

PAPER – II

1. **Principles of Instrumental Analysis**, 5th Ed.; D. S. Skoog, F. J. Holler and J. A. Nieman., *Saunders* (1998).
2. **Fundamentals of Analytical Chemistry**, 7th Ed.; D. S. Skoog, D. M. West and F. J. Holler., *Holt-Saunders* (1996).
3. **Analytical Chemistry**; G. D. Christian., *John Wiley & Sons* (1986).
4. **Instrumental Methods of Analysis**; H. H. Willard, L. L. Meritt Jr. J. A. Dean and F. A. Settler Jr., *CBS* (1986).
5. **Introduction to Instrumental Analysis**; R. D. Brown., *McGraw Hill* (1987).
6. **Theory of X-Ray Diffraction in Crystals**; W. H. Zachariasen., *John Wiley* (1946).
7. **X-Ray Diffraction in Crystals**; A. Gurinier and W. H. Freeman., (1963).
8. **Elements of X-Ray Diffraction**; B. D. Cullity., *Addison Wessley* (1967).
9. **Principles and Practice of X-Ray Spectroscopic Analysis**; E. P. Bertin., *Plenum Press* (1975).
10. **X-Ray Diffraction Procedures**; H. Clug, D. Alexander and E. Leroy, *John Wiley* (1954).
11. **Diffraction Methods**; J. Wormald., *Oxford Univ. Press* (1973).
12. **Neutron Scattering in Chemistry**; G. E. Bacon., *Butterworth* (1977).
13. **Thermal Neutron Scattering**; P. A. Egelstaff., *Academic Press* (1965).
14. **Physical Methods in Chemical Analysis**; W. G. Berl., *Academic Press* (1961).
15. **An Instrumental Approach**; A. K. Srivastava and P. C. Jain., *S. Chand* (1980).

PAPER – III

1. **Chromatographic Separations in Analytical Chemistry by Open Learning**; P. G. Swell and B. Clarke., *John Wiley* (1987).
2. **High Performance Liquid Chromatography Analytical Chemistry by Open Learning**; S. Lindsay., *John Wiley* (1987).
3. **Chemical Separation Methods**; J. A. Dean., *Van Nostrand Reinhold*

4. **Solvent Extraction Chemistry**; T. Skine and Y. Hasegawa., *Marcell Dekker & Co.* (1980).
5. **Solvent Extraction: Principles and Applications to Process Metallurgy**; G. M. Rittory and A. W. Ashbrook., *Elsevier* (1984).
6. **Solvent Extraction and Ion Exchange**; J. Marcus and A. S. Kertes., *Wiley Interscience* (1969).
7. **Solvent Extraction in Biotechnology**; K. Schugert., *Springer Varlay* (1994).
8. **Super Critical Fluid Extraction**; Larry, Taylor., *Wiley* (1996).
9. **Extraction Chromatography**; T. Brown and G. Cherrene., *Elsevier* (1978).
10. **Ion Exchange Separation in Analytical Chemistry**; O-Samuelson., *John Wiley* (1963).
11. **Ion Exchange Chromatography**; Ed. H. F. Walton.; *Honden, Hutchinson and Ross* (1976).
12. **Ion Exchange in Analytical Chemistry**; H. F. Walton and W. Reiman., *Pergamon Press* (1970).
13. **Chemical Separations and Measurements – Introduction to Separation Science**; B. L. Kauger, L. R. Snyder and C. Howath., *Wiley* (1973).
14. **Chromatographic and Electrophoresis Techniques**; J. Smith, Mineman., *Interscience* (1960).
15. **Principles and Practice of Analytical Chemistry**; F. W. Fifield
16. **Instrumental Methods of Chemical Analysis**, 4th Ed.; G. W. Ewing and D. Kealey, *McGraw Hill*
17. **Analytical Chemistry**; Ed. by R. Kellner, J. M. Mermet, M. Otto and M. Wilmer., *Wiley* (1998).
18. **Encyclopedia of Analytical Science**; *Academic Press*
19. **Radioisotope Techniques**; Overman and Clarke., *McGraw Hill* (1960).
20. **Radioisotope Laboratory Techniques**, 4th Ed.; R. A. Faires and G. G. J. Boswell., *Butterworths* (1981).
21. **Nuclear Analytical Chemistry**; D. Brune, B. Forkman and B. Persson., *Chartwell-Bratt* (1984).
22. **Substoichiometry in Radiochemical Analysis**; J. Ruticka and J. Stary, *Pergamon*.

PAPER – IV

1. **Thermal Analysis**, 3rd Ed.; W. W. Wendlandt., *John Wiley* (1986).
2. **Thermal Analysis**; Ed. by W. W. Wendlandt and L. W. Collins., *Dowden Hutchinson* (1976).
3. **Industrial Applications of Surface Analysis**; L. A. Casper and C. J. Powell, *ACS* (1982).
4. **Electrochemical Methods: Fundamentals and Applications**; A. J. Bard and L. R. Faulkner., *John Wiley* (1980).
5. **Electricity and Chemistry**; J. J. Lingane., *Interscience* (1958).
6. **Modern Polarographic Methods in Analytical Chemistry**; A. H. Bond., *Marcell and Dekker* (1980).
7. **Cyclic Voltammetry and Frontiers in Electrochemistry**; M. Noel and K. I. Vasu, *IBH* (1990).
8. **Electroanalytical Chemistry**; A. J. Bard., *Marcell and Dekker*
9. **Electron Microscopy in the Study of Materials : Structures and Properties of Solids**, 7th Ed.; P. J. Grundy and G. A. Jones., *Edward Arnold, London* (1976).
10. **Thermal Analysis : Comparative Studies on Materials**; H. Kambe and P. D. Garn., *Kudanshe Ltd.* (1974).
11. **Fundamentals of Analytical Chemistry**; D. A. Skoog., *Saunders* (1992).
12. **A Basic Concept of Analytical Chemistry**; S. M. Khopkar., *Wiley Eastern* (1988).

PAPER – V

1. **Techniques of Polymer Characterization**; F. Prince, *P. W. Allen edition*, NY
2. **Polymer Science and Technology**; J. R. Fried, *Eastern Economy Publishers*.
3. **Text Book of Polymer Science**; P. L. Nayak, *Kalyani Publishers*.
4. **Experimental Methods in Polymer Science**; Toyochi Tanaka
5. **Physical Properties of Polymers**; James E. Mark et al

PAPER - VI

Cost Accounting and Financial Accounting :

1. **Mergers, restructuring and corporate control;** J. F. Weston, K. S. Chung and S. E. Hoag., *Prentice Hall* (1996).
2. **Valuation – Measuring and Managing the Value of Companies;** T. Copland, T. Collier and J. Murrin., *John Wiley* (1997).

Taxation – Books Published by Govt. of India.

Marketing and Finance :

1. **Financial Engineering;** J. M. Marshall and V. K. Bansal., *Prentice Hall* (1996).
2. **Management Control System;** Anthony and Govind Raj., *Irwin* (1994).

Innovation and Enterprenuership :

1. **Enterprenuership – Starting Developing and Managing a New Enterprise;** D. Robert Hisrich and P. Peters Michael., *Irwin* (1995).
2. **Leading Change;** J. P. Kotler., *Harvard Business Press* (1996).
3. **The Outline of Success;** J. Zimmerman and F. Ben., *McGraw Hill* (1997).
4. **Vision in Action;** J. Zimmerman and F. Ben., *McGraw Hill* (1997).

Sales and Distribution Management :

1. **Retail Management – A Strategic Approach;** Berman and Evans., *Prentice Hall* (1995).
2. **Marketing Channels;** Stern and E. L. Ansary., *Prentice Hall* (1996).
3. **Sales Management;** Still Cundiff and Govoni., *Prentice Hall* (1996).
4. **Sales Force management : Planning, Implementation and Control;** Churchill Neil and Walker, *Irwin Hamerwood II*

Operation Research :

1. **Production and Operation Management;** E. S. Buffa and R. Sarin., *Wiley* (1994).
2. **Production and Operation Management;** E. E. Adams and R. J. Ebert., *Prentice Hall* (1994).
3. **Production, Planning and Control;** S. I. Narsimhan, D. W. McLeavey and P. J. Billington., *Prentice Hall* (1997).
4. **Manufacture, Planning and Control;** T. Vollman, W. E. Berry and Whyback., *McGraw Hill* (1997).

5. **Transportation, Investment and Pricing Principles**; Hendrikson and Wolh., *John Wiley* (1984).

PRACTICALS :

1. **Practical Organic Chemistry Including Organic Analysis**; A. I. Vogel, *ELBS, Longman*.
2. **A Text Book of Quantitative Inorganic Analysis**; A. I. Vogel, *ELBS, Longman*.
3. **Photometric Determination of Traces of Metals, General Aspects**; E. B. Sandell and H. Ohishi.
4. **Synthetic Inorganic Chemistry**; W. L. Jolly, *Prentice-Hall* (1965).
5. **Preparative Inorganic Chemistry**; Brown
6. **Systematic Qualitative Organic Analysis**; H. Middleton, *Orient Longman* (1971).
7. **Macroscale and Microscale Organic Experiments**; K. L. Williamson, 2nd Ed., *D. C. Heath & Co* (1994).
8. **Microscale Organic Laboratory**; D. W. Naya, R. M. Rike and S. Butcher., *John Wiley and Sons*.
9. **An Introduction to Microanalytical Experiments in Organic Chemistry**; R. M. Roberts, T. C. Gilbert, C. B. Rodewald and A. S. W , *Holt, Rinehart and Winston Inc.*
10. **Experiments and Techniques in Organic Chemistry**; D. J. Pasto, C. R. Johnson and M. J. Miller., *Prentice-Hall* (1992).
11. **A Handbook of Organic Analysis**; H. T. Clarke, Revised by Haynes., *Edward Arnold*.
12. **Quantitative Organic Analysis, Part-III**; A. I. Vogel., *CBS*.
13. **Indian Pharmacopoeia**
14. **Encyclopedia of Industrial Chemical Analysis**; F. D. Snell and L. S. Elter., *Interscience*.
15. **Official Methods of Analysis of the Association of Official Analytical Chemists**
16. **Handbook of Physiological Chemistry**; *McGraw-Hill*
17. **Colorimetric Analytical Methods**; L. C. Thomas, *GJ*
18. **Practical Physical Chemistry**; A. M. James and F. E. Richard., *Longman* (1974).

19. **Systematic experimental Physical Chemistry**; S. W. Rajbhoj and T. K. Chandorkar., *Ajanta Pub., Aurangabad*.
20. **Experimental Inorganic Chemistry**; W. G. Palmer., *Cambridge Univ. Press*.
21. **The Systematic Identification of Organic Chemistry**; R. L. Shriner, *John Wiley*.
22. **Laboratory Manual of Organic Chemistry**; B. B. Dey and M. V. Sitaraman, Revised by T. R. Govindachari., *Allied Pub*.
23. **Experimental Physical Chemistry**; V. D. Athawale and P. Mathur., *New Age International Pub.* (2001).

Budget

Receipts	Expenditure
Tuition Fees :	1) Honorarium per annum for :
25,000 x 30 = Rs 7,50,000	a) Lectures :
	200 x 300 = Rs. 60,000
	b) Conducting practicals :
	100 x 480 = Rs. 48,000
	c) Laboratory staff :
	i) Laboratory Assistant :
	30 x 480 = Rs. 14,400
	ii) Laboratory Attendant:
	15 x 480 = Rs. 7,200
	Total Rs. 1,29,600
	2) Incidental Expenses for :
	a) Course Director : Rs. 36,000
	b) Course Coordinator: Rs. 30,000
	Total Rs. 66,000
	3) Consumables = Rs. 1,50,000
	4) Equipments / Instruments :
	Rs. 1,50,000
Rs. 7,50,000	Rs. 4,96,600

Surplus = Rs. 7,50,000 – Rs. 4,96,600 = Rs. 2,53,400