

UNIVERSITY OF MUMBAI

No.UG. 470 of 2004

MUMBAI-400 032

2nd November, 2004

The Director,
University Institute of Chemical Technology,
University of Mumbai,
Matunga,
MUMBAI-400 019.

Sir,

I am to invite your attention to the Bachelor of Technology (B.Tech.) degree course vide pamphlet No.50 and to inform you that the recommendation made by the Board of Studies in Chemical Technology at its meeting held on 25th March, 2004 has been accepted by the Academic Council at its meeting held on 18th June, 2004 vide item No.4.9 and subsequently approved by the Management Council at its meeting held on 31st July, 2004 vide item No.17 and that in accordance therewith Ordinances and Regulations including revised scheme, syllabi and standard of passing relating to the Bachelor of Technology (B.Tech.) degree course is as per Appendix.

They are further informed that the Management Council under Section 54(1) and Section 55(1) of the Maharashtra Universities Act 1994, has made the Ordinances 5433, 5434, 5435, 5436, 5437, 5438, 5439, 5440, 5441, 5442, 5443, 5444, 5445, and 5446 and the Regulations 4767, 4768, 4769, 4770, 4771, 4772, 4773, 4774, 4775, 4776, 4777, 4778, 4779, 4780, 4781, 4782, 4782-A, 4783, 4784, 4785, 4786, 4787, 4788, 4789, 4790, 4791 and 4492 respectively relating to the Bachelor of Technology (B.Tech.) degree course is as per Appendix, and that the same has been brought into force with effect from the academic year 2004-2005.

MUMBAI-400 032

2nd November, 2004

AC/4.9/18.06.2004
MC/17/31.07.2004


for I.C. REGISTRAR

No.UG/ 470-A of 2004, MUMBAI-400 032

2nd November, 2004

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UNIVERSITY OF MUMBAI



Ordinances, Regulations and Syllabus Relating to Bachelor of Technology (B.Tech.) Degree Course

(with effect from the academic year 2004-2005)

UNIVERSITY OF MUMBAI



Ordinances, Regulations and Syllabus Relating to Bachelor of Technology (B.Tech.) Degree Course

(with effect from the academic year 2004-2005)

UNIVERSITY OF MUMBAI
INSTITUTE OF CHEMICAL TECHNOLOGY
MATUNGA, MUMBAI 400 019

Ordinances, Regulations, and Syllabus relating to the Degree of Bachelor of Technology (B. Tech.)

O. 5433- A candidate seeking admission to the degree of Bachelor of Technology must produce a certificate to the effect that he/she has passed the Higher Secondary School Certificate (Std. XII) Examination conducted by the Maharashtra State Board of Higher Secondary Education or its equivalent examination with the following subjects.

- i) Chemistry
- ii) Physics
- iii) Mathematics
- iv) English

O. 5434 The candidate should have minimum of 50% marks at the qualifying examination (45% marks in the case of Backward Class candidates belonging to the state of Maharashtra).

O. 5435 For the purpose of admission to the B.Tech. degree course the marks in the subjects of Physics, Chemistry, and Mathematics at the qualifying examination will be taken into consideration and the candidate should have secured minimum of 50% marks i.e. 150 marks out of 300 marks (45% i.e. 135 marks out of 300 marks for Backward Candidates from Maharashtra State) in these subjects.

R. 4767 The course of study for the degree of B. Tech. shall be of eight Semesters duration and shall comprise of the following specializations:-

- i) Dyestuff Technology (Dyes)
- ii) Fibres and Textile Processing Technology (Textile)
- iii) Food Engineering and Technology (Food)
- iv) Oils, Surfactants, and Oleochemicals Technology (Oils)
- v) Pharmaceutical Chemistry and Technology (Pharma)
- vi) Polymer Engineering and Technology (Polymer)
- vii) Surface Coating Technology (Paints)

[The abbreviations given in the brackets against the technology specialization shall be used in the tables which follow.]

O. 5436 The candidate shall be required to pass eight Semester examinations (Semesters I to VIII).

O. 5437 The candidate failing to pass any one Semester examination may be allowed to appear subsequently for the same examination after paying the requisite examination fee and submitting a fresh application.

O. 5438 All the eight Semester examinations shall be conducted by the Director, MUICT.

O. 5439 Each semester examination shall be conducted at the conclusion of the respective semester.

O. 5440 For those who fail in a semester examination, a repeat examination will be held within a month of the declaration of the result of the respective semester examination.

O. 5441 Notwithstanding anything contained in 0.3795 and 0.3796, a candidate who has failed in the subject head "Seminar" at the Semester VII, but has passed in the other heads of the VIIth Semester examination with 50% or more marks in each head, may enroll for the "Seminar" separately by paying the requisite tuition fee and submitting a fresh application for the VIIth Semester and complete the Seminar task in the VIIIth Semester, provided further that such a candidate pursues the course context of the VIIIth Semester along side to the satisfaction of the Director, MUICT.

R. 4768 (a) To ensure uniform attention of students to their work throughout each semester of their study, the marks at each examination shall be awarded jointly on the basis of semester examination and periodic test/class work, in the following proportion: Seventy percent of the marks to each of the theory / practical head at the semester examination and thirty per cent of the marks to the periodic test/class work of the respective theory / practical head.

(b) The periodic test for each theory head shall be held during the semester. The marks obtained by the students in the periodic tests and class works shall be recorded in the office of the Institute. These marks shall be carried over, unless fresh marks are submitted.

(c) If a candidate fails to appear at a periodic test or fail in the same, he/she may be permitted to appear at the same test next year after paying the requisite fee OR he/she may be permitted to repeat the course work of the respective subject by paying the tuition fee and permitted to appear at the corresponding periodic test.

R. 4769 The marks assigned to a course work for which there is no formal Semester examination, shall be called as Term Work (TW) marks and shall be transmitted to the Director by the heads of the division before commencement of the respective semester examination. These TW marks shall be carried over to subsequent examination unless fresh marks are submitted. A candidate whose TW marks are thus carried over shall be eligible for a class. The minimum passing for a head "Term Work" shall be 50% of the marks allotted to that head.

R. 4770 To pass each Semester Examination a candidate must obtain a minimum of 40 per cent of the marks allotted to each head for which there is a formal examination as well as obtain a minimum of 50 per cent of the total marks assigned to the entire examination.

R. 4771 (a) Successful candidates shall be awarded class on the basis of their marks obtained in the seventh and eighth semesters taken together as described below. :-

- | | | |
|-------|---|------------------------------|
| (i) | Those obtaining 50 per cent and above, but below 60 per cent of the total marks | Second Class |
| (ii) | Those obtaining 60 per cent and above, but below 70 per cent of the total marks | First Class |
| (iii) | Those obtaining 70 per cent of the total marks and above | First Class with Distinction |

(b) The above part of the regulation regarding the award of class shall also be applicable to the candidates passing the entire Seventh and Eighth semester examinations with all heads of passing, each semester examination cleared in one sitting.

R. 4772 a) For any semester examination, a candidate shall be declared failed if he/she secures less than 50% aggregate marks of all the passing heads of that semester OR he/she fails in two or more heads of passing OR he / she fails in any of the Term Works.

(b) The candidate who has failed in a Semester examination due to failure in a Term Work has to take fresh admission for that term and complete the Term Work.

(c) A candidate who has not passed in only one of the passing heads, but has passed in the other heads and also has obtained 50% or more of the aggregate marks in these remaining heads shall be allowed to keep terms (ATKT) for the next semester. This condition does not apply to failure due to failure in a Term Work.

(d) The class, as given in R 3949 (b), shall not be awarded to candidates who clear the semester VII and VIII examinations in parts either through Repeat Tests or Regular Semester examinations.

R. 4773 The candidate who has failed at any semester examination, shall be allowed to appear for the entire or part of the semester examination subject to the following

(a) The passing head in which the candidate has secured more than 50 % of the marks allotted to that head of passing at his option, shall be declared exempted from appearing in that head at the subsequent examination. Such marks shall be carried over.

(b) The candidate may opt to appear for examination in any number of heads at the respective semester examination.

(c) The criteria of passing shall be as given in R 3949 (a)

(d) The candidate availing the benefit of (a) and (b) above shall not be eligible for awarding a Prize, or a Scholarship.

O. 5442 The candidates seeking admission to the fifth semester should have clearly passed the first two semesters (Sem. I & II), while those seeking admission to the seventh semester should have clearly passed the first four semesters (Sem. I to IV)

R. 4774 (a) The candidates studying in the VIIIth semester shall be assigned an experimental "Project" work by the respective division, at least four months prior to the final semester examination.

(b) The candidate shall work under the supervision of a faculty member and submit the report of the work done, with certification from the respective supervisor and the head of the division.

(c) The marks to the project shall be allotted on the basis of experimental work, written report, and the performance in the oral examination.

(d) The candidate must obtain minimum of 50 % marks, allotted to pass this head.

(e) The marks allotted to the project shall be carried over for the candidates who have not passed the semester VIIIth examination.

(f) The candidate who fails to pass the project head shall have to take fresh admission to the VIIIth semester by paying the tuition fee for semester VIII. Such a candidate shall be given a new topic for the project work.

O. 5443 Candidates who have either passed clearly or secured ATKT at the first and / or second semester examinations shall be admitted to the third semester.

O. 5444 Candidates who have passed the first and second semester examinations, and either passed clearly or secured ATKT at the third and /or fourth semester examinations shall be admitted to the fifth semester.

O. 5445 Candidates who have passed the first to fourth semester examinations, and either passed clearly or secured ATKT at the fifth and /or sixth semester examinations shall be admitted to the seventh semester.

O. 5446 Candidates who have passed the Bachelor of Technology Degree examination and who wish to improve their class or percentage of marks be permitted to appear again for the same examination with the same subjects (all subjects of Semester VII and VIII, theory and practical together) without being required to keep any term again. This provision shall be applicable to subsequent not more than three consecutive examinations conducted by the Institute. The marks obtained by the candidate in Seminar / Project / Term Work / Class Work / Periodic Tests shall be carried forward for these consecutive examinations.

R. 4775 To be eligible to appear at any Semester examination a candidate must have kept the respective term satisfactorily

R. 4776 At the end of the sixth semester every candidate shall be required to work for at least six weeks in an approved chemical factory or works, where industrial operations relevant to his/her course of study are carried out. The candidate shall submit a satisfactory report of the work carried out to the Director.

R. 4777 A candidate desirous of improving his/her class, as given in R (b), can do so by appearing at the seventh as well as eighth semester examinations with all subject heads at appropriate times in single attempts. Such a candidate may opt for carrying over his/her marks for the project work.

First Year Course in Bachelor of Technology

SEMESTER I

R. 4778 The candidate shall be examined in the subjects at the Semester I examination as indicated in the following tables.

Theory Papers

Sr. No	Subject	No. of Paper	Examination		Periodic Test Marks	Total Marks
			Hours	Marks		
1.	Communication Skills	1	2	35	15	50
2.	General Chemistry	1	2	35	15	50
3.	Organic Chemistry I	1	3	70	30	100
4.	Applied Physics I	1	3	70	30	100
5.	Computer Applications	1	2	35	15	50
6.	Mechanical Engineering	1	3	70	30	100
	Total	6	—	315	135	450

Practical Examinations

Sr. No	Subject	Examination		Class Work Marks	Total Marks
		Hours	Marks		
7.	Inorganic Chemistry	3	35	15	50
8.	Organic Chemistry I	3	35	15	50
9.	Computer Lab I	3	35	15	50
10.	Engineering Drawing I (Term Work)	—	—	50	50
	Total	—	105	95	200

Grand total at the Examination

650

R. 4779 The following are the syllabi of the various subjects at the Semester I examination.

Semester I

Theory

1. *Communication Skills*

(2 hrs/week)

What is communication? Importance of communication, barriers to communication, verbal and non verbal communication, oral and written communication, techniques to improve communication, internal and external communication

Business correspondence: a) principles of correspondence, language style, tone. b) Form of the business letter, formats. c) Types of business letters. Application letter with biodata. Enquiries, Reply to enquiry, Claims, Adjustments, Sales letters

Group discussion: Importance of Group discussion, techniques of group discussion. Précis writing: Importance of Précis, techniques of précis writing, one word substitution précis of passages, summaries of letters, reports, short messages.

Report writing: What is report, qualities of Reports, Formats (letter report, Memorandum, Book report).

Reports: Informative report, current event report.

Special type of exposition: a) description of object, b) explanation of process, c) giving instructions-oral instructions, written instructions

2. *General Chemistry*

(2 hrs/week)

Periodic variation of properties: Size of atom and ion., ionization energy, electron affinity, electronegativity, Born-Haber cycle, metallic character, standard electrode potential and electrochemical series, melting and boiling points, thermal and electrical conductivity, horizontal and vertical relationship in periodic table. (8)

Bonding: Hybridization, application of molecular orbital theory to simple organic compounds, types of bonds, H-bonding (8)

Acids and Bases: Acid-base concepts - Arrhenius, Bronsted, Lewis, HSAB, Super acids, inorganic and organic acids and bases and their properties. (5)

Nuclear chemistry: Radioactivity - natural and artificial radioactivity, half life, radio-dating, applications of radioisotopes; nuclear fission and fusion; nuclear energy and its applications, Nuclear reactions and synthesis of new elements, Neutron activation analysis. (4)

Green chemistry: Principles of green chemistry with explanation, and applications of each. E-factor, Atom economy/selectivity- concepts and numerical examples of these. (5)

Reference Books:

1. Advanced Chemistry, P. Matthews, Cambridge University Press, 1996.
2. Essentials of Nuclear Chemistry, H. J. Anikar, John Wiley and sons, 1982.
3. University General Chemistry, C. N. R. Rao. Mac Millan Publications.

3.Organic Chemistry - I

(4 hrs/week)

Electronic theory: Types of bonds and bond fission processes, resonance effect and hyperconjugation, tautomerism, ylides.

Reaction Intermediates: Generation, structure and general reactions of carbocations, carbanions, free radicals and carbenes, Electrophiles and nucleophiles. (5)

IUPAC Nomenclature: Systematic IUPAC nomenclature of different classes of aliphatic polyfunctional compounds. (4)

Stereochemistry: Classification of stereoisomers, diastereomers, Separation of enantiomers. Absolute configuration (*R/S*, *E/Z*). Projection formulae. Stereochemistry of compounds containing two asymmetric C-atoms. Elements of symmetry, **Conformation** - conformations around a C-C bond in acyclic compounds. Structure of cycloalkanes - Strains in cyclic compounds, Stereochemistry of cyclohexane and substituted cyclohexanes, Geometrical isomerism, Stereoselective and stereospecific reactions. (6)

Alkanes: Source, Cracking and reforming, reactions. (3)

Alkenes: Methods of preparation and important reactions, Markownikoff rule with explanation and peroxide effect. Dienes- types of dienes and their characteristic reactions, Polymerization of olefinic compounds. (5)

Alkynes: Methods of preparation and important reactions. (3)

Haloalkanes: Methods of preparation and important reactions. S_N reactions, Walden inversion, Neoclassical carbenium ion, NGP involvement, Grignard reagent- Formation and reactions. (8)

Alcohols: Methods of preparation and general reactions, Pinacol rearrangement. Thiols and thioethers. (8)

Aldehydes and ketones: Methods of preparation and important reactions- 1,2-addition, substitution at the alpha position, aldol and related reactions such as, Claisen, Knoevenagel, Claisen ester, Dieckmann, Darzen, Stobbe, Perkin, Reformatsky, Cannizzaro. Examples of syntheses involving active methylene group leading to C-C bond formation. (8)

Carboxylic acids and their derivatives: Methods of preparation and general reactions. (4)

Ethers: Methods of preparation of ethers and general reactions of ethers. Preparation of epoxides and their reactions and applications. (3)

Amines: Basicity of amines, general methods of preparation and general reactions of amines, Hoffmann elimination, preparation and uses of quaternary salts. (3)

Reference Books

1. Organic Chemistry, J. McMurry, 5th Edition, Brooks/Cole.1999.
2. Organic Chemistry, T. W. G. Solomons, C. B. Fryhle, 8th Edition, John Wiley and Sons Inc, 2003.
3. Organic Chemistry, G. Marc Loudon, 4th Edition, Oxford university Press, 2002 (Indian Reprint).
4. Organic Chemistry, L. G. Wade Jr., 5th Edition, Pearson Education, 2003 (Indian Reprint 2004).
5. Stereochemistry of Carbon Compounds, E. L. Eliel, McGraw-Hill, 2003

6. Stereochemistry: Conformations and mechanism, P. S. Kalsi, Wiley Eastern Ltd.
7. Stereochemistry and mechanism through solved problems, P. S. Kalsi 3rd Edition New Age International Pvt. Ltd.
8. Organic Chemistry, I. L. Finar, Vol I & II Logmans ELBS.

4. Applied Physics - I

(4 hrs/ week)

Section I

Heat:

Modes of heat transfer:

Conduction: Thermal conductivity - good/bad conductor, One-dimensional flow of heat (Fourier equation), Determination of thermal conductivity - Searle's and Lee's methods. Conduction of heat through pipes (radial flow). (4)

Radiation: Concept of radiation & radiators, black body radiation; Laws of black body radiation: Kirchhoff's & Stefan-Boltzmann's Laws, Energy distribution in black body spectrum; Wien's law, Rayleigh Jean's law, Planck's law. (8)

Measurement of temperature

Concept of temperature, Measurement of temperature - Pt-thermometer, Pyrometer, Thermo emf, thermistor. (3)

Light:

Introduction to electro magnetic radiation, Propagation of light in space and time, Concept of coherence. (2)

Interference

Thin films, Wedge shaped films, Newton's rings and its applications, Michelson interferometer and its uses. (5)

Diffraction:

Concept of diffraction, Difference between interference & diffraction, Two kinds of diffraction, Diffraction at single slit, Diffraction at multiple slits- diffraction grating. (5)

Resolving Power:

Rayleigh's criterion of resolution, resolving power of prism, diffraction grating, microscope and telescope. (3)

Section II

Solid-State Physics:

Crystal structure, Unit cell, Space lattice, Bravais lattice, Miller indices, Directions and planes, Cubic crystals- SCC, FCC, BCC, atomic radius, packing factor, ionic ligancy and critical ratio, Bragg's law, Determination of crystal structure using Bragg's spectrometer. (11)

Semiconductors:

Formation of energy bands, Concept of Fermi level, Classification of solids: conductor, semiconductor and insulator, Physics of semiconductor.-Intrinsic semiconductor, effect of doping—extrinsic semiconductors, p-n junction, Characteristics of p-n junction, Static and dynamic resistance, Zener diode and LED, Diode as a rectifier, Transistor (pnp and npn) characteristics, Current and voltage gain. (13)

Ultrasonics:

Sound spectrum, Ultrasonic transducers – production of ultrasound: Piezo-electric effect, Magnetostriction effect, Measurement of velocity of ultrasonic waves and detection of ultrasonic waves, Applications of ultrasound. (6)

Text Books:

1. Engineering Physics
R.K. Gaur and S. L. Gupta, Dhanpat Rai Publications, New Delhi. 2003.
2. A text book of Engineering Physics
Avadhanulu and Kshirsagar
3. Fundamentals of Optics
F.A. Jenkins and H.E. White

Reference Books:

1. A Treatise on Heat
M.N. Saha and B.N. Srivastava, The Indian Press Publications Pvt. Ltd.,
Allahabad and Calcutta, 4th Edition
2. Principles of Optics
B.K. Mathur and T.P. Pandya
3. Physics I and II
David Halliday and Robert Resnick, Wiley Eastern Ltd., 1987.
4. Series on Lectures on Physics
R. P. Feynmann
5. Solid State Physics
A.J. Dekker, MacMillan and Co. Ltd., New York, 1957.
6. Solid State Physics
C. Kittel, 7th Edition
7. Ultrasonics - Methods and Applications
Jack Blitz
8. Concepts of Modern Physics
Arthur Beiser, Tata McGraw Hill, 2003

5. Computer Applications

(2 hrs/ week)

Information as a vital element of technological changes, Types of information, Alphanumeric, Numeric, Graphical, Visual, Audio, Electronic and combinations.(2)

Useful Transformations, Software Tools for Technologists; Patterns in information processing.(4)

Algorithm development.(10)

Numerical methods for single algebraic equations, Iterative Techniques, Computational aspects.(3)

Interpolation leading to numerical differentiation, Error analysis.(2)

Matrix Operations, Linear Programming.(4)

Deterministic VS non deterministic processes.(1).

Data Analysis for measures of dispersion, Interval Estimates, Probability density distribution functions-normal & binomial.(4)

Text books / Reference books

Informatics practices Volume I & II by S. Jain & S. Singh, BPB. Publications

1. Information Technology Concepts by Dr M. Jain, Satish Jain, Shashank Jain BPB Publications
2. Oliver and Chapman's Data Processing and Information Technology by Carl French, BPB Publications

- 4 Data, Statistics and decision Models with Excel, D.I. Harnett, J.F. Howel, Wiley & Sons
- 5 Let us C, Kanetkar, BPB publications
- 6 Numerical Methods for Scientists & Engineers, K.S. Rao, Prentice Hall India
- 7 Mathematical Statistics, J.E. Freund, Prentice Hall (India)
- 8 Numerical Recipes in C, W.H. Press, S.A., Teukolsky, W.T. Vetterling and B.P. Flannery, Cambridge University Press

6. Mechanical Engineering

(4 hrs/week)

Brief introduction to the Laws of Thermodynamics.

6 hours.

Properties of perfect gases, Introduction to Enthalpy and Entropy equations. Calculation of work done, power generated, change in enthalpy and entropy.

(5)

Study of air standard cycles such as Otto, diesel, dual, joule cycles, representation of the cycles on P-V and T-S diagrams. Calculations of work done, means effective pressure and efficiency for air cycles.

(6)

Working of two-stroke and four-stroke engines.

(3)

Steam Engineering : Properties of steam, study of steam tables, measurement of dryness fraction/properties of steam.

(3).

Introduction to steam processes and cycles.

(3)

Generation of steam, various types of boilers, their construction features, safety aspects. Boiler regulations and boiler selection.

(4)

Introduction to basic fabrication techniques such as pattern making, casting, sand casting, machine casting, forging, rolling and forming.

(10)

Study of the machining operations and machine tools used for operations of Lathe, Drilling, Shaping, Milling, and Grinding. Various types of tools and accessories used for this processes.

(15)

Introduction to processes such as gas welding, electric arc welding, submerged arc welding, TIG, MIG, soldering and brazing.

(5)

REFERENCE BOOKS :

1. TREATISE ON HEAT ENGINEERING by V. P. Vasandani & D. S. Kumar. Published by Metropolitan Book Co. Pvt. Ltd.
2. ENGINEERING THERMODYNAMICS by P. K. Nag. Publisher Tata McGraw Hill Publishing Company Limited, New Delhi.
3. BASIC ENGINEERING THERMODYNAMICS by T. Roy Chaudhary. Publisher Tata McGraw Hill Publishing Company Limited, New Delhi.
4. ELEMENTS OF HEAT ENGINES by Patel Karamchandani (Volume I, II, and III). Publisher Acharya Publications Vadodara.
5. HEAT ENGINES by Ballaney.

6. A COURSE IN WORKSHOP TECHNOLOGY. Vol I and II by B. S. Raghuwanshi.
7. WORKSHOP TECHNOLOGY by S. K. Hajara Chaudhari Vol I and II.
8. MANUFACTURING TECHNOLOGY by P. N. Rao.
9. WORKSHOP TECHNOLOGY Part I, II and III by W.A.J. Chapman.
10. PRODUCTION TECHNOLOGY by H.M.T.

Practicals

7. Inorganic Chemistry

(1x 4 hrs/week)

1. Preparation of standard solutions and standardization of reagents used for analysis.
2. Volumetric methods of analysis:
 - 2.1. Acid-base titrations: Determination of strength of H_2SO_4 and H_3PO_4 from their mixture by titration with NaOH.
 - 2.2. Complexometric titrations: Standardization of E.D.T.A. solution and estimation of Mg from sample solution by standardized E.D.T.A. solution.
 - 2.3. Redox titrations: Standardization of $KMnO_4$ by oxalic acid and estimation of Fe by $KMnO_4$ method.
 - 2.4. Iodimetric titrations: Standardization of $Na_2S_2O_3$ by $K_2Cr_2O_7$ and estimation of Cu by $Na_2S_2O_3$.
3. Gravimetric methods of analysis: (i) Determination of Fe as Fe_2O_3 in given Fe_2SO_4 solution. (ii) Determination of Ba as $BaSO_4$ solution.

8. Organic Chemistry I

(1x 4 hrs/week)

Systematic qualitative analysis of organic compounds through solubility, elemental analysis, group detection, physical constant and derivatization.

9. Computer Lab I

(1x 4 hrs/week)

Use of application software for Word Processing / Presentation / Spreadsheet Data Base/Image Processing etc.(5)

Development of C program for solving problems based on Scientific Calculations.(10)

Text books / Reference books

Informatics practices Volume I & II by S. Jain & S. Singh, BPB. Publications

3. Information Technology Concepts by Dr M. Jain, Satish Jain, Shashank Jain BPB Publications
4. Oliver and Chapman's Data Processing and Information Technology by Carl French, BPB Publications
5. Data, Statistics and decision Models with Excel, D.I. Harnett, J.F. Howel, Wiley & Sons
5. Let us C, Kanetkar, BPB publications
6. Numerical Methods for Scientists & Engineers, K.S. Rao, Prentice Hall India
7. Mathematical Statistics, J.E. Freund, Prentice Hall (India)
8. Numerical Recipes in C, W.H. Press, S.A. Teukolsky, W.T. Vetterling and B.P. Flannery, Cambridge University Press

10. Engineering Drawing I (Term Work)

(1x 4 hrs/ week)

Orthographic projections including sectional views, isometric projections, missing views, screw threads, nuts, bolts and washers.

SEMESTER II

R. 4780 The candidate shall be examined in the subjects at the Semester II examination as indicated in the following tables.

Theory Papers

Sr. No	Subject	No. of Paper	Examination		Periodic Test Marks	Total Marks
			Hours	Marks		
1.	Physical Chemistry I	1	3	70	30	100
2.	Organic Chemistry II	1	3	70	30	100
3.	Applied Physics II	1	3	70	30	100
4.	Applied Mathematics I	1	2	35	15	50
5.	Engineering Mechanics & Strength of Material	1	3	70	30	100
	Total	5	—	315	135	450

Practical Examinations

Sr. No	Subject	Examination		Class Work Marks	Total Marks
		Hours	Marks		
6.	Organic Chemistry II	6	70	30	100
7.	Physics	6	70	30	100
8.	Engineering Drawing II (Term Work)	—	—	50	50
	Total	—	140	110	250

Grand Total at the Examination

700

R. 4781 The following are the syllabi of the various subjects at the Semester II examination

Semester II

Theory

11. Physical Chemistry I (4 hrs/week)

1. States of matter:
 - 1.1. Gaseous state - Molecular diffusion and effusion, critical constants and liquefaction of gases, super critical fluids and their applications. (3)
 - 1.2. Liquid state: Flow behaviour of liquids, Newtonian and non Newtonian systems, kinematic viscosity, methods of viscosity determination, optical properties. (3)
 - 1.3. Solid state: Types of solids, unit cells, Bravais lattices, close-packed structures, defects in solids, electrical, magnetic and optical properties of solids. (4)
2. Kinetics and molecular reaction dynamics:
 - 2.1. Introduction: Significance of chemical kinetics, concepts of rate laws, rate constant and reaction order, rate laws of simple reactions, experimental techniques. (6)
 - 2.2. Kinetics of complex reactions- Parallel, consecutive and reversible reactions of 1st order. (6)
 - 2.3. Kinetics of chain reactions - Polymerization and photochemical reactions. (2)
 - 2.4. Study of fast reactions - Diffusion controlled and proton transfer reactions, study of fast reaction kinetics by stop flow, relaxation techniques. (2)
 - 2.5. Kinetics and mechanism of chemical reactions.
 - 2.6. Molecular reaction dynamics: Temperature effects of reaction rates, Collision theory, potential energy surfaces, reaction coordinate and the transition state theory, Eyring equation, kinetics of unimolecular reactions. (4)
3. Catalysis:
 - 3.1. Homogeneous catalysis - Acid-base catalysis, catalysis by metal complexes. (2)
 - 3.2. Heterogeneous catalysis- Fundamentals of adsorption, adsorption isotherms, pore volume and surface area, catalyst preparation and characterization techniques, role of catalysis in petroleum industry. (4)
 - 3.3. Enzyme catalysis: Kinetics of enzyme catalysis, immobilization of enzymes and their applications. (2)
 - 3.4. Phase transfer catalysis: Principle and applications. (2)
4. Electrochemistry:
 - 4.1. Equilibrium electrochemistry: Electrochemical cells, half-cell reactions, types of electrochemical cells- redox and concentration cells. Free energy and emf- Nernst equation, applications of emf measurements. (6)
 - 4.2. Ion transport in electrolytes: Conductivity of strong and weak electrolytes, theories of conductance in strong electrolytes, Kohlrausch law and ionic mobility. (4)
 - 4.3. Applications of electrochemistry: Applications in ionic equilibria: Activity coefficient from equilibrium constants, solubility products, ionization of acids and bases, determination of dissociation constants, hydrogen ion concentrations, buffers, theories of indicators. Commercial applications: Batteries and fuel cells, electrocatalysis, electrochemistry in organic synthesis. (10)

Reference Books:

1. Physical Chemistry - G.W.Castellan ,3rd ed., Narosa Publishing House, 2002.
2. Physical Chemistry - K.J.Laidler and J.H. Meiser, 2nd ed., CBS Publishers, 2000.
3. Physical Chemistry: A molecular approach - D.A. Mcquarrie and J.D. Simon, Viva low priced student edition, 1998.
4. Chemical kinetics and catalysis -R.J.Masel, John Wiley and Sons ,2001
5. Chemical kinetics and reaction dynamics-Paul H.Houston, McGraw Hill,2001
6. The elements of physical chemistry- Peter atkins, 3rd ed. Oxford,2000
7. Catalytic chemistry - Bruce C Gates, John Wiley and Sons . 1992
8. Principles and practice of heterogeneous catalysis, J.M.Thomas and W.J.Thomas, John Wiley and Sons, 1996

12. Organic Chemistry II

(4 hrs/week)

1. **Aromaticity:** Characteristics and electronic structures of aromatic compounds. Huckel rule, benzenoid and non-benzenoid compounds. Mechanism of aromatic electrophilic substitution reactions. (8)
2. **Aromatic compounds:** IUPAC nomenclature of aromatic compounds. Isomerism in substituted benzenes and naphthalenes. Orienting influence of substituents. (4)
3. **Friedel-Crafts and related reactions:** Alkylation, acylation, formylation, hydroxyl/chloro/ amino-methylation, carboxylation. (10)
4. **Haloaromatic compounds:** Halogenation of arenes, important reactions including aromatic nucleophilic substitution reactions. (6)
5. **Nitroaromatic compounds:** Nitration of arenes, Reduction products of nitro compounds. (6)
6. **Aromatic amines:** Methods of introduction of amino group in an aromatic nucleus, Basicity of amines, Important reactions, Diazotization of aromatic primary amines and the reactions of aryl diazonium salts. (8)
7. **Aromatic sulphonic acids:** Sulphonation and chlorosulphonation reactions, General reactions, kinetic and thermodynamic controls. (4)
8. **Phenols:** Methods of preparation and important reactions. (4)
9. **Oxidation and reduction:** Applications of the following reagents in organic synthesis: Mn and Cr based oxidizing agents, oxygen, hydrogen peroxide, per acids and peroxides, ozone, SeO₂, Oppenaur oxidation; catalytic hydrogenation, boron hydrides, Clemenson reduction, Hydrazine, Borohydrides LAH, MPV reduction, S and Se, dissolving metal reductions; idea of supported reagent (10)

Reference Books

1. Organic Chemistry, J. McMurry, 5th Edition, Brooks/Cole.1999.
2. Organic Chemistry, T. W. G. Solomons, C. B. Fryhle, 7th Edition, John Wiley and Sons Inc, 2000.
3. Organic Chemistry, G. Marc Loudon, 4th Edition, Oxford university Press, 2002 (Indian Reprints).
4. Organic Chemistry, L. G. Wade Jr., 5th Edition, Pearson Education, 2003 (Indian Reprint 2004).
5. Industrial Aromatic Chemistry: Raw materials, processes, products- H. G. Franck, J. W. Stadehofer- Berlin: Springer- verlag 1988
6. Organic Chemistry Vol I , I. L. Finar, Longmans, ELBS.

13. Applied Physics – II

(4 hrs/ week)

Section I

Laser:

Introduction and principle of Laser, Spontaneous and Stimulated emission, Population inversion, Active medium, Pumping device, Optical resonator, Properties of lasers, Types of lasers: He-Ne Laser, Ruby laser, semi-conductor laser, Applications of lasers:- Remote sensing, Bio-medical and Holography. (10)

Optical Fibres:

Introduction to Optical fibres, Mechanism of communication in Optical fibres, Numerical aperture, Fibre as a wave guide, Loss mechanisms in Optical fibres, Applications of optical fibres (use in communication with block diagram). (6)

Electricity and Magnetism:

Motion of charged particles in electric and magnetic fields. Cyclotron, Magnetic and electrostatic focusing, Cathode ray tube & its application for determination of e/m , Functions and block diagram of CRO, Positive rays, Thomson parabolic method, Isotopes, Mass spectrograph: Aston and Bainbridge mass spectrograph. (14)

Section II

Introduction to Quantum Mechanism:

Introduction to quantum physics (Planck effect, Photoelectric effect, Compton effect) De Broglie hypothesis, wave-particle duality, Verification of matter waves, Uncertainty principle, Schrodinger's wave equation, Wave function and its physical interpretation, Particle in a box, Hydrogen atom (without derivation), Quantum numbers, Atomic orbitals (s and p), Spectra of atoms. (15)

Formation of Molecules:

Diatomic molecules, Molecular orbitals, σ and π m.o.s., Formation of molecular orbitals with reference to H_2 molecule, Characterization of covalent bond, single – double – triple bonds and energies. (7)

Polyatomic molecules, localized orbitals, Formation of H_2O molecule on the basis of localized orbitals. Hybridization, s – p, s – p^2 and s – p^3 in carbon compounds, Allotropes of carbon and hybridization. (8)

Text Books:

1. Engineering Physics
R.K. Gaur and S. L. Gupta, Dhanpat Rai Publications, New Delhi. 2003.
2. Lasers Theory and Applications
K. Thyagarajan and A.K. Ghatak, Macmillan India Ltd., New Delhi, 1984.
3. Fibre Optics through Experiments
A.K. Ghatak and M.R. Shenoy
4. Valence
C.A. Coulson, Oxford University Press, 1961.
5. A text book of Engineering Physics
Avadhanulu and Kshirsagar

Reference Books:

1. Laser Electronics
Joseph T. Verdeyen
2. Optoelectronics : An Introduction
J. Wilson and J.F.B. Hawkes

3. Series on Lectures on Physics
R.P. Feynmann
4. Concepts of Modern Physics
Arthur Beiser, Tata McGraw Hill, 2003.
5. Physics I & II
David Halliday and Robert Resnick, Wiley Eastern Ltd., 1987.
6. Atomic Physics
J.B. Rajam

14. *Applied Mathematics I*

(2 hrs/ week)

Successive derivatives, Rolle's theorem, Mean value theorems, Taylor and Maclaurin series, Maxima and Minima. (4)

Function of more than one variable, partial derivatives, curve tracing, homogeneous functions, chain rule, total derivatives error calculation, (5)

Taylor's series, maxima and minima, Applications. (5).

Infinite sequence and series of real numbers, test of convergence. (3)

Fourier series, Fourier integral, Fourier transform. (7)

Solution of non-linear equations by iterative methods. (2)

Solution of linear algebraic equation by iterative methods and direct methods Matrix transformations and eigenvalues. (2)

Quadrature for integration Curve fitting, Error Analysis. (2)

Text books / Reference books for the above three courses:

1. Numerical Methods for Scientific and Engineering Computation by M.K. Jain, S.R.K. Iyengar, R.K. Jain, Wiley Eastern Limited
2. Applied Numerical Methods by B. Carnahan, H.A. Luther, J.O. Wilkes, John Wiley & Sons
3. Numerical Methods for Engineering by S.C. Chapra, R.P. Canale, McGraw Hill Int Edition
4. Applied Mathematics for Engineering and Physicists Pipes L.A, McGraw Hill Book Co.
5. Advanced Engineering Mathematics by, C.R. Wylie, L.C. Banett, McGraw Hill
6. Calculus and Analytic geometry by G.B. Thomas, R.L. Finny, Narosa Publishing House, 1990
7. Advanced Engineering Mathematics by E. Keysizig, John Wiley and Sons
8. Technical Mathematics with Calculus, P.A. Calter, M.A. Calter, John Wiley and Sons
9. Differential Equations with Applications and Historical notes, G.F. Simmons, Tata McGraw Hill
10. Numerical Analysis & Algorithms P. Niyogi, Tata McGraw Hill
11. Modeling with Differential Equations in Chemical Engineering, S.M. Walas, Butterworth Heinmann
12. Advanced Engineering Mathematics, M.D. Greenberg, Prentice -Hall.

15. Engineering Mechanics And Strength Of Materials

(4 hrs/week)

Basic steps in any Engineering Design, concept of estimation of force, types of forces.

Introduction of mechanics of rigid bodies, deformable bodies and mechanics of fluids.

(2)

Force, system of forces, resultant of force system, moment of a force, couple, properties of couple, Graphical methods - law of triangle, parallelogram, Polygon, Bow's notation, Analysis of beams, trusses.

(4)

Equilibrium of rigid bodies - equations of equilibrium free body diagram, application to analysis of beams, analysis of trusses, method of section.

(6)

Friction : Laws of static friction, coefficient of friction angle of friction, angle of repose, analysis of bodies on inclined plane, ladders, wedge friction etc.

(4)

Centre of gravity, centroid of plane areas, lines, composite figures.

(3)

Moment of Inertia - its use, parallel axis theorem, perpendicular axis theorem polar moment of Inertia, radius of gyration, moment of inertia of composite figures.

(4)

Simple lifting machines - mechanical advantage, velocity ratio and efficiency of machine, law of machine, effort lost in friction, study of simple machines, screw jack, differential axle and wheel etc.,

(3)

Introduction to Kinematics & Kinetics.

Shear force and bending moment diagram. Basic concept, use of S.F. and B.M. diagram, sign convention. Study of S.F. and B.F. diagram for cantilever, simply supported beams subjected to different loads.

(4)

Concept of stress, strain, types of stresses, stress-strain diagram, factor of safety, temperature stress and strain volumetric strain, bulk modulus, relationship between elastic constants.

(6)

Theory and simple bending : Derivation of basic equation. Distribution of stresses, Eccentric loading - Direct and bending stresses problems on theory of bending.

(3)

Shear stress : Derivation of basic formula, shear stress distribution for standard shape, composite figures. Shear stresses in beams and related problems.

(2)

Deflection of beams : Computation of slope and deflection at various points in cantilever, simply supported beams, Macaulay's method, moment area method. (4)

Torsion in circular shafts - Derivation of basic formula, shear stress distribution, problems on shafts subjected to torsion. (3)

Columns & Struts - Derivation Euler's formula, Rankine's formula, short and long columns, limitations of Euler's analysis. Simple problems. (4)

Thin cylinders - Thin cylinders subjected to internal pressure, stresses, volumetric strain, thick cylinders - introduction & theory only. (3)

Welded joints - Types of joints, stresses in welded joints, fabrication of steel structures, beam to beam connection, beam to column connection. (2)

Different materials used in Engg. constructions, their properties, composite materials, mineral and chemical additives. Filler materials, particle size distribution. (3)

Reference books :

1. Engineering mechanics statics, by r. C. Hibbeler.
2. Engineering mechanics, by ashok chavan, publisher nandu.
3. Engineering mechanics vol. I statics, by b. N. Thandani, publisher weinall book corporation.
4. Fundamentals of applied mechanics, by dadhe, jamadar and walavalkar, publisher sarita prakashan, poona.
5. Engineering mechanics, by s. Timoshenko and d. H. Young, publisher mc.graw hill.
6. Engineering mechanics statics, by ferdinand l. Singer.
7. Introduction to mechanics of solids, by egor p. Popov, publisher prentice hall of india pvt. Ltd.
8. Strength of material, by ferdinand l. Singer and andrew pytel, publisher harper collins publishers india pvt. Ltd.
9. Strength of material, by ramamurtham, publisher dhanpat rai.
10. Strength of materials, by g. H. Ryder.
11. Engineering mechanics dynamics, by r. C. Hibbeler.
12. Engineering mechanics dynamics, by b.N. Thodani.

Practicals

16. Organic Chemistry II (2x 4 hrs/week)

Separation of binary mixtures based on physical and chemical properties of the constituents.
Single step preparation of simple organic compounds involving important unit operations.

17. Physics

(2x 4 hrs/ week)

Students will perform about 15 experiments from the list given below:

Heat:

1. Platinum resistance thermometer
2. Calibration of thermocouple
3. Lee's method
4. Stefan's Constant
5. Thermistor

Optic:

1. Dispersive power of prism
2. He-Ne Laser
3. Fibre Optics
4. Diffraction Grating
5. Newton's rings

Sound: - Ultrasonics:

1. To find ultrasonic Velocity in different materials
2. Ultrasonic diffraction grating

Electricity

1. Frequency of a.c. mains
2. LCR circuit
3. CRO- frequency measurement

Magnetism:

1. Hysteresis
2. Hall Effect

Modern Physics:

1. Light detecting Resistor (LDR)
2. Photoelectric Effect (h/e)
3. e/m by CRT.
4. Logic Gate

Properties of matter:

1. Viscosity
2. Surface Tension

18. Engineering Drawing II (Term Work)

(1x 4 hrs/week)

Bearing, stuffing boxes, pipes joints, valves, pressure vessels and its components, heat exchangers

Books for reference :

1. Engineering Drawing by N. D. Bhatt.
2. Machine Drawing by N. D. Bhatt.
3. Engineering Drawing by P. J. Shah.
4. Machine Drawing by P. J. Shah.
5. Engineering Drawing by M. B. Shah and B. C. Rane.
6. Machine Drawing by M. B. Shah and B. C. Rane.
7. Engineering Drawing by Mali and Choudhary.
8. Machine Drawing by P. S. Gill.
9. Machine Drawing by Laxminarayan and Mathur.
10. Engineering Drawing by Kannaih and Narayan.
11. Engineering Drawing by Phakatkar Krishna, Reddy.
12. Engineering Drawing by Dube

SEMESTER III

R. 4782 The candidate shall be examined in the subjects at the Semester III examination as indicated in the following tables.

Theory Papers

Sr. No	Subject	No. of Paper	Examination		Periodic Test Marks	Total Marks	Branches
			Hours	Marks			
1.	Perspectives of Society, Science & Technology	1	2	35	15	50	All
2.	Physical Chemistry II	1	3	70	30	100	All
3.	Applied Mathematics II	1	3	70	30	100	All
4.	Electrical & Electronics Engineering	1	3	70	30	100	All
5.	Special Subject Chemistry of Intermediates & Colorants - I	1	3	70	30	100	Dyes
	Chemistry of Food Constituents	1	3	70	30	100	Foods
	Chemistry of Oils - I	1	3	70	30	100	Oils
	Polymer Science & Technology - I	1	3	70	30	100	Polymer
	Polymer Science & Technology - I	1	3	70	30	100	Paints
	General Aspects of Pharmaceutical & Physio-pharmacology - I	1	3	70	30	100	Pharma
	Technology of Fibres	1	3	70	30	100	Textile
	Total	5	—	315	135	450	

Practical Examinations

Sr. No	Subject	Examination		Class Work Marks	Total Marks
		Hours	Marks		
6.	Physical Chemistry	6	70	30	100
7.	Electrical & Electronics Laboratory I (Term Work)			100	100
	Total	-	70	130	200

Grand Total at the Examination

650

R. 4782 A The following are the syllabi of the various subjects at the Semester III examination

Semester III

Theory

19. *Perspectives of Society, Science and Technology* (2 hrs/week)

Historical background of Science and Technology, the evolution of chemical industry. Unity and interdisciplinary nature Science and Technology. Engineering Science as an intellectual endeavor. The inception and growth of Chemical Technology profession and its scope and versatility. Socio-economic implication of Technology, cultural aspects. National policies pertaining to Science and Technology. Newly emerging technologies, Socio-economic constraints and the future trends.

20. *Physical Chemistry II* (4 hrs/week)

1. Thermodynamics and chemical equilibrium:

1.1. First law of thermodynamics: Origin of the first law, thermodynamic terms and their definitions, heat, energy and work, thermo chemistry, ideal gas relationships, application of first law to chemical reactions. (4)

1.2. Second law thermodynamics: Statements of second law, Carnot cycle, heat pump and refrigerator, thermodynamic temperature scale, concept of entropy, Helmholtz and Gibbs free energy. (4)

1.3. Spontaneous and reversible processes, variation of free energy with temperature and pressure, Gibbs-Helmholtz equation. (4)

1.4. Thermodynamic systems of variable composition: Partial molar properties, chemical potential, activity and fugacity, Gibbs energy and entropy of mixing, the equilibrium constants K_p and K_c , standard free energies of formation, temperature dependence of equilibrium constant, experimental determination of equilibrium constant (8)

1.5. Third law of thermodynamics: Entropy and probability, energy distribution and partition functions. (4)

2. Phase equilibria in simple systems:

2.1. Definition of terms, derivation of Gibb's phase rule, phase diagram of one component systems, Clapeyron and Clausius-Clapeyron equations. (2)

2.2. One-component systems, CO_2 , H_2O and S systems. (3)

2.3. Binary systems of liquid-vapour phases - Raoult's law and systems not obeying Raoult's law, Temperature composition diagrams, fractional distillation, azeotropes, distillation of immiscible liquids, steam distillation. (4)

2.4. Two-component condensed systems, liquid-liquid and solid liquid systems, partially miscible liquids, critical solution temperature, simple eutectics, thermal analysis. (4)

2.5 Ternary systems : Liquid-liquid and liquid-solid ternary systems, solubility of salts.

3. Surface and interfacial chemistry:

3.1. Definition of surface free energy, thermodynamics of surfaces, Gibbs adsorption equation, capillarity and surface tension, methods of determining surface and interfacial tension. (3)

3.2. Liquid-liquid interfaces: Work of adhesion, cohesion, spreading coefficient, study of curved interfaces, bubbles and droplets, Young Laplace and Kelvin equation, concept of super saturation and nucleation. (3)

- 3.3. Solid-liquid interfaces: Contact angle and the phenomena of wetting, critical surface tension, applications of contact angle measurements. (3)
- 3.4. Insoluble monolayers: Molecular self assembly and LB films, self assembled monolayers. (2)
- 3.5. Electrical phenomena at interfaces: Electrical double layer, various models (qualitative treatment), electrokinetic phenomena. (2)
- 3.6. Disperse systems: Emulsions- formation , properties and stability of emulsions, solubilisation and microemulsions, HLB values of emulsions. (3)
- 3.7. Surface active agents: classification, surfactant aggregates, micellisation, critical micellar concentration, applications in agrochemical, petroleum, food, pharmaceutical, textile industries, detergents and froth floatation. (5)

Reference Books:

1. Physical Chemistry - G.W.Castellan ,3rd ed., Narosa Publishing House, 2002.
2. Physical Chemistry - R.J. Silby and R.A. Alberty, Lohm Wiley & Sons, 2002.
3. Physical Chemistry - K.J.Laidler and J.H. Meiser, 2nd ed., CBS Publishers, 2000.
4. Physical Chemistry: A molecular approach - D.A. Mcquarrie and J.D. Simon, Viva low priced student edition, 1998.
5. Surfaces, Interfaces and Colloids: Principles and applications, 2nd ed. Drew Myers, Wiley VCH,1999
6. The elements of physical chemistry- Peter atkins, 3rd ed. Oxford,2000
7. Introduction to colloid and surface chemistry, Duncan J Shaw- Butterworth- Heineman, 1992
8. Physical Chemistry of Surfaces, Arthur W. Adamson, Alice P. Gast, John Wiley and Sons, 1997.

21. Applied Mathematics II

(4 hrs/ week)

- Analytic functions of complex arguments, Taylor's series, Laurent's series, Integration by Residues (6)
- Improper integrals, Beta & Gamma functions, differentiation under integral sign. (5)
- Double, triple and line integrals. (5)
- Application to length area, volume, surface of revolution, C.G. and moment of inertia etc. (7)
- Vector calculus:- Limit, continuity, differentiability, Serret - Frenet formula, Gradient, divergence, curl of a vector point function, line , surface and volume integrals. (4)
- Green's theorem, Stokes theorem and divergence theorem. (3)
- Solution of linear and non-linear first order Ordinary Differential Equations (O.D.E.s). (4)
- Solution of higher order linear equations with constant and variable coefficients, variation of parameters. . (5)
- Singular and regular problems, series solution, special functions. (5)
- Bessel's, Legendre etc. functions. Sturm Liouville problem. (3)
- Difference Equations. (3)
- Simple Partial Differential Equation (P.D.E) of first order. (3)
- Classification of higher order partial differential equations, separations of variable methods and other simple solution procedures. (7)

Text books/Reference books for the above three courses:

1. Numerical Methods for Scientific and Engineering Computation by M.K. Jain, S.R.K. Iyengar, R.K. Jain, Wiley Eastern Limited
2. Applied Numerical Methods by B. Carnahan, H.A. Luther, J.O.Wilkes, John Wiley & Sons
3. Numerical Methods for Engineering by S.C. Chapra, R.P. Canale, McGraw Hill In Edition

4. Applied Mathematics for Engineering and Physicists Pipes L.A, McGrawHill Book Co.
5. Advanced Engineering Mathematics by, C.R. Wylie, L.C. Banett, Mc Graw Hill
6. Calculus and Analytic geometry by G.B. Thomas , R.L. Finny, Narosa Publishing House,1990
7. Advanced Engineering Mathematics by E. Keysizig, John Wiley and Sons
8. Technical Mathematics with Calculus,P.A.Calter,M.A.Calter, John Wiley and Sons
9. Differential Equations with Applications and Historical notes,G.F.Simmons,Tata McGraw Hill
- 10 Numerical Analysis & Algorithms P. Niyogi, Tata McGraw Hill
11. Modeling with Differential Equations in Chemical Engineering, S.M.Walas, Butterworth Heinmann
12. Advanced Engineering Mathematics,M.D.Greenberg,Prentice -Hall.

22. Electrical And Electronics Engineering

(4 hrs/week)

BASIC LAWS :

Kirchoff's current law. Kirchoff's voltage law. Simple series and parallel circuits, star and delta connections of resistances, star and delta transformation, source transformation, Mesh and nodal analysis. Biot-Savart's law. Faraday's law. Basic elements, R, L and C. Concept of self and mutual inductance.

(9)

NETWORK THEOREMS :

Super position theorem. Thevenin's theorem. Norton's theorem. Maximum power transfer theorem. Problems based on them.

(4)

SEMI CONDUCTORS :

Intrinsic and Extrinsic semi conductors, Donor and acceptor impurities, N-type and P-type semi conductors.

(1)

DIODES AND RECTIFIERS :

P. N. junction diode, characteristics, zener diode, Half wave, full wave and bridge rectifiers, filters, cathode ray oscilloscope.

(5)

THE JUNCTION TRANSISTOR :

Transistor current components. Transistor as an amplifier. Transistor input and output characteristics, cut off, active and saturation regions.

(4)

SILICON CONTROLLED RECTIFIER :

SCR characteristics, Principle of operation, methods of turning 'ON'. Gate characteristics, circuits for gate triggering, Applications.

(4)

UNI JUNCTION TRANSISTER :

Principle of operation. Characteristics, negative resistance region, UJT as a relaxation oscillator.

(1)

A. C. FUNDAMENTALS

Equations of alternating voltages and currents, cycle, frequency time period, amplitude. Peak value, average value, R.M.S. value, A.C. through Resistance. Inductance and capacitance. Simple R-L, R-C and R-L-C circuits, Power, power-factor, series and parallel circuits. (8)

3- PHASE SYSTEMS :

Star and delta connections. Relationship between line and phase voltages and currents in star and delta connections, Power in three phase system with a balanced load, Measurement of power in 3 phase circuits. (5)

TRANSFORMER :

Introduction. Principle of operation, e.m.f. equation, phasor diagrams. Ideal transformer, Transformer on no load, Transformer under load, Equivalent circuits, Transformer losses, efficiency, Regulation, Open and short circuit test. (7)

3 PHASE INDUCTION MOTOR :

Concept of rotating magnetic field, Flux and m.m.f. phasors, starters, characteristics. (4)

SYNCHRONOUS MACHINES :

Alternator, Voltage regulation, Introduction to synchronous motors. (4)

D. C. MACHINES :

E.m.f. equation, methods of excitation, characteristics of d.c. generators. d.c. motors, starting, speed control and characteristics. (4)

TEXT BOOKS :

- (2) Electrical Technology by B. L. Theraja & A. K. Theraja. Vol I, II, & IV.
- (3) Electronic principles by Albert Paul Malvino.
- (4) Electronic devices and circuits by Allen Mottershead.

REFERENCE BOOKS_:

- (1) Electrical Machines by P. S. Bhimbara.
- (2) Electrical Machines by Nagrath, Kothari.
- (3) Electrical circuit analysis by Soni Gupta.
- (4) Thyristors and applications by M. Ramamurthy.
- (5) Electronic devices and circuits by Boylestad & Nashelsky.
- (6) Electronic devices and circuits by Millman & Halkias

23. Chemistry of Intermediates and Colorants - I(Dyes)

(4 hrs/week)

Chemical Feedstocks for dyestuff industry- fossil feedstocks -coal, petroleum- coal-tar primaries-renewable raw materials. (4)

Chemistry of benzenoid aromatics. Electrophilic aromatic substitution reactions with their mechanisms, one carbon electrophiles and their utility. Nucleophilic aromatic substitution reactions. Orientations in aromatic substitution reactions. Hammett substitution constants. (16)

Introduction of various functional groups into benzenoid aromatics, functional group interconversions. Synthesis of typical dyestuff intermediates based on benzene, xylene, toluene. Chemistry of fast bases. (16)

Chemistry of naphthalene- Electrophilic aromatic substitution reactions. Bucherer reaction, Reverse Bucherer reaction. Synthesis of naphthols, naphthylamines naphthol sulphonic acid, naphthylamine sulphonic acids, aminonaphthol sulphonic acids. Ben acid arylides as Azo coupling components. (10) Anthracene and condensed aromatics. Anthraquinone and benzanthrone. Reactions of anthraquinone, benzanthrone and synthesis of dyestuff intermediates based on anthraquinone and benzanthrone. (6) Active methylene compounds such as acetoacetic ester, malonic ester, malononitrile and their use in synthesis of dyestuff intermediates, diketene, acetoacetanilides. Simple heterocyclic compounds like pyrazolones, aminopyrazoles, pyrimidines, pyridones. (6) Evolution of dyestuff chemistry. (2)

TEXT/REFERENCE BOOKS :

1. *Industrial Organic Chemistry*, Weissert K., Arpe H.J.VCH, Weinheim, 1993
2. *Organic Synthesis*, Smith M.B., Tata McGraw Hill, New York, 2nd Edn, 2004
3. *Chemistry of Synthetic Dyes*, Lubs H.A., Robert E Krieger Publishing Company New York, 1995
4. *Chemistry of Synthetic Dyes - Vol I*, Venkatraman K., Academic Press, New York, 1952
5. *Organic Chemistry*, Clayden, Greeves, Warren, Oxford Univ. Press, 2001

24. Chemistry Of Food Constituents (Food)

(4 hrs/week)

Food Resources & composition	(4)
Water in Food Systems	(4)
Chemistry of Carbohydrates	(10)
Chemistry of Proteins	(10)
Chemistry of Lipids	(10)
Trace constituents contributing to taste, colour & flavour - native, derived, added	(8)
Vitamins - chemistry, methods of assay and stability in foods	(10)
Antinutritional and toxic components present naturally and developed on processing in foods	(4)

Reference Books:

Food Chemistry by O. R. Fenemba
 Food Chemistry by H.D. Belitz & W. Grosch (II Edition) Springer (1999)
 Sugar Chemistry (1975) R. S. Shallenberger & G.G. Birch
 Advanced Sugar Chemistry (1983) R. S. Shallenberger & G.G. Birch
 Carbohydrates - Chemistry & Biochemistry - Pigman W. & Horton D. (1970)

25. Chemistry Of Oils I (Oils)

(4hrs/ Week)

Introduction to Oil chemistry - whys and whats; use in everyday life. Oils: classification, Natural derivatives of fatty acids, triglycerides, waxes, phosphoglycerides, phosphatidic esters, sphingolipids. (4 hrs) Fatty acids: Nomenclature and classification Different types of naturally occurring fatty acids. Physical properties of fatty acids and their esters, melting point and boiling point. Polymorphism and crystal structure, solubility, refractivity, optical activity, spectroscopic properties. (8 hrs) Separation and isolation of fatty acids; Distillation, crystallization and counter current distribution. Methods of structure determination, physical methods (spectroscopic) and chemical methods. (8 hrs)

Chemical properties of fatty acids and their esters. Reduction and hydrogenation. Oxidation – chemical and autoxidation. Polymerization. Stereomutation, double bond migration and cyclization. Other olefinic reactions. Reaction of the carboxylic acid groups. (30 hrs) Chemical methods and analysis of oils. Acid value, saponification value, hydroxyl value, peroxide value, iodine value, acetyl value, p-anisidine value, titre, halphen test, baudoin test, RM, P & K values, dilatometry, micro penetration tests. (10 hrs)

Books:

- Chemical constitutions of natural fats by T. P. Hilditch and P.N. Williams 4th ed., Chapman and Hall (1964)
- Treatise on Analysis of Foods, Fats and Oils by A. R. Sen, N. K. Pramanik and S. K. Roy, Oil Technologists Association of India (Eastern Zone) (2001)
- Baileys industrial oil and fat products by Daniel Swern, Wiley Interscience publication (1979)
- Chemistry and technology of oils and fats by Prof. M. M. Chakrabarti, allied publishers (2003)
- Official and tentative methods of American Oil Chemists Society by W. E. Link, AOCS publishing (1973)
- Fatty Acids by Markley K. S. Vol. I to IV, Robert E. Krieger publishing Co. (1973)

26. Polymer Science & Technology I (Polymer)

(4 hrs/ week)

Historical developments in polymeric materials, end use sectors (2),

Natural Polymers: Chemical & Physical structure, properties, source, important chemical modifications, applications of polymers such as cellulose, lignin, starch, rosin, shellac, latexes, vegetable oils and gums, proteins etc. (8),

Raw material for synthetic polymers: Manufacturing of various fractions of crude petroleum important for polymer industry for (a) Raw Materials such as ethylene, propylene, butadiene, vinyl chloride, vinylidene dichloride, styrene, acrylic monomers like acrylic acid, acrylonitrile, methacrylic acid, methacrylates, acrylamide etc, (b) solvents such as alcohols, toluene, xylene, acetone, ketones, terpenes, chloromethanes etc, (c) Polyacids such as phthalic acid, terephthalic acid, isomers and anhydrides etc. (d) phenols, polyols and their modifications, (e) Isocyanates, (f) Amino Compounds, (g) Other petroleum based material (35)

Evaluation of raw materials and reactants for synthesis & manufacturing of polymers. (15)

Textbooks/Sourcebooks:

1. Raw Materials for Industrial Polymers by H Ulrich, Hanser Publication 1989.
2. Principles of Polymer Science, by Bahadur and Sastry, Narosa Publishing House 2002.
3. Polymer Science by Gowariker, Johan wiley and Sons 1986.
4. Encyclopedia of Polymer Science and Technology, Johan Wiley and Sons, Inc 1965.
5. Encyclopedia of Polymer Science and Engineering, Johan Wiley and Sons, Inc 1988.
6. Petrochemicals The Rise of an Industry by Peter H. Spitz, Johan Wiley and sons 1988.
7. Polymer Chemistry by Malcolm P. Stevens, Oxford University Press, Inc, 1990.

27. Polymer Science & Technology I (Paints)

(4 hrs/ week)

Historical developments in polymeric materials, end use sectors (2),
Natural Polymers: Chemical & Physical structure, properties, source, important chemical modifications, applications of polymers such as cellulose, lignin, starch, rosin, shellac, latexes, vegetable oils and gums, proteins etc. (8),
Raw material for synthetic polymers: Manufacturing of various fractions of crude petroleum important for polymer industry for (a) Raw Materials such as ethylene, propylene, butadiene, vinyl chloride, vinylidene dichloride, styrene, acrylic monomers like acrylic acid, acrylonitrile, methacrylic acid, methacrylates, acrylamide etc, (b) solvents such as alcohols, toluene, xylene, acetone, ketones, terpenes, chloromethanes etc, (c) Polyacids such as phthalic acid, terephthalic acid, isomers and anhydrides etc. (d) phenols, polyols and their modifications, (e) Isocyanates, (f) Amino Compounds, (g) Other petroleum based material (35)
Evaluation of raw materials and reactants for synthesis & manufacturing of polymers. (15)

(Books Same as for Polymers)

28. General Aspects Of Pharmaceuticals And Physio-Pharmacology-I (Pharma)

(4hr/week)

General Aspects of Pharmaceuticals

Over view of Pharmaceutical Industry (1)
Introduction to human body, Organization of human body, Different system of human body, Definitions and examples of different drug categories, composition and functions of blood, cardiac cycle (14)
Introduction to pharmacopoeias, Routes of drug administration, introduction to bio pharmaceuticals (10)
Discussion of monographs and general test procedures and their importance, inorganic chemicals of pharmaceutical importance with respect to their manufactures and uses, assay methods (5)

Books:

1. Remington's Pharmaceutical Sciences, A.R.Gennaro Mac Pub. Co. Easton, Pennsylvania 1990
2. Indian Pharmacopoeia, British Pharmacopoeia, United States Pharmacopoeia.
3. Bentley's Textbook of Pharmaceutics, Rawlins, Cassell Ltd, London

Physio-Pharmacology-I

Hematinics, thrombolytics, coagulants / anticogulants (4)
Digestive system antacids, purgatives (4)
Structure and function of kidney, diuretics (4)
Respiratory system (3)
General pharmacology (ADME, routes of administration, MOA) (10)
Bioassay: histamine and antihistaminic, Pharmacology and local anesthetics (5)

Books:

1. "Anatomy Physiology", C.C. Chatterjee, Calcuttal Medical Allied agency, 1994
2. "Anatomy Physiology", Toutora, 10th Johns Wiley and Sons, NY, 2003
3. "Pharmacology" Tripath, 4th Jaypee Brother New Delhi, 1999
4. "Pharmacology" Satoskar - Bhandarkar, Popular Prakshan, Mumbai, 2003
5. "Pharmacology" Seth, Churchill Livingstone, New Delhi, 1998
6. "Handbook of in Pharmacology", S.K. Kulkarni, Vallabh Prakashan, New Delhi, 1999
7. "Element of in Pharmacology", Dr. R.K. Goyal, 10th S.B. Shah, Ahmadabad, 2000

29. Technology Of Fibres (Textile)

(4 hrs/week)

Occurrence of polymeric materials; Fibre forming characteristics of polymers; Classification of fibres (4)

Natural fibres of commercial and rural importance such as cotton, wool, silk, ramie, jute, linen, pineapple, etc.; Their occurrence, properties and uses; Morphology and chemical constitution; Action of various chemicals, micro-organisms, heat, radiations, etc. (20)

Fibre Spinning techniques; Regenerated fibres such as viscose, cuprammonium, acetate, Tencel, etc.; Raw materials, manufacture, properties and uses; Morphology and chemical constitution; Action of various chemicals, micro-organisms, heat, radiations, etc. (10)

Synthetic fibres such as polyester, cationic dyeable polyester, differentially dyeable polyester, polyamides, acrylic, polypropylene, polyvinyl alcohol, polyurethane, etc.; Raw materials, synthesis, manufacture, properties and uses ; Morphology and chemical constitution ; Action of various chemicals, micro-organisms, heat, radiations, etc. (15)

Classification of polymers; Degree of polymerisation, Methods of polymerisation; Addition and condensation polymerisation; Brief idea about glass transition temperature, molecular weight and its distribution (4)

Crystalline and amorphous regions and crystalline orientation in fibres (3)

Brief outline about industrial fibres such as glass, carbon, asbestos, metal, aramid, microfibres, etc.;

Developments in fibres for textiles (4)

TEXT/REFERENCE BOOKS :

- 1) *Textile Fibres*, Shenai V.A., Vol-1, Sevak Publications, Bombay, 3rd edition, 1991.
- 2) *Joseph's Introductory Textile Science*, Joseph, M.L., Hudson P.B., Clapp A. C., Fortworth: Harcourt Brace Jovanovich College Publication, 6th edition, 1993.
- 3) *Modern Textile Characterization Methods*, Raheel, M. Marcel Dekker Inc., New York, 1996.
- 4) *Microscopy of Textile Fibres*, Greaves, P.H., Saville B.P.Oxford : BIOS Scientific Publishers Ltd., 1995.
- 5) *Handbbok of Fibre Chemisty*, Lewin Menachem, Eli M. Pearce, Marcel Dekker Inc., New York, 2nd edition, 1998.
- 6) *Textile Fibres*, Mathews, J.M, 4th edition, 1924.
- 7) *Wool Handbook*, Bergon W.V., Interscience Publishers, New York, 3rd edition, 1970.
- 8) *Man-made Fibres*, Moncriff, R.W., Butterworth Science, London, 6th edition, 1975.
- 9) *Textile Chemistry*, Peters R.H, Vol-1, Elsevier Publishing Company, London, 1963.
- 10) *Production of Synthetic Fibres*, Vaidya A.A., Prentice Hall of India Pvt. Ltd., New Delhi, 1988.

Practicals

30. Physical Chemistry

(2x 4 hrs/week)

1. Experiments based on various physical properties such as viscosity, surface tension, optical rotation and refractive index, light absorption
2. Experiments on chemical kinetics and thermodynamics- determination of order of simple reactions, energy of activation, equilibrium constants. Determination of thermodynamic functions.
3. Experiments based on EMF and conductance measurements- determination of electrode potentials, solubility product, pH, equivalent conductance.
4. Experiments on surface and interfacial chemistry- surface tension, CMC measurements, HLB values, adsorption isotherms and determination of surface area.
5. Experiments on phase equilibria: Study of binary and ternary liquid systems

31. Electrical And Electronics Laboratory (Term Work)

(2x 4 hrs/week)

Electrical Experiments:

- (1) Verification of Superposition theorem.
- (2) Verification of Thevenin's theorem.
- (3) Study of a series R-L circuit.
- (4) Study of a series R-C circuit.
- (5) Study of a 3-phase star connection.
- (6) Study of a 3-phase delta connection.
- (7) Load test on transformer.
- (8) Load test on a d.c. shunt motor.
- (9) Load test on a 3-phase induction motor.
- (10) Load test on an alternator.

Electronic Experiments:

- (1) Study of a cathode ray oscilloscope.
- (2) Study of a half wave rectifier.
- (3) Study of a full wave (2-diode) rectifier.
- (4) Study of a bridge rectifier.
- (5) To obtain characteristics of a P-N junction diode.
- (6) Input characteristics of a transistor.
- (7) Output characteristics of a transistor.
- (8) U.J.T. as a relaxation oscillator.
- (9) Resistance triggering method of SCR firing.
- (10) R.C. triggering method of SCR firing.

SEMESTER IV

R. 4783 The candidate shall be examined in the subjects at the Semester IV examination as indicated in the following tables.

Theory Papers

Sr. No	Subject	No. of Paper	Examination		Periodic Test Marks	Total Marks	Branch
			Hours	Marks			
1.	Inorganic Chemistry	1	3	70	30	100	All
2.	Analytical Chemistry	1	3	70	30	100	All
3.	Applied Mathematics III	1	2	35	15	50	All
4.	Material Energy Balance Computation	1	3	70	30	100	All
5.	<u>Special Subject</u> Chemistry of Intermediates & Colorants - II	1	3	70	30	100	Dyes
	Food Additives & Ingredients	1	3	70	30	100	Foods
	Chemistry of Oils - II	1	3	70	30	100	Oils
	Polymer Science & Technology - II	1	3	70	30	100	Polymer
	Polymer Science & Technology - II	1	3	70	30	100	Paints
	Medicinal Chemistry I	1	3	70	30	100	Pharma
	Technology of Yarn & Fabric Manufacture	1	3	70	30	100	Textile
6.	<u>Special Subject</u> Colour Physics & Colour Harmony	1	2	35	15	50	Dyes
	Biochemistry	1	2	35	15	50	Foods
	Chemistry of Surfactants	1	2	35	15	50	Oils
	Colour Physics & Colour Harmony	1	2	35	15	50	Polymer
	Colour Physics & Colour Harmony	1	2	35	15	50	Paints
	Biochemistry	1	2	35	15	50	Pharma
	Colour Physics & Colour Harmony	1	2	35	15	50	Textile
	Total	6	-	350	150	500	

Practical Examinations

Sr. No	Subject	Examination		Class Work Marks	Total Marks	Branch
		Hours	Marks			
7.	Analytical Chemistry	3	35	15	50	All
8.	Engineering Laboratory (Term Work)	—	—	50	50	All
9.	Special Subject (Term Work) Colour Physics	—	—	50	50	Dyes
	Technical Analysis - I	—	—	50	50	Foods
	Analysis of Oils, Fats & Waxes	—	—	50	50	Oils
	Colour Physics	—	—	50	50	Polymer
	Colour Physics	—	—	50	50	Paints
	Physio-pharmacology	—	—	50	50	Pharma
	Colour Physics	—	—	50	50	Textile
	Total	—	35	115	150	

Grand Total at the Examination

650

R. 4784 The following are the syllabi of the various subjects at the Semester IV examination

Semester IV

Theory

32. Inorganic Chemistry

(4 hrs/week)

1. Chemistry of elements: s, p, d, and f block elements and their general properties; correlations among various properties. (8)
2. Metallurgy and hydrometallurgy: Basic physico-chemical principles of the extraction of metals. (6)
3. Chemical bonding: Valence bond theory, crystal field theory, molecular orbital theory, metallic bond. (8)
4. Co-ordination chemistry: Bonding in complex compounds - Werner's theory, effective atomic number rule, electronic spectra and magnetic properties of complex compounds. (5)
5. Non aqueous solvents: Classification and properties of solvents, study of - liquid ammonia, liquid sulphur dioxide with respect to (i) acid-base reaction (ii) redox reaction (iii) complex formation (iv) solvolysis (v) precipitation reaction. (5)
6. Corrosion and passivity: Electrochemical theory of corrosion, protection of metals, passivity, theory of passivity. (4)
7. Inorganic materials: Inorganic polymers, alloys, clays, zeolites, nanomaterials, magnetic materials. (12)
8. Bioinorganic chemistry: Study of involvement of metals such as Fe, Co, Cu, Zn and their compounds in biological processes, biomineralization, inorganic complexes of biological relevance. (6)
9. Organometallics: Organometallic compounds of Pd, Pt, Ru, Metal-Ligand concept, EAN rule, types of ligands, reactions using organometallic compounds such as hydrogenation of alkenes, hydroformylation, Ziegler-Natta polymerization, etc. (5)

Reference Books

- (1) A new concise inorganic chemistry: J.D. Lee Eds., van Nostrand Reinhold, ELBS edition, London.
- (2) Basic inorganic chemistry: F.A. Cotton and G. Wilkinson Eds., John Wiley and Sons, New York, 1976.
- (3) Modern aspects of inorganic chemistry, H.J. Emeleus and A.G. Sharp Eds., Routledge and Kegan Paul.
- (4) Inorganic chemistry. R.T. Sanderson Eds., Reinhold Publishing Co., New York.
- (5) Inorganic chemistry: Principles of structure and reactivity. James E. Huheey, Ellen A. Keiter, Richard L. Keiter Eds., Addison Wesley Publishing Co. New York, 1993.
- (6) Inorganic Chemistry, P.W. Atkins and D.F. Shriver, Oxford University Press, 1999.

33. Analytical Chemistry

(4 hrs/week)

1. Fundamentals of Analytical Chemistry:

1.1 Concept of quality: Definition of quality, Quality control and assurance, TQM. Correlation between quality and analysis, steps and types of chemical analysis, Stoichiometry and expression of concentration. (4)

- 1.2. Theory of errors: Sources and classification of errors. (2)
- 1.3. Statistical treatment of analytical data and presentation of results. (6)
- 1.4. Sampling of solids, liquids and gases. (3)
- 1.5. Evaluation and validation of analytical methods. (2)
- 1.6. Good laboratory practices. (2)
- 2 Spectroscopic methods of analysis: (18)
- 2.1 UV-Vis Spectroscopy: Introduction, theory of Ultraviolet spectrophotometry and colorimetry, Beer-Lamberts law, Deviation of Beer's law, applications.
- 2.2 Mass spectrometry: Introduction, theory, Mass spectrometers, interpretation of mass spectra, applications.
- 2.3 Infrared and Raman Spectroscopy: Introduction, molecular requirements for IR and Raman absorption, modes of vibrations, theory, Differences between Raman and Infra red spectra, applications.
- 2.4 NMR Spectroscopy: Introduction, theory of PMR and CMR, chemical shift, spin-spin coupling, applications.
- 2.5 AAS: Introduction, Principle, advantage and disadvantage of AAS, applications.
- 2.6 Flame Emission Spectroscopy and Fluorimetry: Basic principles, applications.
- 2.7 Arc, Spark and Plasma emission spectroscopy: Basic principles, applications
- 2.8 EPR Spectroscopy: Introduction, types of substances, comparison between NMR and EPR, presentation of EPR spectrum, hyperfine splitting, determination of g values, applications.
- 2.9 Mössbauer Spectroscopy: Introduction, isomer shift, theory and applications.
- 3 Different Analytical Techniques:
- 3.1 Chromatographic methods: (8) Introduction and classification of chromatography. Theory, instrumentation and applications of the following chromatographic techniques: (i) Column chromatography (ii) TLC (iii) Paper chromatography (iv) GC (v) HPLC (vi) Ion exchange chromatography (vii) Size exclusion chromatography.
- 3.2 Electroanalytical Methods: (12)
- Theory, instrumentation, applications, advantages and limitations of the following methods:
- 3.2.1 Potentiometric methods: Nernst equation (no derivation), indicator electrode, reference electrode, glass electrode and ion selective electrode, location of end point, advantages and limitations.
- 3.2.2 DC polarography: Residual currents, migration currents, diffusion currents, limiting currents, polarized electrode, microelectrode, dropping mercury electrode, Ilkovic equation, polarographic waves, oxygen half-potential equation and quantitative analysis.
- 3.3 Amperometric titration: Introduction, apparatus and circuit diagram, technique of titration, biamperometric titrations.
- 3.4 Coulometric analysis: Introduction, Coulometric analysis with controlled potential and at constant current, amplifiers, potentiostats and galvanostats, cyclic voltametry, chronoamperometry, chronopotentiometry, linear sweep voltametry, square wave voltametry.
- 3.5 Thermal methods: TGA, DTA and DSC. (3)

References:

1. Instrumental Methods of Chemical Analysis, E. W. Ewing, McGraw Hill, New York. 2nd Edition.
2. Instrumental Methods of Analysis, H.H. Willard, L.L. Merrit, J.A. Dean, and F.A. Settle, Jr., CBS Publishers and Distributors, New Delhi.

3. New Instrumental Methods in Electrochemistry, P.D. Delahay,
4. Instrumental methods of analysis, D. A. Scoog and D.M. West
5. Inorganic quantitative analysis, A.I.Vogel, Logmans, ELBS

34. *Applied Mathematics Iii*

(2 hrs/week)

Laplace and Fourier transforms and their applications to P.D.E and O.D.E. (6)

Systems of equations, transport applications(4)

Weighted residual and difference methods, application to O.D.E. and P.D.E. (8) Initial value ,

Boundary Value Problems, System of Equations(7 lectures)

Predictor corrector / forward integrator method to solve O.D.E. and P.D.E. (5)

Text books / Reference books:

- (5) Numerical Methods for Scientific and Engineering Computation by M.K. Jain, S.R.K. Iyengar, R.K. Jain, Wiley Eastern Limited
- (6) Applied Numerical Methods by B. Carnahan, H.A. Luther, J.O.Wilkes, John Wiley & Sons
- (7) Numerical Methods for Engineering by S.C. Chapra, R.P. Canale, McGraw Hill Int Edition
- (8) Applied Mathematics for Engineering and Physicists Pipes L.A, McGrawHill Book Co.
- (9) Advanced Engineering Mathematics by, C.R. Wylie, L.C. Banett, Mc Graw Hill
- (10) Calculus and Analytic geometry by G.B. Thomas , R.L. Finny, Narosa Publishing House,1990
- (11) Advanced Engineering Mathematics by E. Keysizig, John Wiley and Sons
- (12) Technical Mathematics with Calculus,P.A.Calter,M.A.Calter, John Wiley and Sons
- (13) Differential Equations with Applications and Historical notes,G.F.Simmons,Tata McGraw Hill
- (14) Numerical Analysis & Algorithms P. Niyogi, Tata McGraw Hill
- (15) Modeling with Differential Equations in Chemical Engineering,S.M.Walas,Butterworth Heinmann
- (16) Advanced Engineering Mathematics,M.D.Greenberg,Prentice -Hall.

35. *Material Energy Balance Computation*

(4 hrs/week)

Units and Dimensions. Applications of Laws of Conservation of Mass and Energy to single and multistage processes. Material and Energy balances for Unit Operations and Processes. Integrated Balances for manufacturing Processes. Machine Computation Techniques. System of Equations.

1. Dimension and Units (2)
2. Mole concept and composition relationships (2)
3. Stoichiometry (2)
4. Behavior of gases and vapours (3)
5. Simple material balances without chemical reactions (4)
6. Humidity and saturation (5)
7. Material balances with chemical reaction (6)
8. Complex material balances (3)
9. Energy balances (8)
10. Combined material and energy balances (4)
11. Combustion balances (4)
12. Balances in (stagewise) unit operations (4)

13. Unsteady state balances
14. Differential balances
15. Balances in chemical processes

(3)
(4)
(6)

Recommended Books:

1. Basic Principles and Calculations in Chemical Engineering: D. M. Himmelblau
2. Stoichiometry: B. I. Bhat & S. M. Vora
3. Chemical Process Principles, Vol.1, O. A. Hougen, K. M. Watson, R. A. Ragatz

36. Chemistry of Intermediates and Colorants - II (Dyes) (4hrs/week)

Color of organic compounds. Spectral properties of colorants, fluorescent brighteners and fluorescent colorants. Jablonski diagram. (2)

Color and chemical constitutional relations- empirical treatment. Classification of chromophores based on application to textiles-Acid dyes, direct dyes, basic dyes, vat dyes, sulphur dyes, solublized sulphur and vat dyes, azoic dyes, oxidation colors, reactive dyes, mineral colors.

(4)

Chemistry of azo dyes- Mechanism of diazotization and coupling reactions. Azoic dyes, Azoic printing compositions. Monoazo and Disazo acid dyes. Direct azo dyes. Substituents for benzidine.

(15)

Basic dyes- conventional and pendant basic dyes. Chemistry of diphenyl and triphenylmethine dyes and their heterocyclic analogues like oxazines, diazines and thiazenes. Cyanines, hemicyanine and diazahemicyanines. dioxazines as direct dyes.(12)

Anthraquinone acid dyes, nitrodiphenylamine acid dyes. Acid dyes obtained from basic dyes.

(5)

Disperse dyes- azo , anthraquinone, nitrodiphenylamine classes. Pendant basic dyes. Properties of disperse dyes like dispersibility, dye uptake, sublimation in relation to their chemical constitution .(10)

Reactive dyes based on halogenated heterocycles and activated double bonds. Bifunctional reactive dyes. (3)

Copper phthalocyanine- synthesis and conversion into other class of colorants. (2)

Chemistry of anthraquinonoid, indigoid and polycyclic quinonoid vat dyes. (7)

Text/Reference Books :

1. Chemistry of Synthetic Dyes, Lubs H.A. , Robert E Krieger Publishing Company New York, 1995
2. Chemistry of Synthetic Dyes - Vol I, Venkatraman K., Academic Press, New York, 1952
3. Chemistry of Synthetic Dyes - Vol II, Venkatraman K., Academic Press, New York, 1952
4. Chemistry of Synthetic Dyes - Vol III, Venkatraman K., Academic Press, New York, 1952
5. Chemistry of Synthetic Dyes - Vol IV, Venkatraman K., Academic Press, New York, 1952
6. Chemistry of Synthetic Dyes - Vol V, Venkatraman K., Academic Press, New York, 1952
7. Chemistry of Synthetic Dyes - Vol VI, Venkatraman K., Academic Press, New York, 1952
8. Fibre Reactive Dyes, Beech
9. Coal tar Dyes, Cain , Thorpe
10. Synthesis and Application of Dyes, Rys , Zollinger

37. Colour Physics And Colour Harmony (Dyes)

(2 hrs/week)

Introduction-geometric and chromatic attributes; Radiation and illumination; SPD, CT and CCT; Sources and illuminants; Need for artificial sources - various ways of producing light and different artificial sources; Lamp efficacy and colour rendering properties of sources (6)
Interaction of radiation with matter - gloss and diffused reflectance, absorption of light in sample; Various transitions in molecule, Beer - Lambert law and its verification, deviation from Beer - Lambert law, Additivity of absorbance, mixture analysis, absorbance and scattering in the sample - Kubelka - Munk theory. (8)
Perception of colour in eye \ brain, various colour theories (3)
Additive - subtractive mixing, colour specification systems - Munsell colour order system, CIE system, colour spaces, colour difference formulae. (6)
Single constant Kubelka - Munk theory of colourant formulation and recipe prediction; Modern computerised methods of colour matching; Finding the dyeing recipes, shade sorting, etc. using the CCM software (3)
Decorative effect using pattern and design theory; Application of CAD for textiles.(4)

Text/Reference Books :

1. *Color : A Multidisciplinary Approach*, Zollinger Heinrich Zurich, Verlag Helvetica Chemica Acta, 1999
2. *The color Science of Dyes and Pigments*, R. McLaren Bristol, Adam Hilger Ltd., 1983
3. *Industrial Color Technology*, Johnson R.M., Sartzman M., American Chemical Society Washington D.C., 1971

Computer Color Analysis : Textile Applications, Sule A.D., New Age International Ltd., New Delhi, 1997

38. Food Additives And Ingredients (Food)

(4 hrs/week)

Additives in food processing and preservation, their functions and safety (4)
Safety and quality evaluation of additives and ingredients, acute and chronic studies, LD₅₀ (2)
Analytical methods, chemical and instrumental (2)
Various additives such as preservatives, antioxidants, colours, flavours, emulsifiers, sequesterants, humectants, stabilizers, sweeteners, acidulants etc, with respect to chemistry, food uses and functions in formulations (28)
Indirect food additives (2)
Natural and synthetic colours (4)
Classification of flavours and the process of preparing including extraction, distillation, fractionation and purification (4)
Stability of flavours (2)
Ingredients used in food production eg. sugars, starches, proteins and fats and their technology of production and application (12)

Books:

Food Additives, 2nd edn, AL Brannen, PM Davidson, S Salminen, JH Thorngate III, 2002 (eds). Marcel Dekker Inc, New York, Basel, pp. 1 - 9.
Handbook of Food Additives, 2nd edn., TE Furia, 1972, (ed.) CRC Press, Cleveland, Ohio.
Ullman's Encyclopedia-

Functional Foods - Designer Foods, Pharma Foods, Nutraceuticals, Israel Goldberg (Editor) (1994), Chapman and Hall, New York.

39. *Biochemistry (Foods)* (2hrs/week)

Enzymes as biocatalysts- chemistry, classification, mode of action, specificity, assay techniques, isolation & purification, stabilization, enzyme kinetics 7

Pathways of metabolism of carbohydrates, proteins, lipids 15

Enzyme biosynthesis and regulation 4

Metabolic regulation, Hormones, release of energy and its trapping 4

Reference Books:

Biochemistry by Lehninger

Biochemistry, 5th edition (2002) by J.M. Berg, J.L. Tymoczko and L. Stryer

40. *Chemistry Of Oils II (Oils)* (4hrs/ week)

Component acids and glycerides of natural fats, component acids, component glycerides, methods of glyceride analysis, patterns of acyl group distribution in natural glycerides, component phosphoglyceride. (10)

Glyceride Synthesis, acylation procedures, introduction and removal of protecting groups, 1-monoglycerides, 2-monoglycerides, 1,2-diglycerides, 1,3-diglycerides, triglycerides, optically active glycerides, phosphoglyceride synthesis. (10)

Tree borne and minor oils. Non triglyceride components in oils and isolation of these components. (5)

Advanced methods of analysis of oils: Harmonization of standard methods. Chromatography of oils, fats and derivatives. Packed column gas chromatography. WCOT (capillary) GLC. Mass spectrometry of triglycerides and related compounds. Thin layer chromatography, High performance liquid chromatography. Stereospecific analysis of triacyl glycerols. Application of wide line NMR in the oils and fats industry. NMR (high resolution) finger printing. (35)

Books:

- Chemical constitutions of natural fats by T.P. Hilditch and P.N. Williams 4th ed., Chapman and Hall (1964)
- Baileys industrial oil and fat products by Daniel Swern, Wiley Interscience publication (1979)
- Chemistry and technology of oils and fats by Prof. M. M. Chakrabarti, Allied publishers (2003)
- Analysis of fats and oils by Mehlenbacher V. C., Garrardpren (1960)
- Nontraditional oilseeds and oils by N. V. Bringi, Oxford and IBH Co. Pvt. Ltd. (1989)
- Fatty Acid by K. S. Markely, Interscience publishers (1968)
- Treatise on fats, fatty acids and oleochemicals by O. P. Narula, Vol I & II, Industrial Consultants (India), (1994)
- Natural fatty acids and their sources by E. H. Pryde

41. Chemistry Of Surfactants (Oils)

(2hrs/ week)

Nature of surfactants, introduction to surfactants, natural surfactants, synthetic surfactants. Types of. Hydrophilic groups and hydrophobic groups. Surface activity - self association, hydrophobic effect.

(3)

Adsorption at liquid interfaces; introduction, measurement of amount absorbed. Adsorption at liquid/liquid interfaces, ultra low interfacial tensions, prediction of emulsion type from packing geometry, phase inversion, micelle formation, structure of micelles, general phase behaviour of surfactants, Kraft and Cloud point, mesomorphic phases, dispersion of surfactant aggregates, vehicles/liposomes.

(5)

Surfactant bilayers foams and emulsions. Soap films, film drainage, foam and foam stability, formation and stability of emulsions, de-emulsification, microemulsions, definition, use of cosurfactants, characteristics.

(5)

Synthesis of various surfactants used commercially, their properties and applications. Analysis of surfactants.

(16)

Books:

- Handbook of surfactants by Porter, M. R. Ed. 2nd, Academic & Professional Publishers (1994)
- Surfactants in consumer products theory, technology and applications by Falbe L. Springer Verlag (1987)
- Industrial applications of surfactants by Karsa D. R. Royal society of chemistry (1990)
- Anionic surfactants by Linfield W.M. (1976)
- Surfactants by Tadros F. Academic press Inc. (1984)
- Cationic surfactants by Jungermann E. Marcel Dekker Inc. (1970)

42. Polymer Science & Technology II (Polymer)

(4 hrs/ week)

Basic polymer structure in terms of its functionality, unsaturation, isotacticity, thermoplastic/thermoset, molecular weight and its distribution, crystalline and amorphous nature glass transition temperature, plasticization, solubility parameter, solution properties, temperature, good/ bad solvent, degradation

(20)

Addition, condensation polymerization, Copolymers, Linear, grafted polymers, IPN, star polymers, blends etc.

(7)

Techniques of polymerization: bulk, solution, suspension, emulsion

(3)

Kinetic schemes for different polymerization processes such as addition/ free radical polymerization, condensation polymerization, ionic polymerization, copolymerization, emulsion polymerization (smith-Ewert theory) etc.

(20)

Rheological concepts of polymer solutions and melts

(5)

Mixing operations: Typical agitation system, dissolution, suspension, removal of water condensates, high speed (low viscosity) stirring, low speed (high viscosity) stirring, selection criterion, power consumption. Heat transfer characteristics, powder mixing, mixing times etc.

(5)

Textbooks/Sourcebooks:

8. Principles of Polymer Science, Bahadur and Sastry, Narosa Publishing House 2002.
9. Polymer Science, Gowarikar, Johan wiley and Sons 1986.

10. Encyclopedia of Polymer Science and Technology, Johan Wiley and Sons, Inc 1965.
11. Encyclopedia of Polymer Science and Engineering, Johan Wiley and Sons, Inc 1988.
12. Polymer Chemistry, Malcolm P. Stevens, Oxford University Press, Inc, 1990.
13. Text book of polymer Science, Billmeyer, John Wiley and Sons 1984.
14. Principles of Polymer Systems, Rodriguez, Hemisphere Publishing Corp, 1982.
15. Introduction to Polymer Science and Technology, H. S. Kaufman and J. J. Falcetta, Wiley - Interscience Publication, 1977
16. Polymer Science and Technology of Plastics and Rubbers, P. Ghosh, Tata McGraw-Hill Publishing Company 1990.
- a. Textbook of Polymer Science, P. Nayak and S. Lenka, Kalyani Publishers, 1986.
- b. Fundamentals of Polymer Science an introductory text, P. Painter and M. Colman, Technomic publishing Co Inc, 1994.
- c. Textbook of Polymer Science and Engg Anilkumar and Gupta, tata McGraw-Hill Publishing Co, Ltd., 1978.
13. Polymer Science and Technology by J. R. Fried, Prentice-Hall, Inc 1995.
14. Polymer chemistry, Seymour and Carraher, Marcel Dekker, 2003.
15. Fundamentals of Polymer Processing, S. Middleman, Houghton Mifflin Company, 1997.

43. Colour Physics and Colour Harmony (Polymers)

(2 hrs/week)

Introduction-geometric and chromatic attributes; Radiation and illumination; SPD, CT and CCT; Sources and illuminants; Need for artificial sources - various ways of producing light and different artificial sources; Lamp efficacy and colour rendering properties of sources (6)

Interaction of radiation with matter - gloss and diffused reflectance, absorption of light in sample; Various transitions in molecule, Beer - Lambert law and its verification, deviation from Beer - Lambert law, Additivity of absorbance, mixture analysis, absorbance and scattering in the sample - Kubelka - Munk theory. (8)

Perception of colour in eye \ brain, various colour theories (3)

Additive - subtractive mixing, colour specification systems - Munsell colour order system, CIE system, colour spaces, colour difference formulae. (6)

Single constant Kubelka - Munk theory of colourant formulation and recipe prediction; Modern computerised methods of colour matching; Finding the dyeing recipes, shade sorting, etc. using the CCM software (3)

Decorative effect using pattern and design theory; Application of CAD for textiles. (4)

Text/Reference Books :

4. Color : A Multidisciplinary Approach, Zollinger Heinrich Zurich, Verlag Helvetica Chemica Acta, 1999
5. The color Science of Dyes and Pigments, R. McLaren Bristol, Adam Hilger Ltd., 1983
6. Industrial Color Technology, Johnson R.M., Sartzman M., American Chemical Society Washington D.C., 1971

Computer Color Analysis : Textile Applications, Sule A.D., New Age International Ltd., New Delhi, 1997

44. Polymer Science & Technology II (Paints)

(4 hrs/ week)

Basic polymer structure in terms of its functionality, unsaturation, isotacticity, thermoplastic/thermoset, molecular weight and its distribution, crystalline and amorphous nature glass transition temperature, plasticization, solubility parameter, solution properties, temperature, good/ bad solvent, degradation (20)

Addition, condensation polymerization, Copolymers, Linear, grafted polymers, IPN, star polymers, blends etc. (7)

Techniques of polymerization: bulk, solution, suspension, emulsion (3)

Kinetic schemes for different polymerization processes such as addition/ free radical polymerization, condensation polymerization, ionic polymerization, copolymerization, emulsion polymerization (smith-Ewert theory) etc. (20)

Rheological concepts of polymer solutions and melts (5)

Mixing operations: Typical agitation system, dissolution, suspension, removal of water condensates, high speed (low viscosity) stirring, low speed (high viscosity) stirring, selection criterion, power consumption. Heat transfer characteristics, powder mixing, mixing times etc. (5)

(Books same as for Polymers)

45. Colour Physics And Colour Harmony (Paints)

(2 hrs/week)

Introduction-geometric and chromatic attributes; Radiation and illumination; SPD, CT and CCT; Sources and illuminants; Need for artificial sources - various ways of producing light and different artificial sources; Lamp efficacy and colour rendering properties of sources (6)

Interaction of radiation with matter - gloss and diffused reflectance, absorption of light in sample; Various transitions in molecule, Beer - Lambert law and its verification, deviation from Beer - Lambert law, Additivity of absorbance, mixture analysis, absorbance and scattering in the sample - Kubelka - Munk theory. (8)

Perception of colour in eye \ brain, various colour theories (3)

Additive - subtractive mixing, colour specification systems - Munsell colour order system, CIE system, colour spaces, colour difference formulae. (6)

Single constant Kubelka - Munk theory of colourant formulation and recipe prediction; Modern computerised methods of colour matching; Finding the dyeing recipes, shade sorting, etc. using the CCM software (3)

Decorative effect using pattern and design theory; Application of CAD for textiles. (4)

Text/Reference Books :

7. *Color : A Multidisciplinary Approach*, Zollinger Heinrich Zurich, Verlag Helvetica Chimica Acta, 1999
8. *The color Science of Dyes and Pigments*, R. McLaren Bristol, Adam Hilger Ltd., 1983
9. *Industrial Color Technology*, Johnson R.M., Sartzman M., American Chemical Society Washington D.C., 1971

Computer Color Analysis : Textile Applications, Sule A.D., New Age International Ltd., New Delhi, 1997

46. Medicinal Chemistry I (Anti-Infective) And Physio-Pharmacology-II (Pharma) (4hrs/week)

Medicinal Chemistry I (Anti-infective)

1. Introduction to Medicinal and Pharmaceutical Chemistry (1)
 - (a) Methods of classification of drugs based on structure and biological activity (1)
 - (b) Concept of acidity and basicity of drugs and pKa values. Introduction of absorption and distribution of drugs based on physicochemical properties (3)
 - (c) Drug metabolism chemistry. (3)
2. Study of the chemistry of the following classes of drugs: nomenclature, classification, SAR
 - (a) Anti-infective agents: antiseptic and disinfectant; antibacterial-sulfonamides, quinoline, DHFR antagonists, antibiotics including stability and degradation products, antiparasitic agents-antimalarial, antiamoebic, antihelminthic, antimycobacterial agents, antifungal agents, anticancer agents, antiviral agents (18)
 - (b) Non-steroidal anti-inflammatory agents (4)

Books:

1. Burger's Medicinal Chemistry & Drug Discovery: Vol. 1 to 6; Ed.: A. Burger and M.E. Wolff; John Wiley & Sons-New Jersey.
2. Foye's Principles of Medicinal Chemistry; Ed.: W. O. Foye; Lippincott Williams & Wilkins-Philadelphia.
3. Textbook of Medicinal and Pharmaceutical Chemistry; Ed.: Charles Owens Wilson; Lippincott Williams & Wilkins -Philadelphia.
4. Organic Synthesis-The Disconnection Approach; Ed.: Warren S.; John Wiley & Sons-Chichester.
5. Pharmaceutical Substances: Synthesis, Patents, Applications (N-Z); Ed: A. Kleemann; Georg Thieme Verlag-Stuttgart.
6. Strategies for Organic Drug Synthesis and Design; Ed.: Lednicer & Daniel; John Willey & Sons Inc.-New York.
7. Organic Chemistry of Drug Synthesis: Vol. 1 to 6; Ed.: Daniel Lednicer; John Wiley & Sons Inc.-New York.

Physio-pharmacology-II

- | | | |
|---|-----|------|
| CNS and drugs acting on CNS | (8) | |
| ANS and drugs acting on uterus, oral hypoglycemic, chemotherapy | | (12) |
| Drugs used in hypertensive, vasodilator, Immunopharmacology | (5) | |

Books:

1. "Anatomy Physiology", C.C. Chatterjee, Calcuttal Medical Allied agency, 1994
2. "Anatomy Physiology", Toutora, 10th Johns Wiley and Sons, NY, 2003
3. "Pharmacology" Tripath, 4th Jaypee Brother New Delhi, 1999
4. "Pharmacology" Satoskar - Bhandarkar, Popular Prakshan, Mumbai, 2003
5. "Pharmacology" Seth, Churchill Livingstone, New Delhi, 1998
6. "Handbook of in Pharmacology", S.K. Kulkarni, Vallabh Prakashan, New Delhi, 1999
7. "Element of in Pharmacology", Dr. R.K. Goyal, 10th S.B. Shah, Ahmadabad, 2000

47. Biochemistry (Pharma)

(2 hrs/week)

Chemical basis of life

- a. Cellular level cell and cell organelles. Coenzymes and cofactors: role of vitamins as coenzymes. Enzyme : structure, classification, mechanism of enzyme action, enzyme kinetics, enzyme inhibitors (10)
- b. Oxidative metabolism: biological oxidation, respiratory cycle, oxidation phosphorylation, metabolism of carbohydrates: Photosynthesis, glycolysis, pentose phosphate cycle, TCA cycle. Metabolism of proteins and amino acids, urea cycle. Metabolism of lipids: formation of fatty acids, beta oxidation of fatty acids. Nucleic acids: DNA as carrier of genetic information, transfer of information, protein biosynthesis. (15)

Miscellaneous: role of hormone and other body fluids. Introduction, importance general application in pharmaceutical industry concept of GMP (5)

Books Same as Food Section

48. Technology Of Yarn And Fabric Manufacture (Textile)

(4hrs/week)

Grading of natural and synthetic fibres; Fibre properties and their measurements (2)

Preparatory processes and machinery used for manufacture of yarn from natural and synthetic fibres; Spinning of yarn-ring and rotor spinning, friction spinning, air-jet spinning (18)

Natural and Synthetic fibres for blended and fancy yarns (1)

Yarn properties and their measurement; Doubling of yarns; Requirement of yarn for weaving/knitting - based on end use (5)

Warp and weft preparation, Sizing of yarn - machinery involved (8)

Weaving of fabric - loom, use of dobby and jacquard (10)

Shuttleless looms - air jet, rapier, etc. for high speed weaving (5)

Basic knitting machine (2)

Fabric construction and their effect on various properties - related to end use; Cloth analysis - weaves such as plain, twill, satin, etc.; Subjective evaluation of different fabric qualities (4)

Fabric defects, causes and remedies (1)

Statistical quality control for textiles - equipment and testing (2)

Modernisation, automation, recent developments - in spinning and weaving; Productivity evaluation of weaving and knitting machines (2)

Text/Reference Books :

- 1) *Weaving: Machines, mechanisms, management*, Talukdar, M.K., Sriramulu P.K., Ajgaonkar D.B., Mahajan Publishers Private Ltd., Ahmedabad, 1998.
- 2) *Textiles - Fibre to Fabrics*, Corbman B.P., McGraw Hill Book Company Inc., New York, 6th edition, 1983.
- 3) *Manual of Textile Technology*, Klein, W., The Textile Institute, Manchester, Vol. 1-6, 1987.
- 4) *The Motivate series Textiles*, A.Wynne.
- 5) *Textile Yarns, Technology, Structure and Applications*, B.C. Goswami, J.G.Martindale and F.L.Seardino.
- 6) *Weaving - Conversion of Yarn to Fabric*, P.R.Lord and M.H.A.Mohamed.
- 7) *Knitting Technology*, D.B.Ajgaonkar.
- 8) *Elements of Spinning, Blow Room, Carding, Comber and Ring Frame*, Vol. 1-4, A.R.Khare.
- 9) *Textile Design and Colour*, Watson.

49. Colour Physics And Colour Harmony (Textile)

(2hrs/week)

Introduction-geometric and chromatic attributes; Radiation and illumination; SPD, CT and CCT; Sources and illuminants; Need for artificial sources - various ways of producing light and different artificial sources; Lamp efficacy and colour rendering properties of sources (6)

Interaction of radiation with matter - gloss and diffused reflectance, absorption of light in sample; Various transitions in molecule, Beer - Lambert law and its verification, deviation from Beer - Lambert law, Additivity of absorbance, mixture analysis, absorbance and scattering in the sample - Kubelka - Munk theory (8)

Perception of colour in eye/brain, various colour theories (3)

Additive - subtractive mixing, colour specification systems - Munsell colour order system, CIE system, colour spaces, colour difference formulae (6)

Single constant Kubelka - Munk theory of colourant formulation and recipe prediction; Modern computerised methods of colour matching; Finding the dyeing recipes, shade sorting, etc. using the CCM software (3)

Decorative effect using pattern and design theory; Application of CAD for textiles (4)

Text/Reference Books :

- 1) *Color: A Multidisciplinary Approach*, Zollinger Heinrich Zurich, Verlag Helvetica Chimica Acta, 1999.
- 2) *The Colour Science of Dyes and Pigments*, R. McLaren Bristol, Adam Hilger Ltd., 1983.
- 3) *Industrial Colour Technology*, Johnson R.M., Sartzman M., American Chemical Society Washington D.C., 1971.
- 4) *Computer Colour Analysis: textile applications*, Sule A.D., New Age International Ltd., New Delhi, 1997.

Practicals

50. Analytical Chemistry

(1x 4 hrs/week)

1. Water analysis: Determination of – acidity, alkalinity, hardness, COD and BOD.
2. Water purification: (i) Removal of toxic metal ions from water using ion exchange chromatography.
(ii) Demineralization of water using ion exchange chromatography.
3. Statistical data treatment and validation of methods of analysis.
4. Preparation of organic and inorganic samples for analysis, decomposition of sample by acid/base treatment, separation of interfering component by physical methods and analysis of active component by titrimetric / spectrophotometric analysis.
5. Determination of composition of metal complexes by Job's method.

51. Engineering Laboratory (Term Work)

(1x 4 hrs/week)

(1) **Demonstration** : Demonstrations of machining of the work pieces with machine tools such as lathe, drilling, milling, grinding, shaping. Measurement of dimensions with the help of various measuring instruments such as calipers, screw gauges, dial indicators, etc. Demonstration of pipe threading and fittings.

(2) **Practice** : Each student will have to perform one work piece on lathes involving operations such as plain turning, step turning, taper turning, facing and drilling, grinding etc. They also will be working on 2nd work piece which involves metal fitting practices and joining pieces with electric arc welding methods

52. Color Physics (Dyes) (Term Work)

(1x 4hrs/week)

1. Determination of unknown concentration of a dye in solution by Dubosque colorimeter.
2. Verification of B-L law (dependence of absorbance on concentration) by spectrophotometer.
3. Mixture analysis using spectrophotometer.
4. Determination of gloss of various samples using gloss meter
5. Determination of color of various textile samples in terms of Lovibond primaries and chromaticity co-ordinates using Lovibond tintometer
6. Specification of color of a textile sample in terms of 'Lab' at using color computer.

7. Finding color differences(ΔE) between set of samples vis a vis dye solution concentration.
 8. Finding color differences(ΔE) between set of samples vis a vis time of exposure.
 9. Determination of colors of samples in terms of Munsell color system using Munsell Color Tree.
 10. Recipe prediction and matching of colored samples using CCM
- Suitable number of experiments from the above list will be performed

53. *Technical Analysis I (Food) (Term Work)* (1x4 hrs / week)

Chemical analysis of carbohydrates, proteins and fats. Testing for water quality for potable purposes and for use in industry. Analysis of effluents.

54. *Analysis of Oils, Fats and Waxes (Oils) (Term Work)* (1x4 hrs/week)

Analysis of materials used in oils, fats and soap industry. Water, acids and industrial solvents, Analysis of Oils and Fats: Determination of physical and chemical characteristics of oils, fats, Vanaspati, margarine, ghee and waxes. Analysis of seeds, cakes and extractions. Detection of oils in mixtures. Thin-layer chromatography, auto-oxidation and rancidity (estimation). Analysis of mixture of fatty acids. Titre. GLC analysis. R.M., P and K values determination for butter and coconut oil. Analysis of crude and pure glycerine. Analysis of commercial fatty acids, including GLC. Analysis of monoglycerides, oleochemicals and oil derivatives.

55. *Color Physics (Polymers) (Term Work)* (1x 4hrs/week)

1. Determination of unknown concentration of a dye in solution by Dubosque colorimeter.
 2. Verification of B-L law (dependence of absorbance on concentration) by spectrophotometer.
 3. Mixture analysis using spectrophotometer.
 4. Determination of gloss of various samples using gloss meter
 5. Determination of color of various textile samples in terms of Lovibond primaries and chromaticity co-ordinates using Lovibond tintometer
 6. Specification of color of a textile sample in terms of 'Lab' at using color computer.
 7. Finding color differences(ΔE) between set of samples vis a vis dye solution concentration.
 8. Finding color differences(ΔE) between set of samples vis a vis time of exposure.
 9. Determination of colors of samples in terms of Munsell color system using Munsell Color Tree.
 10. Recipe prediction and matching of colored samples using CCM
- Suitable number of experiments from the above list will be performed

56. *Color Physics (Paints) (Term Work)* (1x 4hrs/week)

1. Determination of unknown concentration of a dye in solution by Dubosque colorimeter.
2. Verification of B-L law (dependence of absorbance on concentration) by spectrophotometer.
3. Mixture analysis using spectrophotometer.
4. Determination of gloss of various samples using gloss meter

5. Determination of color of various textile samples in terms of Lovibond primaries and chromaticity co-ordinates using Lovibond tintometer
 6. Specification of color of a textile sample in terms of 'Lab' at using color computer.
 7. Finding color differences(ΔE) between set of samples vis a vis dye solution concentration.
 8. Finding color differences(ΔE) between set of samples vis a vis time of exposure.
 9. Determination of colors of samples in terms of Munsell color system using Munsell Color Tree.
 10. Recipe prediction and matching of colored samples using CCM
- Suitable number of experiments from the above list will be performed

57. *Physio-Pharmacology Laboratory (Pharma) (Term Work)* (1x4 hrs/week)

RBC count, WBC count, Differential leucocytes count, Hemoglobin estimation, Blood grouping (5)
 Histology, study of effects of various drugs on isolated frogs heart e.g Ach, adrenaline, effect of adrenergic and cholinergic blockers, effect of ions on the isolated frog heart (8)
 Demonstration of different routes of administration of drugs. Effects of clotting time, bleeding time (2)

58. *Color Physics (Textile) (Term Work)* (1x 4hrs/week)

1. Determination of unknown concentration of a dye in solution by Dubosque colorimeter.
2. Verification of B-L law (dependence of absorbance on concentration) by spectrophotometer.
3. Mixture analysis using spectrophotometer.
4. Determination of gloss of various samples using gloss meter
5. Determination of color of various textile samples in terms of Lovibond primaries and chromaticity co-ordinates using Lovibond tintometer
6. Specification of color of a textile sample in terms of 'Lab' at using color computer.
7. Finding color differences(ΔE) between set of samples vis a vis dye solution concentration.
8. Finding color differences(ΔE) between set of samples vis a vis time of exposure.
9. Determination of colors of samples in terms of Munsell color system using Munsell Color Tree.
10. Recipe prediction and matching of colored samples using CCM

Suitable number of experiments from the above list will be performed

SEMESTER V

R. 4785 The candidate shall be examined in the subjects at the Semester V examination as indicated in the following tables.

Theory Papers

Sr. No	Subject	No. of Paper	Examination		Periodic Test Marks	Total Marks	Branch
			Hours	Marks			
1.	Economics & Industrial Management	1	3	70	30	100	All
2.	Chemical Engineering Operations	1	3	70	30	100	All
3.	Fluid Flow and Heat Transfer	1	3	70	30	100	All
4.	<u>Special Subject</u> Technology of Intermediates & Colorants - I	1	3	70	30	100	Dyes
	Nutrition	1	2	35	15	50	Foods
	Technology of Oils & Fat Production	1	3	70	30	100	Oils
	Thermoplastics Polymer Technology	1	3	70	30	100	Polymer
	Thermoplastics Polymer Technology	1	3	70	30	100	Paints
	Pharmaceutical Chemistry & Pharmaceutical Analysis	1	3	70	30	100	Pharma
	Technology of Textile Pretreatments	1	2	35	15	50	Textile
5	<u>Special Subject</u> Chemistry of Intermediates & Colorants - III	1	3	70	30	100	Dyes
	General Microbiology	1	2	35	15	50	Foods
	Technology of Oleochemicals & Surfactants	1	2	35	15	50	Oils
	Technology of Thermoset Resins	1	3	70	30	100	Polymer

	Technology of Thermoset Resins	1	3	70	30	100	Paints
	Microbiology & Formulation Technology of Liquids & Topicals	1	3	70	30	100	Pharma
	Techniques & Theory of Textile Colourations	1	4	70	30	100	Textile
6	<u>Special Subject</u>						
	Food Chemistry	1	3	70	30	100	Food
	Soaps, Detergents & Applications	1	2	35	15	50	Oils
	Technology of Textile Polymers	1	2	35	15	50	Textile
	Total	5	—	350	150	500	

Practical Examinations

Sr. No	Subject	Examination		Class Work Marks	Total Marks	Branch
		Hours	Marks			
7.	<u>Special Subject</u>					
	Analysis of Intermediates & Dyes	6	70	30	100	Dyes
	Technical Analysis - II (Foods)	3	35	15	50	Foods
	Analysis & Surfactants & Oleochemicals	6	70	30	100	Oils
	Analysis of Characterization of Raw Materials & Polymers	6	70	30	100	Polymer
	Analysis & Characterization of Raw Materials & Polymers	6	70	30	100	Paints
	Technology of Liquids & Topicals Laboratory	6	70	30	100	Pharma
	Experimental Dyeing - I	6	70	30	100	Textile
8	<u>Special Subject</u> (Term Work)					
	Experimental Dyeing	-	-	100	100	Dyes
	Biochemistry	-	-	100	100	Foods
	Processing of Oils, Fats & Waxes	-	-	100	100	Oils
	Synthesis & Characterization of Resins & Polymers	-	-	100	100	Polymer
	Synthesis & Characterization of Resins & Polymers	-	-	100	100	Paints
	Biochemistry & Microbiology Lab	-	-	100	100	Pharma
	Experimental Dyeing - II	-	-	100	100	Textile
9.	<u>Special Subject</u>					
	Food Chemistry	3	35	15	50	Food
	Total	-	70	130	200	

Grand Total at the Examination

700

R. 4786 The following are the syllabi of the various subjects at the Semester V examination

Semester V

Theory

59. Economics and Industrial Management

(4 hrs/week)

Economics:

Nature and significance of economics. Basic economic concepts. Demand and supply, elasticity of demand and supply, money. Real and opportunity cost. Concept of profit and revenue, tax tariff and subsidies, wants and utilities. Concept of equilibrium and margin economic systems, capitalism, socialism and mixed economy. Factors of product. Introduction to micro and macro economics and price theory. Money banking and trade. Nature and functions of money. Commercial and central banking. Problems of foreign exchange and implications of currency devaluation. Economic development of India. Structure and features of India economy. Growth of public sector in India. Role of agriculture in Indian economy. Meaning and tools of economy planning. Five year plans of India.

Industrial management:

Introduction: Management principles. Management and engineering studies. Meaning and type of management. Concept of scientific management. Functional areas of business. Forms of business organization. Theory and practice of management, planning, organizing, staffing, coordinating and control.

Production management: Introduction to work study, concept of productivity, wages and incentives, production planning and control, scheduling of projects, materials management. Quality control and preventive maintenance.

Financial and accounting management: Sources of industrial finance. Institutional financing. Principles of accounting. Management accounting.

Marketing and sales management: The sales organization of a firm. Management of sales and advertisement. Market research.

60. Chemical Engineering Operations

(4 hrs/week)

Definition of Unit Operations and their Industrial Relevance (1)

Size Reduction and Analysis (3)

Mixing Solid - Solid, Equipment (3)

Filtration and Centrifuging : Theory of Filtration, Industrial Filters (5)

Distillation: Vapour-Liquid Equilibria, Batch and Continuous Distillation, (9)

Separation of azeotropes, Steam Distillation, Equipments (9)

Absorption : Diffusivity, Henry's law, Design of Absorbers, Equipments (8)

including Falling Film Absorber, Venturi Scrubber, Spray Columns (8)

Extraction : Solvent Selection, Batch Extraction, Equipments (4)

Adsorption : Adsorption Isotherms, Industrial Adsorbents with their characteristics, Break through curve, adsorption columns.	(4)
Humidification and Dehumidification, Cooling Towers	(3)
Drying : Theory, Dryers for Wet Solids, Slurries and Solutions	(5)
Crystallization: Super Saturation, Industrial Strategies for creating Super Saturation, Industrial Crystalizers	(5)
Evaporation : Boiling point elevation, Single and Multiple effect evaporators, Industrial evaporators	(5)
Membrane Processes: MF,UF, RO and Pervaporation	(5)
Note: Simple design problems for each of the Unit Operations shall be covered under individual subject heading as practiced presently.	

Text Books:

1. Unit Operations by McCabe & Smith
2. Transport Processes and Unit Processes by Geankoplis.

61. Fluid Flow And Heat Transfer

(4 hrs/week)

Fluid Flow

Introduction to engineering principles of fluid mechanics	(2)
Units and conversions. Basics of fluid statics and dynamics.	(2)
Definition of fluid, Newtonian and Non-Newtonian fluids, viscosity, density, pressure, surface tension. Hydrostatic equation, manometry, capillarity, buoyancy and pressure measurements.	(4)
Principle of momentum transfer and balances.	(3)
Flow characteristics , laminar and turbulent flows.	(3)
Significance of Reynolds number. Bernoulli's theorem and its significance.	(3)
Flow measurement - orifice meter, venturi meter, rotameter, pitot -tube, weirs, electronic devices	(4)
Flow through ducts - pipes and open channels; concept of friction factor.	(4)
Pipe fittings and valves.	(2)
Dimensional analysis and similarity; importance of dimensionless numbers in transport processes	(2)
Flow past immersed bodies, packed and fluidised beds.	(2)
Turbomachinery - principles of operation and selection of pumps, compressors, blowers, fans, ejector etc. for chemical and allied process industries.	(2)
Mixing of fluids - types of mixers and blenders for Newtonian and non-Newtonian fluids in single and multiphase systems in chemical and allied process industries.	(2)

Reference books:

1. Chemical Engineering, Volume 2, (6th edition) by Coulson & Richardson
2. Introduction to Chemical Engineering, (4th Edition) by McCabe & Smith
3. Transport Phenomena, by (2nd Edition) Bird

Heat Transfer

Mechanism of heat transfer by conduction, convection and radiation. (4)

Concept of individual and overall heat transfer coefficient. (4)

Applications of the principles of heat transfer to design equipment such as heat exchangers, condensers, jacketed kettles and coils, reboilers. (4)

Evaporation. Refrigeration. (3)

Dropwise and filmwise condensation. (3)

Boiling. (3)

Unsteady state heat transfer. (3)

Heat transfer media. (2)

Analogy between Heat, Mass and Momentum Transfer- Reynold Analogy, Chilton-Colburn's Analogy and Von Karman Analogy (4)

Reference books:

1. Chemical Engineering, Volume 2, (6th Edition) by Coulson & Richardson
2. Introduction to Chemical Engineering, (4th Edition) by McCabe & Smith
3. Process Heat Transfer (2nd Edition) by D. Q. Kern

62. Technology Of Intermediates And Colorants – I(Dyes)

(4hrs/week)

Unit operations in dyestuff industry, Heating and cooling media, Materials of construction, pressure reactors. (5)

Pressure reactions – engineering aspects. Pressure vessels, their design and material of construction (5)

Technology involving unit processes like nitration, sulphonation, reduction, halogenation. hydrogenation reaction, ammonolysis, aminolysis, hydroxylation, Friedel Craft's reactions and other commonly used unit processes. (10)

Acidity functions. Safer methods of nitrations, sulphonation, chlorosulphonations, Friedel Craft's reactions. (5)

Some aspects of unit operations like evaporation, distillation, filtration, drying and transportation of materials in dyestuff industry. (3)

Agitation systems and particle size reduction. (2)

Technology of some typical bulk dyestuff intermediates such as phenol, aniline, 2-naphthol, anthraquinone and its derivative, BON acid, phthalic anhydride, naphthol sulphonic acids, naphthylamine sulphonic acids, aminonaphthol sulphonic acids. Factory layout and design related to the topics. (5)

Technology involved in the production of azo acid, direct, reactive, metal-complex dyes, azoic components, basic dyes, typical fluorescent whiteners. Factory layout and design related to the topics. (5)

Principles of isomer separations. Continuous versus batch and semi-batch and operations with examples. (5)

Solvents used in typical reactions with emphasis on selection criteria. Ionic liquids as solvents. (7)

Solid-solid reaction (7)

Statistical quality control techniques. Specifications of raw materials, process parameters, other quality parameters and their statistical treatment. (8)

Text/Reference Books :

1. Unit Processes in Organic Synthesis, Groggins P.H.
2. Chemical Process Industry, Shrieve
3. Unit Operations, McCabe, Smith
4. Material of Construction, Lee
5. Fundamental Processes of Dye Chemistry, Fierz, David, Blangey

63. Chemistry Of Intermediates And Colorants - III(Dyes) (4hrs/week)

Chemistry of disperse dyes with special emphasis on environmental safety. Dispersant free disperse dyes. Replacement of anthraquinone disperse dyes- Heterocyclic diazo and coupling components. Styryl and extended styryl disperse dyes. (20)

Chemistry of reactive dyes with special emphasis on environmental issues. High fixation, low salt, highly substantive reactive dyes. neutral fixing and acid fixing reactive dyes. Heterocyclic reactive systems and multifunctional reactive dyes. Reactive basic dyes. (10)

Fluorescent whiteners and dyes. Basic concepts of fluorescence, fluorophoric systems such as stilbenes, coumarins, carbostyryls, pyrazolines, naphthalimides and other heterocyclic systems. (12)

Introduction to pigments. Colour and Physical constitution. Optical properties of pigments. Crystalline modifications and other basic properties. (6)

Lake pigments, Condensation pigments, arylide pigments, benzimidazolone pigments, vat pigments, quinacridone pigments. (7)

Speciality dyes for textile applications, benzidine free direct dyes - heterocyclic diamines, Technical properties in relation to chemical constitutions. (5)

Text/Reference Books :

1. Advances in Color Chemistry Vol I, Peters A.T.
2. Color Chemistry, Zollinger
3. Chemistry of Synthetic Dyes - Vol III, Venkatraman K., Academic Press, New York, 1952 .
4. Chemistry of Synthetic Dyes - Vol V, Venkatraman K., Academic Press, New York, 1952
5. Non-Textile Dyes, Freeman

64. Nutrition (Food)

(2hrs/week)

Metabolic rate and caloric needs	4	
Requirements and role of nutrients in human health, RDAs. Nutrition Fibres		10
Biological Value of proteins	8	
Energy Value of Foods	2	
Techniques of Diet & Health Surveys	4	
Formulation of diets and foods for specific needs	2	
Total	30	

Reference Book:

Modern Nutrition in Health & Disease by Young & Shils.

65. General Microbiology (Food)

(2 hrs/week)

Introduction	1
Microscopy	2
Study of bacteria Yeast Molds Viruses with respect to morphology reproduction growth requirements	7
Growth Requirements, Media, Nutritional Isolation Preservation and maintenance of pure culture, Enumeration	7
Growth Curve	1
Mutation Introduction to Genetics	2
Methods of sterilisation disinfection sanitation	7
Principles of Immunology	3

Books for General Microbiology

Food Microbiology: Pelzar M J et al.

Textbook of Pharmaceutics :- A C Bentley

Microbiology Fundamentals and Applications: S S Purohit

Medical Microbiology Infections: Mackie & McCartney

66. Food Chemistry (Food)

(4 hrs/week)

Chemical composition, standards of identity, purity and methodology of analysis of: cereals, legumes, oilseeds, fruits and vegetables and their products, tea, coffee, cocoa, chocolate, spices condiments	(15)
The effect of food constituents on quality of foods	(3)
Different forms of water present in foods and their effect on quality and preservation of foods	(2)
Chemistry of food ingredients and components affecting properties of foods such as texture, colour, taste, odour, functional properties etc.	(4)
Chemical and enzymatic changes affecting the above properties during harvesting, storing, processing etc.	(3)
Statistical evaluation and sensory analysis	(3)
Interaction amongst food constituents	(12)
Food toxicants and contaminants, safety of food from chemical and microbiological considerations	(12)
Food legislation, Indian and international standards	03
Use of the hazard analysis, critical points critical control points system to ensure microbiological safety and quality of foods	03

Books:

Prevention of Food Adulteration Act, 1954. ed. 9th ed., 1986

ISI Handbook of Food Analysis : Indian standers institution., 1980-1984

Food Chemistry: W. Grosch by Belitz, H.D., Grosch, W. - ed. 2nd - Berlin : Springer, 1999

Food Chemistry : by O.R.Fennema by Fennema, O.r., ed. 2nd ed., New York :Marcel Dekkers, 1985.

Quality control in the food industry by Herschoerfer, S.M. - ed. 2nd ed. - London : Academic Press, 1986

Sensory Evaluation Techniques by M. Meilgaard & others, CRC Press, Florida, 1990

Sensory Evaluation of Food by M. O'Mahony, Marcel Dekker, Inc., NY, 1986

67. Technology Of Oil And Fat Production (Oils) (4hrs/ week)

Natural sources of oils and fats, domestic and world production, trade and marketing of oilseeds and oils. (6 hrs) Storage, sampling, grading, cleaning, crushing, and heat treatment of oilseeds. (10 hrs) Mechanical expression, solvent extraction, rendering and other methods of recovering oils and fats. Economic aspects of these processes. (16 hrs) Specific methods for the production of palm oil, palm kernel oil and rice bran oil. (5 hrs) Antinutritional constituents of oilseeds. General methods of upgrading and utilization of oils, oil cakes and other products. (8 hrs) technical refining of oils for industrial uses, detoxification and technical products from oil cakes, edible products from oil meals, synthetic fatty material. (15 hrs)

Books:

- Bailey's Industrial Oil and Fat Products Volume I to V by Daniel Swern, A Wiley Interscience Publication (1979)
- Palm oil by F. D. Gunstone, John Wiley and Sons (1987)
- Oils and Fats Manual (Vol. I & II) by A. Karleskind and J. P. Wolff, Lavoisier Publishing (1996)
- Oils, Fats and fatty foods by K. A. Williams, J. A. Churchill Ltd. (1966)
- Journal of American Oil Chemists' Society, International News on Fats, Oils and Related Materials, Lipids.
- Treatise on fats, fatty acids and oleochemicals by O. P. Narula, Vol I & II, Industrial Consultants (India), (1994)
- Recent advances in chemistry and technology of fats and oils by R. J. Hamilton, Elsevier Applied Science (1987)

68. Technology of Oleochemicals and Surfactants (Oils) (2hrs/ week)

Fatty alcohols: production from natural source such as oils and fats, petroleum source, conventional methods and recent developments. (5 hrs) Epoxidation of oils and fats with special reference to poly unsaturated soybean oil. Alkyd resins and surface coatings from linseed oil, soybean oil, glycerol, monoglycerides and fatty acids. (4 hrs) Fatty acid methyl esters: production, properties and applications. (3 hrs) Dimer, trimer fatty acids, polymerized fatty acids, dibasic fatty acids, Castor oil derivatives: estolides, hydrogenated castor oil (HCO), dehydrated castor oil (DCO), 12-hydroxy stearic acid (HSA), turkey red oil (TRO), sebacic acid. (6 hrs) Plant & processes for the production of important anionic, non-ionic, cationic and amphoteric surfactants. (5 hrs) Fluorinated surfactants, new generation surfactants such as gemini surfactants, silicon surfactants, sugar based surfactants. (3 hrs) Biodegradability of surfactants, Biosurfactants: production, properties and applications. (4 hrs)

Books:

- Treatise on fats, fatty acids and oleochemicals by O. P. Narula, Vol I & II, Industrial Consultants (India), (1994)
- Fatty acids in industry by R. W. Johnson, Marcel Dekker Inc. (1989)
- Fats, Oleochemicals and surfactants challenges in 21st Century by V. V. S. Mani and A. D. Shitole, Oxford and IBH Publishing Co. Pvt. Ltd. (1997)
- Surfactants in consumer products theory, technology and applications by Falbe L. Springer Verlag (1987)
- Anionic surfactants by Linfield W.M. (1976)
- Fatty Acids by Markley K. S. Vol. I to IV, Robert E. Krieger publishing Co. (1973)

69. Soaps, Detergents And Applications (Oils)

(2hrs/ week)

Raw materials for the soap industry, classification and selection of raw materials, properties of soaps and soap solution, phases in soap boiling, processes employed in the manufacture of soap, various types of soaps and cleaning preparations, testing and evaluation, Indian Standard Institution methods, essential oils and other ingredients for soaps. (12 hrs) Detergents, their classification, raw materials, processes, and plants for the manufactures of detergents for domestic and industrial consumption, product evaluation, Indian Standard Institution Methods, essential oils and other ingredients for detergents. (10 hrs) Application of soaps and detergents in food, pharmaceuticals, textile, leather, surface coating, adhesives and other industries. (8 hrs)

Books:

- Perfume, Cosmetics and Soap by Poucher W., Chapman and Hall Ltd., (1959)
- Perfumes, Soaps detergents and Cosmetics by S. C. Bhatia, CBC Publishers and Distributors (2001)
- Detergency Theory and technology by Cutler W. G., Marcel Dekker Inc. (1987)
- Detergent analysis by B. M. Milwidsky, Micelle Press (1994)
- Synthetic detergents by A. S. Davidson by, Longmann Scientific and technical publishers (1987)
- Soaps in industry by Milton L., Chemical Publishing Co. (1946)
- Soaps and detergents by Thomssen (1949)
- Manufacture of soaps, other detergents and glycerin by E. Woollatt, John Wiley and Sons (1985)

70. Thermoplastic Polymer Technology (Polymer)

(4 hrs/week)

Polyethylenes-LLDPE, LDPE, HDPE, ULDPE; Polypropylene and copolymer of propylene with ethylene, isobutylene, modified polyethylenes (6)
Polyvinyl chloride, copolymers with vinyl acetate, vinyl alcohol, maleic anhydride etc (4)
Styrenic polymers-polystyrene, HIPS, SAN, ABS, important copolymers of styrene maleic anhydride and styrene acrylics, toughening mechanism (5)
Polyesters such as PET, PBT, PTT (5)
Polymamides- Nylon 6, Nylon 6,6, Nylon 11, aromatic polyamide such as Kevlar (5)
Polycarbonates, polyoxymethylene i.e. Polyacetal (5)
Acrylic polymers-polyacrylic acid, polyacrylamide, PMMA, ASA, Polyacrylonitrile etc. (5)
Modified cellulose: Cellulose esters and ethers such as Ethyl cellulose, CMC, HPMC, cellulose acetals etc., Liquid crystalline polymers; polyamides and other high temperature polymers, speciality plastics- PES, PAES, PEEK, PEAK etc. (15)
Developments in new polymers such as dendrites, oil field polymers, biopolymers etc. (10)

71. Technology Of Thermoset Resins (Polymer)

(4 hrs/ week)

Alkyd resins: Basic components like polyfunctional alcohols, poly-basic acids, vegetable oils/fatty acids. Different types of drying oils: drying, semi-drying and non-drying with examples. Influence of all these components in the synthesis and properties of the final alkyds obtained. modification of alkyds: modification with rosin, maleic anhydride, acrylics, vinyls, imides, etc. (10)

polyesters Resins- unsaturated polyesters resins: Raw material: poly-basic acids, polyfunctional glycols. Curing of resins through unsaturation of the resin/polymer backbone. Curing systems, catalysts and accelerators. Moulding compositions, fibre and film forming compositions. (4)

phenolics: Basic components of the polymer. Different kinds of phenols and their derivatives, different kinds of aldehydes used. Novolacs and Resol: effect of the ratio of phenol to aldehyde on the nature and the property of the polymer. Theory of resinification and effect of pH on the reaction mechanism and the reaction product. Curing of phenolics

Modification of phenolics such as oil soluble and oil reactive. Phenolic moulding compounds, ingredients, compounding and applications. (10)

Amino resins: Basic raw materials used like urea/melamine/ aniline/ formaldehyde. Synthesis of UF and MF resins. Theory of resinification and effect of pH on the reaction mechanism and the reaction product. Properties and application of the UF, MF and AF resins Modification of resins with alcohols and phenols Moulding materials, compounding, processing and application. (6)

Epoxy resins: Basic raw materials like epichlorohydrin and di hydroxy phenol. Different di hydroxy phenolic compounds which can be used. Classification of epoxy resins. Synthesis of epoxy resins. Ratios of reaction components and their effect on the properties of reaction product and molecular weight in particular. Curing of the resin: curing agents like amines, acids, anhydrides, etc. Epoxy compositions and their ingredients, like diluents, flexibilizers, etc. Epoxy novolac systems Modified epoxides. (9)

Polyurethanes- Thermoplastic and Thermoset: Basic components: diisocyanates and diols, different diisocyanates and diols used Reactions of isocyanates with various other functional groups Synthesis of polymers Polyurethane foams, polyester and polyether foams. Processes like one-shot process, Polyether pre-polymers, Quasi-pre-polymer polyether foams, etc. Flexible foams Polyurethanes in Coatings Polyisocyanates IPN using polyurethanes-acrylic blends (9)

Silicones Thermoplastic and Thermoset: Preparation of intermediates, Grignard's method, direct method, olefin addition method, sodium condensation method, rearrangement of organo chlorosilanes. Nature and effect of Si-H, Si-O, Si-Si, and Si-C bond. Silicone fluids, resins, elastomers. Their compounding, processing and applications. Silicone modified resins. (6)

Thermosetting acrylics: Synthesis of acrylic polymers and co-polymers, different techniques. Structure property relationship application of thermosetting acrylics, like anaerobic adhesives, laminating resins, etc. (4)

Miscellaneous thermosetting polymers: (2)

Text/ Source Books

1. Text book of Polymer Science by Billmeyer, John Wiley and Sons 1984.
2. Encyclopedia of Polymer Science and Technology, John Wiley and Sons, Inc 1965.
3. Encyclopedia of Polymer Science and Engineering, John Wiley and Sons, Inc 1988.
4. Polymer Chemistry by Malcolm P. Stevens, Oxford University Press, Inc, 1990.
5. Introduction to Polymer Science and Technology by H. S. Kaufman and J. J. Falcetta, Wiley - Interscience Publication, 1977
6. Handbook of Polyethylene, A. J. Peacock, Marcel Dekker Inc, 2000
7. PVC Technology, A. S. Athalye and Prakash Trivedi, Multi-Tech Publishing Co, 1994.
8. Engineering Thermoplastics Polycarbonates Polyacetals Cellulose Esters, L. Bottenbruch, Hanser Publishers, 1996.
9. Composite Polymeric Material, R. P. Sheldon, Applied Science Publishers, 1982.
10. Composites: Design Guide, Industrial Press Inc, 1987.

11. Composite Material Handbook, M. M. Schwartz, McGraw-Hill company, 1984.
12. Biopolymers, Wiley, VCH Verlag, 2003
13. Handbook of Thermoplastics, O. Olabisi, Marcel Dekker, 1997.
14. Plastics Materials J. A. Brydson, Butterworth Scientific, 1990.
15. Polymer chemistry, Seymour and Carraher, Marcel Dekker, 2003.
16. Polymer and Resins; Their Chemistry and Chemical Engg, Brage Golding, D. Van Nostrand Company Inc, 1959.
17. Structures of Cellulose, Atlla, American Chemical society, 2003.
18. Styrene Based Plastics and their Modifications, Svec, Ellis Harwood, 1991.
19. Polymer Technology by Miles and Briston
20. Surface Coating, OCCA Publication.
21. Organic Coating Technology by H. F. Payne.
22. Organic Coating: Science and Technology by Z. Wicks.]

72. Thermoplastic Polymer Technology (Paints)

(4 hrs/week)

- Polyethylenes-LLDPE, LDPE, HDPE, ULDPE; Polypropylene and copolymer of propylene with ethylene, isobutylene, modified polyethylenes (6)
- Polyvinyl chloride, copolymers with vinyl acetate, vinyl alcohol, maleic anhydride etc (4)
- Styrenic polymers-polystyrene, HIPS, SAN, ABS, important copolymers of styrene maleic anhydride and styrene acrylics, toughening mechanism (5)
- Polyesters such as PET, PBT, PTT (5)
- Polymamides- Nylon 6, Nylon 6,6, Nylon 11, aromatic polyamide such as Kevlar (5)
- Polycarbonates, polyoxymethylene i.e. Polyacetal (5)
- Acrylic polymers-polyacrylic acid, polyacrylamide, PMMA, ASA, Polyacrylonitrile etc.
- Modified cellulotics: Cellulose esters and ethers such as Ethyl cellulose, CMC, HPMC, cellulose acetals etc., Liquid crystalline polymers; polyamides and other high temperature polymers, speciality plastics-PES, PAES, PEEK, PEAK etc. (15)
- Developments in new polymers such as dendrites, oil field polymers, biopolymers etc. (10)

73. Technology Of Thermoset Resins (Paints)

(4 hrs/ week)

- Alkyd resins: Basic components like polyfunctional alcohols, poly-basic acids, vegetable oils/fatty acids. Different types of drying oils: drying, semi-drying and non-drying with examples. Influence of all these components in the synthesis and properties of the final alkyds obtained. modification of alkyds: modification with rosin, maleic anhydride, acrylics, vinyls, imides, etc. (10)
- Polyesters Resins- unsaturated polyesters resins: Raw material: poly-basic acids, polyfunctional glycols. Curing of resins through unsaturation of the resin/polymer backbone. Curing systems, catalysts and accelerators. Moulding compositions, fibre and film forming compositions. (4)
- Phenolics: Basic components of the polymer. Different kinds of phenols and their derivatives, different kinds of aldehydes used. Novolacs and Resol: effect of the ratio of phenol to aldehyde on the nature and the property of the polymer. Theory of resinification and effect of pH on the reaction mechanism and the reaction product. Curing of phenolics
- Modification of phenolics such as oil soluble and oil reactive. Phenolic moulding compounds, ingredients, compounding and applications. (10)

Amino resins: Basic raw materials used like urea/melamine/ aniline/ formaldehyde. Synthesis of UF and MF resins. Theory of resinification and effect of pH on the reaction mechanism and the reaction product. Properties and application of the UF, MF and AF resins Modification of resins with alcohols and phenols Moulding materials, compounding, processing and application. (6)

Epoxy resins: Basic raw materials like epichlorohydrin and di hydroxy phenol. Different di hydroxy phenolic compounds which can be used. Classification of epoxy resins. Synthesis of epoxy resins. Ratios of reaction components and their effect on the properties of reaction product and molecular weight in particular. Curing of the resin: curing agents like amines, acids, anhydrides, etc. Epoxy compositions and their ingredients, like diluents, flexibilizers, etc. Epoxy novolac systems Modified epoxides. (9)

Polyurethanes- Thermoplastic and Thermoset: Basic components: diisocyanates and diols, different diisocyanates and diols used Reactions of isocyanates with various other functional groups Synthesis of polymers Polyurethane foams, polyester and polyether foams. Processes like one-shot process, Polyether pre-polymers, Quasi-pre-polymer polyether foams, etc. Flexible foams Polyurethanes in Coatings Polyisocyanates IPN using polyurethanes-acrylic blends (9)

Silicones Thermoplastic and Thermoset: Preparation of intermediates, Grignard's method, direct method, olefin addition method, sodium condensation method, rearrangement of organo chlorosilanes. Nature and effect of Si-H, Si-O, Si-Si, and Si-C bond. Silicone fluids, resins, elastomers. Their compounding, processing and applications. Silicone modified resins. (6)

Thermosetting acrylics: Synthesis of acrylic polymers and co-polymers, different techniques. Structure property relationship application of thermosetting acrylics, like anaerobic adhesives, laminating resins, etc. (4)

Miscellaneous thermosetting polymers: (2)

Text/ Source Books

(Same as for Polymers)

74. *Pharmaceutical Chemistry (Synthesis Of Drug Molecules) And Pharmaceutical Analysis (Pharma)* (4hrs/week)

Pharmaceutical Chemistry (Synthesis of Drug Molecules)

Retro synthesis analysis, concepts

- (a) Retro synthetic analysis and synthesis of 30 drugs in the classes of anti-infective, antihistaminic, CNS drugs, CVS drugs and NSAIDs with aromatic, (10)
- (b) Heterocyclic and fused ring systems giving approximate conditions and emphasis on techno-commercial potential routes, synthesis of vitamins, peptide (20)

Pharmaceutical Analysis

Statistical methods and their application in analytical chemistry (2)

The basic understanding, underlined principles, application and limitations relevant to pharmacy, of the following techniques

Infra red spectroscopy, NMR spectroscopy, Mass spectroscopy (6)

Fluorescence and phosphorescence spectroscopy, Flame photometry, Atomic absorption spectrophotometry (5)

Chromatographic techniques-GC, HPLC (5)

Radio-immunoassays	(1)
Nephelometry and turbidimetry	(1)
Electro-analytical techniques, U.V/ Visible spectrophotometry	(5)
Structure elucidation of simple organic molecules using spectral properties	(5)

Books:

1. Principles of Instrumental Analysis, Skoog D. A. (III Edition), Saunder Collage publication
2. Quantitative Pharmaceutical Chemistry, Glann L. Jenkins, Adelbert M. (VI Edition) McGraw-Hill Books Company
3. Pharmaceutical Exepients. Characterization by IR, Raman and NMR Spectroscopy, David E. Bugay, W. paul Findlay, Marcel Dekker, Inc., New York Vol 94
4. Text Book of Pharmaceutical Analysis, Kenneth A., Connors, A Willey Interscience Publication, USA

75. Microbiology And Formulation Technology Of Liquids And Topicals (Pharma) (4hrs/week)

Microbiology

Microscopy concept of magnification resolution, basis of light microscopes. Dyes and stains, Observation of micro organisms under light microscopy-wet mount, hanging drop, gram staining and acid fast stains. Cultivation and growth requirements, nutritional aspects and other conditions. Basis of growth media classification-principles and application. Concept of pure culture, clone, isolation, preservation and maintenance of pure cultures. Basis of identification and characteristics of micro organisms-its relevance. Basis morphology of a typical prokaryotic cell. Appendages external to cell wall, cell membrane, cytoplasm and cell inclusions. Study of bacteria, yeast, mold, algae and viruses-morphology, structure. Reproduction isolation, cultivation and metabolism, Immunology-basic classification of antigen/antibody immunoglobulins, concept of allergy-antigen and antibody reaction. Concept of vaccines- Manufacture of bacterial and viral vaccines. Sterilization-methods and validation, aseptic techniques, sterility testing. Disinfections and disinfectants, phenol coefficient tests. (30)

Books: (Same as Food)

Formulation Technology of Liquids And Topicals

- Introduction and classification of pharmaceutical dosage forms (2)
- Preformulation, formulation, evaluation, large scale manufacture and packaging with focus on equipment with reference to liquid dosage forms; Monophasic solutions syrups, elixirs, Nasal and ear drops etc. (6)
- Biphasic suspensions and emulsions (10)
- Topicals: ointments, creams, gels and suppositories (8)
- Layout design and Unit operations related to above dosage forms (4)

Books:

1. Pharmaceutical Dosage Forms And Drug Delivery Systems, Ansel, Philadelphia, Fea and Febiger, 1985
2. Introduction to Pharmaceutical Dosage Forms, Ansel, Henry Kimpton Publishers, London.
3. Pharmaceutics: The Science of Dosage Form Design, Aulton, New Delhi, B.I. Naverly Pvt. Ltd., 1995
4. Dermatological Formulations, B.W.Barry, New York, Marcel Dekker 1983
5. Modern Pharmaceutics, G.S. Banker, New York, Marcel Dekker 1990
6. Bentely's Textbook of Pharmaceutics, Rawlins, Cassell Ltd, London

7. Fundamentals of Pharmacy, Blome H.E, Philadelphia, Fea and Febiger, 1985
8. Pharmaceutical Production Facilities: Design and Applications, G.C.Cole, New York Ellis Horwood 1990
9. Husa's Pharmaceutical Dispensing, Martin E.W. , Easton Mack Pub. Co. 1971
10. Transdermal Delivery of Drugs, A.Kydonieus, Florida, CRC Press, 1987

76. Technology Of Textile Pretreatments(Textile)

(2 hrs/week)

Singeing; Natural and added impurities in textile fibres; Sizing and desizing of cotton (5)
 Techniques for scouring and bleaching of cotton; Machinery used for these preparatory processes in batchwise and continuous operations for different forms of textiles such as loose fibres, yarn and fabric; Brief idea about mercerisation (12)
 Silk degumming and bleaching; Scouring and bleaching of wool; Carbonisation of wool; Scouring and bleaching of synthetics and their blends with natural fibres (5)
 Combined preparatory processes for various textiles; Efficiency of various pretreatment processes (5)
 Concept of conservation of chemicals, energy and water; Ecofriendly pretreatments; Advances in pretreatment techniques (3)

Text/Reference Books :

- 1) *Technology of Bleaching and Mercerising*, Shenai V.A., Sevak Publication, Bombay, Vol.- 3, 3rd edition, 2003.
- 2) *Textile Bleaching*, Steven A.B., Pitman and Sons, London.
- 3) *Technology of Scouring and Bleaching*, Trotman E.R., Griffin, London, 1968.
- 4) *Technology of Bleaching and Dyeing*, Chackraverty, R.R., Trivedi S.S., Vol. 1, Mahajan Publishers Private Ltd., Ahmedabad, 1979.
- 5) *Textile Chemistry*, Peters R.H, Vol-2, Elsevier Publishing Company, London, 1967.

77. Techniques And Theory Of Textile Colouration (Textile)

(4 hrs/week)

Physical and chemical structures of fibres and dyes in relation to dyeing; Classification of colouring matters according to their application to the textile fibres (4)
 Interaction between dye molecules and the fibres (2)
 Dyeing of different dyestuffs onto various natural textile fibres (13)
 Rapid dyeing concept (8)
 Dye-fibre bonds and parameters affecting them. (3)
 Thermodynamics of dyeing process; Kinetics of dyeing; Affinity of dyes towards the fibres; Adsorption isotherms; Equilibrium adsorption and factors influencing the same; Saturation value; Diffusion coefficient; Glass transition temperature and its effect on dyeability; Electro-kinetic properties of dye-fibre systems (10)

Compatibility of dyes in mixtures; Dyeing of fibre blends (4)
 Important properties of dyestuffs and their evaluation; Evaluation of fastness properties of dyed materials and their acceptability limits; Novel dyeing techniques (10)
 Theories behind different techniques such as, solvent dyeing, mass colouration, heat transfer coloration, etc; Concept of eco-friendliness in dyestuffs and dyeing techniques (6)

TEXT/REFERENCE BOOKS :

- 1) *Reactive Dyes for Textile Fibres*, Renfrew A., A.Hunter M., SDC Publ., Bradford, 1999.
- 2) *The Theory and Practice of Wool Dyeing*, Bird, C.L., SDC Publ., Bradford, 1972.
- 3) *Theory of Colouration of Textiles*, Johnson A.s, SDC Publ., Bradford, 2nd edition, 1989.

- 4) *Chemical Processing of Synthetic Fibres and Blends*, K.V. Datye and A.A. Vaidya, John Wiley and Sons, New York, 1984.
- 5) *Textile Chemistry*, Peters R.H, Vol-3, Elsevier Publishing Company, London, 1975.
- 6) *Chemical Processing of Synthetic Fibres and Blends*, Datye K.V., Vaidya A.A., Wiley-Interscience Publ., New York, 1984.

78. Technology Of Textile Polymers (Textile)

(2hrs/week)

- General polymer chemistry; Various synthetic polymers used in textile industry. (3)
- Thermosetting and thermoplastic polymers in textile applications; Mechanism of addition and condensation polymerisation (3)
- Number average and weight average molecular weights and their measurements (4)
- Swelling and dissolution for polymeric materials; Chemical used for it (3)
- Determination of crystalline, non-crystalline regions and crystalline orientation in fibre structure; Micro structures of fibre and their theories (3)
- Development and modification of fibre structure through different techniques of spinning, drawing and texturising (4)
- Physical and chemical modifications of fibres and their effect on properties; Graft and block copolymerisation reactions (3)
- Brief idea about characterisation of polymers by different physical techniques such as DTA, DSC, TGA, IR, X-Ray diffraction, etc. (4)
- Brief idea about polymer composites; Recent developments in synthetic polymers for textiles; Polymer waste and techniques of utilisation (3)

TEXT/REFERENCE BOOKS :

- 1) *Synthetic Fibres : Machines and Equipment Manufacture Properties*, Fourné, Franz, Munich, Hanser Publications, 1998.
- 2) *Natural Polymer man-made Fibres*, Carrol and Porczynski C.Z., National Trade Press Ltd., London, 1965.
- 3) *Visco-Elastic Properties of Polymers*, Ferry, J.D., John Wiley and Sons, New York, 3rd edition, 1980.
- 4) *Textbook of Polymer Science*, Billmeyer F.W., John Wiley and Sons, New York, 3rd edition, 1984.
- 5) *Man-made Fibres*, Moncriff, R.W., Newnes Butterworth, London, 6th edition, 1965.

Practicals

79. Analysis Of Intermediates And Dyes (Dyes)

(2×4 hrs/week)

Estimation of inorganic reagents used in organic synthesis by volumetric titrations

1. Sodium sulphide
2. Sodium sulphite
3. Sodium bisulphite
4. Sodium metabisulphite
5. Sodium hydrosulphite
6. Rhongalite C
7. Bleaching powder
8. Ferric alum

9. Iron powder
10. Zinc dust
11. Formaldehyde
12. Hydrogen peroxide
13. Copper sulphate
14. Manganese dioxide
15. Sodium nitrite

Estimation of aromatic amines by diazotization

1. Aniline
2. Sulphanilic acid
3. Chloroanilines
4. Toluidines
5. Anisidines
6. Nitroaniline
7. Fast Red R
8. Sulphanilic acid
9. Metanilic acid
10. Anthranilic acid

Suitable experiments from above list will be performed.

Estimation by bromination

1. Phenol
2. Aniline
3. 2-naphthol
4. 1-naphthol
5. Schaffer acid
6. R-acid
7. NW-acid

Estimation by diazo-coupling

1. 2-naphthol
2. Schaeffer acid
3. R salt
4. 1-Phenyl-3-methyl-5-Pyrazolone
5. Gamma acid
6. J-acid
7. 1-(4-sulphophenyl)3-methyl-5-Pyrazolone

Introduction of dyes into main class and subclass

1. Acid dyes
2. Basic dyes
3. Direct dyes
4. Acid mordant dyes
5. Sulphur dyes
6. Vat dyes

Suitable experiments from above list will be performed.

80. *Experimental Dyeing (Dyes) (Term Work)*

(2×4 hrs/week)

1. Study of effect of material/Liquor ratio of dyeing study of effect of temperature on exhaust dyeing of cotton.
 2. Study of effect of percentage shade on exhaust dyeing of direct dyes on cotton.
 3. Study of alter treatments of direct dyeings
 4. Dyeing of cotton and viscose with reactive dyes
 5. Dyeing of cotton and viscose with azoic dyes
 6. Dyeing of cotton and viscose with basic dyes
 7. Dyeing of cotton and viscose with solubilised vat dyes
 8. Dyeing of cotton and viscose with sulphur dyes
 9. Dyeing of polyamide fibre with basic dyes
 10. Dyeing of polyamide fibre with acid dyes
- Suitable experiments from the above list will be performed.

81. *Technical Analysis II (Food)*

(1x4 hours / week)

Analysis of proximate constituents and special constituents like organic acids, pigments using colourimetry, spectrophotometry and chromatography.

82. *Biochemistry (Food) (Term Work)*

(2x4 hours / week)

Methods for estimation of proteins and carbohydrates. Extraction and assay of enzymes. Enzyme kinetics. Vitamin assays using spectrophotometric, colorimetric and microbial assay methods. Use of chromatographic techniques.

83. *Food Chemistry (Food)*

(1x4 hours / week)

Qualitative and quantitative analysis of food additives. Analysis of toxic metals and chemicals in foods, sensory analysis of foods. Instrumental methods for food texture determination.

84. *Analysis Of Surfactants And Oleochemicals (Oils)*

(2X4 hrs/week)

Analysis of basic ingredient of surfactants: LABS, soap, non-ionic, LAS, alkylsulphate etc. Analysis of detergents for active matter, water/alcohol insolubles, free alkalinity etc

Qualitative analysis of types of surfactants: analysis of types – pinacryptol yellow/ anionic, cationic, nonionic, amphoterric surfactants.

Elemental analysis and class of surfactants: carboxylates, sulfates, sulfonates, types of hydrophobes in these anionics specifically sulfates, sulfonats, Spot tests for various functional groups

Cationics: quarternary ammonium compounds, amine salts, characterization of amines

Nonionics: glycerol esters, ethylene oxide, propylene oxide, simple tests of SV, AV, OHV, for nonionics like fatty alcohols (see also quantitative)

Separation of mixtures of surfactants: ion exchange, silica/ alumina columns/ TLC

Quantitative analysis: for anionics and cationics, preparation of various, reagents and standardization of these, quantitative separation using column chromatography

Quantitative tests: amine value, acid value, sap value,
Physicochemical evaluation: surface tension, interfacial tension, determination of CMC using these and also using dye methods, emulsification tests, determination of HLB of surfactants, lime soap dispersion tests, foaming using Ross/ Mils tests.

Detergency tests: standard soiling and tergotometer, instrumental methods of analysis.
Analysis of Detergents - including PO₄s, silicate, actives, enzymes, bleaches, polymers.

85. Processing Of Oils, Fats And Waxes (Oils) (Term Work) (2X4 hrs/week)

Mechanical expelling, Hydraulic Expelling, aqueous extraction of oil seeds, liquid-liquid extraction, double solvent refining, miscella refining, degumming, alkali refining, bleaching, cottonseed processing, extraction of oil and refining, acid oil from soap stock, purification of waxes (rice bran wax), blending of waxes, wool wax, paraffin wax, Enzymatic hydrolysis of oil
Rice bran oil processing, Pigments in oils and fats, Super critical fluid extraction, alternative solvent for oil extraction, Winterization and epoxidation

86. Analysis And Characterization Of Raw Materials And Polymers (Polymers) (2 x 4hrs/week)

1. Analysis of

- Water,
- Melamine,
- Glycerine,
- Solvents like xylene, acetone, toluene, MTO, Hexane, ethyl acetate, methanol IPA etc. to analyze specific gravity, R.I, aniline point, distillation range etc.
- Acrylates like MMA, AA etc
- Calcium Chloride
- Sodium/Potassium dichromate
- Hydrogen peroxide etc.

2. Analysis and Determination of purity of

- Phenols and substituted phenols by Bromination
- Formaldehyde
- Phthalic Anhydride
- Hexamine
- Epichlorohydrine etc.

3. Determination of functional groups in Resins and Polymers

- Saponification Value
- Acid Value
- Hydroxyl Value
- Carbonyl Value
- Peroxide Value
- Iodine Value etc.

4. Physical Properties of Polymers

- Viscosity by Brookfield, Gardner, Ford cup and Rotational Viscometer, K Value.
- Melting and softening point of resin
- Bulk density of Fillers

5. Chemical Identification of Natural Resins such as
a. Rosin
b. Shellac etc.

87. Synthesis And Characterization Of Resins And Polymers (Polymers)
(Term Work) (2 x 4hrs/week)

1. Bulk, Solution and Suspension polymerization of monomers like Styrene, MMA etc. and to analyse % solids, %yield, melting range etc.
2. Aqueous polymerization of monomers like AA, Acrylamide etc. and analyse % solids, %yield melting range etc.
3. Emulsion polymerization of monomers like vinyl acetate, Styrene etc and to analyse polymer content, %solids etc
4. Synthesis of phenolic resin such as novalac, resol Melamine formaldehyde and urea formaldehyde resin and to analyse free formaline, free phenol content, %solids, curing characteristics etc.
5. Synthesis of epoxy resin and to find epoxy value, epoxy equivalent yield etc.
6. Synthesis of Unsaturated polyesters and to analyse saponification value, hydroxyl value, yield etc
7. Synthesis of copolymer of styrene and acrylate and to analyse yield melting range molecular weight etc.

88. Analysis And Characterization Of Raw Materials And Polymers (Paints)
(2 x 4hrs/week)

1. Analysis of
 - a. Water,
 - b. Melamine,
 - c. Glycerine,
 - d. Solvents like xylene, acetone, toluene, MTC, Hexane, ethyl acetate, methanol IPA etc. to analyze specific gravity, R.I, aniline point, distillation range etc.
 - e. Acrylates like MMA, AA etc
 - f. Calcium Chloride
 - g. Sodium/Potassium dichromate
 - h. Hydrogen peroxide etc.
2. Analysis and Determination of purity of
 - a. Phenols and substituted phenols by Bromination
 - b. Formaldehyde
 - c. Phthalic Anhydride
 - d. Hexamine
 - e. Epichlorohydrine etc.
3. Determination of functional groups in Resins and Polymers
 - a. Saponification Value
 - b. Acid Value
 - c. Hydroxyl Value
 - d. Carbonyl Value
 - e. Peroxide Value
 - f. Iodine Value etc.

4. Physical Properties of Polymers

- Viscosity by Brookfield, Gardner, Ford cup and Rotational Viscometer, K Value.
- Melting and softening point of resin
- Bulk density of Fillers

5. Chemical Identification of Natural Resins such as

- Rosin
- Shellac etc.

89. *Synthesis And Characterization Of Resins And Polymers (Paints)* (Term Work) (2 x 4hrs/week)

- Bulk, Solution and Suspension polymerization of monomers like Styrene, MMA etc. and to analyse % solids, %yield, melting range etc.
- Aqueous polymerization of monomers like AA, Acrylamide etc. and analyse % solids, %yield, melting range etc.
- Emulsion polymerization of monomers like vinyl acetate, Styrene etc and to analyse polymer content, %solids etc
- Synthesis of phenolic resin such as novalac, resol Melamine formaldehyde and urea formaldehyde resin and to analyse free formaline, free phenol content, %solids, curing characteristics etc.
- Synthesis of epoxy resin and to find epoxy value, epoxy equivalent yield etc.
- Synthesis of Unsaturated polyesters and to analyse saponification value, hydroxyl value, yield etc
- Synthesis of copolymer of styrene and acrylate and to analyse yield melting range molecular weight etc.

90. *Technology Of Liquids And Topicals Laboratory (Pharma)* (2x4 hrs\week)

- | | |
|--|-----|
| Preparation and evaluation of oral syrups, elixirs, tinctures, ear drops, nasal drops | (7) |
| Preparation and evaluation of suspensions/dry syrup/emulsions of containing hydrophilic and hydrophobic drug | (7) |
| Preparation and evaluation of topical liniments and lotions | (3) |
| Preparation and evaluation of ointments representing each type of base, and gels | (7) |
| Preparation of suppositories (any 2 base) | (2) |
| Large scale manufacture of one monophasic and one biphasic liquid | (4) |

Books:

- Pharmaceutical Production Facilities: Design and Applications G.C.Cole
- New York Ellis Horwood 1990
- Husa's Pharmaceutical Dispensing Martin E.W. Easton Mack Pub. Co. 1971
- Transdermal Delivery of Drugs A.Kydonieus Florida, CRC Press, 1987
- Transdermal Controlled System Medications Y.W.Chien, New York, Marcel Dekker 1987
- The Theory and Practice of Industrial Pharmacy, Lachman Bombay, K.M. Warghese Co. 1976
- The Theory and Practice of Industrial Pharmacy, Lachman Bombay, K.M. Warghese Co. 1976
- Pharmaceutical Dosage Forms Vol. I & II, Liebermann, New York, Marcel Dekker, 1996.
- Drug Delivery Devices : Fundamentals and Applications, Tyle New York, Marcel Dekker 1988

91. *Biochemistry And Microbiology Laboratory (Pharma) (Term Work)* (2X4 hrs\week)

Biochemistry Laboratory

Qualitative test for carbohydrates, confirmatory tests by osazone formation, Quantitative estimation of glucose by Wilstaters and Lane and Eynon method, estimation of sucrose, simple color reactions of proteins and amino acids, precipitation reactions of proteins; Determination of acid value and iodine value of lipids; enzymes: Ptyline activity of saliva (15)

Microbiology Laboratory

Study of microscopy, study of common laboratory equipment; Preparation and sterilization of nutrient broth, agar slants, stabs, plates; inoculation technique: Colony characteristics and growth patterns in broth of cocci and bacilli, Grams staining monochrome staining, negative and vital staining; cell wall spore, capsule and flagella staining; motility by hanging drop technique; Microbial limit test, microbial assay, biochemical tests (15)

92. *Experimental Dyeing-I (Textile) (Term Work)* (2x4 hrs/week)

1. To study effect of liquor ratio and salt concentration on exhaust dyeing of direct dyes on cotton
 2. To study the effect of temperature on exhaust dyeing of direct dyes on cotton
 3. To study effect of percentage shade on exhaust dyeing of direct dyes on cotton and determine the absorption of exhausted bath
 4. To study various after treatments of direct dye dyeings
 5. To study dyeing of different types of reactive dyes on viscose and cotton
 6. To study the effect of pretreatments of cotton on dyeing with direct dye
 7. To study dyeing of azoic colours on cotton.
 8. To study dyeing azoic colour mixtures on cotton.
 9. To study dyeing of solubilised vat dyes on cotton
 10. To study dyeing and after treatments of sulphur dyes on cotton
 11. To study the dyeing of vat dyes on cotton and viscose
 12. To study vat pigmentation and vat acid method dyeing on cotton
 13. Dyeing of jute with direct, basic and reactive dyes
 14. To study dyeing of acid dyes on wool and silk
 15. To study dyeing of cotton, viscose, wool and silk using basic dyes
 16. To study dyeing of wool and silk using metal complex dyes
 17. To study dyeing of wool and silk using acid mordant dyes
 - 18-19. To study dyeing of polyesters using different disperse dyes and dyeing techniques and measurement of absorbance of extracted dye.
 20. To study comparative dyeing of PET, CDPET, PBT with disperse dyes at boil and 130°C
 21. To study dyeing of Nylon, polypropylene, acrylic with disperse dyes
 22. To study dyeing of Nylon with acid, metal complex, reactive and direct dyes
 23. To study dyeing of acrylic fabric and CDPET with cationic dyes
 24. To study dyeing of Lycra
 - 25-26. Dyeing of Natural dye on wool and cotton followed by application of mordants
- Suitable number of experiments from the above list will be performed.

93. Experimental Dyeing - II (Textile)

(2x4 hrs/week)

1. Stripping of dyed materials and redyeing with Sulphur Black dye.
2. To study dyeing of cotton with reactive dye on padding mangle
3. To study dyeing of cotton with vat dyes by exhaust and padding technique
4. To study dyeing of cotton with azoics on padding mangle
5. To study dyeing of cotton with pigments and Phthalogen Blue on padding mangle
6. To study dyeing of cotton with solubilised vat on padding mangle
7. To study dyeing of cotton hank by tub liquoring using azoics
8. Shade matching of Vat and Reactive dye on cotton hank (12 experiments)
- 21 To study dyeing of cotton \ polyester blend by different techniques.
- 22 Estimation of % purity of Reactive and Disperse dyes.
- 23 Beck matching of vat colours on cotton yarns
- 24 Identification of class of dye present on dyed fibre
- 25 Identification of fibres and blends by different tests.

SEMESTER VI

R. 4787 The candidate shall be examined in the subjects at the Semester VI examination as indicated in the following tables.

Theory Papers

Sr. No	Subject	No. of Paper	Examination		Periodic Test Marks	Total Marks	Branch
			Hours	Marks			
1	Statistics & Simulation	1	2	35	15	50	All
2.	Instrumentation and Process Control & Chemical Reaction Engg	1	3	70	30	100	All
3.	Material Technology	1	2	35	15	50	All
4.	<u>Special Subject</u> Technology of Intermediates and Colorants II	1	3	70	30	100	Dyes
	Food Packaging	1	2	35	15	50	Foods
	Biochemistry	1	2	35	15	50	Oils
	Compounding and Polymer Processing I	1	3	70	30	100	Polymer
	Technology of Pigments	1	3	70	30	100	Paints
	Medicinal Chemistry II	1	3	70	30	100	Pharma
	Technology of Textile Coloration	1	3	70	30	100	Textile
5.	<u>Special Subject</u> Technology of Dyeing & Printing	1	2	35	15	50	Dyes
	Foods Microbiology	1	2	35	15	50	Foods
	Cosmetics Science I	1	2	35	15	50	Oils
	Compounding and Polymer Processing - II	1	3	70	30	100	Polymer

	Paint Technology I	1	3	70	30	100	Paints
	Technology Solid Dosage Forms and Medicinal Natural Product	1	3	70	30	100	Pharma
	Testing of Textile Materials	1	2	35	15	50	Textile
6	<u>Special subject</u> Chemistry of Intermediatess and colorants -IV	1	2	35	15	50	Dyes
	Food Engineering & Principle of Food Preservation	1	3	70	30	100	Food
	Technology of edible fat Production	1	3	70	30	100	Oils
	Chemistry of Intermediatess and Dyes	1	2	35	15	50	Textiles
	Total	5	—	280	120		400

Practical Examinations

Sr. No	Subject	Examination		Class Work Marks	Total Marks	Branch
		Hours	Marks			
6.	Statistics & Simulation	3	35	15	50	All
7.	Chemical Engineering Laboratory (Term Work)	—	—	100	100	All
8.	<u>Special Subject</u> (Term Work) Wet Processing of Textile	—	—	50	50	Dyes
	Microbiology (Foods)	—	—	100	100	Foods
	Processing of Oleochemicals & Cosmetics	—	—	100	100	Oils
	Processing of Polymer I	—	—	100	100	Polymer
	Processing of Paints I	—	—	100	100	Paints
	Medicinal Natural Product & Pharmaceutical Analysis	—	—	100	100	Pharma
	Technical Analysis (Textiles)	—	—	50	50	Textile
9	<u>Special Subject</u> Analysis of Intermediates and Dyes	—	—	50	50	Dyes
	Tinctorial Chemistry Lab	—	—	50	50	Textile
	Total	—	35	215	250	

Grand Total at the Examination

650

R. 4788 The following are the syllabi of the various subjects at the Semester VI examination

Semester VI

Theory

94. Statistics And Simulation

(2 hrs/week)

Measures of Central tendency / dispersion, Moment Generating functions, Interval / Point Estimates .	(2)
Binomial, F, χ^2 , t distribution, Bivariate Distributions.	(4)
Tests of Significance.	(2)
Statistics: Analysis of Variance.	(2)
Regression (Multiple, Linear, Polynomial), Correlation.	(3)
Design of Experiments.	(3)
Quality control and Acceptance sampling and related distributions.	(2)
Mathematical Modeling / simulation of Technological Processes. .	(4)
Model reduction ,Parameter estimation. Optimization Techniques for simple applications.	(4)
Population Balance Models. .	(4)

Text books / Reference books

1. Numerical Recipes in C by William H. Press , Saul A. Teukolsky, William T. Vetterling, Brian P Flannery
2. Operations Research An Introduction by H.A. Taha, Prentice Hall of India,
3. Mathematical Statistics, J.E. Freund, Prentice Hall of India
4. Elementary Statistics From discovery to decision, M.K. Pelosi, John Wiley and Sons
5. Introduction to Probability and Statistics, J.S. Milton, J.C. Arnold, John Wiley and Sons
6. Using Process Simulators in Chemical engineering-A multimedia guide, D.R. Lewin et al' John Wiley and Sons
7. System Simulation, G. Gordon, John Wiley and Sons
8. Product and Process design principles Synthesis, W.D. Seider, J.D. Seider, John Wiley and Sons
9. Applied Multivariate techniques, Sharma S. John Wiley and Sons
10. Optimisation of Chemical Processes, Edgar T.F., D.m. Himmelblau, John Wiley and Sons
11. Process design principles, W.D. Seider, D.R. Lewin, John Wiley and Sons
12. Response Surface Methodology; Process and Product Optimization Using designed experiments, R.H. Myers, D.C. Montgomery, John Wiley and Sons
13. A concrete approach to Mathematical Modeling, M.M. Gibbons, John Wiley and Sons
14. Reality Rules vol 1 & 2, J.L. Cast, John Wiley and Sons

95. Instrumentation And Process Control & Chemical Reaction Engineering

(4hrs/week)

Instrumentation And Process Control

1. Introduction to Industrial Process Control	2
2. Strategies for Control : Feedback/feedforward	1
3. Process and Reactor Dynamics	4
4. Solution to dynamic differential equations (linear and non-linear)	2

Books for reference:

Introduction to Engg. Materials
Mechanical Metallurgy
Material Science
Corrosion Engineering

B.K.Agrawal
Dieter
V. Raghavan
Fontana & Greene

97. Technology Of Intermediates And Colorants - II (Dyes) (4 hrs/week)

Technology involved in typical dyestuff intermediates in benzene, naphthalene, anthraquinone and heterocyclic systems. Factory layout and design related topics. (15)

Technology involved in vat dyes and other anthraquinone such as disperse, reactive, solubilised vat dyes, phthalocyanine, cyanine dyes, sulphur dyes and typical pigments. Factory layout and design related to the topics. (15)

Elements of process selection, process optimization, experimental design, process intensification. (15)

Continuous and semi continuous processes. Process control techniques. (15)

Text/Reference Books :

1. Unit Processes in Organic Synthesis, Groggins P.H.
2. Chemical Process Industry, Shrieve
3. Unit Operations, McCabe, Smith
4. Material of Construction, Lee
5. Fundamental Processes of Dye Chemistry, Fierz, David, Blangey
6. BIOS Reports
7. CIOS Reports
8. FIAT Reports

98. Technology Of Dyeing And Printing (Dyes) (2 hrs/week)

General considerations of the application of different classes of synthetic dyes to important textile fibres; Introduction to physico-chemical principles involved in dyeing. (6)

Methods of dyeing and dyeing machinery. (9)

Preparation of fabrics for printing; Procedure for printing of various fabrics; Selection of thickening agents, chemicals and dyestuffs for printing etc. Formulation and properties of printing pastes. (6)

Introduction to different machines used for printing and styles of printing; Printing of cotton and synthetic fabrics with various classes of dyes in different styles. (9)

Text/Reference Books :

1. Technology of Dyeing, Shenai V.A. Vol. 6, Sevak Publ., Bombay, 2nd Edn, 1994
2. Dyeing and printing, Cockett S.R., Hilton K.A., Leonard Hill Books Ltd., London, 1961
3. Technology of Printing, Shenai V.A. Vol. 4, Sevak Publ., Bombay, 2nd Edn, 1994
4. Thoms and Hudson Manual of Textile Printing, Storey J., Thames and Hudson Ltd., London, 1992
5. Textile Printing, Miles L.W.C., SDC, London, 2nd Edn, 1994

99. Chemistry Of Intermediates And Colorants -IV (Dyes) (2 hrs/week)

Heterocyclic analogues of conventional dyes.

Introduction to functional dyes - Laser dyes, liquid crystal dyes, dyes in electro photography, dyes for inkjet printing, dyes in photography. Non linear optical properties of dyes and infrared absorbing dyes, Developments in colour and chemical constitution. (10)

Elements properties of dyes in relation to functional manifestations.

Physicochemical aspects of pigments. High performance pigments. Dioxazine pigments, (5)
diketopyrrolopyrrole pigments, perylene pigments and other condensed heterocyclic pigments,
quinonophthalone pigments, azamethine pigments, thiazine pigments.
Heterocyclic analogues of conventional pigments, luminescent pigments. (15)

Text/Reference Books :

1. Advances in Color Chemistry Vol I, Peters A.T.
2. Advances in Color Chemistry Vol III, Peters A.T.
3. Non-Textile Dyes, Freeman
4. Chemistry of Synthetic Dyes - Vol V, Venkatraman K., Academic Press, New York, 1952
5. Industrial pigments, Herbst, Hunger
6. High Performance Pigments, Smith
7. Color and Chemical Constitution- Griffith

100. Food Packaging (Food)

(2hrs/week)

Packaging as a method of food conservation and preservation. Functions of Packaging (1)
Different packaging materials and their properties - Glass, Aluminium, Tin, Paper, Boards, Plastics, Composites. Properties including barrier properties, strength properties, optical properties etc. (10)
Packaging of various food commodities including fresh produce (fruits and vegetables), meat, fish, poultry and processed foods. (5)
Evaluation of quality and safety of packaging materials - different testing procedures. (5)
Food and Packaging material interaction including migration, scalping of flavour etc. (2)
Package design, Solution of packaging material and design (2)
Newer packaging technologies, CAP/MAP packaging, Aseptic processing and packaging, Irradiated packaging, Retort pouch, Microwavable packaging. (5)

Reference Books

Packaging Media by Paine, F.A. Publisher: Blackie and son Ltd., Bishopbriggs (1977).
Food Packaging and Preservation: theory and practice by Mathlouthi, M. Publisher Elsevier applied science publishers, London (1986)
Food and Packaging Interactions by Risch, S.H. Publisher American chemical society, Washington (1991).
Handbook of Food Packaging by F.A. Paine and H.Y. Paine Publisher: Blackie and son Ltd. London (1983).
Food Packaging Technology (Vol. 1 & 2) by G. Bureau and J.L. Multon, Publisher: VCH, New York (1996).
Packaging Materials and Containers by Paine, F.A. Publisher: Blackie and sons Ltd., London, 1967

101. Food Microbiology (Food)

(2hrs/week)

Factors Affecting spoilage of food (1)
Microflora associated with various food groups their spoilage potential and control; Microbiological food spoilage associated with typical food products (8)
Food borne infections and food poisoning, Microbial toxins (5)
Newer pathogens (2)
Microbiological quality assurance Systems in Food Industry, HACCP (4)

Food Standards	(2)
Rapid Methods of Microbial Analysis	(2)
Applications of Immunological techniques to food industry	(2)
Detection methods of related important pathogens	(2)
Microbes in manufacture of food ingredients and food fermentations	(2)
Text Books	
Food Microbiology: W C Frazier	
Dairy Microbiology: E M Foster	
Food Microbiology and Fundamentals and Frontiers: M P Doyle	
Food Borne bacterial pathogens: M P Doyle	

102. Food Engineering & Principles Of Food Preservation (Food) (4hrs/week)

Principles of mass and energy balance. Transport phenomena with respect to foods. Factors affecting heat and mass transfer.	(8)
Study of heat transfer and its application in the design of thermal processes and freezing.	(2)
Thermal processing	(4)
Calculation of process time temperature-schedules	(3)
Canning of food products	(3)
Newer methods of thermal processing. Batch and continuous	(2)
Application of infra-red microwaves, Ohmic heating.	(3)
Control of water activity. Preservation by concentration and dehydration	(4)
Osmotic methods. Drying process for typical foods	(1)
Rate of drying for food products	(3)
Design parameters of different type of dryers	(2)
Properties of air-water mixtures. Psychrometric chart	(4)
Freezing and cold storage	(3)
Freeze concentration, dehydrofreezing, freeze drying	(3)
IQF: Calculation of refrigeration load, design of freezers and cold storages	(3)
Chemical preservatives, Preservation by ionizing radiations, Ultrasonics, high pressure	(2)
Fermentation, curing, pickling, smoking	(2)
Membrane technology	(1)
Hurdle technology	(1)
Food packaging	(1)
Materials of construction, food plant layout effluent treatment and waste utilization in food industry.	
Economics of Food Processing.	(3)

Books

- Food Engineering Fundamentals, Batty J.C.
- The Technology of Food Preservation, Desrosier N.W.
- Food Engineering Systems, Vol. 1 - Operations, Farrall Arthur al
- Food processing Technology: Principles & Practice, Fellows P.
- Principles of Food Science, Fennema O.R.
- Encyclopedia of Food Engineering, Hall C.W.
- Fundamentals of food canning technology, Jackson J.M. & Shinn B.M
- Complete course in canning, Lopez, A.

103. *Biochemistry (Oils)*

(2hrs/ week)

Enzymes as biocatalysts, chemistry, classification, mode of action, specificity, assay techniques, isolation and purification, stabilization, enzyme kinetics. (7 hrs) Pathways of metabolism of carbohydrates, proteins, lipids (15 hrs) Enzyme biosynthesis and regulation (4 hrs), metabolic regulation, hormones, release of energy and its trapping, (4 hrs)

Books:

- Biochemistry by Lehninger
- Biochemistry by J. M. Berg, J. L. Tymoczko and L. Stryer, 5th edition (2000)

104. *Cosmetics Science I (Oils)*

(2hrs/ week)

Common ingredients used in cosmetics, surfactants, additives, antioxidants, preservatives. (8 hrs) Equipments, plants and machinery used for manufacture. (8 hrs)

Essential oils: extraction from different sources, separation and purification, analysis of essential oils (7 hrs). characteristics of sandal wood oil, cedar wood oil, palmrosa oil etc. Role of essential oil in aroma therapy. (7 hrs)

Books:

- Essential oils (Vol. I to VI) by Guenther E., D. Van Nostrand Co. Inc. (1947)
- Perfume and flavour materials of natural origin by Arctander S., Det Hoffensbergske establishment (1960)
- Perfume, Cosmetics and Soap by Poucher W., Chapman and Hall Ltd., (1959)
- Chemistry and manufacture of cosmetics by Denavarre, Grosse farm

105. *Technology Of Edible Fat Production (Oils)*

(4hrs/ week)

Processes and plants employed for refining, bleaching, deodorization, (10 hrs) hydrogenation and winterization of oils or edible purposes, (10 hrs) manufacture and evaluation of auxiliary materials such as activated earth and carbon, Ni catalysis and hydrogen (8 hrs), utilization of wastes and by products, newer techniques of refining of oils and fats (10 hrs), manufacture of butter, margarine an ghee, Vanaspati, bakery and confectionery fats and fatty foods (10 hrs), composition and properties of these spoilage during storage of fats, and fat products, protection against auto oxidation (12 hrs).

Books:

- Baileys industrial oil and fat products by Daniel Swern,, Wiley Interscience publication (1979)
- Chemistry and technology of oils and fats by Prof. M. M. Chakrabarti, allied publishers (2003)
- Treatise on fats, fatty acids and oleochemicals by O. P. Narula Vol. I & II, Industrial Consultants (India), (1994)
- Natural fatty acids and their sources by E. H. Pryde
- Hydrogenation of fats and oils by H. Patterson, Applied Science publishers (1983)

106. Compounding And Polymer Processing- I (Polymer)

(4 hrs/ week)

Basic Concept of Compounding and Processing; Concept of Master batches (2)
Classification and type of Additive for Plastics: Antioxidants, Light stabilizers, UV stabilizers, Lubricants and relative auxiliaries, Processing aids, Impact modifiers, Flame retardance, antistatic agents. PVC stabilizers and Plasticizers (3)
Colouration of Plastics: Chemistry, synthesis, properties and applications of -Inorganic Pigments such as Titanium dioxide, Zinc oxide, Lithophone, Carbon blacks, Metal oxide pigments, Chromium and Cadmium pigments, Ultra marine blue etc. (12)
Commonly used Organic pigments such as Anthraquinone, Benzimidazolone dioxazines, Diazo lakes, lake reds, Lithol rubones, Monoazo lakes, Naphthol AS lakes, Naphthol AS, Perylenes, Phthalocyanines, Quinacridones, Dyes for transparent plastics. Dispersion of Pigments as well as agglomeration aspect should also be covered. In addition shrinkage and warpage will also be discussed. (15)

Processing Techniques: Basic of various processing techniques such as (3)

- a) One-dimensional process is like Coating and Adhesives. (3)
- b) Extruders: single screw and twin screw extruders, Film blowing, coextrusion of multilayered films, Fiber spinning, Pipe extrusion, Extrusion of profiles, coextrusion of pipes, Extrusion of cable material, extrusion of sheet, Calendaring, Thermoforming. (15)
- c) Molding: Injection molding Blow molding, Compression molding, Injection stretch blow molding, Resin transfer molding, Gas and water assisted injection molding and other three dimensional molding. (10)

107. Compounding And Polymer Processing- II (Polymer)

(4 hrs/ week)

Fillers and reinforcement: Various materials such as Calcium carbonate, Dolomite, Silica Glass, Mica, Talc, Carbon, Clay etc. and reinforcement such as Inorganic and Organic fiber such as glass fiber, boron fiber, carbon fiber, aramide fibers, natural fibers etc. Functional fillers (8)

Polymer composites such as DMC, SMC, FRP etc. using fillers reinforcement and other polymeric fillers (8)

Reaction Injection Molding, Pultrusion, Pull winding (5)

Simple flow models for extrusion: Equation of continuity, Equation of motion, role of Rheology in Polymer processing. Laminar flow of Newtonian and non-Newtonian fluids, through circular pipes between parallel plate and flow through annulus etc. Drag flow and pressure flow models for extrusion. Concept of model aspects applied to other processing techniques. (12)

Post extrusion techniques such as -Metallization, electroplating, Stamping, Welding and bonding, printing and painting on plastics etc. (10)

Crosslinking of thermoplastics materials. Cellular plastics (5)

Degradation and stabilization of plastics: Biostabilizers, metal deactivators environmental aspects of polymers. (7)

Characteristics of packaging films such as - Permeability, Heat seal, Printing, Drop impact etc. (5)

Text/Source Books

1. Encyclopedia of Polymer Science and Technology, Johan Wiley and Sons, Inc 1965.
2. Encyclopedia of Polymer Science and Engineering, Johan Wiley and Sons, Inc 1988.
3. Transport Phenomena, Bird and Steuwart, John Wiely and Sons, Inc 1960.
4. Unit Operation of Chemical Engineering, McCabe and Smith, McGraw-Hill Book Company, 1985.

5. *Plastics Engineering* by R. J. Crawford, Pergamon Press 1989.
6. *Understanding Injection Molding Technology* by Herbert Rees, Hanser Publishers, 1994.
7. *Understanding Extrusion* by Chris rauwendaal, Hanser Publishers, 1998
8. *Rotational Molding* by Glenn L. Beall, Hanser Publishers, 1998
9. *Polymer Chemistry* by Malcolm P. Stevens, Oxford University Press, Inc, 1990.
10. *Introduction to Polymer Science and Technology* by H. S. Kaufman and J. J. Falcetta, Wiley - Interscience Publication, 1977
11. *Under standing Compounding*, R. H. Wildi and Maier, Hanser Publisher Inc, 1998.
12. *Fundamentals of Polymer Processing*, S. Middleman, Houghton Mifflin Compony, 1997.
13. *Injection Moulding of Plastics a User Guide* by Klockner Windosor India Ltd. 1994.
14. *Fillers and Filled Polymers*, J. F. Gerard, Wiley-VCH verlag GmbH, 2001.
15. *Handbook of Fillers*, G. Wypych, Chem Tech Publishing 2000.
16. *Handbook of Fillers and Reinforcements for Plastics*, H. S. Katz and J. V. Milewski, Van Nostrand Zeinhold Co, 1978.
17. *Composite Polymeric Material*, R. P. Sheldon, Applied Science Publishers, 1982.
18. *Composites: Design Guide*, Industrial Press Inc, 1987.
19. *Composite Material Handbook*, M. M. Schwartz, McGraw-Hill company, 1984.
20. *Polymer Processing Fundamentals*, Osswald, A. Tim, Hanser Publishers, 1998.
21. *Fundamentals of Reaction Injection Moulding*, C. W. Macosko, Hanser Publishers, 1989.
22. *Flow of High Polymers*, S. Middleman, Interscience Publishers, 1968.
23. *Metallizing of Plastics*, H. Narcus, Reinhold Publishing Corp, 1960.
24. *Decorating Plastics*, J M Margolis, Hanser Publishers, 1986.
25. *Handbook of Plastics Joining: a Practical Guide*, Plastics Design Library, 1997.
26. *Plastics Finishing and Decoration*, D. Sastas, Van Nostrand Reinhold Co, 1986.
27. *Crosslinking and Network Formation in Polymers*, f. R. Jones
28. *Plastics Films*, J. H. Briston, The Plastics Institute, 1974.
29. *Plastics process Engineering*, Thorne, Marcel Dekker, 1979.
30. *Thermoforming* J. L. Thorne, hanser Publishers, 1988.
31. *Understanding Blow Moulding*, N. C. lee, Hanser Publishers, 2001.

108. *Technology Of Pigments (Paints)*

(4 hrs/ week)

Properties required in a pigment and extender

(4)

Pigment dispersion basics

(2)

Inorganic pigments such as titanium dioxide, zinc oxide, carbon black, chromate pigments, molybdate orange, iron oxide pigments, chrome green, ultramarine blue, iron blue, cadmium red, micaceous iron oxide, pearlescent and other effect pigments (15) corrosion inhibiting pigments, such as zinc phosphate, zinc and barium chromate pigments, ceramic pigments, metal flake pigments, extenders(9)

Theory of color formation in organic compounds, effect of auxiliary groups on the shade and hue of the pigment (Bathochromic and hyper chromic shift)

(3)

Organic pigments such as monoazo pigments, copper Phthalocyanine blue, green and other Phthalocyanine pigments, anthraquinone pigments, diarylid yellows, Napthol pigments, BONA lakes, Benzimidizolone, diazo condensation pigments, azo metal complex pigments, dioxazine violet, violet 23, di keto pyrrolopyrrol pigments, rhodamine phosphotungstic acid complex pigments, quinophthalone pigments, thio indigo polycyclic pigments, perlin and iso indoline pigments, solvent soluble colors, polymeric pigments

(27)

109. Paints Technology- I (Paints)

Colloidal chemistry of coatings, surface chemistry of pigments	(6)
Pigment dispersion and wetting, flushing of pigments, effect of pigment volume concentration on paint properties	(4)
Paint additives, solvents	(12)
Basics of Paint formulations	(4)
Machinery for grinding of pigments and extenders	(4)
Paint manufacturing machinery for pigment dispersion (Ball mill, Sand mill, Attritor mills, Drais mill, basket mill, kaddy mills, twin shaft dispenser, alpine mills, horizontal V, vertical mills)	(6)
Manufacture of dry distempers, oil based distempers and paints, other surface paints, putties	(2)
Manufacture of alkyds, emulsions and hard resins, filtration of resins, paints, ultra filtration of resins, forming of hard resins, marking and labeling of packaged products	(3)
Manufacture of powder coatings	(4)
Utilities in paint plant (steam, hot oil, cooling water, chilled water, compressed air)	(4)
Plant layout, Inventory control, use of computers in paint industry, interphasing with R&D	(5)
Solvent emission, recovery and disposal, environmental, health and safety issues	(2)
Recommended Books	

(1) Paint and Surface Coatings	Lambourne and Strivens
(2) Organic Coatings Science and Technology	Zeno Wicks et al
(3) Surface Coatings Science and Technology	Swaraj Paul
(4) Introduction to Paint Chemistry	Turner
(5) Pigment Hand Book Part 1, 2, 3	Patton
(6) Encyclopedic Hand book of Emulsions Technology	Sjoblom
(7) Application properties of Pigments	A. Karnik
(8) Paint Film Defects	Hess
(9) Industrial Organic Pigments	W. Herbst
(10) High performance pigments	Huge M. Smith
(11) Printing ink Formulations principles	Ronal Todd

110. Medicinal Chemistry II (Pharma)

(4 hrs./week)

(ANS, CNS and CVS -Drugs, Drug Design and Discovery)**ANS, CNS- Drugs**

Study of the chemistry of the following classes of drugs including nomenclature, classification, SAR

Synthesis:

- (a) Drugs affecting neurotransmission-cholinergic (6)
- (b) Serotonergics and their antagonists (6)
- (c) General Anesthetics, hypnotics, anti-seizure drugs, Antipsychotic and antianxiety agents, analgesics, anti-Parkinson drugs, (18)

CVS-Drugs, Drug Design and Discovery

Concept of drug action, receptor theory with relevant examples, enzymes and enzyme inhibitors (4)

Modern methods of drug design and discovery, introduction to combinatorial chemistry and CADD, antihistaminic including anti ulcer drugs (10)

Cardiovascular drugs Diuretics, anticoagulants, thrombolytics and antithrombotics, cardiac agents, antihypertensive, antihyperlipidemics, local anesthetics, diagnostic agents anticancer agents, antiviral agents, (16)

Books:

1. Burger's Medicinal Chemistry & Drug Discovery: Vol. 1 to 6; Ed.: A. Burger and M.E. Wolff; John Wiley & Sons-New Jersey.
2. Foye's Principles of Medicinal Chemistry; Ed.: W. O. Foye; Lippincott Williams & Wilkins-Philadelphia.
3. Textbook of Medicinal and Pharmaceutical Chemistry; Ed.: Charles Owens Wilson; Lippincott Williams & Wilkins -Philadelphia.
4. Organic Synthesis-The Disconnection Approach; Ed.: Warren S.; John Wiley & Sons-Chichester.
5. Pharmaceutical Substances: Synthesis, Patents, Applications (N-Z); Ed: A. Kleemann; Georg Thieme Verlag-Stuttgart.
6. Strategies for Organic Drug Synthesis and Design; Ed.: Lednicer & Daniel; John Willey & Sons Inc.- New York.
7. Organic Chemistry of Drug Synthesis: Vol. 1 to 6; Ed.: Daniel Lednicer; John Wiley & Sons Inc.- New York.

111. *Technology Of Solid Dosage Forms And Medicinal Natural Products* (Pharma) (4hrs/week)

Technology of Solid Dosage Forms

Preformulation, Formulation, Evolution, Large scale manufacture and packing with focus on equipment with reference to tablets (12)

Coated tablets (5)

Capsules: Hard gelatin and soft gelatin, microcapsules (10)

Layout design and Unit operations related to above dosage forms (3)

Books:

1. Remington's Pharmaceutical Sciences , A.R.Gennaro Mac Pub. Co. Easton, Pennsylvania 1990.
2. Indian Pharmacopoeia, British Pharmacopoeia, United States Pharmacopoeia
3. Coated Pharmaceutical Dosage Forms, K.H.Bauer, CRC Press, Boca Raton. Med Pharm.
4. Pharmaceutical Coating Technology, G.C.Cole, New York, Ellis, Horwood, 1990
5. Pulsed and Self-Regulated Drug Delivery, J.Kost, Florida, CRC Press, 1987
6. Extended Release Dosage Forms, -Klow Czynski, Florida, CRC Press 1987
7. Treatise on Controlled Drug Delivery, A.Kydonieus CRC Press 1991
8. The Theory and Practice of Industrial Pharmacy, Lachman, Bombay, K.M. Warghese Co. 1976
9. Pharmaceutical Dosage Forms Vol. I & II, Liebermann, New York, Marcel Dekker, 1996.
32. Hard Capsules : Development and Technology, K. Ridgway, London Pharmaceutical Press 1987

Medicinal Natural Products

Scope of the subject, Source of the drug of natural origin, Classification of drug, factors involved in the production of drugs (8)

Phytochemistry

Chemical constituents in the production of plants (carbohydrates, protein enzymes, lipids, alkaloids, glycosides, steroids, tannins, terpenoids, flavonoids, plant pigments, etc) (5)

- Biosynthesis approach (3)
 Extraction and isolation of plant drugs: conventional and modern techniques used in extraction and separation of phytoconstituents (3)
 Commerce and quality control, application of spectroscopy and chromatography techniques for isolation, identification and analysis of phytoconstituents (5)
 Detailed study of one representative from each of the above mentioned chemical class (10 drugs) (5)
 Recent advances in phytopharmaceuticals (topic of current interest) (1)

Books:

1. Paul M. Dewick, Medicinal Natural Products, A Biosynthetic Approach, Chichester : John Wiley and Sons, Ltd., 2nd Edn., 2002
2. G.E. Trease & W.C. Evans, Pharmacognosy Edinburgh : W.B. Saunders, 15th Edn., 2002.
3. Varro E. Tyler, Lynn R. Brady, James E. Robbers, Pharmacognosy, Philadelphia : Lea & Febiger, 8th Edn, 1981.
4. T.E. Wallis, A Text book of Pharmacognosy London : J & A Churchill Ltd., 5th Edn., 1967.

112. Technology Of Textile Colouration (Textile)

(4 hrs/week)

Technology of Dyeing

- Earlier developments in processes and machinery for dyeing of textiles in various forms such as loose fibres, yarns as well as woven and knitted fabrics (4)
 Batch type and continuous type dyeing machinery for all forms of textiles; Faults in dyed materials and their correction (12)
 Dyeing of union and blended fibre fabrics; Dyeing of micro fibre fabrics (5)
 Machinery used for washing and soaping of dyed materials; Application and functions of dyeing assistants (5)
 Recent developments in machinery and dyeing techniques; Concept of conservation of chemicals and water in dyeing (4)

Technology of Printing

- Preparation of fabrics for printing; Steps in printing of various fabrics; Historical printing techniques (3)
 Selection of thickening agents, chemicals and dyestuffs for printing; Formulation and rheological properties of printing pastes (4)
 Printing of textile materials with different dyes; Printing of blended fibre fabrics (5)
 Machines used for printing, steaming and other methods of print development; Brief idea about preparation of flat and rotary screens for printing (6)
 Different methods of printing and styles of printing; Aftertreatment of printed materials; Faults in printing, their prevention and correction (6)
 Special printing techniques; Printing of velvet, carpets and knits (2)
 Ecological printing of textiles; Recent developments in printing machinery and techniques; Concept of conservation of water and chemicals in printing (4)

Text/Reference Books :

- 1) *Handbook of Synthetic Dyes and Pigments*, K.M.Shah, Multitech Publishing Company, Bombay, 2nd edition, 1998.
- 2) *Technology of Dyeing*, Shenai V.A., Vol. 6, Sevak Publication, Bombay, 2nd edition, 1994.
- 3) *A manual of Dyeing : For use of Practical Dyers, Manufacturers, Students and all interested in art of dyeing*, E.Knecht, C. Rawson, R.Loewenthal, Charles Griffin and Company Ltd., London, Vol. 1, 1983.
- 4) *Dyeing and Printing*, Cockett S.R., Hilton K.A., Leonard Hill Books Ltd., London, 1961.

- 5) *Introduction to Textile Printing*, W. Clarke, Newness Butterworths, London, 4th edition, 1977.
- 6) *Guide to Printing Techniques*, Naoharu Oyabu, Mahajan Brothers Publishers Ltd., Ahmedabad, 1978.
- 7) *Technology of Printing*, V.A. Shenai, Sevak Publications, Bombay, Vol. 4, 1990.
- 8) *Thames and Hudson Manual of Textile Printing*, Storey, J., Thames and Hudson Ltd., London, 1992.
- 9) *Textile Printing*, Miles, L.W.C., Society of Dyers and Colourist, London, 2nd edition, 1994.
- 10) *Advances in Textile Printing*, Lynn J.E., Press J.J., Textile Book Publishers Inc., New York, 1961.
- 11) *Principles of Cotton Printing*, Kale D.G., Bombay Publication Committee, 1956.
- 12) *Exploring Fabric Printing*, Robinson, S. and Robinson, P., Mills and Boon Ltd., London, 1970.
- 13) *Ideas for Fabric Printing and Dyeing*, Gooch P.H., B.T. Batsford Ltd., London, 1974.

113. Testing Of Textile Materials (Textile)

(2 hrs/week)

- Objects of testing; Testing of raw materials and finished products (5)
 Process control; Various test specifications such as BIS, AATCC, ISO, etc. (4)
 Sampling and statistical analysis of the results; Determination of different physical properties of textiles (5)
 Testing in relation to quality control; Ecotesting of textiles (3)
 Norms of global standards for textile production and use, e.g. care labels, eco labels, etc. (3)
 Testing equipments and their use; Analysis of results (10)

Text/Reference Books :

- 2) *Textile Analysis*, Trotman E.R., Trotman S.R., Charles Griffin and Co., London, 1932.
- 3) *Principles of Textile Testing : An introduction to Physical methods and Testing textile fibres, yarn and fabric*, Booth J.E., Heywood Books, London, 3rd edition, 1968.
- 4) *Textile Testing and Analysis*, Collier, B.J. and Hellen H., Upper Saddle River : Pentice Hall Inc., 1999.
- 5) *Microscopic and Chemical Testing of Textiles*, Koch, P.H., Chapman and Hall, London, 1963.
- 6) *Physical Properties of Textile Fibres*, Morton, W.E. and Hearle, J.W.S., Textile Institute, Manchester, 2nd edition, 1975.
- 7) *Society of Dyers and Colourists : standard methods for the determination of the colour fastness of Textiles and Leather*.
- 8) *Handbook of Textile Testing and Quality Control*, Grover, B. and Hemby, P.S., Wiley Eastern Ltd., New Delhi, 2nd edition, 1988.

114. Chemistry Of Intermediates And Dyes (Textile)

(2 hrs/week)

- Spectral properties of colourants; Jablonski diagram classification of dyes according to application constitution; Empirical treatment of colour and chemical constitution (4)
 Azo dyes - Diazotisation and coupling reactions; Azoic dyes, acid dyes, mono azo dyes, diazo nitro diphenylamine and anthraquinone classes; Acid mordant dyes, azo metal complex dyes; Direct dyes - azo dyes (8)
 Basic dyes- Diphenyl methane and triphenyl methane dyes and their heterocyclic analogues; Triphenyldioxazine dyes, chemistry of disperse dyes - azo, anthraquinone, dinitrophenylamine, methane dyes; Properties of disperse dyes in relation to constitution (8)
 Chemistry of vat dyes - Indigoid, anthraquinoid and polycyclic quinoid vat dyes; Solubilised vat dyes; Sulphur dyes - Sulphurised vat dyes (4)
 Introduction to classes of pigments; Copper phthalocyanine and other colourants based on phthalocyanine (2)

Chemistry of reactive dyes - Chlorotriazine and other halo heterocyclic compounds; Vinyl sulphone based dyes; High fixation, highly substantive, neutral fixing bifunctional reactive dyes; Mineral colours and oxidation colours (4)

Text/Reference Books :

- 1) *Colour Chemistry*, Zollinger.
- 2) *Industrial Dyes*, Hunger, VCH, 2003.
- 3) *Chemistry of Synthetic dyes and Pigments*, Labs H.A.
- 4) *Colour and Chemical Constitution*, Griffiths.

Practicals

115. Statistics And Simulation

(1x4 hrs/week)

- Use of Spreadsheet programs in Numerical Analysis. (4)
- Numerical Solutions of model based on Ordinary Differential Equations. (2)
- Numerical Solutions of model based on P Differential Equations. (2)
- Statistical Methods for data analysis. (6)
- Use of MATLAB/SCI LAB/MATHCAD/SPSS etc. packages together With exercises on Modeling of Real Processes. (6)

The topics for exercises be selected by consultation with the respective divisions.

Text books / Reference books

1. Numerical Recipes in C by William H. Press , Saul A. Teukolsky, William T. Vetterling, Brian P Flannery
2. Operations Research An Introduction by H.A. Taha, Prentice Hall of India,
3. Mathematical Statistics, J.E. Freund, Prentice Hall of India
4. Elementary Statistics From discovery, to decision, M.K. Pelosi, John Wiley and Sons
5. Introduction to Probability and Statistics, J.S. Milton, J.C. Arnold, John Wiley and Sons
6. Using Process Simulators in Chemical engineering-A multimedia guide, D.R. Lewin et al' John Wiley and Sons
7. System Simulation, G. Gordon, John Wiley and Sons
8. Product and Process design principles Synthesis, W.D. Seider, J.D. Seider, John Wiley and Sons
9. Applied Multivariate techniques, Sharma S. John Wiley and Sons
10. Optimisation of Chemical Processes, Edgar T.F., D.m. Himmelblau, John Wiley and Sons
11. Process design principles, W.D. Seider, D.R. Lewin, John Wiley and Sons
12. Response Surface Methodology; Process and Product Optimization Using designed experiments, R.H. Myers, D.C. Montgomery, John Wiley and Sons
13. A concrete approach to Mathematical Modeling, M.M. Gibbons, John Wiley and Sons
14. Reality Rules vol 1 & 2, J.L. Cast, John Wiley and Sons

116. Chemical Engineering Laboratory (Term Work)

(2x4 hrs/week)

1. Differential Distillation
2. Distillation in Plate Column
3. Distillation in Packed Column
4. Steam Distillation
5. Vapour Liquid Equilibrium
6. Characteristics of Flow Through Coil
7. Characteristics of Flow Through Circular Pipes
8. Pressure Drop across Pipe Fittings
9. Characteristics of Non-Newtonian Fluid Flow Through Circular Pipe
10. Capillary viscometer
11. Liquid-Solid Fluidization
12. Sedimentation Characteristics
13. Estimation of Discharge Co-Efficient for Orificemeter
14. Estimation of Discharge Co-Efficient for Venturi Meters
15. Hydrodynamics (Gas-Liquid) of a Packed Tower
16. Mixing Time Studies in Bubble Column
17. Power Consumption Characteristics for Different Impellers
18. Characteristic of Sparkler Filter
19. Diffusivity of benzoic acid
20. Gas Absorption in Packed Column
21. Gas absorption in Mechanical Agitated Contactor
22. Liquid-Liquid Equilibrium
23. Solid Dissolution with Instantaneous Reaction
24. Ion Exchange Column
25. Spray Extraction
26. Kinetics of Condensation Polymerization
27. Specific Heat of Liquid
28. Heat Transfer by Natural Convection
29. Finned Tube Heat Exchanger

117. Wet Processing Of Textiles (Dyes) (Term Work)

(1x4 hrs/week)

1. To study dyeing of cotton with reactive dye and azoic padding mangle
 2. To study the dyeing of cotton hank by tub liquoring using azoics
 3. Beck matching of vat colours on cotton yarns
 4. Identification of class of dye present on dyed fibre
 5. Identification of fibres by different tests.
 6. Direct style of printing - Direct, Reactive, solubilised vat and azoic
 7. Direct style printing on Polyester and Nylon with disperse dyes
 8. Direct style printing on Nylon and Wool with acid and direct dyes
 9. Printing with Pigments and Phthalogen Blue
 10. Discharge style of printing - white discharge under direct and azoic ground
 11. Resist style of printing - under reactive
 12. Resist style of printing - white resist and colour resist under Phthalogen Blue
- Suitable number of experiments from the above list will be performed

118. *Analysis Of Intermediates And Dyes (Dyes) (Term Work)* (1×4 hrs/week)

Identification of fast bases

Separation of mixture

Estimation of dyes by reductions

1. Sunset yellow
2. Ponceau 4R
3. Tartrazine
4. Orange II
5. CongoRed
6. Amaranths
7. Methylene Blue

Suitable experiments from the above list will be performed.

119. *Microbiology (Food) (Term Work)*

(2x4 hours / week)

Use of microscopic techniques in the identification of micro-organisms on the basis of cell morphology and specific staining techniques. Isolation of pure cultures of bacteria, yeasts, moulds and taxonomic identification on the basis of morphology and physiology. Growth characteristics and optimum physico-chemical and nutritional requirements. Measurement of activity of antimicrobial agents. Microbiological assays of growth factors. Evaluation of microbiological quality of potable water, milk and selected food products involving total, viable and coliform count, counting for yeasts and moulds, testing for *Salmonella*, fecal *Streptococci* & *Staphylococci*. Use of micro-organisms in food preservation.

120. *Processing Of Oleochemicals And Cosmetics (Oils) (Term Work)*

(2x4 hours / week)

Methyl esters from oil and fatty acids, Selective hydrogenation of oil for preparation of Vanaspati, Fatty acids by saponification and acidulation, Pressure fat splitting, Metallic soap by double decomposition and fusion method, Turkey red oil, Urea adduction, Rice bran wax processing (separation of fatty acid and fatty alcohol), Biodiesel preparation and properties, Study in esterification reaction of butyl esters, reaction kinetics, Alkyd resin, Wax esters, Cosmetic creams, shaving soap, Shoe polish, Lipstick
Glycerin, GC analysis in oils and fats, Pigments in oils and fats, Dimer fatty acids,
Drying, semidrying and nondrying oils

121. *Processing Of Polymers -I (Polymer) (Term Work)* (2 × 4hrs/week)

1. Synthesis of

- a. Alkyd resin of various oil lengths and to analyse solids, colour, viscosity.
- b. Polyvinyl alcohol and to analyse yield, sap value, hydroxyl value etc.
- c. Potassium Polyacrylate and to analyse yield, melting range etc.
- d. Furfural resins like Bisphenol A/ furfural resin, Ketonic base furfural resin and to analyse yield, melting range etc.
- e. Polyacetal resin and to analyse yield, R.I, hydroxyl value etc
- f. Styrene acrylic copolymer by emulsion polymerization and to analyse %solids and polymer content.
- g. Nitrocellulose, epoxy lacquers etc

- h. Preparation of resol laminate and Processing of UF and MF molding powder, novolac resin
- i. To study Injection molding machine, compression molding machine, Two roll mill, blown film plant and compounding equipments.

122. Processing Of Paints -I (Paints) (Term Work)

(2 x 4hrs/week)

Synthesis of pigments like

1. Iron oxide, Iron blue etc
2. Lemon chrome
3. Middle chrome
4. Zinc phosphate and Zinc Chromate
5. Para red
6. Toluidine red
7. Hansa Yellow
8. Lithol red
9. Phthalocyanine blue
10. Precipitated barium sulphate
11. Characterisation and testing of pigments like moisture content, hiding power, yield, bulk density etc.

123. Medicinal Natural Products Laboratory And Pharmaceutical Analysis (Pharma) (Term Work)

(2x4 hrs/week)

Medicinal Natural Products Laboratory

Standardization of plant drugs using following methods

- a. Morphology, microscopic quantitative microscopy, details microscopic study of drugs (5)
- b. Physical constants like : specific gravity, swelling factor, ash values, extractive values, refractive index, optical rotation, etc (7)
- c. Chemical methods identification tests for various classes of phytoconstituents, Extraction and isolation of active principles such as alkalis, glycosides, tannins, carbohydrates resin, essential oils, fats etc. from natural drugs (4-5 drugs) and evaluation of isolated material by chromatography and spectroscopy. (3)

Pharmaceutical Analysis

Analysis of bulk actives, raw material, and active ingredients in formulation:

- wet and instrumental methods (10)
- structural analysis using spectra (3)
- Some specific tests from monographs (2)

124. Technical Analysis (Textile) (Term Work)

(1x4 hrs/week)

1. Estimation of sodium nitrite and hydrogen peroxide
2. Estimation of peroxide stabiliser.
3. Estimation of bleaching powder and sodium chlorite
4. Estimation of sodium silicate and sodium carbonate

5. Estimation of composition of alkali mixture and barium hydroxide
 6. Estimation of Glauber's salt and sodium chloride
 7. Estimation of chrome alum and hardness of water
 8. Estimation of sodium hydrosulphite and Rangolite C
 9. Estimation of formaldehyde and oxalic acid
 10. Estimation of sodium alginate
 11. Estimation of acid value and Iodine value of fatty acids
 12. Analysis of cotton / polyester, cotton / wool blend samples
- Suitable number of experiments from the above list will be performed.

125. *Tinctorial Chemistry Laboratory (Textile) (Term Work)* (1x4 hrs/week)

I. Estimation of aromatic anilines by diazotizations

Aniline

Chloroaniline

Nitroaniline

Anisidine

Toluidine

Anisidine sulphonic acids

Anthranilic acid

II. Estimation of coupling components by diazo-coupling

2-naphthol

Schaffer acid NW acid R-salt

Pyrazolone - p Sulphonic acid

Phenyl methyl pyrazolone

Gamma acid

J acid

III. Identification of Dyes

Suitable number of experiments from the above list will be performed.

SEMESTER VII

R. 4789 The candidate shall be examined in the subjects at the Semester VII examination as indicated in the following tables.

Theory Papers

Sr. No	Subject	No. of Paper	Examination		Periodic Test Marks	Total Marks	Branches
			Hours	Marks			
1	Chemical Process Technology	1	3	70	30	100	All
2.	Industrial Safety and Environmental Engineering	1	3	70	30	100	All
3.	Special Subject						
	Technology of Intermediates & Colorants III	1	3	70	30	100	Dyes
	Technology of Fruits, Vegetables & Greens	1	3	70	30	100	Foods
	Cosmetic Science II	1	2	35	15	50	Oils
	Evaluation & Testing of Polymers	1	3	70	30	100	Polymer
	Evaluation & Testing of Polymers	1	3	70	30	100	Paints
	Pharmaceutical Technology & Process Technology of Drugs & Intermediates	1	3	70	30	100	Pharma
	Technology of Textile finishing	1	3	70	30	100	Textile
4.	Special Subject						
	Analytical Instruments in Colorants Chemistry	1	2	35	15	50	Dyes
	Technology & Dairy, Animal & Plantation Products	1	3	70	30	100	Foods
	Nutration	1	2	35	15	50	Oils
	Structure Properties relationship	1	2	35	15	50	Polymer
	Structure Properties relationship	1	2	35	15	50	Paints
	Medicinal Chemistry III & Sterile Product Tech.	1	3	70	30	100	Pharma
	Chemistry & Application of Specialty Chemical	1	2	35	15	50	Textile

5	Special Subject						
	Chemistry of Intermediates & Colorants V	1	2	35	35	50	Dyes
	Waxes Lubricants & greases	1	3	70	30	100	Oils
	Technology of Elastomers	1	2	35	35	50	Polymer
	Technology of Painting inks	1	2	35	35	50	Paints
	Textile Process House Management	1	2	35	35	50	Textile
	Total	4/5	-	280	135	400	

Practical Examinations

Sr. No	Subject	Examination		Class Work Marks	Total Marks	Branches
		Hours	Marks			
5.	Special Subject					
	Preparation of Intermediates and Dyes I	6	70	30	100	Dyes
	Food Analysis	6	70	30	100	Foods
	Processing of Soups & Detergents	6	70	30	100	Oils
	Analysis & Characterization of Polymers	6	70	30	100	Polymer
	Analysis & Testing of Paints	6	70	30	100	Paints
	Pharmaceutical Chemistry Laboratory	6	70	30	100	Pharma
	Wet Processing of Textiles	6	70	30	100	Textile
6.	Special Subject (Term Work)					
	Preparation of Intermediates & Dyes II	-	-	100	100	Dyes
	Food Preservation	-	-	100	100	Foods
	Processing of surfactants	-	-	100	100	Oils
	Processing of Polymer - II	-	-	100	100	Polymer
	Processing of Paints - II	-	-	100	100	Paints
	Technology of Solid dosage forms & sterile Products Lab	-	-	100	100	Pharma
	Testing of Textile	-	-	100	100	Textile
7.	Seminar (Term Work)	-	-	50	50	All
	Total	-	70	180	250	

Grand Total at the Examination

Semester VII

Theory

126. Chemical Process Technology

(4hrs/week)

A) Organic:

- A.1 Feed stock for building blocks ethylene, propylene, butenes and benzene, toluene, xylene manufacture Petroleum crude characteristics, Natural Gas, Crude distillation (4)
- A.2 Manufacture of ethylene, propylene, butadiene, & the rest C₄ components (4)
- Manufacture of aromatics (3)
- Manufacture of syn - gas from Natural gas, naphtha and coal (4)
- A.3 Process engineering aspects of manufacture of Methanol and methanol based chemicals such as acetic acid, dimethyl ether, dimethyl carbonate, etc. Ethylene oxide, glycols, vinyl chloride, vinyl acetate, α -olefins Propylene oxide, hydroformylation of propene to manufacture n & i butyraldehyde, 2 ethyl hexanol Separation & utilization of C₄ stream of steam naphtha cracker & FCC cracker (butadiene, isobutylene based ethers, maleic anhydride) (17)
- A.4 Processing engineering aspects of manufacture of aromatic compounds: terphthalic acid, phthalic anhydride, phenol linear alkyl benzene, nitrobenzene aniline. (10)

- | | | |
|----|--|---|
| 1. | Sulphuric Acid | 3 |
| 2. | Ammonia & Nitric acid, Urea | 6 |
| 3. | Chlor alkali (Caustic Soda & Soda ash) | 4 |
| 4. | Phosphoric acid and its compounds | 3 |
| 5. | Process water | 1 |
| 6. | Air Separation | 1 |

Recommended Books:

- i) Kirk Othmer Encyclopedia of Chemical Technology
- ii) Ullmann's Encyclopedia of Industrial Chemistry
- iii) Weissmer K and Arpe H. J. Industrial Organic Chemistry
- iv) Hatch L. F. and Matar S. from Hydrocarbons to Petrochemicals
- v) Chemical Process Industries IV Edn : Shreve, Brink and Austin Mc Graw Hill
- vi) Chemical Process Technology: Moulijn, Makkee and van Dippen, II Edn.

127. Industrial Safety And Environmental Engineering

(4hrs/week)

Industrial Safety

Industrial Hygiene and safety aspects related to toxicity, noise, pressure, temperature, vibrations, radiations, etc. explosions including dust, vapour cloud and mist explosions. Hazard identification, assessment and safety audit, HAZOP, HAZAN and consequence analysis. Safety aspect related to

1. Transport, handling and storage flammable liquids and gases and toxic materials
2. Process equipment including piping (fire, static electricity, pressure, temperature, etc.) safety aspects at process development and design stage. Reliability engineering. Hazard mitigation systems. Emergency planning. Case studies.

Environmental Engineering
 Environmental aspects to process development and design stage, environmental audit. Water pollution: characterization of industrial waste waters. Permissible limit of pollutants. Primary, secondary and tertiary treatment methods. Recovery methods for pollutants. Air pollution: nature of pollutants, their sources sinks. Meteorology and problems associated with dispersion. Sampling methods. Controlled techniques for gaseous and particulate pollutants. Waste treatment of solid. Management of hazardous wastes.

128. *Technology Of Intermediates And Colorants -III (Dyes)* (4hrs/week)

Physicochemical principles in the formulation of colorants. Dispersing, spray drying, granulations, microencapsulation, liquid formulation and other dust free formulation. (20)
 Physical modification of pigments, crystal engineering some simple methods. (10)
 Elements of waste disposal, waster management, gaseous, liquid and solid wastes, their treatment methods. (20)
 Environmental, safety and health issues associated with colorants. (10)

Text/Reference Books :

1. Advances in Color Chemistry Vol IV, Peters A.T.
2. Industrial pigments, Herbst, Hunger
3. High Performance Pigments, Smith
4. Chemical Engineer's Handbook, Perry

129. *Analytical Instruments In Colorants Chemistry (Dyes)* (2hrs/week)

Importance of instrumental methods in conjunctions with conventional analytical methods. (1)
 Spectral methods of analysis - interaction of electromagnetic radiation with colorants and various types of spectral methods and information obtained from them - quantitative. (1)
 Ultraviolet and visible spectrophotometry - solutions coloristics. Usefulness of visible spectral data for obtaining structural informations. (1)
 Nuclear magnetic resonance spectroscopy - Principles and applications in structure determinations of simple organic intermediates and dyes. (5)
 Infrared absorption spectroscopy - empirical treatment for identifying functional groups and structure elucidations of organic intermediates and dyes. (5)
 Mass spectroscopy fragmentation patterns - empirical approach in structure elucidation of organic intermediates and dyes. (5)
 Combined applications of UV-visible, NMR, ir and mass spectral data for structure elucidation. (5)
 Chromatographic techniques such as GC, HPLC and HPTLC and their utility in dyestuff chemistry. (5)
 Physicochemical specifications of colorants using a-ray diffraction, electron scanning and similar techniques. (2)

Text/Reference Books :

1. Spectral Identification of organic Compounds, Silverstein
2. Organic structure Determinations, Field
3. Spectroscopy, Dyer
4. Spectroscopic Methods, Pasic
5. Analytical Chemistry of Synthetic Dyes, Venkatraman K., Academic Press, New York, 1952
6. Advances in Color Chemistry Vol I, Peters A.T.

130. Chemistry Of Intermediates And Colorants -V (Dyes) (2hrs/week)

Developments in metal complex dyes, formazan dyes and formazan metal complex dyes, metal complex reactive dyes (8)

Indicator dyes, dyes used in other analytical techniques (5)

Light fastness of dyes in relation to chemical constitution light fast dyes, water repellent dyes and dyes with other specific properties (8)

Colorants used in light harvesting devices like solar cells and other related uses (5)

Quasi aromatic fluorescent compounds and laser dyes (4)

Text/Reference Books:

1. Non-textile dyes, Freeman
2. Laser Dyes, Schaeffer
3. Color Chemistry, Zollinger
4. Color and Chemical Constitution - Griffith

131. Technology Of Fruits, Vegetables And Grains (Food) (4hrs/week)

Fruits and Vegetables: Post harvest handling, storage, control of ripening, etc. (4)

Fruits: Processing techniques, juices, concentrates, preserves and other traditional products (10)

Vegetables: Processing techniques, pickles, fermented pickles and other traditional products (10)

Dehydrated and speciality products and by-products of fruits and vegetables (6)

Honey sugars and saccharine products, soft drinks (3)

Storage of grains (2)

Grain and pulse milling, pearling and flour milling (4)

Par boiling (2)

Bakery technology (10)

Malting and malt products (3)

Extruded and puffed products (4)

Fermented cereals, legume based traditional products (2)

Books

- Postharvest biotechnology of vegetables, Salunkhe D.K.
- Postharvest biotechnology of fruits, Salunkhe D.K.
- Handbook of fruit science and technology, Salunkhe D.K. and Kadam S.S.
- Handbook of vegetable science and tech., Salunkhe D.K. and Kadam S.S.,
- Processing vegetable: Sc. & Tech., Smith et al.,
- The chemistry and technology of cereals as food and feed, Matz S.A.,
- Cereal science and technology, Hosenay R.C.,

132. Technology Of Dairy, Animal And Plantation Products (Food) (4hrs/week)

TQM in Food industry, Technology of milk and dairy products. Pasteurization, Sterilization, HTST and UHT process. (5)

Manufacture of condensed milk, milk powders, cheese, ice cream, butter, ghee, malted products, evaporated and dried products. Traditional dairy products. Milk confections. (12)

Substitutes for milk and milk products. Casein, lactose and other by-products. Technology of baby foods, weaning foods, therapeutic foods. Fortification and enrichment.	(8)
Technology of meat products including slaughter house practices. Processing of frozen, smoked, cured and ready to serve products. Traditional meat products.	(8)
Poultry and egg technology. Traditional poultry products.	(5)
Processing of fish and sea foods. Surimi technology. Traditional fish products.	(5)
Processing of tea, coffee, cocoa.	(8)
Technology of spices, condiments, oleoresins, flavour extract etc.	(5)
Traditional products from typical plantation crops.	(4)

Books:

Egg and Poultry Meat Processing, W. J. Stadelman, V. M. Olson, G. A. Shenwell, S. Pasch (1988), VCH, Ellis Horwood.

Processed Meats, II Edition, A. M. Pearson & F. W. Touber (1984), Avi Inc, Westport, Connecticut.

Surimi and Surimi Seafood, Jae W. Park (Ed), (2000), Marcel Dekker Inc, New York, Basel.

Outlines of Dairy Technology, S. De (1980), Oxford University Press, Bombay, Calcutta, Madras.

Milk and Dairy Product Technology, E. Spreer (1998), Marcel Dekker, New York.

Milk and Milk Products Technology, Chemistry and Microbiology, A. H. Varnam and J. P. Sutherland (1994), Chapman and Hall, London.

The Technology of Dairy Technology, 2nd Edn, R. Early (1998), Blackie Academic and Professional, London.

133. *Cosmetics Science II (Oils)*

(2hrs/week)

Formulations of different cosmetic creams such as hair care products, nail polish, lipsticks. (7 hrs)

Stability tests and product specifications (7 hrs) Concept of product design, labeling, claiming and claim support understanding of current needs, translation of current needs to products (16 hrs)

Books:

- Perfumes, Soaps detergents and Cosmetics by S. C. Bhatia, CBC Publishers and Distributors (2001)
- Modern Cosmetics by Thomssen, Universal Publishing Corporation (1951)
- Formulations and functions of cosmetics by Jellinek, Wiley Interscience (1970)
- Chemistry and manufacture of cosmetics by Denavarre, Grosse farm

134. *Nutrition (Oils)*

(2hrs/week)

Metabolic rate and caloric needs. (4 hrs) Requirements and role of nutrients in human health, RDAs, nutrition fibres (10 hrs) biological value of proteins (8 hrs) Energy value of foods (2 hrs) Techniques of diet and health surveys (4 hrs) formulation of diets and foods for specific needs (2 hrs)

Books:

Modern nutrition in health and disease by Young and Shils

135. Waxes, Lubricants And Greases (Oils)

(4hrs/ week)

Petroleum products: Origin & history of petroleum, Crude Oil/ Properties/ Types/ Evaluation (3 hrs), Petroleum refining operations: Primary refining steps, Secondary refining steps/ Refining products - Gases, Fuels, Lubes, Waxes, Production of Lubricating oils, Hydrocracking / hydroprocessing (5 hrs), Waxes: Petroleum waxes/ asphalt/ other residues, Properties and applications of waxes, Waxes/structure/properties/ types of waxes (plant and animal based) (3 hrs), Non petroleum based materials: Applications of vegetable oils, Vegetable oils/structure and properties & waxes (5 hrs), Lubrication principles: Tribology/ friction and wear, Hydrodynamic, boundary lubrication, Basic properties: viscosity, viscosity index and other properties. (5 hrs), Classification of lubricants: Automotive, industrial and different applications, Liquid and Solid Lubricants (2 hrs), Automotive lubricants: Engine oils, Types of engines, two stroke and four stroke engine oils, requirements of engine oils, Petrol and diesel I/ C engines, Knocking octane number, cetane number, Gear oils: Classification/ properties, Other automotive oils (7 hrs), Industrial lubricants: Hydraulic oils, Gear and machinery oils, Metal working oils, Quenching oils/ corrosion preventing, Specialty oils (6 hrs), Greases: Types/ classification, Manufacture and applications, Testing of greases (5 hrs), Synthetic oils: Need and justification, Classification and types, Esters, Synthetic hydrocarbons, Others, Applications, Biobased lubricants (4 hrs), Lubricant additives: Types/ classification, chemistry/ function, Antifricition, antiwear, EP additives, antioxidants, corrosion inhibitors, Multifunctional additives and modern trends (4 hrs)

Testing & performance evaluation of lubricants: Analytical methods, acid number, base number, pour point, cloud point, smoke point, carbon residue ash etc. Industrial techniques IR/ AA/ GCMS/ DSC etc (4 hrs), Blending & manufacture of lubricants: Types of operations, Layout, Packaging and quality control, Environmental control, Economics (3 hrs), Conservation, disposal, re-refining of lubricants and World market for lubricants and waxes (4 hrs)

Books:

- Industrial Waxes by Bennet H., Chemical publishing Co. (1975)
- Manufacture and applications of Lubricating greases by C. J. Boner, R. E. Krieger Co. (1971)
- Petroleum processing handbook by W. F. Bland and R. L. Davidson
- Crude oil, waxes, emulsions and asphaltenes by J. R. Becker, Penn Well Books (1997)
- Mechanics and chemistry in lubrication by A. Dorinson, Elsevier (1985)
- Proceedings of LAWSPSP symposium by M. C. Dwivedi Vol. 1 to 13.
- Fatty acids in industry by R. W. Johnson, Marcel Dekker Inc. (1989)
- Fats, Oleochemicals and surfactants challenges in 21st Century by V. V. S. Mani and A. D. Shitole, Oxford and IBH Publishing Co. Pvt. Ltd. (1997)
- Bio based industrial fluids and lubes by Sevim J., Erhan, AOCS Press (2002)
- Synthetic lubricating oils by Roberts F. CIOS - XXX-5

136. Evaluation And Testing Of Polymers (Polymer)

(4hrs/ week)

Thermal properties of polymers: Glass transition temperature, melting temperature, heat distortion temperature, etc. Sample preparation, standardization, conditioning of sample, processibility test, dynamic mechanical analysis, melt flow rate, Vicat softening temperature. Study. of a dilatometer. Study of thermo-chemical analysis and differential scanning calorimeter and their applications to polymers with suitable examples.

(6)

Structural evaluation of polymers: Principles, theories and applications to polymeric systems with suitable illustration of the following techniques: Fourier transform infrared spectrometry, Ultraviolet-visible spectrometry, Nuclear magnetic resonance spectrometry, Mass spectrometry, X-ray diffraction spectrometry, Gas chromatography (16)

Molecular weight determination: Study of the respective principles, theories and applications by the following techniques: Gradient elution technique, Gel permeation chromatography, Vapour pressure osmometry, Cryoscopy and ebullioscopy (8)

Viscosity of polymer solutions and polymers: Their significance, application to polymers using different viscometers. (2)

Electrical properties: Surface volume resistivity, Breakdown voltage, Arc resistance, Tan Delta, Etc. The theory behind these phenomena, application to polymers and evaluation. (4)

Mechanical properties: Their principles and applications to polymers, Tensile strength, flexural strength, impact resistance, percentage elongation, Griffin theory, tear test, fatigue and wear, hardness, compressive strength time dependant properties like creep, stress, relaxation, etc. (8)

Environmental resistance: Stress cracking, effect of weathering, biological degradation, fire, radiation staining. (2)

Optical properties: Refractive index, gloss, colour matching, haze (2)

Fire test: Ignition of flame and spread, limiting oxygen index, rate of heat release, smoke toxicity test (4)

Adhesion test: Peel test, tension test, shear test. (2)

Microscopy: Scanning electron microscopy, travelling electron microscope. (2)

Identification of polymers using chemical methods (4)

Text/Source Books

1. Handbook of Plastics Analysis, H. Lobo and J. V. Bonilla, Marcel Dekker, 2003.
2. Handbook of polymer Testing Roger Brown, Marcel Dekker Inc, 1999.
3. Instrumental Methods by Dyer.
4. Developments in Polymer Characterization 1-5 by J. V. Dawkins

137. Structure Properties Relationshis (Polymer)

(2 hrs / week)

General structural features of polymers: Effects of atoms types of bonds, bond dissociation energy and functional groups on properties of polymers (3)

Configuration and conformation and structure properties of polymers (2)

Molecular mass heterogeneity and structure properties (1)

Polymers solutions: thermodynamics of dissolution, factors effecting dissolution and swelling of polymers, phase equilibrium of polymer-solvent systems, polymer solution, Florry-Huggins theory (6)

Polymer chain flexibility: concept of flexibility, various factors deciding flexibility of polymers with case studies, properties of polymers affected by flexibility (6)

Intermolecular orders: Amorphous, crystalline and oriented forms of polymers, crystallinity, polymers, factors affecting crystallinity, properties affected by crystallinity of polymers (6)

Thermal properties of polymers: fire retardant polymers, factors affecting glass transition (T_g) temperature, heat stability etc. with case studies (4)

Degradation and stabilization: various stresses acting on polymers and their influence, method of improving the stability of polymers with case study (6)

Text/Source Books

1. Polymer Structure, Properties and application, R.D. Deanin, American Chemical Society, 1974.
2. Relating Materials, Properties to Structure; Handbook and Software for Polymer calculations and Materials Properties, D. J. David and Ashok Mishra, Technical Publishing Company, Inc, 1999.
3. Properties of Polymer; Correlations with Chemical Structures and their numerical Estimation and Predication from Additive Group Contribution van Krevelen, Elsevier Publication Company, 1990.
4. Relating Materials Properties to structure, D. J. David, Technical Publishing Company Inc, 1999.
5. Polymer Chemistry, C. E. Carrshar, Marcel Dekker Inc, 2003.
6. Physical chemistry of Polymers, A. Tager, Mir Publishers, 1978.
7. Polymer Association Structures M. A. EL-Nokally, American Chemical Society, 1989.
8. Polymer Solutions; Introduction to Physical Properties, Teraoka, Iwao, John Wiley and Sons. Inc, 2002.
9. Polymer Chemistry; An Introduction, M. P. Stevens, Oxford University Press, 1990.

138. Technology Of Elastomers (Polymer)

(2 hrs / week)

Definition of elastomers and requirements of polymer to be elastomer: effect of molecular weight, tie points and glass transition temperature (T_g) (3)

Different types of monomers used in synthesis of elastomers, classifications of elastomers, compounding and vulcanization of rubbers, different ingredients used in it and functions of various compounding ingredient, various equipments used for compounding and their comparison (4)

Different types of vulcanization systems used for compounding and fillers used in elastomers, measurement of mooney viscosity and state of cure for rubber compound. (5)

Synthesis of various rubbers natural rubber/ synthetic polyisoprene, styrene butadiene rubber, SBS block copolymer, nitrile rubber, EPR and EPDM rubber, polybutadiene rubber, butyl and neoprene rubber etc and their properties and applications (18)

Text/Source Books

1. Encyclopedia of Polymer Science and Technology, John Wiley and Sons, Inc 1965.
2. Encyclopedia of Polymer Science and Engineering, John Wiley and Sons, Inc 1988.
3. Rubber as an Engineering Material, K. Nagdi, Hanser Publishers, 1993.
4. Handbook of Rubber Technology, S. Blow, Galgotia Publications Pvt. Ltd., 1998.
5. Rubber Technology, Morell S. H. applied Science Publication, 1981.
6. Plastics and Rubber, E. W. Duck, Butterworth, 1971.

139. Evaluation And Testing Of Polymers (Paints)

(4hrs/ week)

Thermal properties of polymers: Glass transition temperature, melting temperature, heat distortion temperature, etc. Sample preparation, standardization, conditioning of sample, processibility test, dynamic mechanical analysis, melt flow rate, Vicat softening temperature. Study of a dilatometer. Study of thermo-chemical analysis and differential scanning calorimeter and their applications to polymers with suitable examples. (6)

Structural evaluation of polymers: Principles, theories and applications to polymeric systems with suitable illustration of the following techniques: Fourier transform infrared spectrometry, Ultraviolet - visible spectrometry, Nuclear magnetic resonance spectrometry, Mass spectrometry, X-ray diffraction spectrometry, Gas chromatography (16)

Molecular weight determination : Study of the respective principles, theories and applications by the following techniques: Gradient elution technique, Gel permeation chromatography, Vapour pressure osmometry, Cryoscopy and ebullioscopy	(8)
Viscosity of polymer solutions and polymers : Their significance, application to polymers using different viscometers.	(2)
Electrical properties: Surface volume resistivity, Breakdown voltage, Arc resistance, Tan Delta, Etc. The theory behind these phenomena, application to polymers and evaluation.	(4)
Mechanical properties : Their principles and applications to polymers, Tensile strength, flexural strength, impact resistance, percentage elongation, Griffin theory, tear test, fatigue and wear, hardness, compressive strength time dependant properties like creep, stress, relaxation, etc.	(8)
Environmental resistance: Stress cracking, effect of weathering, biological degradation, fire, radiation staining.	(2)
Optical properties: Refractive index, gloss, colour matching, haze	(2)
Fire test: Ignition of flame and spread, limiting oxygen index, rate of heat release, smoke toxicity test	(4)
Adhesion test: Peel test, tension test, shear test.	(2)
Microscopy: Scanning electron microscopy, travelling electron microscope.	(2)
Identification of polymers using chemical methods	(4)

Text/Source Books

- Handbook of Plastics Analysis, H. Lobo and J. V. Bonilla, Marcel Dekker, 2003.
- Handbook of polymer Testing Roger Brown, Marcel Dekker Inc, 1999.
- Instrumental Methods by Dyer.
- Developments in Polymer Characterization 1-5 by J. V. Dawkins

140. *Structure Properties Relationships (Paints)*

(2 hrs / week)

General structural features of polymers: Effects of atoms types of bonds, bond dissociation energy and functional groups on properties of polymers	(3)
Configuration and conformation and structure properties of polymers	(2)
Molecular mass heterogeneity and structure properties	(1)
Polymers solutions: thermodynamics of dissolution, factors effecting dissolution and swelling of polymers, phase equilibrium of polymer-solvent systems, polymer solution, Florry-Huggins theory	(6)
Polymer chain flexibility: concept of flexibility, various factors deciding flexibility of polymers with case studies, properties of polymers affected by flexibility	(6)
Intermolecular orders: Amorphous, crystalline and oriented forms of polymers, crystallinity in polymers, factors affecting crystallinity, properties affected by crystallinity of polymers	(6)
Thermal properties of polymers: fire retardant polymers, factors affecting glass transition (Tg) temperature, heat stability etc. with case studies	(4)
Degradation and stabilization: various stresses acting on polymers and their influence, method of improving the stability of polymers with case study	(6)

Text/Source Books

- Polymer Structure, Properties and application, R.D. Deanin, American Chemical Society, 1974.
- Relating Materials, Properties to Structure; Handbook and Software for Polymer calculations and Materials Properties, D. J. david and Ashok Mishra, Technical Publishing Componey, Inc, 1999.

12. Properties of Polymer; Correlations with Chemical Structures and their numerical Estimation and Predication from Additive Group Contribution van Krevelen, Elsevier Publication Company, 1990.
13. Relating Materials Properties to structure, D. J. David, Technical Publishing Company Inc, 1999.
14. Polymer Chemistry, C. E. Carrshar, Marcel Dekker Inc, 2003.
15. Physical chemistry of Polymers, A. Tager, Mir Publishers, 1978.
16. Polymer Association Structures M. A. EL-Nokally, American Chemical Society, 1989.
17. Polymer Solutions; Introduction to Physical Properties, Teraoka, Iwao, John Wiley and Sons, Inc, 2002.
18. Polymer Chemistry; An Introduction, M. P. Stevens, Oxford University Press, 1990.

141. *Technology Of Printing Inks (Paints)*

(2 hrs / week)

- Manufacture of paper: qualities and properties of paper (2)
- Letterpress printing: Process- characteristics- raw materials- formulations for different substrates- ink related problem and their solution, latest developments (3)
- Screen printing: Process- characteristics- raw materials- formulations for different substrates- ink related problem and their solution, latest developments (4)
- Flexography: Process- characteristics- raw materials- formulations for different substrates- ink related problem and their solution, latest developments (5)
- Gravure: Process- characteristics- raw materials- formulations for different substrates- ink related problem and their solution, latest developments (5)
- Lithography: Process- characteristics- raw materials- formulations for different substrates- ink related problem and their solution, latest developments (5)
- Non impact printing (4)
- Other than above printing method: pad printing, transfer printing and latest development (2)

142. *Pharmaceutical Technology (Catalytic Processes) And Process Technology Of Drugs And Intermediates (Pharma)*

(4 hrs/week)

Pharmaceutical Technology

- Raw materials for Pharmaceutical Industry (1)
- Enzymes as catalyst (a) in Synthesis for Pharmaceuticals (b) Introduction to Principle of enzymes catalyst, Lipases and esterase's for hydrolytic conversion. Lipases and esterase's in organic solvents, other hydrolytic reactions, Enzyme-catalyzed oxidation reactions, Enzyme-catalyzed C-X bond synthesis, Enzyme-catalyzed reduction, Chiral Technology (14)
- Chemical Development of enantiomerically pure products, resolution, chiral synthesis etc (2)
- Separation (a) aspect of Chemical Purification and process separation technology (b). Introduction to Separation technology; choosing a separation process, Adsorption Separation methods, Simulated moving bed (SMB) chromatography; Large scale chromatography; Homogeneous, Heterogeneous catalyst and phase transfer catalyst (8)
- Mixing (a) Flow pattern and theories (impeller); suspension of solid particles; lipid-lipid dispersion; three phase dispersion; mass transfer at gas-liquid, solid-liquid, solid-solid, process design and scale up of mixing (5)

Books:

1. Wolfgang Aehle, "Enzymes in Industry Production and Applications" Wiley VCH Publication, 2003
2. Heinrich Klefenz, "Industrial Pharmaceutical Biotechnology" Wiley-VCH Publication, 2002
3. T. Scheper, "Process Integration in Biochemical Engineering" Springer Publication, 2003.
4. Oligan Repic, "Principles of Research and Chemical Development in the Pharmaceutical Industry" Wiley Interscience 1998
5. Romano Di Fabio, "From Bench to Market the Evolution Chemical Synthesis" Oxford University Press, 2000

Process Technology of Drugs and Intermediates

Manufacturing processes for drugs involving multiple steps and comparative study of various routes of synthesis (10)

1. The Design and Development of Safe Chemical Processes (5)

(a) Introduction, the chemical process life-cycle, Legislative requirements for safe process development and scale up, Development techniques for safe process design, Unit operations posing particular hazards during development, Strategies for chemical hazards assessment, Hazards of gas and vapor generation, Identification of highly-energetic materials, Small scale screening tests; case studies, Flammability issues associated with chemical manufacture, Gas and Vapor pressure systems, Process control considerations and safety critical systems, GMP in chemical development (15)

2. Optimization of Organic Reactions and Processes

(a) Introduction-the purpose of chemical development, Discovering the best synthetic route; Selecting the best route for scale-up, Choice of raw materials, reagents etc; case studies, The investigative approach to chemical development, Effect of process variables on yield and quality of products; Quality control in process analysis as an aid to optimization, Designing a robust process and preventing scale-up problems, Solvent effects, Work up and product isolation, Selecting the parameters to vary, Planning for scale up, Design of environmentally friendly processes, Effluent minimization and control, Statistical methods of optimizations

Books:

1. A. Liese, "Industrial Bio transformations" Wiley - VCH 2000
2. Mahmoud M. "Pollution Prevention Through Process Integration (Systematic Design Tools)" Academic Press, 1997
3. Neal G. Andreson, "Practical Process Research and Development" Academic Press, 2000
4. A. Cybulski, "Fine Chemicals Manufacture - Technology and Engineering Elsevier Publication, 2000
5. "Mixing Equipment (Impeller type)" AIChE Publication 2001
6. "Chemical Process Quantitative Risk Analysis" AIChE Publication, 2000

143. Medicinal Chemistry III And Sterile Product Technology (Pharma)

(4hrs/week)

Medicinal Chemistry III (Drugs for Metabolic Disorders)

Bioorganic chemistry of vitamins, Peptide and protein drugs, Carbohydrate drugs (11)

Drugs acting on hormonal system (2)

(a) Ant diabetic agents (2)

(b) Steroid hormones-adrenocorticoids (2)

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|-----|--|-----|
| (c) | Sex steroids and antagonists, oral contraceptives | (3) |
| (d) | Thyroid and ant thyroid agents | (2) |
| (e) | Drugs acting on calcium homeostatic, iron preparations | (2) |
| (f) | Prostaglandin's and related compounds | (2) |

Books:

1. Burger's Medicinal Chemistry & Drug Discovery: Vol. 1 to 6; Ed.: A. Burger and M.E. Wolff; John Wiley & Sons-New Jersey.
2. Foye's Principles of Medicinal Chemistry; Ed.: W. O. Foye; Lippincott Williams & Wilkins-Philadelphia.
3. Textbook of Medicinal and Pharmaceutical Chemistry; Ed.: Charles Owens Wilson; Lippincott Williams & Wilkins -Philadelphia.
4. Organic Synthesis-The Disconnection Approach; Ed.: Warren S.; John Wiley & Sons-Chichester.
5. Pharmaceutical Substances: Synthesis, Patents, Applications (N-Z); Ed: A. Kleemann; Georg Thieme Verlag-Stuttgart.
6. Strategies for Organic Drug Synthesis and Design; Ed.: Lednicer & Daniel; John Willey & Sons Inc.- New York.
7. Organic Chemistry of Drug Synthesis: Vol. 1 to 6; Ed.: Daniel Lednicer; John Wiley & Sons Inc.- New York.

Sterile Product Technology

Preformulation, Formulation, Evolution, Large scale manufacture and packing with focus on equipment with reference Parenterals and ophthalmic (12)

Layout design and Unit operations related to above dosage forms (5)

Blood products, Glandular products, medical sutures, ligatures (5)

Stability evolution of pharmaceutical dosage forms (8)

Books:

1. Dispensing for Pharmaceutical Students, Cooper and Gunn, London, Pitman Medical Pubs. Co 1965
2. Therapeutic Systems: Pattern-Specific Drug Delivery , Heilmann , Struttgart, G.Thiense Pub. 1978
3. Encyclopedia of Pharmaceutical Technology , J. Swarbrick , New York , Marcel Dekker, 1993
4. Remington's Pharmaceutical Sciences, A.R.Gennaro Mac Pub. Co. Easton, Pennsylvania 1990
5. Indian Pharmacopoeia, British Pharmacopoeia, United States Pharmacopoeia.

144. Technology F Textile Finishing (Textile)

(4hrs/week)

Physical and chemical aspects of mercerisation of cotton; Determination of efficiency of mercerisation and factors affecting it (4)

Machinery used for the mercerisation of yarn and woven and knitted fabric; Mercerisation of blended fabrics (4)

Mercerisation at different stages and their comparison (2)

Classification of finishes; Various finishing agents to assist mechanical finishes and their functions;

Chemical finishing agents like stiffeners, binders, weighting agents, softeners, optical brighteners, etc. (8)

- Mechanical finishes of cotton and synthetic fabrics; Decatising of wool; Heat setting of synthetic fabrics; Machinery used (10)
- Chemistry and technology used for improving wrinkle resistance, wash and wear, and durable press properties of fabrics; Non-formaldehyde finishes (5)
- Study of various types of finishes such as creeping, softening, stiffening, wetting, antipilling, laminating, etc.; Organdie finish (4)
- Functional finishes like antibacterial, flame retarding, water repelling, antisoil, antistatic finishes, etc. (10)
- Finishes of blended fabrics; Antifelting, carbonising and other finishes for wool; Finishing of knitted and texturised fabrics (3)
- Evaluation and durability of finishes: (6)
- Concept of conservation of chemicals, water, energy; Eco-friendliness of various finishes (4)

Text/Reference Books :

- 1) Encyclopedia of Textile Finishing, Rouette, H.K., Springer Verlag, New York, 2001.
- 2) Handbook of Fibre Finish Technology, Slade, P.E., Marcel, New York, 1998.
- 3) Textile Finishing, Hall A.J., Heywood book, London, 1966.
- 4) An Introduction to Textile Finishing, Marsh J.T., B.I. Publication, Bombay, 1979.
- 5) Technology of Finishing, V.A. Shenai, Vol. 10, Sevak Publication, Bombay, 1990.
- 6) Low liquor Dyeing and Finishing - Textile Institute, Manchester.

145. Chemistry And Application Of Specialty Chemicals (Textile) (2hrs/week)

- Nomenclature, functions and classification of textile auxiliaries such as wetting agents, detergents, protective colloids, levelling agents, dye fixing agents, proofing agents, etc. used in textile processing (4)
- Surface active and non-surface active auxiliaries (10)
- Chemistry and synthesis of important textile auxiliaries (6)
- Qualitative and quantitative evaluation of auxiliaries; Testing of surfactants, detergency, identification of ionic nature (5)
- Eco friendly textile auxiliaries; Recent developments in textile auxiliaries (5)

Text/Reference Books :

- 1) *Colourants and Auxiliaries: Organic Chemistry and Application Properties*, Shore, J., SDC, Bradford, 1990.
- 2) *Laundry Detergents*, Smulders, E., Wiley VCH, Weinheim, 2002.
- 3) *Chemistry and Textile Auxiliaries*, Shenai V.A., Vol. 65, Sevak Publication, Bombay, 2nd edition, 2002.
- 4) *Textile Auxiliaries*, Batty, J.W., Dergamon Press, Oxford, 1967.
- 5) *Textile Chemicals and Auxiliaries*, Speel H.C., Reinhold Processing Corporation, New York, 1952.

146. Textile Process House Management (Textile) (2hrs/week)

Process House Planning

Selection of site for different types of process houses; General layout of building and machinery including pollution control and safety measures; construction of a modern process house; Sourcing of raw materials, handling, inventory, infrastructure requirements such as water, steam, electricity, oil, etc. with their costs; Human resource requirements; Process controls for quality production in each department (10)

Quality Management and Economics of Textile Processing

Methods of assessment of quality with respect to economy, performance and consumer appeal; Importance of raw materials and machinery in terms of quality of textile goods; ISO 9000 series of certification; R and D efforts in monitoring the quality; Economics at different stages of production in textile industry; Factors influencing the cost of production; Methods of reduction in cost of production such as recycling of chemicals, raw materials, energy conservation, substitution by cost effective techniques, Right First Time approach, Rearranging number of processes; Cost of quality (10)

Environmental Aspects of Textile Processing

Types of pollution in a textile industry; Precautions to minimise pollution such as source reduction; Methods of analysing, measuring and controlling pollution; Pollution due to discharges from the textile processing industry and its characteristics; Ecological balance and effluents; Methods of recovery, reuse and neutralisation of various ingredients present in the effluents; Cost of effluent treatment; Tolerance level of pollutants and advantages of pollution control in relation to textile industry; Banned dyes, red listed chemicals and their eco friendly substitutes; ISO 14000 certification (10)

Text/Reference Books :

- 1) Treatment of Textile Processing effluents, Manivasakam, M., Sakthi Publication, Coimbatore, 1995.
- 2) Water Used in Textile Processing: quality, treatment and analysis, Manivasakam, M., Sakthi Publication, Coimbatore, 1995.
- 3) Heat Economy in Textile Mills, Prabhu M.R., ATIRA Publ., Ahmedabad, 1981.
- 4) Ecology and Textiles, Shenai V.A., Sevak Publication, Bombay, 1997.
- 5) Azo Dyes: facts and figures, Shenai V.A., Sevak Publication, Bombay, 1999.
- 6) Management of Textile Industry, Dudeja, U.P., Dudeja V.P., Textile Trade Press Ahmedabad, 1981.
- 7) An Introduction to Management in the Dyeing Industry, Park J., SDC, Bradford, 1984.

Practicals

147. Preparation Of Intermediates And Dyes -I (Dyes) (2×4 hrs/week)

Preparation of some simple intermediates from benzene, naphthalene, anthraquinone and heterocyclic systems

1. m-Dinitrobenzene
2. m-Nitroaniline
3. metaphenylenediamine
4. p-Nitroacetanalide
5. p-Nitroaniline
6. m-Nitrobenzene sulphonic acid
7. Sulphanilic acid
8. Fast Scarlet R
9. Phenylhydrazine-p-sulphonic acid
10. R-acid
11. 1,2,4-acid
12. Anthraquinone 2- sulphonic acid
13. Benzanthrone
14. 1-Phenyl-3-methyl-5-Pyrazolone
15. Acetoacetanalide

Suitable experiments from above list will be performed.

148. Preparation Of Intermediates And Dyes -II (Dyes)(Term Work) (2x4 hrs/week)

Preparation of dyes from various classes:

1. Acid dyes
2. Metal Complex dyes
3. Direct dyes
4. Basic dyes
5. Reactive dyes
6. Pigments

Suitable experiments from the above list will be performed.

149. Food Analysis (Food) (2x4 hrs / week)

Analysis of food products for standards and for detection and estimation of adulterants. Examination of typical food products including Tea, coffee, cocoa, chocolate. Dairy, Bakery, confectionery products, Alcoholic beverages, Saccharine materials, Edible oils and spices using instrumental techniques and sensory analysis.

150. Food Preservation (Food) (Term Work) (2x4 hrs/ week)

Experiments based on preservation methods such as thermal processing, freezing, dehydration, etc. thermal process time determination and evaluation of a process. Drying rate studies including constant rate and falling rate periods and the effects of various factors on them. Freezing rate and time studies. Effects of temperature of cooling medium and food material on rates. Typical examples of preparation of products using these preservation.

151. Processing Of Soaps And Detergents (Oils) (Term Work) (2X4 hrs/ week)

Preparation and analysis of toilet soap, bathing bar, laundry soap, liquid soap, shaving soap and detergents

Classification of soaps, Classification of surfactants with one example and a method of preparation, Auxiliary chemicals used in soaps and detergents (builders, fillers etc.)

152. Processing Of Surfactants (Oils) (2x4 hrs/ week)

Preparation of various classes of surfactants: Sulfonation of AB/ Napthalene using oleic acid, Sulfonation of alcohols/ ether alcohols using chlorosulfamic acid, Preparation of sulfates, sulphonates of other materials - castor oil, other vegetable oils, maleic, esters using sulfonic acid, sulfamic acid, sodium bisulfite, sodium sulfite

Preparation of nonionics: Esters of DEG, PEG, PPG, Sorbitan esters, Polyglycerol esters, Mono, di ethanol amides, Tri ethanol amide esters (as conditioners), Amine oxides

Preparation of cationics: Benzalkonium chlorides, Amido amine salts, Cationic salts, Quarternary ammonium compounds

Preparation of amphoterics: Acetates, Propionates, characterization and physicochemical properties, Purification of surfactants, Principles of purification through crystallization, physicochemical properties of surfactants,

Application of surfactants: End products of cosmetics, detergents, textile auxiliaries, leather auxiliaries using these surfactants

153. Analysis And Characterization Of Polymers (Polymers) (2 x 4hrs/week)

1. To determine the melting range and softening range of polymers like

Polyolefines, styrenics, engineering polymers

2. To determine the chlorine content of the chlorinated polymers.

3. Identification of polymers

a. Virgin PP, LDPE, HDPE, LLDPE

b. Virgin PS, HIPS, ABS, SAN

c. Virgin PVC, PVF, PVB, Polyacetals

d. Phenolic resin, MF, UF, Alkyds, Epoxy resin

e. Cellulosic polymers like NC, CAB, HEC CMC

f. Elastomers like natural rubber, nitrile rubber, silicone rubber, SBR

154. Processing Of Polymers -II (Polymer) (Term Work) (2 x 4hrs/week)

1. To determine

a. MFI of polymers like Polyolefins, Styrenics

b. BDV, Arc resistance, volume resistivity

c. HDT, Vicat softening temperature, T_g , T_c , T_m

d. Tensile strength, flexural strength, % elongation, Izid impact strength

e. Accelerated weathering resistance

2. Compounding of polymers like filled Polyolefines, PVC using Batch mixer, two roll mill, twin screw extruder

3. Injection, compression molding and extrusion blown film of polyolefines

155. Analysis And Testing Of Paints (Paints) (2 x 4hrs/week)

1. Analysis Of Linseed Oil (IV, Sap Value, Colour, Refractive Index, Viscosity)

2. Analysis Of A Synthetic Enamel (Black, Red, White) Zinc Chrome Primer, Red Oxide

Primer, Intermediate Coat, (NVM, Viscosity, WPL, Grind, Hiding, Drying Time,

Scratch Hardness, Impact Test, Flexibility, Gloss, Dry Film Thickness, Acid, Alkali,

and Water Resistance, Adhesion As Per IS101, Corrosion Resistance By Salt Spray

And Humidity Cabinet, Accelerated Exposure Of Paints In Q UV And Atlas Apparatus

3. Analysis of Emulsion Paint (NVM, % Solids, Scrub Resistance, Stain Resistance)

4. Analysis Of Cement Primer

5. Colour Matching Of Synthetic Enamel, Plastic Emulsion Paint And Distemper

6. Analysis Of An Alkyd (Oil Length, Acid Value, Hydroxyl Value, Phthalic Content

7. Analysis Of Pigments (Solvent Bleed In About 10 Different Solvents, Water Solubles,

Mass Tone, Under Tone, Strength By Reduction, Ease Of Dispersion By Muller,

Particle Size By Microscopy And Screening, Resistance To Acids And Alkalies Light

Fastness in QUV)

156. Processing Of Paints -II (Paints) (Term Work) (2 x 4hrs/week)

1. Evaluation of paints as per IS 1012
 2. Preparation of
 - a. Alkyd Resin and its evaluation (Long, medium and Short by different groups)
 - b. acrylic/vinyl acetate emulsion
 - c. Plastic emulsion paint and evaluation (To include determination of surfactant demand by Daniel Flow Point method and evaluation of final properties of the prepared paint. Scrub resistance, stain resistance, detergent and soap resistance to be evaluated)
 - d. Polyester polyol from Aliphatic and aromatic dibasic acids, aliphatic diols, triols and its characterization (A.V. and Hydroxyl value)
 - e. Suspension polymer from MMA and Butyl methacrylate
 - f. Cement paint and application on exterior surface
 - g. Alkyd paint for base coat and top coat at different PVC
 - h. high gloss coating from the polyol and evaluation of the coating properties
 - i. varnishes for wood finishing
3. Flushing of a pigment cake and comparison of the colour properties of the flush with the dry pigment

157. Pharmaceutical Chemistry Laboratory (Pharma)(Term Work) (2X4 hrs\week)

Preparation of compounds in common use in pharmaceutical industry-simple transformation using newer reagents (10 exercises) (10)

Concise writing of procedures and presentation for selected reaction from the latest literature (5 examples)

158. Technology of Solid Dosage Forms and Sterile Product Laboratory (Pharma) (2X4 hrs\week)

(1) Solid Dosage Forms

- (a) Preparation and evaluation of tablets of the following types: conventional, chewable, effervescent, soluble, dispersible, mouth dissolve (7)
- (b) Coating of tablets (demonstration) (1)
- (c) Evaluation of coated tablets (1)
- (d) Filling and evaluation of hard gelatin capsules (1)
- (e) Large scale manufacture and evaluation of tablets (demonstrations) (1)
- (f) Micro encapsulation of ligands and solids (1)

(2) Sterile Product

- (a) Preparation and evaluation of injectables solutions to represent different methods of sterilization, tonicity adjustment (4)
- (b) Preparation and evaluation of one LVP (1)
- (c) Preparation and evaluation of parental suspension and emulsion (2)
- (d) Monographic testing of water for injection (1)
- (e) Evaluation of parental containers and closures (2)
- (f) Preparation and evaluation of eye drops and eye ointments (3)
- (g) Workshop on accelerated stability testing (2)

159. Wet Processing Of Textiles

(2X4 hrs\week)

1. Desizing of cotton-acid desizing, enzyme desizing, oxidative desizing
2. Evaluation of desizing efficiency-staining with iodine, loss in weight and estimation of residual starch
3. Scouring of cotton-open boil, pressure boil, pad-steam process
4. Evaluation of scouring efficiency-wetting time, sinking time, loss in weight
5. Bleaching of Cotton by bleaching powder, hydrogen peroxide
6. Bleaching of polyester and nylon with sodium chlorite and hydrogen peroxide
7. Evaluation of bleaching efficiency -whiteness index and % reflectance
8. Mercerisation of cotton with and without tension
9. Evaluation of mercerization-Shrinkage, Barium Activity no., dye uptake, strength and elongation and microscopic observation
10. Scouring and bleaching of wool; Degumming and bleaching of silk
11. Scouring and bleaching of polyester/cotton blends
12. Preparation of Thickeners
13. Direct style of printing - Direct, Reactive, solubilised vat and azoic
14. Direct style printing on Polyester and Nylon with disperse dyes
15. Direct style printing on Nylon and Wool with acid and direct dyes
16. Direct style of printing - vat dyes on cotton, basic dyes on jute, wool and acrylic
17. Printing with Pigments and Phthalogen Blue
18. Discharge style of printing - white discharge under direct and azoic ground
19. Discharge style of printing - white discharge, and vat discharge on direct dyed ground
20. Discharge style of printing - white and pigment under reactive dyed ground
21. Resist style of printing - under reactive
22. Resist style of printing - white resist and colour resist under Phthalogen Blue
23. Special print effect - crimp, batik, burnt out and tie and dye, etc.

Suitable number of experiments from the above list will be performed

160. Testing Of Textiles (Textile) (Term Work)

(2X4 hrs\week)

1. Surface etching to produce silk like finish on polyester
2. Determination of colour fastness to various agencies like washing, light and rubbing,
3. Determination of colour fastness to perspiration and bleaching agents,
4. Determination of colour fastness to sublimation and hot pressing.
5. Determination of copper number and Methylene Blue absorption of cotton
6. BOD and COD determination of various textile auxiliaries
7. Determination of the single yarn strength and elongation at break of the yarns.
8. Determination of bursting strength of a fabrics
9. Determination of abrasion resistance of a fabrics
10. Application of cross linking agent and testing of finished fabric for crease recovery angle, tensile and tear strength
11. Application of antistatic agent and testing of finished fabric for static charge
12. Application of flame retarding agent and testing of finished fabric by measurement of char length, rate of burning and Limiting Oxygen Index

13. Application of softeners and testing of finished fabric for its feel and drapability
14. Application of water repellent/waterproof agent and evaluation of fabric for water repellency by spray/shower test and water penetration test
15. Application of Optical brightening agent and evaluation of fabric for its whiteness
16. Application of stiffening agent and evaluation of fabric for its feel and bending length
17. Qualitative and quantitative analysis of printing binders
18. Qualitative and quantitative analysis of dye fixing agent
19. Qualitative and quantitative analysis of wetting agent
20. Qualitative and quantitative analysis of leveling agent
21. Estimation of resin content of fabric

Suitable number of experiments from the above list will be performed.

161. Seminar (Term Work) (Common For All Branches)

Students will be required to prepare critical reviews of selected topics in Chemical Technology and Allied subjects and submit in the form of standard typed report. The students will also be required to make an oral presentation of the review.

SEMESTER VIII

R. 4791 The candidate shall be examined in the subjects at the Semester VIII examination as indicated in the following tables.

Theory Papers

Sr. No	Subject	No. of Paper	Examination		Periodic Test Marks	Total Marks	Branches
			Hours	Marks			
1.	Organizational Behavior and Production Management	1	3	70	30	100	All
2.	Project Economics	1	2	35	15	50	All
3.	Introduction to Multiphase Reactors	1	2	35	15	50	All
4.	Special Subject Case Studies in Dyestuff Industry	1	2	35	15	50	Dyes
	Fermentation Technology & Genetic Engineering	1	3	70	30	100	Foods
	Fermentation Technology & Genetic Engineering	1	3	70	30	100	Oils
	Design & Fabrication of Moulds	1	3	70	30	100	Polymer
	Paint Technology II	1	3	70	30	100	Paints
	Drug delivery system & Pharmaceutical Biotechnology	1	3	70	30	100	Pharma
	Advanced Textile Technology	1	2	35	15	50	Textile
5.	Special Subject Technology of Intermediates & Colorants IV	1	2	35	15	50	Dyes
	Current Topics in Food Science & Technology	1	2	35	15	50	Foods
	Technology of Fats based products.	1	2	35	15	50	Oils

	Additives for Polymers	1	2	35	15	50	Polymer
	Paint Technology III	1	2	35	15	50	Paints
	Validation & Regulatory Requirements	1	2	35	15	50	Pharma
	Technology of Garment Manufacturing & Processing	1	2	35	15	50	Textile
6	Special Subject						
	Chemistry of Intermediates & Colorants VI	1	2	35	15	50	Dyes
	Merchandising & Designing of Textiles	1	2	35	15	50	Textile
	Total	5	-	245	105	350	

Practical Examinations

Sr. No	Subject	Examination		Class Work Marks	Total Marks	Branches
		Hours	Marks			
6.	Special Subject (Term Work)					
	Instrumental Methods of Analysis (Dyes)	-	-	100	100	Dyes
	Food Processing & Analysis	-	-	100	100	Foods
	Lube Oil Testing Laboratory & Tutorials	-	-	100	100	Oils
	Design of Moulds Drawing	-	-	100	100	Polymer
	Processing of Paints - III	-	-	100	100	Paints
	Pharmaceutical Process Technology Lab	-	-	100	100	Pharma
	Dyehouse	-	-	100	100	Textile
7.	Project Work	-	-	-	150	All
	Total	-	-	100	250	

Grand Total at the Examination

600

Semester VIII

Theory

162. Organizational Behaviour And Production Management (4hrs/week)

Organisational Behaviour.

1. Individual Behaviour: Personality; Ability and emotion; Perception; Learning; Attitudes and values; Motives; Frustration. 10
2. Group Behaviour in the Organizational Environment: Formal & informal groups; Team development; Leadership styles and effectiveness; Communication in groups; Conflict; Power.
3. Organisation Structure and Human Behaviour: Organisational culture; Organisational Change and Organisational development; Organisation designs and in changing corporate environment; Ethics in business. 10

Books/Periodicals

1. Organisational Behaviour by Stephen Robbins
2. Organisational Behaviour by Fred Luthans
3. Organisational Behaviour by K. Ashwathappa
4. Business World, Business India, Economic Times, Financial Express, Harvard Business Review

Production Management

1. Production Function: Nature and scope, interface with other functional areas, types of production systems (4)
2. Plant location and plant layout: Objectives, considerations and how to do it using various qualitative and quantitative methods, material handling equipment. (4)
3. Inventory Management: Objectives, considerations, various control techniques, economic order quantity calculations in various situations, inventory pricing methods. (4)
4. Scheduling and networking: Scheduling considerations, facility loading and optimum sequencing. Activity analysis and making network, establish critical path, project duration with probability, slacks objectives and floats, cost crashing. (8)
5. Reliability Maintenance and Plant Services: Establishing system reliability, total productive maintenance, technical and utilities services. (5)
6. Total quality control: Statistical quality control, control charting, productivity techniques, value analysis and value engineering (5)

Text Book:

Production and operations Management by B. S. Goel, Pragati Prakashan

Industrial management -I by Jhamb, Everest Publications.

Quality Planning and Analysis by Juran and Gryna

Chemical Industry Digest-Qtly C. I. magazine, A Blackdale publication.

163. Chemical Project Economics

(2 hrs/week)

- | | |
|----------------------------|-----|
| Introduction | (1) |
| Project Cost Estimation | (7) |
| Estimation of product cost | (2) |
| Financing options/funding | (1) |

Interest burden/Depreciation	(3)
Project Profitability	(1)
Modern concepts of feasibility evaluation 'EVA'	(5)
Economy of scale & product pricing	(2)
Process & site selection	(4)
Preparation of project report	(1)
Project Management & Control	(2)
Annual Report	(1)

Reference Books:

1. Peters, M. S. & Timmerhaus, K. D. Plant Design and economics for chemical engineers V Edn. 2003, Boston McGraw - Hill

164. *Introductory To Multiphase Reactors* (2 hrs/week)

1. Various regimes of mass transfer with Chemical Reactions in Multiphase Systems and Methods for discerning the controlling regime. (6)
2. Design of Various Multiphase Reactors :a. Stirred Vessels including self inducing reactors (8)
 - b. Sparged Reactors including sparged and bio reactors, jet and venturi loop reactors (4)
 - c. Falling and wiped film equipment (3)
 - d. Fluidized Beds (4)
 - e. Liquid-Liquid Spray, Packed and Plate Reactors (5)

Recommended Book:

Heterogeneous Reactions Vol.II : Analysis, Examples and Reactor Design Fluid-Fluid Solid Reactions, Doraiswamy L.K., Sharma M.M. John Wiley & Sons, 1984

165. *Case Studies In Dyestuff Industry (Dyes)* (2hrs/week)

Case studies in intermediates and dyes with emphasis on sources of literature selection of miles. (30)

Text/Reference Books :

1. BIOS Reports
2. FIAT Reports
3. CIOS Reports
4. Organic Synthesis - Collective Volumes I-V

166. *Technology Of Intermediates And Colorants -IV (Dyes)* (2hrs/week)

Process optimizations, Process selections, Statistical quality control techniques for dyestuff industry (10)

Design aspects like reactor design and pressure vessels (10)

Scaling up of processes from laboratory to pilot plant and plant vessels (10)

Text/Reference Books :

1. Fundamental Processes of Dye Chemistry, Fierz, David, Blangey
2. Taguchi Methods Explained Practical Steps to Robust Design, T.P. Bagachi
3. Chemical Process synthesis in Engineering Design , Anil Kumar

167. Chemistry Of Intermediates And Colorants -VI (Dyes) (2 hrs/week)

- Heterocyclic analogues of conventional pigments with emphasis on synthesis (10)
Color constitution relations and constitutional relations with technical properties of pigments (10)
An Advanced treatment of reaction mechanisms of reactions used in colorants chemistry (10)

Text/Reference Books :

1. Advances in Color Chemistry Vol I, Peters A.T.
2. Advances in Color Chemistry Vol III, Peters A.T.,
3. Advances in color science, Leeds Univ., Vol I-IV, 1998
4. Advance Organic Chemistry, Jerry March
5. Name Reactions, Li

168. Fermentation Technology and Genetic Engineering (Food) (4hrs/week)

- Application of Biotechnology in foods, pharma and other industries with special reference to enzymes. (1)
Definition, Nomenclature and Terminologies. Isolation, Purification Strain Improvement and optimisation of growth and product formation using industrially important micro-organisms. (6)
Genetic Engineering principles and techniques (8)
Principles of surface, submerged and solid-state fermentations (4)
Design of different fermentors (4)
Biochemical Engineering aspects (8)
Process control of fermentations (2)
Industrial fermentative production of alcoholic beverages, vinegar, dairy starter cultures, single cell protein, organic acids, amino acids, vitamins, polysaccharides, antibiotics, etc. (10)
Enzyme fermentation and technology including immobilisation, stabilisation and enzyme reactors. (6)
Fermentative bioconversions with special reference to steroids (4)
Newer techniques like plant tissue cultures, micro-algal cultivation etc. Design aspects of photobioreactors. (5)
Genetically modified foods, cloning of animals and other developments (2)

Books:

- Principles of fermentation technology, Stanbury P.F. and Whitaker A.
Industrial microbiology, Prescott S. and Dunn C.
Elements of biotechnology, Gupta P.K.
Plant cell, Tissue and Organ culture, Gamborg O.L. and Phillips G.C.
Basic bioreactor design, Riet K.V. and Tramper J.
Bioreactor system design, Asenjo J.A.
Bioreactor immobilized enzymes and cells: fundamentals & applications, Moc-young M.
Industrial fermentations: Underkofler L.A. and Hickey R.J., Vol. I and II

169. Current Topics In Food Science & Technology-(Food) (2hrs/week)

- Enzymes in Food Processing (2)
Genetically Modified Foods (2)
Pesticide Residues (2)
Newer Processing Technology (2)

Newer Sources of Ingredients (2)
 Nutraceuticals (2)
 Use of Antibiotics & Hormones in Food Processing & Agricultural Practices (2)
 Newer Developments in Food Products, Processes, Machinery, Packaging etc., Techno-Commercial (16)
 Aspects of Food Industry etc.

Books:

Handbook of Food Engineering Practice: K.J. Valentas, Enrique Rostein, R. Paul Singh, Boca Roton, New York, 1997

Chemical Engineering for the Food Industry: P.J. Fryer, D.L. Pyle and C.D. Rielly, Blackie Academic and Professional, 1997

Food Processing: Recent Developments: A.G. Gaonkar, Elsevier, 1995

Fundamentals of Food Biotechnology: Byong H. Lee, VCH Publishers, Inc., New York, 1996

Food Processing Biotechnological Applications, First Edition,

S.S. Marwaha, I.K. Arora, Asiatech Publishers Inc., New Delhi, August 2000

Active Food Packaging: M.L. Rooney, Blackie Academic & Professional, 1995

Food Shelf Life Stability: N.A. Michael Eskin and D.S. Robinson

CRC Press LLC, 2001

Nonthermal Preservation of Foods: Barbosa-Canovas G.V., Pothakamury U.R., Palou E. & Swanson B.G., Marcel Dekker, NY, 1998

UHT Processing of Milk & Milk Products, H. Burton, Blackie, Academic & Professional, London 1994

Functional Foods: I. Goldberg, Chapman Hall, NY 1994

Fat and Cholesterol Reduced Foods: C. Haberstroh & C.E. Morris, Gulf Publ. Co., Houston 1991

Fruit and Vegetable Processing: Improving Quality: W. Jongen, CRC-Woodhead Publ., Cambridge, 2002

Handbook of Herbs and Spices: KV Peter, CRC - Woodhead Publ., 2001

Food Process Modelling: LMM Tijskens, MLATM Hertog, BM Nicolai, CRC - Woodhead Publ., Cambridge 2001

Handbook of Organic Food: Processing & Production, 2nd Edition, S. Wright & D. McCrea, Blackwell Science 2000

Enzymes in Food Processing: Tucker G.A. & Woods L.F.J., Blackie, Glasgow 1991

170. Technology of Fat Based Products (Oils)

(2hrs/ week)

Fatty acids, theory and practice of fat splitting, and purification of products (5 hrs) Separation of fats and fatty acids (4 hrs). Miscellaneous applications of these in food, pharmaceutical, textile, plastic, leather and other industries (7 hrs)

Glycerine: Processes for treatment of sweet water and spent soap lye, Manufacture of glycerine from natural sources. Synthetic glycerin, grades of glycerin, properties and utilization of glycerin (5 hrs)

Miscellaneous fat-based products: Manufacture and utilization of nitrogen, phosphorous and sulfate containing products (5 hrs). Products obtained by interesterification, hydrogenation, oxidation and pyrolysis. Metallic soaps (4 hrs)

Books:

- Glycerin, Key cosmetic ingredient by Eric Jugermann, Marcel Dekker Inc., (1991)
- Treatise on fats, fatty acids and oleochemicals by O. P. Narula, Industrial Consultants (India), Vo. I & II (1994)
- Recent advances in chemistry and technology of fats and oils by R. J. Hamilton, Elsevier Applied Science (1987)

- Natural fatty acids and their sources by E. H. Pryde
- Fatty Acids by Markley K. S. Vol. I to IV, Robert E. Krieger publishing Co. (1973)
- Fatty acids in industry by R. W. Johnson, Marcel Dekker Inc. (1989)
- Fats, Oleochemicals and surfactants challenges in 21st Century by V. V. S. Mani and A. D. Shitole, Oxford and IBH Publishing Co. Pvt. Ltd. (1997)
- Manufacture of soaps, other detergents and glycerin by E. Woollatt, John Wiley and Sons (1985)

171. *Fermentation Technology And Genetic Engineering (Oils)*

(4hrs/ week)

Applications of biotechnology in foods, pharma and other industries with special reference to enzymes. (1hr) Definitions, nomenclature and terminologies. Isolation, purification, strain improvement and optimization of growth and product formation using industrially important microorganisms. (6 hrs) Genetic engineering, principles and techniques. (8 hrs) Principles of surface, submerged and solid state fermentations. (4 hrs) Design of different fermentors (4 hrs) Biochemical engineering aspects. (8 hrs) Process control of fermentations. (2 hrs) Industrial fermentative production of alcoholic beverages, vinegar, dairy starter cultures and single cells protein, organic acids, amino acids, vitamins, polysaccharides, antibiotics, etc. (10 hrs) Enzyme fermentation and technology including immobilization, stabilization and enzyme reactors. (6 hrs) Fermentative bioconversions with special reference to steroids. (4 hrs) Newer techniques like plant tissue cultures, micro-algal cultivation, etc. Design aspects of photobioreactors. (5 hrs) Genetically modified foods, cloning of animals and other developments. (2 hrs)

Books:

- Principles of fermentation technology by Stanbury P. F. and Whitaker A.
- Industrial microbiology by Prescott S. and Dunn C.
- Elements of biotechnology by Gupta P. K.
- Plant cell, tissue and organ culture by Gamborg O. L. and Phillips G. C.
- Basic bioreactor design by Riet K. V. and Tramper J.
- Bioreactor system design by Asenjo J. A.
- Bioreactor immobilized enzymes and cells by fundamentals and applications by Moo-young M.
- Industrial fermentations by Underkofler L. A. and Hickey R. J. (Vol. I & II)

172. *Design And Fabrication Of Moulds (Polymers).*

(4hrs/ week)

Compression moulds : Positive, semi-positive and flash mould with horizontal and vertical flash, arrangement of loading shoes, simple two plate and three-plate moulds, split moulds.

(15)

Transfer moulds : Principles of integral pot, auxiliary ram and separated pot mould, calculation of number of cavities.

(5)

Injection moulds : Two plate and three plates types, injection, venting, runner and gates, calculation of number of cavities, hot runner mould.

(15)

Extrusion dies : extrusion of simple shapes tubing, cable covering and sheeting dies. (10)

Mould fabrication : steels for moulding tools and their treatment include processes used for mould fabrication, finishing processes. (5)

Heating systems for plates and moulds, measurement and control of temperature of moulds and dies, simple blow mould. (5)

Introduction to computer aided design and software design aspects for moulds and dies. (5)

Reference Books :

- (1) PLASTIC MOULD ENGINEERING HAND BOOK by Du Boi's and I. Pribble.
- (2) PLASTIC MOULDS AND DIES Laszlo Sors.
- (3) INJECTION MOULDS by PYE.
- (4) COMPRESSION AND TRANSFER MOULDING OF PLASTICS by J. Butler.
- (5) EXTRUSION DIES DESIGN by M. V. Joshi.
- (6) PLASTIC ENGINEERING DATA BOOK by Glanvill.

173. Additives For Polymers (Polymer)

(2 hrs/ week)

Concepts of degradation of plastics due to UV, heat , ageing etc.; Use of additives to prevent this; Chemical nature, composition and testing of various additives such as UV stabilizer, anti-oxidants, heat stabilizers (6)

Plasticizers, Lubricants, Processing aids (6)

Fillers and Reinforcements (8)

Flame retardants, antistats, nucleating agents, blowing agents (5)

Impact modifiers, cross linking agents and miscellaneous (5)

Text/Source Books

1. Encyclopedia of Polymer Science and Technology, Johan Wiley and Sons, Inc 1965.
2. Encyclopedia of Polymer Science and Engineering, Johan Wiley and Sons, Inc 1988.
3. Handbook of polymer Testing Roger Brown, Marcel Dekker Inc, 1999.
4. Plastics Additive Handbook, Gachter and Mullar, Hanser Publishers, 1987.
5. Fillers and Filled Polymers, J. F. Gerard, Wiley-VCH verlag GmbH, 2001.
6. Handbook of Fillers, G. Wypych, Chem Tech Publishing 2000.
7. Handbook of Fillers and Reinforcements for Plastics, H. S. Katz and J. V. Milewski, Van Nostrand Zeinhold Co, 1978.
8. Crosslinking and Network Formation in Polymers, f. R. Jones
9. Photochemical Conversion and Stabilization of Polymers, V .Shlyapitokh, Hanser Publication, 1984.
10. Handbook of Plastics Analysis, H. Lobo and J. V. Bonilla, Marcel Dekker, 2003.

174. *Paints Technology (II) (Paints)*

(4hrs/week)

Paint industry overview, problems and prospects	(1)
Formulation of primers, zinc rich epoxy, Micaceous iron oxide, zinc chromate and tetraoxy chromate, zinc phosphate based primers, wash primers,	(8)
Anti fouling coatings	(3)
Paints for marine environments, vinyl paints	(1)
Road marking paints	(2)
Cement paints	(2)
Automotive protection products, paints, finishing and refinishing	(4)
Electrodeposition coatings	(2)
UV curable coatings	(1)
Coatings for high temperature	(2)
Coatings for aerospace and aircrafts	(2)
Electrical insulation coatings	(3)
Electrical conducting coatings	(1)
Thermal sensitive paints	(1)
Insulating paints	(1)
Metallic paints	(1)
Powder coatings	(2)
Coil coatings	(2)
Wood Finishing	(4)
Strippable coatings, lacquers	(1)
Treatment of air for paint application	(1)
Surface treatment and paint application methods	(2)
Treatment of over sprays	(1)
Reworking of painted products	(1)
Paint application and curing methods	(1)
Formulation and application of paints and coatings	(10)

175. *Paints Technology (III) (Paints)*

(2hrs/week)

Analysis of Paints	(6)
Theory and practice in testing of paints	(6)
Paint film defects and their remedies	(8)
Rheology of paints	(2)
Analytical instruments in paint technology, UV, IR, GCMS, X-Ray Diffraction, LCMSMS, Microscopy,	
Particle size analysis of pigments, Accelerated weathering of Paints	(8)

Recommended books

- (1) Paint and Surface Coatings
- (2) Organic Coatings Science and Technology
- (3) Surface Coatings Science and Technology
- (4) Introduction to Paint Chemistry
- (5) Pigment Hand Book Part 1, 2,3

Lambourne and Strivens
Zeno Wicks et al
Swaraj Paul
Turner
Patton

- | | |
|--|---------------|
| (6) Encyclopedic Hand book of Emulsions Technology | Sjoblom |
| (7) Application properties of Pigments | A. Karnik |
| (8) Paint Film Defects | Hess |
| (9) Industrial Organic Pigments | W. Herbst |
| (10) High performance pigments | Huge M. Smith |
| (11) Printing ink Formulations principles | Ronal Todd |

176. Drug Delivery Systems And Pharmaceutical Biotechnology (Pharma) (4 hrs\week)

Drug Delivery Systems

Preformulation, Formulation, Evolution, Large scale manufacture and packing with focus on equipment with reference to Oral sustained and controlled release dosage forms and Aerosols (14)

Introduction to Novel drug Delivery Systems: Transdermal, Transmucosal, Ophthalmic, Colloidal: (10)

Liposome's, nanoparticles, emulsion systems etc (4)

Introduction to Radio pharmaceuticals, Overview of cosmetic products

Books:

1. Pharmaceutical Dosage Forms And Drug Delivery Systems, Ansel, Philadelphia, Fea and Febiger, 1985
2. Introduction to Pharmaceutical Dosage Forms Ansel, Henry Kimpton Publishers, London.
3. Pharmaceutics: The Science of Dosage Form Design Aulton, New Delhi, B.I. Naverly Pvt. Ltd., 1995
4. Modern Pharmaceutics G.S. Banker New York, Marcel Dekker 1990
5. Bentley's Textbook of Pharmaceutics Rawlins Cassell Ltd, London
6. Fundamentals of Pharmacy Blome H.E. Philadelphia, Fea and Febiger, 1985
7. Fundamentals of Pharmacy Blome H.E. Philadelphia, Fea and Febiger, 1985
8. Pharmaceutical Production Facilities: Design and Applications G.C.Cole
9. New York Ellis Horwood 1990
10. Husa's Pharmaceutical Dispensing Martin E.W. Easton Mack Pub. Co. 1971
11. Transdermal Delivery of Drugs A.Kydonieus Florida, CRC Press, 1987
12. Transdermal Controlled System Medications Y.W.Chien, New York, Marcel Dekker 1987

Pharmaceutical Biotechnology

Application of biotechnology in foods, pharma, and other industries with special reference to enzymes
Definition, nomenclature and terminologies, isolation purification strain improvements, optimisation of growth and product formation using industrially important micro organism

Genetic engineering principles and technique

Principles of surface and solid state fermentation, Design of deferent fermentors and the biochemical engineering aspects. Process control of fermentations. Fermentation technology of industrial chemicals, organic acids, amino acids, vitamins, polysaccharides, antibiotics, etc.

Enzyme fermentation and technology including immobilization and enzyme reactors. Fermentative bioconversions with special; reference to steroids. Design aspect of photobioreactors. Cloning of animals, and other developments

Books: (Same as Food Section)

177. *Validation And Regulatory Requirements (Pharma)* (2 hrs\week)

CGMP and Quality assurance	(6)
Process, product validation and quality audits. Documentation	(9)
New drug approval	(3)
DPCO, drugs and cosmetics act and rules including licensing intermediates industry	(12)

Books:

1. Beotra's Law of Drugs Medicines and Cosmetics K.K. Singh, L.R. Bugga for the Law Book Co. Pvt. Ltd., Allahabad
2. Modern Pharmaceutics, G.S. Banker, New York, Marcel Dekker 1990
3. Fundamentals of Pharmacy, Blome H.E, Philadelphia, Lea and Febiger, 1985
4. Pharmaceutical Production Facilities: Design and Applications, G.C.Cole, New York Ellis Horwood 1990
5. Drug Delivery Devices: Fundamentals and Applications, Tyle, New York, Marcel Dekker 1988
6. Microbial Quality Assurance in Pharmaceuticals Cosmetics and Toiletries, S.F. Bloomfield, Chichester, Ellis, Horwood, 1998.
7. Encyclopedia of Pharmaceutical Technology, J. Swarbrick, New York, Marcel Dekker, 1993
8. Remington's Pharmaceutical Sciences, A.R.Gennaro Mac Pub. Co. Easton, Pennsylvania 1990.
9. Indian Pharmacopoeia, British Pharmacopoeia, United States Pharmacopoeia.
10. Oral Mucosal Drug Delivery, Rathbone, New York, Marcel Dekker, 1996
11. Good Laboratory Practice Regulations A.F. Hirsch, New York, Marcel Dekker, 1989
12. Good Laboratory Practice Regulations Weinberg New York, Marcel Dekker, 1995.

178. *Advanced Textile Technology (Textile)* (2hrs/week)

Technical Textiles

Fibres for technical textiles; Nonwoven materials and their preparation	(3)
Classification of industrial applications of textiles; Requirements of fibres and chemicals for each type of application	(5)
Brief idea about polymer composites and coatings for various applications; Advances in industrial textile materials	(2)

Application of Computer Colour Matching System

CCM and its application in colour matching, global tolerance, ΔE , metamerism; Automatic colour dispensing systems; Use of computers and information technology in the Indian textile industry; Developments in computer colour matching systems	(10)
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Biotechnology and Nanotechnology for Textiles

Concept of biodegradable materials in textiles; Enzymes as bio catalysts; Sources, classification, manufacture, standardisation of enzymes; Various uses of enzymes in textile processing with their mechanism of action and results; New developments in enzyme usage for textiles	(6)
Concept of nanotechnology; Application of nanotechnology in the fields of nanofibres, nanocomposites, nanofilters and nanochemicals; Utilisation of nanotechnological fields for textile industry	(4)

Text/Reference Books :

- 1) Coated and Laminated Textiles, F. Walter, Boca Raton, CRC Press, 2002.
- 2) Handbook of Technical Textiles, Horrocks, A.R, Boca Raton : CRC Press, 2000.
- 3) Industrial Textiles, Svedova, J., Elsevier Science, Amsterdam, 1990.
- 4) High Temperature and Flame Resistant Fibres, Preston J. and Economy, J., John Wiley and Sons, New York, 1973.

179. Technology Of Garment Manufacturing And Processing (Textile)

(2 hrs/week)

- Selection of fabric for specific garments; Compatibility of different fibres used that go into making a garment; Characteristics of different garments (5)
Brief idea about pattern making, size charts, tailoring aspects such as cutting, sewing, etc. (4)
Accessories in garment making (3)
Processing of garments and machinery requirements (12)
Value addition by special effects; Novel effects on denim; Quality control in garment making (6)

Text/Reference Books :

- 1) Apparel Manufacturing Analysis, Solinger, J., Textile Publisher Inc., New York, 1961.
- 2) Garment Processing, Mittal, R.M.,
- 3) A Introduction to Quality Control for the Apparel Industry, Mehta, P.V.

180. Merchandising And Designing Of Textiles (Textile)

(2 hrs/week)

- Sourcing of textiles materials; Inventory planning and marketing of final products; Techniques and principles of merchandising; Merchandising according to domestic and international demand, requirements and supply; Application of information technology in merchandising; Costing with respect to export and domestic market (20)
Yarn and fabric textures, colorant types and finishes in relation to design; Concept of need based product development; Application of CAD to product designs; Importance of design in relation to fashion trends (10)

Text/Reference Books :

- 1) Screen Process Printing : For the Serigraphic and Textile Design, Schwalbach M.V., Van Nastrand Reinhold Company, New York, 1970.
 - 2) Watson's Textile Design & Colour : Elementary Weaves and Figured Fabrics, London : Newness Butterworths, 7th edition, 1975.
 - 3) World Review of Textile Design, Manchester : Textile Institute and International Textiles, 1993.
- Textile : A complete solution, Computer Aided textile design creativity and Processing, Kankia Akshay, Mumbai, 2002.

Practicals

181. Instrumental Methods Of Analysis (Dyes) (Term Work)

(2 x 4 hrs/week)

Instrumental analysis of dyestuffs and their intermediates

1. UV Spectroscopy
2. Visible Spectroscopy
3. Infra Red spectroscopy
4. NMR Spectroscopy
5. Spectrophotometry
6. Gas chromatography
7. HPTLC
8. HPLC

Suitable experiments from the above list will be performed.

182. Food Processing And Analysis (Food) (Term Work) (2x4 hrs/week)

Experiments on preparation of various processed food products from fruits and vegetables, cereals and legumes, milk and its products, fish, meat and poultry, eggs, soft drinks, instant mixes, extruded products, etc. and fermented foods. Evaluation of their quality by analysis.

183. Lube Oil Testing Laboratory And Tutorials (Oils) (Term Work) (2x4 hrs/week)

Flash point and fire point, Viscosity and viscosity index of lube oil samples, Distillation range of petroleum products (petrol, diesel, kerosene etc.), Copper corrosion test for lube oil, Worked and unworked penetration of grease sample, Ramsbottom carbon residue of the lube oil sample, Shear stability of grease, Drop point of grease, Wear scar test for lube oil (4 ball weld load apparatus), Extreme pressure test for a lubricant (4 ball weld load apparatus).
Study experiments on phosphate esters, multifunctional additives and greases.

184. Design Of Moulds/Drawing (Polymers) (Term Work) (2x4 hrs/week)

- (1) Compressor Mould Design.
- (2) Transfer Mould Design.
- (3) Injection Mould Design.
- (4) Extrusion Die Design.
- (5) Blow Mould Design.

185. Processing Of Paints -III (Paints) (Term Work) (2 x 4hrs/week)

1. Synthesis of Alkyds like Drying And Non Drying Alkyds, Long, Medium, Short oil length Alkyds, Modified alkyds (Styrenated, Acrylated)
2. Synthesis of Reduced phenolics like Phenol (M.P120-240° C), P-Tert Butyl Phenol Bisphenol
3. Synthesis of polymers by Emulsion, Solution polymerization like S-BA, S-MMA
4. Synthesis of Water Dispersible Polyester
5. Synthesis of Cationic Polymer For Electrodeposition And Application
6. Synthesis of Water Soluble Melamine, Urea Formaldehyde, Butylated Melamine Formaldehyde
7. Paint Application & Curing

186. Pharmaceutical Process Technology Laboratory (Pharma) (Term Work) (2x4 hours/week)

Synthesis of drugs involving two or more steps (a) with analysis of raw materials and product synthesis (b) in process control and reaction monitoring (11)
Any innovative modifications in the process of drug synthesized (2 examples) and no repetition of the same from previous years. (2)
bioconversions. (2)

187. Dyehouse (Textile) (Term Work)

(2x4 hours/week)

- 1-2. Dyeing of cotton on jigger
- 3-5. Dyeing of cotton on continuous dyeing range
6. Screen design making and printing
- 7-10 Dyeing and printing for making an exhibit -Flat bed, rotary and block printing
11. Desizing of cotton knit on soft flow machine
12. Scouring of cotton knit on soft flow machine
13. Bleaching of cotton knit on soft flow machine
14. Combined desizing, scouring and bleaching of cotton knit on soft flow machine
15. Dyeing of cotton knit on soft flow machine
16. Dyeing of Polyester on soft flow machine
17. Dyeing of Polyester/cotton blend on soft flow machine
18. Synthesis and analysis of TRO
19. Synthesis and analysis of soap
20. Synthesis and analysis of softener (PE and wax based)
21. Synthesis and analysis of resin

Suitable number of experiments from the above list will be performed.

188. Project Work (Term Work) (Common For All Branches)

Every student will be required to submit a project report in a typed standard format on a topic set by one or more faculty members. The object of the project work is to test the ability of the student to tackle an investigational problem in his field of specialization. Every student will be orally examined in the subject incorporated in his project report.