CURRICULUM
AND
SYLLABI

B.TECH. DEGREE PROGRAMME
(7 SEMESTERS - PART TIME)

LEATHER TECHNOLOGY
(Under Regulations 2002)

ANNA UNIVERSITY
Chennai - 600 025.
ANNA UNIVERSITY
REGULATIONS 2002
B.E./B.TECH DEGREE PROGRAMME
(PART-TIME - SEVEN SEMESTERS)
[APPROVED IN THE 47TH MEETING OF THE ACADEMIC COUNCIL HELD ON 15.12.2001 (ITEM NO. 47.3)]
(Applicable For Students Admitted From January 2002 Onwards)

1. CONDITIONS FOR ADMISSION:

1.1 QUALIFICATIONS
Candidates for admission to the first semester, also known as Bridge semester of the seven semester part-time B.E./B.Tech degree programme shall be required to have passed the Diploma Examination in Engineering/Technology in the relevant branch of specialization of the State Board of Technical Education, Tamil Nadu or any other equivalent examination already recognized by Anna University.

1.2 ELIGIBILITY
Candidate seeking admission shall satisfy the following conditions:

i) Eligibility conditions such as class, marks, number of attempts shall be as prescribed by the syndicate of the University from time to time.

ii) Shall have completed one year after qualifying for the Diploma, the period being counted as on first January of the year of which admission is sought.

iii) Notwithstanding the qualifying examination the candidate might have passed (vide clause 1.1) he/she shall have a minimum level of proficiency in Mathematics, Physics, Chemistry and the
relevant branch of study as may be prescribed by the University.

iv) Shall be employed within a zone of 65km radius from the study campus of the University.

v) Shall satisfy the conditions of physical fitness as prescribed by the syndicate of the university.

2. DURATION OF PROGRAMME

The duration of the programme shall be seven consecutive semesters, spread over 3.5 academic years, two semesters constituting an academic year. Each semester shall have a minimum of 75 working days excluding the end-semester examination.

3. BRANCHES OF STUDY

A candidate may be offered, at the time of admission, one of the following branches of study.

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Degree and branch</th>
<th>Qualification for admission</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>B.E. Civil Engineering</td>
<td>Diploma in Civil Engg.</td>
</tr>
<tr>
<td>3</td>
<td>B.E. Civil Engineering with diversification in Geomatics</td>
<td>Diploma in Civil Engg.</td>
</tr>
<tr>
<td>4</td>
<td>B.E. Civil Engineering with diversification in Environmental Engineering.</td>
<td>Diploma in Civil Engg.</td>
</tr>
<tr>
<td>5</td>
<td>B.E. Civil Engineering with diversification in Building Technology</td>
<td>Diploma in Civil Engg.</td>
</tr>
</tbody>
</table>

6. B.E. Mechanical Engg. Diploma in Mechanical Engineering / Metallurgy / Automobile Engineering / Mechanical and Rural Engineering / Machine Tool Engineering / Machine Design and Drafting / Refrigeration and Air-conditioning / Production Engineering / Tool and Die Design


<table>
<thead>
<tr>
<th>14. B.Tech Chemical Engineering</th>
<th>Diploma in Chemical Engg. / Chemical Technology / Chemical Technology (SW) / Petroleum Engineering / Petro Chemical Technology / Plastic Engineering(SW)/ Plastic Mould Technology / Polymer Technology / Polymer (SW) / Pulp and Paper Technology / Sugar Technology.</th>
</tr>
</thead>
<tbody>
<tr>
<td>15. B.Tech Leather Technology</td>
<td>Diploma in Leather Technology.</td>
</tr>
</tbody>
</table>


4 Course of Study
The course of study shall include theory and practicals as detailed in the respective curriculum. The medium of instruction shall be English.

5 Evaluation of Candidates Performance
5.1 The maximum marks for each theory and practical course (subject) shall be 100 comprising of 20 marks for continuous assessment and 80 marks for the examinations conducted by the University. The examinations shall ordinarily be conducted in November / December or in April / May depending on odd or even semesters. For practical examinations (including Project work), both internal and external examiners shall be appointed by the University.

5.2 Procedures for awarding marks for continuous assessment
5.2.1 Theory Subjects
Three tests each carrying 100 marks shall be conducted by the department / institution. The total marks obtained in all the tests put together out of 300, shall be reduced to 20 marks and rounded to nearest integer (This implies equal weightage to all the three tests).
5.2.2 Practical subjects
   Every practical exercise / experiment shall be evaluated based on conduct of experiment / exercise and records maintained. There shall be at least one mid-semester test. The criteria for arriving at the internal assessment marks shall be decided by the Head of the institution and shall be announced at the beginning of every semester.

5.2.3 Theory Subjects with Laboratory component:
   If there is a theory subject with laboratory component, there shall be three tests; the first two tests (each 100 marks) will be from theory portions and the third test (maximum mark 100) will be for laboratory component. The sum of marks of first two tests shall be reduced to 10 marks and the third test mark shall be reduced to 10 marks. The sum of these for 20 marks may then be arrived at and rounded to nearest integer.

5.2.4 Project Work:
   There shall be three assessments (each 100 marks) during the semester by a review committee. The student shall make presentation on the progress made before the committee. The Head of the institution shall constitute the review committee for each branch of study. The total marks obtained in the three assessments shall be reduced to 20 marks and rounded to the nearest integer.

6. DISCIPLINE

6.1 Every student is required to be disciplined and to have decorous behavior both inside and outside the campus and not to indulge in any activity, which will tend to bring down the prestige of the university.

6.2 Any act of indiscipline of a student reported to the Dean / Head of Institution will be referred to a Discipline and Welfare Committee nominated by the Syndicate from time to time, for taking appropriate action.

7. REQUIREMENT FOR COMPLETION OF A SEMESTER

7.1 A candidate who fulfills the following conditions shall be deemed to have satisfied the requirements for the completion of a semester.

i. He / she secures not less than 70% overall attendance taking into account the total number of periods attended by the candidate in all the courses put together as against the total number of periods in all the courses offered during the semester.

ii. He / she earns a progress certificate from the Head of the Department and the Dean / Head of Institution for having satisfactorily completed the programme of study in all the courses pertaining to that semester.

iii. His / her conduct is found to be satisfactory as certified by the Head of the Department and the Dean / Head of Institution.

7.2. Candidates who do not complete the semester (as per clause 7.1), will not be permitted to write the end-semester examination and are not permitted to go to next semester. They are required to repeat the incomplete semester in the next academic year.

8. REQUIREMENTS FOR APPEARING FOR END SEMESTER EXAMINATION

A candidate shall normally be permitted to appear for the end-semester examination of the current semester. If he / she has satisfied the semester completion requirements (vide clause 7) and has registered for examination in all the courses of that semester.

9. REQUIREMENT FOR PROCEEDING TO A HIGHER SEMESTER

A candidate shall be permitted to proceed from the current semester to the next semester, irrespective of the arrear courses he / she may have in the earlier semester only if.
10. PASSING REQUIREMENTS AND CLASSIFICATION OF SUCCESSFUL CANDIDATES

10.1 A candidate shall be declared to have passed the examination in a course of study if he/she secures 50% of the total marks (continuous assessment plus end semester examination marks) prescribed for that course and if he/she has also secured 50% of the marks in the end semester examination conducted by the University. The rule is applicable to theory as practical courses including Project Work.

10.2 A candidate who has been declared as "failed" in a particular course may reappear for the end semester examination in that course as and when the examination in that course is conducted and secure a pass. However, the continuous assessment marks obtained by the candidate in the first attempt shall be retained and considered valid for all subsequent attempts unless the candidate chooses the option of improving the continuous assessment marks (vide clause 13). Further, the semester examination marks obtained in the latest attempt shall alone remain valid.

10.3 A student can apply for revaluation of his/her semester examination answer paper in a course, within 2 weeks from the declaration of results, on payment of a prescribed fee through proper application to the Controller of Examinations through the Heads of Departments concerned. The Controller of Examination will arrange for the revaluation and the results will be intimated to the candidate concerned through the Heads of the Departments.

10.4 A candidate who qualifies for the award of the degree (vide clause 14) passing the examination in all the courses in all the seven semesters in his/her first appearance within seven consecutive semesters (3.5 academic years) and in addition secures an aggregate of not less than 75% of the total marks (continuous assessment plus semester examination marks) for all the courses in the semester II to VII put together shall be declared to have passed the examination in First Class with Distinction. For this purpose, the withdrawal from examination (vide clause 11) shall not be construed as an appearance. Further any authorized break of study will be excluded from the total duration while finding the period of completion (vide clause 12.3).

10.5 A candidate who qualifies for the award of the degree (vide clause 14) passing the examination in all the courses in the semester II to VII within a period of seven consecutive semesters after his/her commencement of study in the second semester and in addition secures an aggregate of not less than 60% of the total marks (continuous assessment plus semester examination marks) for all the courses in the semesters II to VII put together shall be declared to have passed the examination in First Class. For this purpose the period of completion will be arrived at by excluding any authorized break of study (vide clause 12.3).

10.6 All other candidates who qualify for the award of the degree (vide Clause 14) shall be declared to have passed the examination in Second Class.

10.7 A candidate who absents in the end semester examination in a course/project work after having registered for the same, shall be considered to have appeared in that examination for the purpose of classification.
11. PROVISION FOR WITHDRAWAL FROM SEMESTER EXAMINATION

11.1 A candidate, may for valid reasons and on prior application, be granted permission to withdraw from appearing for the examination of any one course or consecutive examinations of more than one course in a semester examination.

11.2 Such withdrawal shall be permitted only once during the entire period of study of the degree programme.

11.3 Withdrawal application is valid only if it is made within the prescribed number of days prior, to the commencement of the examination in that course or courses and recommended by the Head of Department and the Dean/Head of the Institution.

11.4 Withdrawal shall not be construed as an appearance for the eligibility of a candidate for First Class with Distinction.

11.5 The candidate shall reappear in the examination only when the examination in the withdrawn course or courses is conducted subsequently.

12. PROVISION FOR BREAK OF STUDY

12.1 Break of study shall not normally be permitted. However, if a candidate intends to temporarily discontinue the programme in the middle, for valid reasons, and to rejoin the programme in a later semester, permission may be granted based on the merits of the case provided he/she applies to the university in advance, but not later than the last date for registering for the end semester examination of the semester in question, through the Head of the Department and the Dean/Head of Institution stating the reasons therefore and the probable date of rejoining the course.

12.2 The candidate rejoining the programme after the authorized break of study shall be covered by the rules and regulations in force at the time of rejoining.

12.3 The duration specified for passing all the courses for the purpose of classification (vide clause 10.3 and 10.4) shall be increased by the period of such authorized break of study.

12.4 The total period for completion of the programme reckoned from the commencement of the first semester to which the candidate was admitted shall not in any case exceed the prescribed maximum period (vide clause 14), irrespective of the period of break of study.

12.5 If any student is either detained in a semester for want of requisite attendance progress and good conduct or suspended from the programme by Discipline and Welfare Committee, the resulting period of break of study shall not be considered as an authorized break of study for purpose of classification and clause 12.3 is not applicable in this case.

13. PROVISION FOR IMPROVING CONTINUOUS ASSESSMENT MARKS

If a candidate wishes to improve his/her continuous assessment marks in any course or courses, he/she shall apply through the Head of the Department and the Dean/Head of Institution for permission to rejoin and repeat that course or courses. Permission may be granted on the merits of the case subject to the following conditions.

i. Such candidate can rejoin the regular semester or semesters when these courses are offered and shall repeat the programme of study in these courses satisfying all requirements (vide clause 7).

ii. The maximum period for completion of the programme shall remain as prescribed in clause 14.

iii. He/she shall be eligible to rejoin and repeat all the courses in any one semester or up to a maximum of five courses, if the regular semester time-table accommodates.
iv. He/she will be eligible for repeating a course or courses while undergoing a regular semester course of study, if the same is offered by the concerned Head of the Department.

v. The continuous assessment marks and semester examination marks earned during the repeat semester(s) shall alone be valid subsequently.

vi. The candidate will not be eligible for first class with distinction if he/she repeats courses or semester(s) other than the first semester even if he/she is eligible otherwise for the same (vide clause 10.3 and 10.4).

vii. For the purpose of attendance requirement (vide clause 7 (i), the attendance will be considered course wise for each course, if the candidate does not repeat all the courses in a semester.

14. ELIGIBILITY FOR THE AWARD OF THE DEGREE
A candidate shall be declared to be eligible for the award of the Degree if he/she has:

i. Undergone the programme for a period of seven semesters.

ii. Passed the examination in all the courses prescribed in the perspective curriculum within maximum period of 8 years reckoned from the commencement of the first semester to which the candidates was admitted. This maximum period shall be 10 years in the case of women candidates.

iii. No disciplinary action pending against him/her. The award of the degree must be approved by the syndicate.

15. REVISION OF REGULATIONS AND CURRICULUM
The University may from time to time revise, amend or change the regulations, courses of study, syllabi and assessment procedure if found necessary.

<table>
<thead>
<tr>
<th>Sem.</th>
<th>Existing</th>
<th>Read as</th>
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<tbody>
<tr>
<td>1</td>
<td>B.Tech. Materials Technology</td>
<td>3 1 100</td>
</tr>
<tr>
<td>2</td>
<td>B.Tech. Leather Technology</td>
<td>3 1 100</td>
</tr>
<tr>
<td>3</td>
<td>B.Tech. Metallurgical Engineering</td>
<td>3 0 100</td>
</tr>
<tr>
<td>4</td>
<td>B.Tech. Metal Cutting and Metal Forming</td>
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</tr>
<tr>
<td>5</td>
<td>B.Tech. Electronics</td>
<td>3 0 100</td>
</tr>
<tr>
<td>6</td>
<td>B.Tech. Electronics</td>
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</tr>
<tr>
<td>7</td>
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<td>9</td>
<td>B.Tech. Electronics</td>
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</table>

The changes to be made in the curriculum are given below:

- B.Tech. Materials Technology
- B.Tech. Leather Technology
- B.Tech. Metallurgical Engineering
- B.Tech. Metal Cutting and Metal Forming
- B.Tech. Electronics
- B.Tech. Electronics
- B.Tech. Electronics
- B.Tech. Electronics
- B.Tech. Electronics
### ANNA UNIVERSITY
**DEGREE OF BACHELOR OF TECHNOLOGY**
(PART TIME 7 SEMESTER PROGRAMME)
**BRANCH : LEATHER TECHNOLOGY**

#### CURRICULUM

**SEMESTER I**

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Code No.</th>
<th>Course</th>
<th>Lecture</th>
<th>Lab</th>
<th>Marks</th>
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**SEMESTER II**

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<th>Code No.</th>
<th>Course</th>
<th>Lecture</th>
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<td>1</td>
<td>PTMA231</td>
<td>Mathematics II</td>
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<tr>
<td>2</td>
<td>PTCH233</td>
<td>Electrical Machines &amp; Drives</td>
<td>3</td>
<td>0</td>
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<tr>
<td>3</td>
<td>PTCH234</td>
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<tr>
<td>4</td>
<td>PTCH235</td>
<td>Mechanics Of Solids</td>
<td>3</td>
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<tr>
<td>5</td>
<td>PTCH236</td>
<td>Organic Chemistry</td>
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## SEMESTER III

<table>
<thead>
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<th>Sl. No.</th>
<th>Code No.</th>
<th>Course</th>
<th>Lecture</th>
<th>Lab</th>
<th>Marks</th>
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<tr>
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<td>Physical Chemistry</td>
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<tr>
<td>2</td>
<td>PTL241</td>
<td>Chemistry and Technology of Leather Manufacture</td>
<td>3</td>
<td>0</td>
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<tr>
<td>3</td>
<td>PTL242</td>
<td>Principles of Unit Operations and Processes in Leather Manufacture</td>
<td>3</td>
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<tr>
<td>4</td>
<td>PTL243</td>
<td>Principles of Material Testing</td>
<td>3</td>
<td>0</td>
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<tr>
<td>5</td>
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<td>Computer Application Packages for Leather Technology</td>
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## SEMESTER IV

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<tbody>
<tr>
<td>1</td>
<td>PTL331</td>
<td>Theory of Skin Proteins and Pretanning Operations</td>
<td>3</td>
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<td>PTL332</td>
<td>Practice of Leather Manufacture I</td>
<td>2</td>
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<tr>
<td>3</td>
<td>PTL333</td>
<td>Theory &amp; Mechanism of Organic Tannages</td>
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<tr>
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<td>PTL334</td>
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<tr>
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<td>Elective I</td>
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## SEMESTER V

<table>
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<th>Code No.</th>
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<th>Lecture</th>
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<tbody>
<tr>
<td>1</td>
<td>PTLT341</td>
<td>Practice of Leather Manufacture II</td>
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<td>2</td>
<td>PTLT342</td>
<td>Theory and Mechanism of Inorganic Tannages</td>
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<tr>
<td>3</td>
<td>PTLT348</td>
<td>Chemistry and Technology of post tanning, Finishing and Leather Auxiliaries</td>
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<tr>
<td>4</td>
<td>PTLT344</td>
<td>Leather goods and Garment Technology</td>
<td>3</td>
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<td>5</td>
<td>PTLT345</td>
<td>Entrepreneurship in Leather Sector</td>
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## SEMESTER VI

<table>
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<tr>
<th>Sl. No.</th>
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<th>Course</th>
<th>Lecture</th>
<th>Lab</th>
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<tbody>
<tr>
<td>1</td>
<td>PTLT431</td>
<td>Principles of Plant Design for Leather and Process Control Systems</td>
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<td>2</td>
<td>PTLT432</td>
<td>Tannery Waste Management</td>
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<td>3</td>
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### SEMESTER VII

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<th>Lecture</th>
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<tr>
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<td>Process Economics and Industrial Management</td>
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<tr>
<td>2</td>
<td>PTLT438</td>
<td>Footwear Materials and Components</td>
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<td>PTLT</td>
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<td>Project work</td>
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### LIST OF ELECTIVE SUBJECTS

<table>
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<tr>
<th>Sl. No.</th>
<th>Code No.</th>
<th>Course Titles</th>
<th>Lecture/ Week</th>
<th>Marks</th>
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<tr>
<td>1</td>
<td>PTLT034</td>
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<td>2</td>
<td>PTLT035</td>
<td>Animal By-products Utilisation</td>
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<tr>
<td>3</td>
<td>PTLT036</td>
<td>Advanced Physics and Chemistry of Leather I</td>
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<tr>
<td>4</td>
<td>PTLT048</td>
<td>Cleaner Production in Tanneries</td>
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<td>8</td>
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<td>9</td>
<td>PTLT041</td>
<td>Costing and Value Engineering in Leather</td>
<td>3</td>
<td>100</td>
</tr>
</tbody>
</table>

### PTMA130 MATHMATICS I

1. **MATRICES**
   - Characteristic equation – Eigen values and Eigen vectors of a real matrix - Cayley Hamilton theorem – Reduction of a real symmetric matrix to diagonal form.

2. **FUNCTIONS OF SEVERAL VARIABLES**

3. **ORDINARY DIFFERENTIAL EQUATIONS**
   - Linear equations of second order with constant coefficients – Euler’s equation – Simultaneous equations of first order with constant coefficients.

4. **ANALYTIC FUNCTIONS**
   - Cauchy – Rieamnn equations – Properties – Finding harmonic conjugates and analytic functions – Conformal mappings of \( w = z + a, \frac{1}{z}, k z, \sin z, \cos z, e \text{ and bilinear transformations.} \)
UNIT III: OPTICS AND LASERS


UNIT IV: MODERN PHYSICS

Quantum Nature of energy – Dual nature of matter – Einstein’s mass-energy relation – Nuclear fission – Controlled chain reaction – Nuclear power reactor – Nuclear fusion – Crystalline and non-crystalline solids – Unit cell and Bravais lattices – Miller indices – Packing factor of SC, BCC and FCC.

UNIT V: NON-DESTRUCTIVE TESTING

Different steps involved in non-destructive testing – Principle of X-ray radiographic technique – Comparison between X-ray radiography and gamma ray radiography – Liquid penetrant method – Ultrasonic method – Magnetic and electrical methods.

REFERENCES:


PTCM130 CHEMISTRY

1. WATER

2. ENERGY SOURCES:

3. CORROSION AND ITS CONTROL

4. POLYMERIC MATERIALS

5. POLLUTION AND ITS CONTROL

L = 45 Total = 45

TEXT

PTEC130 BASIC ELECTRONICS

1. SEMICONDUCTOR DEVICES
PN Junction diode – Zener diode – Bipolar junction – Transistor, JFET, MOSFET, Thyristors – UJT – Photo diode and LED.

2. ELECTRONIC CIRCUITS
3. INTEGRATED CIRCUITS
   IC technology – Operational Amplifier and its applications

4. DIGITAL INTEGRATED CIRCUITS
   Logic gates – Flip Flop – counters, A/D and D/A converters.

5. COMMUNICATION
   AM – FM Modulation and demodulation, Concept of Tuned Amplifier, AM – FM Receivers: Characteristics and Types.

TEXT BOOK

REFERENCES

PTGE130 COMPUTER PROGRAMMING

1. COMPUTER FUNDAMENTALS
   Hardware and Software – Typical specification of a computer system – concepts of networking, e-mail, internet – Operating systems: Windows, UNIX fundamentals.

2. GENERAL APPLICATION SOFTWARE
   Word processing, Database Management system, spreadsheet package, presentation software.

3. C-PROGRAMMING

4. LABORATORY PRACTICE

TOTAL 45

REFERENCES

PTMA231 MATHEMATICS II

1. FOURIER SERIES:
   Dirichlet’s conditions, General Fourier series, Half range sine and cosine series, Parseval’s identity, Harmonic Analysis.

2. FOURIER TRANSFORMS:
   Fourier integral representation, Fourier transform pairs, Properties, Fourier sine and cosine Transforms, Transforms of simple functions, Transforms of derivatives, The convolution integrals of Fourier, Application to one dimensional wave and diffusion equations.
3. LAPLACE TRANSFORMS: 9
Transforms of simple functions, Basic operational properties, Transforms of derivatives and integrals, Periodic functions, Convolution theorem, Inverse transforms, Initial and final value theorems, Applications of Laplace transforms to linear ordinary differential equations.

4. PARTIAL DIFFERENTIAL EQUATIONS: 9
Formation, Solution of standard types of first order equation and LaGrange’s Linear Equation, Linear partial differential equations of second, and higher order with constant coefficients.

5. BOUNDARY VALUE PROBLEMS: 9
Classification of second order partial differential equations, Transverse vibrations of a string, One – dimensional heat equation and two dimensional heat flow, Fourier series solutions in Cartesian coordinates.

TOTAL = 45

TEXT BOOKS

REFERENCES:


FTCH233 ELECTRICAL MACHINES AND DRIVES

1. ELECTRIC CIRCUITS 6
Definition – ohm’s law – series parallel circuit – parallel circuit – Division of current – Kirchoffs law; Superposition and Thevenin’s Theorem; Star-delta transormation; Simplification of networks.

2. A.C.CIRCUITS 10
Alternating Voltage; Need for A.C.Voltage; Sinusoidal A.C. Voltage; R.L. and R.LC networks; Impedance angle; Power and Power factor; Actual and apparent power; Resonance in A.C.Circuits; Series, parallel and series-parallel resonance; Vector Diagram (Phasor Diagram); Complex algebra applied to sinusoids; Three phase circuits; Three phase loading; Balanced loads; Simple problems.

3. D.C.MACHINES 10
Lenz’s law of electromagnetic induction; Fleming’s rule, Principle of operation of D.C.Machines; Kinds of D.C.machines; Emf equation of D.C. generators; Speed control of D.C. motor; Starters; Application of D.C. Machines.

4. A.C.MACHINES 15
Principle of operation of A.C.Machines : Transformer; single and three phase induction motors, Alternators; Synchronous motors; Equivalent circuit, Regulation and efficiency of single phase transformer; Slip—torque characteristics induction motors; starting of induction motors. Emf equation, Regulation and synchronisation of alternators; Synchronous condenser; Hunting in synchronous motor; Single phase induction motors and their applications.
5. DRIVES
Industrial requirements and Ward Leonard System of Drives, Servo—Motors; Basic theory and applications.

TEXT BOOKS

PTCH234 MECHANICAL ENGINEERING

1. LAWS OF THERMODYNAMICS
Basic concepts and hints; Zeroth law; First Law of Thermodynamics – Statement and application; Steady flow energy equation; Second law of Thermodynamics—Statement; Limitations Heat Engine; Heat Pump, Available energy; Kelvin—Planck statement and Clausius statement; Equivalence entropy; Reversibility; Entropy charts; Third law of Thermodynamics—Statement.

2. HEATING AND EXPANSION OF GASES
Expressions for; work done; Internal energy, Hyperbolic and polytropic processes; Free expansion and Throttling.

3. AIR STANDARD EFFICIENCY
Carnot cycle; Stirling Cycle; Joule Cycle; Otto Cycle; Diesel Cycle; Dual combustion Cycle.

4. I.C. ENGINES
Engine nomenclature and classifications; SI Engine: CI Engine; Four Stroke cycle: Two stroke cycle; Performance of I.C. Engine; Brake thermal efficiency; Indicated Thermal Efficiency; Specific fuel consumption.

5. STEAM AND ITS PROPERTIES
Properties of steam; Dryness fraction; latent heat; Total heat of wet steam; Superheated steam. Use of steam tables; volume of wet steam; Volume of superheated steam; External work of evaporation; Internal energy; Entropy of vapour, Expansion of vapour, Rankine cycle; Modified Rankine cycle.

6. STEAM ENGINES AND TURBINES
Hypothetical indicator diagram of steam engine; Working of a simple steam engine: steam turbines—Impulse and Reaction types—Principles of operation.

7. SIMPLE MECHANISM
Kinematic Link, Kinematic Pair Kinematic Chain; Slider Crank mechanism and inversions; Double slider crank mechanism and inversions.

8. FLY WHEEL
Turning moment Diagram; Fluctuation of Energy; Design of fly wheel.

9. DRIVES
Bell and rope drives; Velocity ratio; slip; Ratio of tensions; Length of belt; Maximum HP; simple compound and Epicyclic gear trains.

10 BALANCING
Balancing of rotating masses in same plane; Balancing of masses rotating in different planes.
TEXT BOOKS

PTCH235 MECHANICS OF SOLIDS

1. STRESS, STRAIN AND DEFORMATIONS OF SOLIDS
   Rigid bodies and deformable solids - forces on solids and supports - equilibrium and stability - strength and stiffness - tension, compression and shear stresses - Hooke's law and simple problems - compound bars - thermal stresses - elastic constants and Poisson's ratio - welded joints - design.

2. TRANSVERSE LOADING ON BEAMS
   Beams - support conditions - types of beams - transverse loading on beams - shear force and bending moment in beams - analysis of cantilevers, simply - supported beams and overhanging beams - relationships between loading, S.F. and B.M. in beams and their applications - S.F. & B.M. diagrams.

3. DEFLECTIONS OF BEAMS
   Double integration method - Macaulay's method - Area moment theorems for computation of slopes and deflections in beams - conjugate beam method.

4. STRESSES IN BEAMS

5. TORSION
   Torsion of circular shafts - derivation of torsion equation (\( T/J = C/R = GqL \)) - stresses and deformation in circular and hollow shafts - stresses and deformation in circular and hollow shafts - stepped shafts - shafts fixed at both ends - stresses in helical springs - deflection of springs - spring constant.

6. COLUMNS
   Axially loaded short columns - columns of unsymmetrical sections - Euler's theory of long columns - critical loads for prismatic columns, with different end conditions - effect of eccentricity.

L = 45 TOTAL = 45

TEXT BOOKS

PTCH236 ORGANIC CHEMISTRY

1. CARBOHYDRATES
   Introduction - Mono and Disaccharides - Important reactions - Polysaccharides - Starch and Cellulose - Derivatives of...
Cellulose – Carboxy Methyl cellulose and gun cotton – structural aspects of celullose

2. ORGANO METALLIC COMPOUNDS
   Grignard reagents and their synthetic utility – Organo Silicon compounds

3. OILS, FATS AND WAXES
   Analysis of oils and fats – classification of waxes

4. HETEROCYCLIC COMPOUNDS
   Furan, Thiophene, Pyrrole, Pyridine, and Indole – Their important derivatives

5. DYES AND DYEING
   Color and constitution
   - Synthesis of some important azo dyes (Methyl orange, Methyl red and Congo red)
   - Synthesis of Triphenyl methane dyes (Malachite green, Para Rosaniline Anthraquinone dyes (Alizarin)
   - Phthalein dyes - Eosin preparation
   - Introduction to Natural and Reactive dyes

6. AMINO ACIDS AND PROTEINS

7. PHARMACEUTICAL CHEMISTRY
   Synthesis of antimalarial drugs - Isopentaquine and chloroquine - Antibacterial drugs – Synthesis of sulphanilamide, sulphaspyridine

L = 45 TOTAL = 45

REFERENCES


PATCH242 PHYSICAL CHEMISTRY

1. ELECTROCHEMISTRY

2. CHEMICAL KINETICS
3. PHASE RULE
Definition – Derivation – Application of phase rule to water system – Thermal Analysis – Cooling curves – Two Component system – Eutectic and compound formation.

4. ADSORPTION AND CATALYSIS
Physical and chemical adsorption – Types of adsorption isotherms, BET method, Gibbs equation, Homogeneous catalysis – Heterogeneous catalysis, acid – base catalysis, Enzyme catalysis – Applications of catalysts in industries.

5. COLLOIDS

6. PHOTOCHEMISTRY
Laws of Photochemistry, Quantum efficiency, Photochemical reactions, Actinometry, Kinetics and mechanism of Hydrogen – Bromine reaction.

L = 45 Total = 45

REFERENCES

PTLT241 CHEMISTRY AND TECHNOLOGY OF LEATHER MANUFACTURE

1. HIDES AND SKINS AND PRESERVATION

2. PRETANNING PROCESSES
Principles involved in soaking, liming, deliming, drenching, bating, pickling, depickling and degreasing.

3. TANNING PROCESSES
Various types of tanning materials - Vegetable and Mineral tanning salts - Principles involved in vegetable and chrome tanning and their mechanism in brief and combination tannages.

4. POST TANNING PROCESSES

5. FINISHING TECHNIQUES
Types of auxiliaries and finishes used and general machinery employed in leather production.

L = 45 TOTAL 45
REFERENCES

PTLT242 PRINCIPLES OF UNIT OPERATIONS AND PROCESSES IN LEATHER MANUFACTURE

1. CONCEPTS & METERING OF FLUIDS

2. HEAT TRANSFER

3. MASS TRANSFER
   Diffusion: Binary diffusion, concept of mass transfer coefficients and interface mass transfer and stage wise contact.

Distillation: Principle of distillation, Application of distillation in leather chemicals and auxiliaries processing.

Extraction: Extraction principles, Leaching and Extraction equipment and their application in leather chemicals manufacture.

Drying: Drying characteristics, theory and mechanism of drying, estimation of drying rate, design and performance of industrial dryers for leather and chemicals.

Humidification: Humidity charts, methods of humidification and dehumidification; Equipment and their design aspects; Humidity control in leather processing.

4. MECHANICAL SEPARATIONS
   Size reduction: Theory and equipment; application in leather chemical processing


Mixing: Basic theory and application in leather and leather chemical processing.

5. PRINCIPLES OF UNIT PROCESSES
   General concepts for unit processes; Development of process flow sheets with reference to leather and leather chemical industries design, control safety pollution abatement. Principles of: halogenation, esterification, hydrolysis, oxidation, hydrogenation. Polymerization, sulphation and sulphonation, diazotization and coupling.

6. WATER AND INORGANIC CHEMICALS
   Treatment of water for domestic and industrial purposes, manufacture of sodium chloride, sodium sulphide, sodium sulphite and bisulphite, soda ash, caustic soda, lime, sulphuric and hydrochloric acids.
7. TANNING AGENTS
Vegetable tannins and Vegetable tannin extracts, Basic Chromium Sulphate, Aluminium, Zirconium, Titanium and Iron salts for leather processing.

8. OILS, FATS AND DETERGENTS
Oils and fats; their nature and products derived from oils and fats, Fatty Acids and Alcohols, waxes and Fattiquors.

9. SYNTHETIC BINDERS
Based on Acrylics, Polyamides, polyesters, polyurethanes, polypropylene.

10. DYES AND INTERMEDIATES & SURFACE COATING AGENTS
Raw materials; important unit processes; Types of dye intermediates and dyes; pigments, lacquers.

REFERENCES

PTL243 PRINCIPLES OF MATERIAL TESTING
1. MICROSCOPY & BACTERIOLOGY
Mechanical and optical parts of compound microscope, images formed, defects in eye pieces and their rectification etc. Preparation of microscopical slides, fixing, embedding, sectioning, staining and mounting. Fibre structure and assessment - Orientation of fibre structure in curing, soaking, liming, pickling, tanning etc. Optimal condition of fibre structures in various types of leathers. Assessment of finished leather, heavy leathers and light leathers. Structure of bacterial cell, nutritional requirements, culture media, sterilization, staining of bacterial cells. Effect of environmental factors on bacterial growth, enzymes of bacteria, biochemical properties of bacteria, control of bacterial growth. Testing of bacterial action on raw hides and skins and in the different stages of Leather Manufacture.

2. ANALYSIS OF VARIOUS LEATHER CHEMICALS AND AUXILIARIES / PROCESS LIQUORS
Salt, lime, sodium sulphide, ammonium salts, delining acids, bates, neutralising agents, oils and fats, sulphated oils, soap, fattiquors and other auxiliaries like resin binders, wax emulsions, etc. Principles of analytical methods employed in analysis of water. Analysis of Soak liquor, lime liquor and Pickle liquor.

3. ANALYSIS OF TANNING AGENTS
Vegetable tanning materials and extracts, chrome extracts and liquors, zirconium and aluminium tanning agents, formaldehyde.

4. MYCOLOGY & ENTOMOLOGY
Structure of moulds associated during different stages of leather manufacture. Effect of environmental factors on mould

REFERENCES


PTLT244 COMPUTER APPLICATION PACKAGES FOR LEATHER TECHNOLOGY

1. COMPUTER PROGRAMMING LANGUAGES OPERATING SYSTEMS

An overview of operating systems - DOS, Unix, OS/2, MS-Windows Review of Programming languages - Basic, C & Fortran.

2. DATA PROCESSING

- Introduction to spreadsheets, Analysis of data, Graphical representations.

3. OFFICE AUTOMATION & PRESENTATION SOFTWARES

- Word Processing, Presentation Soft wares Professional Report generation using the above.
- Audio visual presentations using Multimedia

4. DATABASE AND ITS APPLICATIONS

- Basic structures Retrieval of data for Reports, query and other formats and their export to other applications.

5. CAD SYSTEMS FOR LEATHER & LEATHER PRODUCTS

- Pattern grading & Cutting for Footwear and Garments.
- Design & Development of Leather Products.
- Computerised colour matching system - its Principle & application.

REFERENCES

3. Reference Manuals for CAD systems for Footwear and Garments
PTLT331 THEORY OF SKIN PROTEINS AND PRETANNING OPERATIONS

1. PROTEINS
   General and Physical Chemistry of proteins with special reference to hide proteins. Chemical constitution of hides and skins: Reactions of proteins with acids, bases and salts; Structure and chemical features of collagen; Reactive groups; Cross linking.

2. POLYMORPHISM & AGGREGATION PHENOMENA OF COLLAGEN
   Tropocollagen molecules; Sub-units of collagen; Types of collagen; Structure and function. Kinetics of fibril formation; precipitated forms of collagen; Electron Microscopy of the collagen fibre; Biosynthesis.

3. THERMAL TRANSITION AND DEGRADATION OF COLLAGEN
   Denaturation temperature; Mechanism of denaturation process; Thermal shrinkage; Factors influencing melting transition.
   Degradation of collagen - collagenases; Physico-chemical properties methodology, mechanism of action.

4. PRETANNING PROCESSES
   Chemistry and principles of different pretanning processes - Soaking, liming, deliming, bating, pickling, depickling and degreasing.

5. PRACTICE AND QUALITY CONTROL
   Different methods of pretanning processes as applied to light, heavy and industrial leathers. Process control in pretanning operations.

L = 45 TOTAL 45

REFERENCES:

PTLT332 PRACTICE OF LEATHER MANUFACTURE

1. GENERAL TANNING PRACTICES & SOLE LEATHERS

2. INDUSTRIAL LEATHERS
   Belting leathers, honing leathers, picking band leathers, picker as Apron leathers. Hydraulic and pneumatic leathers such as hand pump leathers, deep bore well leathers.

3. SPORTS GOOD LEATHERS
   Sports good leathers such as football, Rugby balls, Volley balls, hockey balls, Cricket balls, etc. Glove leathers for wicket keepers, belting boxing etc. Harness, Saddlery, Bridle leathers.

4. LIGHT LEATHERS
   Full chrome, retan, hunting suede, softy nappa and burnishable upper leathers from cattle hides. Printed and shrunken grain leathers. Dressing of E.I. kips into upper, lining, bags and for leathergoods, hides and their dressing.
into Kattai, Bunwar Upper and Case hides. Chrome tanned buffalo upper, upholstery and printed leathers.

5. METHOD OF FINISHING

Formulation and methods of application of different dye-stuffs, fatsiours, leather auxiliaries like casein and acrylic binders, pigments, wax emulsions, lacquers and lacquer emulsions, silicones and slip agents. Pretanning syants, neutralising syants etc. in the manufacture and finishing of the above leathers. Methods of drying of above leathers. Different types of finished leathers made from bag tanned leathers. Processing of splits for shoe suedes garments suede, grain finished leather and speciality finishes.

REFERENCES:


PTLT333 THEORY AND MECHANISM OF ORGANIC TANNAGES

1. Vegetable tannins - definition and classification. Occurrence

Chemistry of hydrolysable tannins - gallotannins, ellagic tannins - their structural aspects including ellagi tannin dimers, trimers, etc., Chemistry of condensed (flavanoid) tannins proanthocyanidins, dimers, trimers and other oligomers.

2. Tannins as well as non-tannins, polyphenollic constituents present in popular indigenous tanning materials like avaram, konnam, wattle, cutch, babul, myrobalan, etc

Physico-chemical properties of tannins, non-tannins and their effect on the physical properties of leathers. Manufacture of vegetable tannin extracts.


4. Synthetic tannins - Classification - properties used in leather industry and their general methods preparation. Mechanism of reaction with collagen.

5. Formaldehyde, glutaraldehyde, oil, sulphonyl chloride and quinone tannages.

REFERENCES

2. Rodd, “Chemistry of carbon compounds”, Vol. III-D, Chapter on “Hydrolysable tannins”.

L = 25 T = 20 TOTAL 45

L = 45 TOTAL 45
6. O'Flaherty and Roddy, T.W., Lollar, R.M. "The Chemistry and 

7. Gustavson, K.H. "Chemistry of Tanning Processes" 

8. Vegetable and Synthetic Tanning agents, Sundara Rao, 

REFERENCES

1. Briggs, P.S. 'Gloving, clothing and special leathers', Tropical 

2. Karthi, Fucha, H.P. 'The Chemistry and technology of 
Novelty Leathers' FAO, United Nations, Rome.

3. CLRI Process Bulletins.

PTLT334 ADVANCED PRACTICE OF LEATHER 
MANUFACTURE - II

1. UTILITY, FASHION AND SPECAL MANUFACTURE

Different types of raw materials used, properties of these 
leathers physical and chemical standards required process 
details to achieve the specification. Other types of leathers 
such as upholstery, washable, water resistant leathers, 
chamois glove and fashion leathers. Processing of exotic 
leathers such as reptiles, crocodies, lizards etc.

2. PROCESS OPTIMISATION

Salt free curing options, sulphide free unhairing systems, 
ammonia free deliming, salt free pickling systems, solvent free, 
eco friendly degreasing systems, eco friendly tanning systems, 
solvent free finishing systems, and integrated strategies to 
achieve permissible BOD, COD, and TDS standards of tannery 
effluents. Eco labeling practices followed in grading and 
assessment of finished leathers for various end uses.

3. ADVANCED FINISHING TECHNIQUES

Role of newer equipments like Autospay, Roller Coats, 
Continuous Embossing Machines, Finiflex, Auto toggles, 
Staking machines etc. Methods such as oil pull up, waxy, 
burnishable, crazy horse, antique grain, sueded, screen 
printing, roller printing, tie and dye finishing also pearl finishing, 
easy care, patent finishing, cationic finishing, novel finishing 
techniques etc.

4. SPLIT PROCESSING AND UPGRADATION

Split Shoe suede, garment suide, grain finished leather and 
speciality finishes. Processing technologies and finishing 
techniques specially suited for the purpose. Upgradation of 
lower ends for better utilization. Transfer foil, lamination 
techniques, etc in split finishing.

TOTAL 45

REFERENCES

1. P.S. Briggs, "Gloving, Clothing and special leathers" products 
Institute, London 1981.

Producers Association, Northampton NN3 1JD, Reprinted 1995.

ELECTIVE I

As per the choice of students

PTLT341 PRACTICE OF LEATHER MANUFACTURE - II

1. Finished Leathers and Composition of finishes Tanned 
leathers/semi finished leathers EI leathers - Wet blue - Wet
white - properties of these leathers - short description of their manufacture. 9

Function of different ingredients - Newer approaches in finishing. Problems encountered in finishing and their solutions. 9

2. Finished leathers from goat skins Glaze kid - Resin uppers - Glazed uppers - lining leathers - shoe suedes - garment suedes - Details of processing techniques. 9

3. Finished leathers from hair sheep and wool sheep skin. EI and Wet blue leathers - various types of finished leathers from them - sheep nappa, suede garments, upper-lining, diaphragm leathers, glove leathers. Assortment of leathers. 9

4. Upgradation of leathers & Special effects Retannages - Embossing - Special effects by screen and block printing - Roller coating and other modern equipments Tie and dye leathers; Burnishable leathers and oil pull up leathers. 9

5. Specialty leathers - exotic leathers and furs Morocco, pleated leathers, book binding and chamois leathers; reptiles: crocodiles, lizards, etc: Dressing of fur skins. 9

TOTAL = 45

REFERENCES


3. CLRI Process Bulletins.

*This course will be offered as Theory/Practical with the Counselling of the Department.

PTLT342 THEORY AND MECHANISM OF INORGANIC TANNAGES

1. INTRODUCTION TO COORDINATION CHEMISTRY METAL IONS IN TANNING 12

Werner's theory of coordination, origins of coordinative interactions, role of d and f orbitals, definition of ligands, nucleophilicity of ligands and electronegativity of donor atoms, chelation and masking, ligand field stabilization energy and introduction of factors controlling molecular stability of transition metal complexes. Historical introduction to mineral tanning. Role of Aluminium (III) salts, transition metals in mineral tanning, historical overview of mineral tanning using chromium, zirconium, iron, silica and poly phosphates.

2. AQUEOUS CHEMISTRY OF CHROMIUM 8

Electronic configuration and its implications, common oxidation states of chromium, redox stabilities of chromium (VI) and chromium (III) salts, redox potentials and their interconversion, protolysis, kinetic inertness of chromium (III), basicity, elation, oxolation and polymerisation, Stiasny's series, Mc Clandish precipitation point.

3. FACTORS CONTROLLING CHROME TANNING 8

Single and double bath chrome tannages and their relative merits and demerits, preparation of Basic chromium sulphate salt, reaction parameters influencing composition of BCS, kinetics of chrome tanning, diffusion and complexation, effects of foam volume, pH, basicity, masking, temperature, drum speed, ageing chrome tanned substrates.

4. MECHANISM OF CHROME TANNAGE 9

Theories of chrome tanning: absorption, coating, electrostatic and hydrogen bond interactions and
coordinative forces involved in chrome tanning, indirect evidence for chrome binding sites in proteins, hydrothermal stability of chrome-collagen compound, chromium induced structural changes in collagen.

5. OTHER INORGANIC TANNAGES

Aqueous chemistry of aluminium (III), zirconium (IV) and titanium (IV) and its relevance to mineral tanning, chemistry of silicates and phosphates and their tanning mechanisms, mechanistic classification of inorganic tannages and their relevance to combination tanning.

REFERENCES:


PTL734 LEATHER GOODS AND GARMENTS TECHNOLOGY

1. MATERIAL

Classification of Leather Goods and Garments. Selection of Materials, grading and assorting of leathers for leather goods & garments; Property requirements for leather and lining materials; Accessories for Leather goods & garments.

2. CUTTING AND CLICKING

Introduction of hand cutting; Preparation of knives & tools. Clicking machines - mechanical and pneumatic hydraulic; Pattern interlocking/nesting for material optimisation.

3. ASSEMBLY & STITCHING

Introduction to various sewing machines - Flat bed; cylinder bed & special type machines; different feed mechanisms; Basic sewing practice; Various types of Assembly techniques for Leather Goods and Garments.

4. PATTERN DESIGNING

Basic design development - measurements / Sizing chart for men, women & children; Adoption of styles to basic blocks; Pattern development for leather goods; Pattern grading for Leather Garments; CAD applications for Leather Goods and Garment design & production.

5. ORGANISATION & MANAGEMENT

Feasibility reports for leather goods and garment production; Machinery requirement/plant layout; Process scheduling and line balancing; Quality control measures in leather products manufacture; Packaging methods & practices; Costing, pricing and marketing procedures - for domestic, international markets.

REFERENCES:


PTLT348 CHEMISTRY AND TECHNOLOGY OF POST TANNING, FINISHING AND LEATHER AUXILIARIES

1. DYESTUFFS AND DYEING OF LEATHER
   Classification of dyes based on their chemical nature and also according to their application, their properties, blending of dyes, theory and practice of colour matching, theory and mechanism of dyeing, chemistry and application of dyeing auxiliaries such as leveling agents, wetting agents, dispersing agents and dye fixatives.

   Theory of colours, chromophoric groups and their optical absorption, structural features of dyes, factors affecting hue and colour, intensity, acid, basic and reactive dye classification, introduction to the chemistry and technology of dye manufacture.

2. FATLIQUORS AND FATLIQUERING
   Theory of leather lubrication, composition of fatliquors, functionalisation of oils for surface active function, chemical classification natural and synthetic oils, sulphation, sulphonation, sulphonation reactions of oils, role of double bonds and iodine value in functionalisation of oils, sulphochlorination, sulphaemidation, transesterification, maleinisation, phosphorylation reactions for fatliquor preparation. Stability of emulsions, grain and particle sizes of emulsions, factors controlling grain sizes of emulsions. Introduction to fatliquor manufacturing technology.

3. RETANNING AGENTS
   Chemical classification of syntans, sulphonation of naphthalene phenols, Napthol, phenol- formaldehyde condensation reactions and Naivalac, characterisation and photo oxidation mechanisms of phenolic tannins, chemistry of light fast syntans, chemistry of amino resins and PU, Unit operations in syntan manufacture.

4. PIGMENTS, BINDERS, TOP COATING AGENTS AND OTHER AUXILIARIES
   Definition of pigments, groups of polymer bases for color classification, formulations of pigments, particle size, refractive index, density, opacity criteria for the choice of pigment bases, different techniques in particle size reduction and importance of particle size on functional properties of pigment formulation.

   Functional definition of binders, chemical classification of binders, acrylic, protein polyurethane, introduction to manufacturing of binder formulations.

   Different types of top coat formulations, choice of polymers for surface protection, role of plasticizers, internal and external plasticizers.

   Principles of feel modification of polymer surfaces, types of feel modifiers and matting agents.

TOTAL = 45

REFERENCES

PTLT345 ENTREPRENEURSHIP IN LEATHER SECTOR

1. INDUSTRIAL ENTERPRISE


2. VENTURE PLANNING AND DEVELOPMENT


3. TECHNO – ECONOMIC FEASIBILITY REPORTS (TEFR)


4. RESOURCE MANAGEMENT


5. PRODUCTION PLANNING

   Operations research – time-motion studies – Principles of time management – Management information system – Intranet and Internet communication and its relevance in managing enterprises – Factors concerning system productivity in leather sector.

6. MANAGING MARKETS


TOTAL 45

PTLT431 PRINCIPLES OF PLANT DESIGN FOR LEATHER AND PROCESS CONTROL SYSTEMS

1. INTRODUCTION

   Brief description of tannery operations where measurement and control is needed. Discussion of parameters to be measured and controlled, viz. flow, temperature, pressure, pH etc. Discussion on necessity for controls. Advantages and disadvantages of process control application in tannery.
2. PRINCIPLES, ILLUSTRATIONS AND METHODOLOGY OF THE FOLLOWING WITH REFERENCE TO THEIR APPLICATION IN THE LEATHER PROCESSING

- Process Design
- Process flowsheeting
- Material and energy flows and networks
- Process engineering flow schemes
- Codes, Standards and Fabrication processes
- Utilities/Offsite facilities
- Inplant safety
- Selection of Materials of construction

3. BASIC DESIGN OF PROCESS EQUIPMENTS & LAYOUT PRINCIPLES:

- Basic Design of process Equipments:
- Stirred reactors (gas liquid and liquid - solid systems)
- Tanning drums and supporting units
- Forced circulation leather dryer
- Distillation units
- Principles of layout for Tanneries and Chemical Process Units
- Factors to be considered for layout selection
- Types of layouts and their design basis

4. INDUSTRIAL INSTRUMENTATION


5. PROCESS CONTROL


6. ROLE OF COMPUTERS IN PROCESS CONTROL

Case studies in wet operation, Utility - Requirements.

TOTAL = 45

REFERENCES

1. Eckman, D.P. Industrial Instrumentation.
2. Millard H. Lajoie, Industrial Automatic Control
8. 'Tannery design' - CLRI Publication.
PTLT432  TANNERY WASTE MANAGEMENT

1. PERSPECTIVES  9
Leather industries and environmental implications. Legislation on environmental protection, standards for discharge of liquid effluents, air emissions into environment.

2. TANNERY EFFLUENTS  9
Sources of generation of liquid and solid wastes in tanneries. Characterisation of liquid wastes and assessment of critical parameters of pollution (solids, BOD, COD, nutrients, metals and phenolics).

3. PRINCIPLES OF TREATMENT OF TANNERY WASTE-WATER AND DESIGN OF EFFLUENT TREATMENT PLANTS  9
Units of operation in controlling solids at primary stages of treatment, units of operation in controlling dissolved organics at secondary stages of treatment, units of operation in controlling pollutants at tertiary stage.

4. SOLID WASTE MANAGEMENT  9
Composition of solid wastes - physical, chemical and biological characteristics. Principles of treatment and disposal of solid wastes.

5. IN-PLANT MANAGEMENT FOR REDUCTION OF POLLUTION  9
House-keeping, segregation of waste streams, Recovery and reuse of valuable waste materials found in liquid effluents including chromium, sulphides etc.

TOTAL 45

REFERENCES
1. Thomas, C. Thortensen, Fundamentals of Pollution Control for the leather industry.

PTLT433  ORGANISATION AND MANAGEMENT OF LEATHER MANUFACTURE

1. Scope and significance of leather industry - Livestock Population - India Vs. world trends in their growth,
Availability of Hides and Skins - Recovery process - wastage of fallen hides/skins, marketing of hides/skins. 5

2. Location, lay-out and selection of machinery for tanneries for manufacturing different types of leathers. Estimates of investment, costing and feasibility reports. Levels of Industry - Cottage, small, medium and large scale. Demand, capacity and production estimates - Employment of these levels of industry. Employment generation - training and training institutes at state and central Govt, organisation and private organisations - Labour Laws for tanneries. Technology and Modernisation. 12


4. Features of overseas sales contract - Important clauses - Formalities at the port of shipment and customs clearance - Air cargo - documentation - types of Invoices, Letter of Credit, Bill of loading, Incoterms, etc. 8

5. Financing of Imports and Exports of leather industry - safeguard against risks. Significance of marine Insurance - ECGC - EXIM Bank. Role of financial Institutions - State and Central Bodies. Role of Research, service and development institutions - State and Central Govt. organisations, Leather Expos and Marts. 8

L = 45 TOTAL 45

REFERENCES:


ELECTIVE II

As per choice of the students

PTECH431 PROCESS ECONOMICS AND INDUSTRIAL MANAGEMENT

PART A

1. PRINCIPLES OF MANAGEMENT AND ORGANISATION 7
Planning, organisation, staffing, coordination, directing, controlling, communicating, organisation as a process and a structure; types of organisations.

2. PRODUCTION AND MANAGEMENT 10
Method study; work measurement techniques; basic procedure; motion study; motion economy; principles of time study; elements of production control; forecasting; planning, routing; scheduling; despatching; costs and costs control, inventory and inventory control.
3. QUALITY AND QUALITY CONTROL
Elements of quality control, role of control charts in production and quality control.

PART B
1. ENGINEERING ECONOMICS FOR PROCESS ENGINEERS

2. INTEREST, INVESTMENT COSTS AND COST ESTIMATION
Time value of money; capital costs and depreciation, estimation of capital cost, manufacturing costs and working capital; invested capital and profitability.

3. PROFITABILITY, INVESTMENT ALTERNATIVE AND REPLACEMENT
Estimation of project profitability, sensitivity analysis; investment alternatives; replacement policy; forecasting sales; inflation and its impact.

4. ANNUAL REPORTS AND ANALYSIS OF PERFORMANCE
Principles of accounting; balance sheet; income statement; financial ratios; analysis of performance and growth.

5. ECONOMIC BALANCE
Different unit operations with single and multiple variables.

REFERENCES


PTLT438 FOOTWEAR MATERIALS AND COMPONENTS

1. UPPERS & LINING:
   i. Leathers: Different types of upper and lining leathers, manufacturing techniques, defects, grain characteristics, stretch direction, cuttablety, area measurement, evaluation-strength, wear and comfort properties.

2. SOLING MATERIALS
Different types of soling material – leather, rubber, PU, PVC, EVA, TPR, resin rubber, their method of manufacturing, assessment and application.

3. ADHESIVES
Different types of adhesives used in footwear industry – latex, polychloroprene, polyurethane – single and double component, hot melt adhesives, method of manufacturing, evaluation techniques and applications.

4. INSOLES
Kind of insole boards, leathers, cellulose, synthetic fibre, non wovens, seat boards, manufacture, performance, evaluation.

5. GRINDERS
Manufacture, performance and evaluation of toepuff, steel shanks, heels and tapes and bindings.
6. FASTENERS
Materials, Manufacture, use and properties of elastics, touch and close fasteners, slide fasteners, buckles and trims, and shoe laces.

7. DRESSING MATERIALS
Shoe polishes, waxes, cream: Different types of dressing materials, crayons etc., formulation techniques and application, evaluation.

TOTAL 45

REFERENCES

ELECTIVE IV & V
As per the choice of the students

PTLT444 PROJECT WORK
Each student is required to submit a Report on the project assigned to him by the Department. The report should be based on the information available in the literature or data determined in the laboratory/industry. The object of the project is to make use of the degree programme. This helps to judge the level of proficiency, originality and capacity for application of the knowledge attained by the student at the end of the programme.

LIST OF ELECTIVE SUBJECTS

PTLT034 SCIENCE OF LEATHER SUPPLEMENTS AND SYNTHETICS

1. Chemistry of the most common polymeric materials used in leather industry as supplements. 5

2. POLYMERISATION FUNDAMENTALS 15
Concept of a macromolecule, natural and synthetic polymer, modes of polymerisation, radical, condensation, stereo regular polymerisation, polymerisation kinetics, mechanism, anionic and cationic polymerisation.
Polymers with linear, branched and cross-linked structures, thermoplastic and thermo set polymers, bulk, solution, suspension and emulsion polymerisation.

3. ANALYSIS AND TESTING OF POLYMERS 15
Molecular weight and distributions of polymers, different methods of molecular weight determinations, colligative properties, viscometry, light scattering techniques, thermal analysis of polymer, crystallinity and glass transitions and other mechanical properties, spectral analysis such as IR, UV, and NMR of polymers.

4. POLYMERS FOR LEATHER APPLICATION 10
Polymers for leather processing, syntans, filling agents, base coats, top coats and adhesives.

L = 45 Total 45

REFERENCES:


PTLT035 ANIMAL BYPRODUCTS UTILISATION

1. Types of animal byproducts - from abattoirs, meat processing plants, poultry, fishing and other sources including fallen animals. Present methods of collection, processing and utilisation in developing countries vis-a-vis developed countries: conservation techniques and concept of two tier technology. Protein meals from animals by-products including fallen animals and their significance in livestock feeds.

2. DIFFERENT METHODS OF RENDERING

Bone products and their utilisation. Keratinous proteins - various sources keratinous based products and their uses.

3. ANIMAL BLOOD, ITS PRODUCTS AND THEIR UTILISATION


4. COLLECTION AND CONSERVATION OF ORGANS AND GLANDS FROM SLAUGHTERED ANIMALS: POSSIBLE SCOPE OF THEIR UTILISATION

Anaerobic digestion, its significance for the preparation of animal feed, fuel gas, fertilizer, etc. Quality control including microbiological aspects of products processed from animal by-products.

5. PRESENT INDUSTRIAL STATUS OF VARIOUS BY-PRODUCTS IN THE COUNTRY

Process studies on
a. Glue making from tannery wastes
b. Bone glue and deproteinisation of bone
c. Horn and hoof meal
d. Protein meals by different methods

TOTAL 45

REFERENCE:


PTLT036 ADVANCED PHYSICS AND CHEMISTRY OF LEATHER - I

1. Histology and fibre packing in skins. Techniques for study of macro-ultra and microstructural details of skins. Primary, secondary, tertiary and quaternary structure of collagen. 10

2. Molecular architecture of collagen. Inter and intra-change forces in the stabilisation and aggregation of collagen molecules. Three-dimensional network of collagen fibres in skins and leather matrix. 10

3. Hydration, fibre swelling and phase transitions in collagen fibres and their role in the dimensional stability of skin and leather matrix. 6

4. Molecular mechanisms in protein, relaxation and folding with special reference to collagen. Helix coiled transition and effects of thermo mechanical stress on connective tissue fibres. 9

5. Shrinkage and cross-linking phenomena in collagen. Influence of electromagnetic and high energy radiation on collagen molecule. Gamma ray analysis and dosage dependence of physical chemical events on collagen. 10

REFERENCES:


PTLT038 LEATHER FINISHING TECHNOLOGY

1. PIGMENTS

Inorganic and organic pigments. Nacreous (Pearlescent) and interference pigments - their representation code in the colour index. Different forms of pigments' powders and pastes. Evaluation and control of their brilliance, opacity, particle size, resistance to solvent, heat and light and colour matching.

2. POLYMERIC MATERIALS AND THEIR DISPERSION FORMS

General introduction to addition, condensation, natural polymers, Casein, cellulose nitrate, cellulose acetate, acrylcs, vinlyls and urethanes - lacquers - solvents and thinners - emulsion and emulsifiers, Lacquer emulsion - evaluation and control.

3. PRINCIPLES OF FINISHING, FINISH FORMULATION AND THEIR APPLICATION

Definition, aims, film formation mechanisms, properties of films such as transparency, gloss and resistance to heat, light and solvent. Pigment volume concentration, plasticizer, Wetting agents, role in dispersion and stability - Requirements in multiple coat technique - single coat composition methods like spraying, curtain coating, roller coating etc. Cationic finishes and their relative merits. Eco-friendly finishing - volatile organic compounds (VOC) reductions.

4. NOVEL FINISHING TECHNIQUES

Role of newer equipments like aerospray, roller coats, continuous embossing machines, dom busch, finiflex, etc. Methods such as oil pull-up, waxy burnishable, antique,
grain suede, screen printing, roller printing, tie and dye finishing. Also Pearl finishing, easy-care and patent finishing.

5. SPLIT PROCESSING AND UPGRADEATION
For shoe suede, garment suede, grain finished leather and specialty finishes. Processing technologies and finishing techniques specially suited for the purpose.

TOTAL 45

REFERENCES:

PTLT039 TECHNOLOGY OF LEATHER SUPPLEMENTS & SYNTHETICS
1. Technology of the most common polymeric materials used in leather industry as supplements. Polymer and Rubber industries in India
2. Manufacture of industrially important polymers for plastics, fibres and elastomer - Polyethylene, polypropylene, polyvinyl chloride, polyvinyl alcohol, polyacrylicnic, polystyrene, polyurethane, fluoro-carbon polymers, epoxy resins, polyamides, polyesters, alkyl resins, silicone polymers, celluloses.
3. Fabrication of polymeric materials, compounding and mixing, casting, extrusion, fibre spinning, molding, coating, foam fabrication.

PTLT041 COSTING AND VALUE ENGINEERING IN LEATHER
1. INTRODUCTION TO VALUE ENGINEERING
   a. Value and value analysis
   b. Identification of its function
2. OBJECTIVES OF VALUE ANALYSIS
   a. Importance in import substitution
3. VALUE ANALYSIS AT DIFFERENT STAGES
   a. Techniques of value analysis
4. VALUE ANALYSIS PROCEDURE
   a. the information phase
b. The analytical phase

c. Recommendation

d. Implementation

5. ORGANISATION FOR VALUE ANALYSIS

a. Organisation structure

b. Responsibilities of individual departments

PROJECT WORK

Application of value analysis - A case study

L = 45 TOTAL 45

REFERENCES:


PTLT043 ADVANCED PHYSICS AND CHEMISTRY OF LEATHER II

(Prerequisite: Elective 036)

1. Macro and microporosity of skin and influence of hydration and water structure on the pore size pattern in skin. Functional sites in protein for interactions with vegetable and pectaming materials, Electrophilic and nucleophilic reactions at protein sites.


3. Molecular level processes and changes in soaking, liming/dehairing, deliming/bating, pickling, tanning, dyeing and Fatliquoring.

4. Dimensional changes and Ultra and micro structural variations of skins during soaking, liming, deliming/bating, pickling, tanning, retanning, Fatliquoring and drying as well as finishing with resin and casein finishes.

5. Surface science application to leather. Surface charge and energy of full chrome and chrome retanned leather. Emulsions in leather processing and the surface charge and potential of leather finish films, adhesion, mechanisms, influence of opacity, refractive index and scattering coefficient of pigments and pigment formulations and factors controlling the stability of leather finish films.

TOTAL 45

REFERENCES:


1. PROTEINS AND NUCLEIC ACID & ENZYMOLGY

2. GENETIC ENGINEERING (RECOMBINANT DNA TECHNOLOGY)

3. BIOTECHNOLOGY FOR HIDES/SKINS IMPROVEMENT
   Cleaner Leather Processing: Use of enzyme options in beam house operations - Soaking, unhairing, bating, degreasing, oiling treatment. Types of enzymes - proteases, lipases - properties, assay systems and production.

   Types of fermentation, Preparation of media, preparation of inoculum, separation and purification of products.

4. WASTE MANAGEMENT AND UTILISATION OF COLLAGENOUS TISSUES FOR BIOMEDICAL AND OTHER APPLICATIONS

REFERENCES:

PTLT046 SAFETY IN LEATHER INDUSTRY

SAFETY PHILOSOPHY
Legal framework of safety & health in India
International conventions and trends
Responsibilities and enforcement mechanism
Need for safety & health (cost/benefit rational; safety, environment and productivity triangle)

HAZARD IDENTIFICATION AND ASSESSMENT
Role of industrial hygiene
Hazard classification (hazard categories and groups)
Hazard identification and assessment (tools and methods)

SAFETY IN USE OF HAZARDOUS SUBSTANCES AT WORK 8
Chemical and biological hazards in the work place in the leather industry
Health effects of chemical and biological exposure
Hazard information systems on hazardous substances (material safety data sheets, labeling)
Workplace exposure monitoring and evaluation
Hazard prevention and control measures (storage, handling and disposal) in the leather industry.

PRODUCTIVE MACHINE SAFETY IN THE LEATHER INDUSTRY 8
Safety hazards of machinery, machine tools and electrical installations
Hazard prevention and safeguarding of machinery (guards, machine controls, ergonomics)
Role of preventive maintenance

WORK ECOLOGY AND ERGONOMICS 9
Safe workstation design and layout
Manual handling of material
Lighting (standards, use of natural and artificial illumination)
Climate control (standards, temperature/humidity, improving general ventilation)
Noise management (standards, prevention and protection)

Safety of factory premises and installations (railings, flooring, safe structures)
Welfare measures
Personal protection and hygiene selection, se. maintenance

EMERGENCY PREVENTION AND PREPAREDNESS 7
Planning for emergencies
Control of fire and explosion
Dealing with medical emergencies

SAFETY & HEALTH MANAGEMENT AND PROMOTION 3
Promoting safety & health practices at the workplace (training, safety and warning signs)
Role and responsibilities of managers, supervisors and workers

REFERENCES:
PTLT047 TOTAL QUALITY MANAGEMENT IN PROCESS INDUSTRIES

1. EVOLUTION OF QUALITY CONCEPTS AND THEIR OVERVIEW
   - Development of various quality control and quality assurance concepts.
   - Concept of product quality
   - Concept of quality control system
   - Introduction to ISO 9000 and TQM and TQM

2. ISO 9000
   - ISO 9000 genesis, advantages, documentation, procedures etc.,
   - ISO 9000 Vs. classical quality control concept
   - system evaluation
   - system development
   - system implementation and maintenance
   - ISO 9000 and ISO 14000 standards

3. TQM
   - total quality management concept
   - internalisation of quality
   - customer driven quality activity
   - system development for TQM
   - ideal TQM system

4. QUALITY ASSURANCE TOOLS
   - Statistical methods
   - quality costing

5. ISO 9000 AND TQM PROCESS INDUSTRIES
   - CASE STUDY
     - Impediments in implementing ISO, TQM & solutions
     - Model quality assurance system for leather
     - ISO 14000

REFERENCE:

1. CURRENT LEVEL OF POLLUTION LOAD IN LEATHER PROCESSING - POLLUTION CONTROL NORMS FOR VARIOUS PARAMETERS - ECO-LABELLING CONCEPTS IN LEATHER SECTOR.

Less salt and salt-less curing techniques - controlled drying techniques - cooling and freezing - chemical alternatives of curing - use of biocides.

2. CLEANER PRETANNING OPERATIONS


3. CLEANER TANNING METHODS:

High exhaustion chrome tanning - Recycle and reuse methods - chrome recovery and reuse - closed pickle - tan recycling procedures. Less chrome and chrome-free tanning - organic tannages - full vegetable tanning processes - alternative mineral tanning systems.

4. Cleaner wet finishing technologies - use of high performance auxiliaries - Screening of chemicals/auxiliaries based on biodegradability and exhaustion characteristics - process control for optimisation of use of chemicals/auxiliaries for pollution reduction - Formaldehyde - free retanning and AOX-free fatliquoring - Natural dyes Dyeing with Objectionable - arylamine - free dyes.

5. CLEANER FINISHING TECHNOLOGIES

Water based Finishing technologies - Reduction of VOC - formaldehyde - free protein finishes - Safer pigments free from TOXIC metal ions. Newer finish applications for pollution reduction.

REFERENCES

1. Process Bulletins of CLRI.
2. Leather Journals from 1990 onwards
3. Proceedings of the Workshop on "Cleaner Production Technology" conducted by UNIDO held in Chennai, 1998

PTLT049 TECHNOLOGY OF LIGHT LEATHER MANUFACTURE (PRACTICALS)

Assortment of skins training in the various unit operations such as curing, beam house, tanning, finishing etc. Practical training in various machines employed in the tannery. Manufacture of wet blue, E.I. skins and their assortment.

Different types of leathers using raw, wet blue, E.I. goat and sheep skins.

Nappa leathers
Grain garment leathers
Softy Uppers
Resin upper leathers
Aniline and Semi-aniline upper leathers
Glazed kid leathers
Crushed kid leathers
Gold and Silver kid Nubuck leathers
Dress glove and utility glove leathers
Suede garments
Sede Uppers
Tie and dye leathers
Mesh leathers
Diaphragm leathers
Roller leathers
Lining leathers
Book binding leathers
Chamois leathers
Skins with hair on sheer links
Dressing of rabbit skins
Reptile leathers

Different types of leathers using raw and wet blue Cow and Buffalo hides
Nappa leathers
Grain garment leathers
Softy Uppers
Resin upper leathers
Aniline and Semi-aniline upper leathers
Glazed Uppers
Belting leathers
Cyclo saddle leathers
Pickling band leathers
Pickers
Apron leathers
Football leathers
Cricket ball leathers
Hockey ball leathers
Volley ball leathers
Upholstery leathers
Shoe Upper leathers
Aniline & semi-aniline calf/side leathers
Box and Willow leathers
Zug grain upper leathers
Patent leathers
Shrunken grain leathers
Mesh leathers
Kattai & Bunwar leathers

PTLT050 TECHNOLOGY OF HEAVY LEATHER
MANUFACTURE (PRACTICALS)

Assortment of hides training in the various unit operations such as curing, beam house, tanning, finishing et., Manufacture of wet blue and their assortment.

Manufacture of vegetable tanned sole leathers
i. by pit
ii. by rapid tanning methods
Manufacture of chrome and waxed chrome sole leathers. Manufacture of water proof sole leathers, processing harness and saddlery leathers, lining leathers.
3. FACTORS INFLUENCING PLANT LOCATION-LOCATION
Analysis - Location decisions - Single facility and Multi - facility need for layout study - classification of lay-out.

4. MATERIAL HANDLING IN TANNERIES
Objectives and benefits of better handling - relationship between layout and materials - principles of material handling - Basic handling equipment types, handling system design - equipment selection - packaging - storage systems

5. SERVICES AND ENVIRONMENT
Illumination, Noise Technology, Ventilation & climate, waste management. Methods and equipments for tannery waste treatment - water pollution from tanneries.

REFERENCES
8. James Apple Material handling system design Ronald Press.


REGULATIONS AND SYLLABUS

(REGULATIONS 2002)

(B.TECH., Degree Programme Part - time 7 Semesters)

TEXTILE TECHNOLOGY

ANNA UNIVERSITY
CHENNAI · 600 025
CURRICULUM
AND
SYLLABI

B.TECH. DEGREE PROGRAMME
(7 SEMESTERS - PART TIME)

TEXTILE TECHNOLOGY
(Under Regulations 2002)

ANNA UNIVERSITY
Chennai - 600 025.
1. CONDITIONS FOR ADMISSION:

1.1 QUALIFICATIONS
Candidates for admission to the first semester, also known as Bridge semester of the seven semester part-time B.E. / B.Tech degree programme shall be required to have passed the Diploma Examination in Engineering / Technology in the relevant branch of specialization of the State Board of Technical Education, Tamil Nadu or any other equivalent examination already recognized by Anna University.

1.2 ELIGIBILITY
Candidate seeking admission shall satisfy the following conditions:

i) Eligibility conditions such as class, marks, number of attempts shall be as prescribed by the syndicate of the University from time to time.

ii) Shall have completed one year after qualifying for the Diploma, the period being counted as on first January of the year of which admission is sought.

iii) Notwithstanding the qualifying examination the candidate might have passed (vide clause 1.1) he / she shall have a minimum level of proficiency in Mathematics, Physics, Chemistry and the
relevant branch of study as may be prescribed by the University.
iv) Shall be employed within a zone of 65km radius from the study campus of the University.
v) Shall satisfy the conditions of physical fitness as prescribed by the syndicate of the university.

2. DURATION OF PROGRAMME
The duration of the programme shall be seven consecutive semesters, spread over 3.5 academic years, two semesters constituting an academic year. Each semester shall have a minimum of 75 working days excluding the end-semester examination.

3. BRANCHES OF STUDY
A candidate may be offered, at the time of admission, one of the following branches of study.

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Degree and branch</th>
<th>Qualification for admission</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>B.E. Civil Engineering</td>
<td>Diploma in Civil Engg.</td>
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<tr>
<td>3.</td>
<td>B.E. Civil Engineering with diversification in Geoinformatics</td>
<td>Diploma in Civil Engg.</td>
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<tr>
<td>4.</td>
<td>B.E. Civil Engineering with diversification in Environmental Engineering</td>
<td>Diploma in Civil Engg.</td>
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<tr>
<td>5.</td>
<td>B.E. Civil Engineering with diversification in Building Technology</td>
<td>Diploma in Civil Engg.</td>
</tr>
<tr>
<td>6.</td>
<td>B.E. Mechanical Engg.</td>
<td>Diploma in Mechanical Engineering / Metallurgy / Automotive Engineering / Mechanical and Rural Engineering / Machine Tool Maintenance and Repairs / Machine Design and Drafting / Refrigeration and Air-conditioning / Production Engineering / Tool and Die Design</td>
</tr>
<tr>
<td>7.</td>
<td>B.E. Manufacturing Engg.</td>
<td>Diploma in Manufacturing Engineering / Metallurgy / Automotive Engineering / Mechanical and Rural Engineering / Machine Tool Maintenance and Repairs / Machine Design and Drafting / Refrigeration and Air-conditioning / Production Engineering / Tool and Die Design</td>
</tr>
<tr>
<td>8.</td>
<td>B.E. Industrial Engg.</td>
<td>Diploma in Manufacturing Engineering / Metallurgy / Automotive Engineering / Mechanical and Rural Engineering / Machine Tool Maintenance and Repairs / Machine Design and Drafting / Refrigeration and Air-conditioning / Production Engineering / Tool and Die Design</td>
</tr>
<tr>
<td>10.</td>
<td>B.Tech, Production Engg.</td>
<td>Diploma in Manufacturing Engineering / Metallurgy / Automotive Engineering / Mechanical and Rural Engineering / Machine Tool Maintenance and Repairs / Machine Design and Drafting / Refrigeration and Air-conditioning / Production Engineering / Tool and Die Design</td>
</tr>
<tr>
<td>11.</td>
<td>B.E. Printing Technology</td>
<td>Diploma in Printing Technology</td>
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<td>Course Code</td>
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<tr>
<td>14.</td>
<td>B.Tech Chemical Engineering Diploma in Chemical Engg. / Chemical Technology / Chemical Technology (SW) / Petroleum Engineering / Petro Chemical Technology / Plastic Engineering (SW) / Plastic Mould Technology / Polymer Technology / Polymer (SW) / Pulp and Paper Technology / Sugar Technology.</td>
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<tr>
<td>15.</td>
<td>B.Tech Leather Technology Diploma in Leather Technology</td>
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<tr>
<td>18.</td>
<td>B.Tech. Information Technology</td>
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</table>

4. COURSE OF STUDY
The course of study shall include theory and practicals as detailed in the respective curriculum.

The medium of instruction shall be English.

5. EVALUATION OF CANDIDATES PERFORMANCE
5.1 The maximum marks for each theory and practical course (subject) shall be 100 comprising of 20 marks for continuous assessment and 80 marks for the examinations conducted by the University. The examinations shall ordinarily be conducted in November / December or in April / May depending on odd or even semesters. For Practical examinations (including Project work), both internal and external examiners shall be appointed by the University.

5.2 Procedures for awarding marks for continuous assessment
5.2.1 Theory Subjects
Three tests each carrying 100 marks shall be conducted by the department / institution. The total marks obtained in all the tests put together out of 300, shall be reduced to 20 marks and rounded to nearest integer (This implies equal weightage to all the three tests).
5.2.2 Practical subjects
Every practical exercise / experiment shall be evaluated based on conduct of experiment / exercise and records maintained. There shall be at least one mid-semester test. The criteria for arriving at the internal assessment marks shall be decided by the Head of the institution and shall be announced at the beginning of every semester.

5.2.3 Theory Subjects with Laboratory component:
If there is a theory subject with laboratory component, there shall be three tests; the first two tests (each 100 marks) will be from theory portions and the third test (maximum mark 100) will be for laboratory component. The sum of marks of first two tests shall be reduced to 10 marks and the third test mark shall be reduced to 10 marks. The sum of these for 20 marks may then be arrived at and rounded to nearest integer.

5.2.4 Project Work:
There shall be three assessments (each 100 marks) during the semester by a review committee. The student shall make presentation on the progress made before the committee. The Head of the institution shall constitute the review committee for each branch of study. The total marks obtained in the three assessments shall be reduced to 20 marks and rounded to the nearest integer.

6. DISCIPLINE
6.1 Every student is required to be disciplined and to have decorous behavior both inside and outside the campus and not to indulge in any activity, which will tend to bring down the prestige of the university.

6.2 Any act of indiscipline of a student reported to the Dean / Head of Institution will be referred to a Discipline and Welfare Committee nominated by the Syndicate from time to time, for taking appropriate action.

7. REQUIREMENT FOR COMPLETION OF A SEMESTER
7.1 A candidate who fulfills the following conditions shall be deemed to have satisfied the requirements for the completion of a semester.

i. He / she secures not less than 70% overall attendance taking into account the total number of periods attended by the candidate in all the courses put together as against the total number of periods in all the courses offered during the semester.

ii. He / she earns a progress certificate form the Head of the Department and the Dean / Head of Institution for having satisfactorily completed the programme of study in all the courses pertaining to that semester.

iii. His / her conduct is found to be satisfactory as certified by the Head of the Department and the Dean / Head of Institution.

7.2 Candidates who do not complete the semester (as per clause 7.1), will not be permitted to write the end-semester examination and are not permitted to go to next semester. They are required to repeat the incomplete semester in the next academic year.

8. REQUIREMENTS FOR APPEARING FOR END SEMESTER EXAMINATION
A candidate shall normally be permitted to appear for the end semester examination of the current semester. If he / she has satisfied the semester completion requirements (vide clause 7) and has registered for examination in all the courses of that semester.

9. REQUIREMENT FOR PROCEEDING TO A HIGHER SEMESTER
A candidate shall be permitted to proceed from the current semester to the next semester, irrespective of the aforesaid courses he / she may have in the earlier semester only if
i. He / she has satisfied all the semester completion requirements of the current semester and.

ii. He / she has registered for the end semester examination in all the courses of the current semester, and also in all arrears course, if any.

10. PASSING REQUIREMENTS AND CLASSIFICATION OF SUCCESSFUL CANDIDATES

10.1 A candidate shall be declared to have passed the examination in a course of study if he / she secures 50% of the total marks (continuous assessment plus end semester examination marks) prescribed for that course and if he / she has also secured 50% of the marks in the end semester examination conducted by the University. The rule is applicable to theory ad practical courses including Project Work.

10.2 A candidate who has been declared as "failed" in a particular course may reappear for the end semester examination in that course as and when the examination in that course is conducted and secure a pass. However, the continuous assessment marks obtained by the candidate in the first attempt shall be retained and considered valid for all subsequent attempts unless the candidate chooses the option of improving the continuous assessment marks (vide clause 13). Further, the semester examination marks obtained in the latest attempt shall remain valid.

10.3 A student can apply for revaluation of his / her semester examination answer paper in a course, within 2 weeks from the declaration of results, on payment of a prescribed fee through proper application to the Controller of Examinations through the Heads of Departments concerned. The Controller of Examination will arrange for the revaluation and the results will be intimated to the candidate concerned through the Heads of the Departments.

10.4 A candidate who qualifies for the award of the degree (vide clause 14) passing the examination in all the courses in all the seven semesters in his / her first appearance within seven consecutive semesters (3.5 academic years) and in addition secures an aggregate of not less than 75% of the total marks (continuous assessment plus semester examination marks) for all the courses in the semester II to VII put together shall be declared to have passed the examination in First Class with Distinction. For this purpose, the withdrawal from examination (vide clause 11) shall not be construed as an appearance. Further any authorized break of study will be excluded from the total duration while finding the period of completion (vide clause 12.3).

10.5 A candidate who qualifies for the award of the degree (vide clause 14) passing the examination in all the courses in the semester II to VII within a period of seven consecutive semester after his / her commencement of study in the second semester and in addition secures an aggregate of not less than 60% of the total marks (continuous assessment plus and semester examination marks) for all the courses in the semesters II to VII put together shall be declared to have passed the examination in First Class. For this purpose the period of completion will be arrived at by excluding any authorized break of study (vide clause 12.3).

10.6 All other candidates who qualify for the award of the degree (vide Clause 14) shall be declared to have passed the examination in Second class.

10.7 A candidate who absents in the end semester examination in a course / project work after having registered for the same, shall be considered to have appeared in that examination for the purpose of classification.
11. PROVISION FOR WITHDRAWAL FROM SEMESTER EXAMINATION

11.1 A candidate, may for valid reasons and on prior application, be granted permission to withdraw from appearing for the examination of any one course or consecutive examinations of more than one course in a semester examination.

11.2 Such withdrawal shall be permitted only once during the entire period of study of the degree programme.

11.3 Withdrawal application is valid only if it is made within the prescribed number of days prior to the commencement of the examination in that course or courses and recommended by the Head of Department and the Dean/Head of the Institution.

11.4 Withdrawal shall not be construed as an appearance for the eligibility of a candidate for First Class with Distinction.

11.5 The candidate shall reappear in the examination only when the examination in the withdrawn course or courses is conducted subsequently.

12. PROVISION FOR BREAK OF STUDY

12.1 Break of study shall not normally be permitted. However, if a candidate intends to temporarily discontinue the programme in the middle, for valid reasons, and to rejoin the programme in a later semester, permission may be granted based on the merits of the case provided he/she applies to the university in advance, but not later than the last date for registering for the end semester examination of the semester in question, through the Head of the Department and the Dean/Head of Institution stating the reasons therefore and the probable date of rejoining the course.

12.2 The candidate rejoining the programme after the authorized break of study shall be covered by the rules and regulations in force at the time of rejoining.

12.3 The duration specified for passing all the courses for the purpose of classification (vide clause 10.3 and 10.4) shall be increased by the period of such authorized break of study.

12.4 The total period for completion of the programme reckoned from the commencement of the first semester to which the candidate was admitted shall not in any case exceed the prescribed maximum period (vide clause 14), irrespective of the period of break of study.

12.5 If any student is either detained in a semester for want of requisite attendance progress and good conduct or suspended from the programme by Discipline and Welfare Committee, the resulting period of break of study shall not be considered as an authorized break of study for purpose of classification and clause 12.3 is not applicable in this case.

13. PROVISION FOR IMPROVING CONTINUOUS ASSESSMENT MARKS

If a candidate wishes to improve his/her continuous assessment marks in any course or courses, he/she shall apply through the Head of the Department and the Dean/Head of Institution for permission to rejoin and repeat that course or courses. Permission may be granted on the merits of the case subject to the following conditions.

i. Such candidate can rejoin the regular semester or semesters when these courses are offered and shall repeat the programme of study in these courses satisfying all requirements (vide clause 7).

ii. The maximum period for completion of the programme shall remain as prescribed in clause 14.

iii. He/she shall be eligible to rejoin and repeat all the courses in any one semester or up to a maximum of five courses, if the regular semester time table accommodates.
15. REVISION OF REGULATIONS AND CURRICULUM

The University may from time to time revise, amend or change the regulations, courses of study, syllabuses and assessment procedures if found necessary.

16. ELIGIBILITY FOR THE AWARD OF THE DEGREE

A candidate shall be eligible for the award of the Degree if he / she has satisfactorily passed the examination in all the courses prescribed in the programme for a period of seven semesters. The examination is deemed to be passed if the candidate has obtained the minimum marks specified in the programme. The candidate is required to pass the examination in 12 courses of the total 18 courses in the programme.

The University may from time to time, in its discretion, grant a certificate of completion to a candidate who has satisfactorily passed the examination in the courses prescribed in the programme for a period of seven semesters.

ERRATA

The changes to be made in the curriculum are given below:

<table>
<thead>
<tr>
<th>Sem.</th>
<th>B.E. Civil Engineering</th>
<th>Existing</th>
<th>Read as</th>
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<tr>
<td>2</td>
<td>PTCE239 Surveying I</td>
<td>3 0 100</td>
<td>PTCE239 Surveying 3 0 100</td>
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<td>PTCE Elective-IV</td>
<td>3 0 100</td>
<td>PTCE Elective-V 3 0 100</td>
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| B.Tech. Information Technology | 4 PTIF233 Microprocessors and Application | 3 2 100 | PTIF233 Microprocessors and Application 3 0 100 |
| B.Tech. Textile Technology  | 4 PTIF334 Network Components & Programming | 3 2 100 | PTIF334 Network Components & Programming 3 0 100 |
| B.Tech. Leather Technology | 4 PTEC332 Signals & Systems | 3 2 100 | PTEC332 Signals & Systems 3 0 100 |

| B.Tech. Production Engineering | 1 PTEC130 Basic Electronics | 3 1 100 | PTEC130 Basic Electronics 3 0 100 |
| B.Tech. Production Engineering | 1 PTEC130 Basic Electronics | 3 1 100 | PTEC130 Basic Electronics 3 0 100 |

<p>| B.Tech. Production Engineering | 3 PTIP 300 Theory Metal Cutting and Metal Forming | 3 0 100 | PTIP 300 Metal Forming Theory &amp; Practice 3 0 100 |</p>
<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Code No.</th>
<th>Course</th>
<th>Lecture</th>
<th>Lab</th>
<th>Marks</th>
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<tr>
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**SEMESTER II**

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### SEMESTER VI

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<td>Process Control In Weaving</td>
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<td>PTTT355</td>
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### SEMESTER VII

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<td>PTTH553</td>
<td>Textile mill planning and management</td>
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### LIST OF ELECTIVE SUBJECTS

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<td>Theory of staple fibre individualization</td>
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<td>PTTH039</td>
<td>Technology of staple-fibre yarn twisting</td>
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<td>PTTH041</td>
<td>Mechanics of textile structures</td>
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<td>PTTH054</td>
<td>Cad and cam in textile manufacture</td>
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<td>6</td>
<td>PTTH048</td>
<td>Synthetic fibre colouration</td>
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<td>7</td>
<td>PTTH049</td>
<td>Eco-friendly dyes and chemicals</td>
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<td>8</td>
<td>PTTH050</td>
<td>Work study in textile industry</td>
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<td>PTTH052</td>
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<td>PTTH045</td>
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### PTMA130 MATHEMATICS I

1. **MATRICES**
   - Characteristic equation – Eigen values and Eigen vectors of a real matrix – Cayley Hamilton theorem – Reduction of a real symmetric matrix to diagonal form.

2. **FUNCTIONS OF SEVERAL VARIABLES**

3. **ORDINARY DIFFERENTIAL EQUATIONS**
   - Linear equations of second order with constant coefficients – Euler’s equation – Simultaneous equations of first order with constant coefficients.

4. **ANALYTIC FUNCTIONS**
   - Cauchy – Riemann equations – Properties – Finding harmonic conjugates and analytic functions – Conformal mappings of \( w = z + a, \frac{1}{z}, kz, z, \sin z, \cos z, e \) and bilinear transformations.

5. **COMPLEX INTEGRATION**
   - Cauchy’s theorem – Cauchy’s integral formula – Taylor and Laurent’s series, singularities and residues – Cauchy’s residue theorem – Contour integration around circular and semi-circular contours.

**TOTAL 45**

### REFERENCE:


PTPH130 PHYSICS

UNIT I: PROPERTIES OF MATTER

UNIT II: ACCOUSTICS AND ULTRASONICS
Classification of sound — Characteristics of musical sound — Units of loudness — decibel and phone — Intensity of sound — Acoustic pressure — Acoustics of buildings — Reverberation time — Sabine's formula — Absorption coefficient — Sound absorbing materials — Sound insulation in machines — Ultrasonic — Production, properties and applications.

UNIT III: OPTICS AND LASERS

UNIT IV: MODERN PHYSICS
Quantum nature of energy — Dual nature of matter — Einstein's mass-energy relation — Nuclear fission — Controlled chain reaction — Nuclear power reactor — Nuclear fusion — Crystalline and non-crystalline solids — Unit cell and Bravais lattices — Miller indices — Packing factor of SC, BCC and FCC.

UNIT V: NON-DESTRUCTIVE TESTING
Different steps involved in non-destructive testing — Principle of X-ray radiographic technique — Comparison between X-ray radiography and gamma ray radiography — Liquid penetrant method — Ultrasonic method — Magnetic and electrical methods.

REFERENCE:
PTCM130 CHEMISTRY

1. WATER
Sources and impurities — hardness of water — expression and estimation by EDTA — treatment of water for boilers — lime soda, zeolite and deionization process — internal treatment of boiler water — domestic water treatment — coagulation, filtration and disinfection — reverse osmosis.

2. ENERGY SOURCES:
Classification of fuels — gross and net calorific values — approximate analysis of coal — manufacture of coke — refining of petroleum — cracking — thermal and catalytic — petrol knocking octane number — unleaded petrol — diesel knocking cetane number — water gas, producer gas and bio-gas.

3. CORROSION AND ITS CONTROL
Corrosion — chemical and electrochemical factors affecting corrosion — sacrificial anode, impressed current cathode protection — surface treatments and protective coatings — oil paint — emulsion paint — special paints — heat resistant, fire retardant and luminous.

4. POLYMERIC MATERIALS
Polymers — addition and condensation — thermoplastics and thermo-setting plastics — preparation and uses of polythene, PVC, teflon, nylon, terylene and Bakelite — compounding of plastics — natural rubber — vulcanization of rubber — synthetic rubbers — butyl, nitrile and styrene — butadiene rubber — adhesives — epoxides, urethanes and silicones.

5. POLLUTION AND ITS CONTROL

PTGE130 COMPUTER PROGRAMMING

1. COMPUTER FUNDAMENTALS
Hardware and Software — Typical specification of a computer system — concepts of networking, e-mail, internet — Operating systems: Windows, UNIX fundamentals.

2. GENERAL APPLICATION SOFTWARE
Word processing, Database Management system, spreadsheet package, presentation software.

3. C-PROGRAMMING
Data types — expressions — input/output statements — control statements, loops — arrays — pointers, file handling.

4. LABORATORY PRACTICE

TOTAL 45
REFERENCE:

PTEC130 BASIC ELECTRONICS

1. SEMICONDUCTOR DEVICES
   - PN Junction diode - Zener diode - Bipolar junction - Transistor, JEET, MOSFET, Thyristors - UJT - Photo diode and LED.

2. ELECTRONIC CIRCUITS

3. INTEGRATED CIRCUITS
   - IC technology - Operational Amplifier and its applications

4. DIGITAL INTEGRATED CIRCUITS
   - Logic gates - Flips - Flop -counters, A/D and D/A converters.

5. COMMUNICATION
   - AM - FM Modulation and demodulation, Concept of Tuned Amplifier, AM - FM Receivers: Characteristics and Types.

TEXT BOOK
2. G.Kennedy and Fernand Davis, "Electronic Communication Systems"

REFERENCE:

PTMA331 MATHEMATICS II

1. FOURIER SERIES
   - Dirichlet's conditions, General Fourier series, Half range sine and cosine series Parseval's identity, Harmonic Analysis.

2. FOURIER TRANSFORMS

3. LAPLACE TRANSFORMS
   - Transforms of simple functions, Basic operational properties, Transforms of derivatives and integrals, Periodic functions, Convolution theorem, Inverse transforms, initial and final value theorems, Applications of Laplace transforms to linear ordinary differential equations.

4. PARTIAL DIFFERENTIAL EQUATIONS
   - Formation, Solution of standard types of first order equation and LaGrange's Linear Equation, Linear partial differential
equations of second and higher order with constant coordinates.

5. BOUNDARY VALUE PROBLEMS

Classification of second order partial differential equations, Transverse vibrations of a string, One-dimensional heat equation and two-dimensional heat flow, Fourier series solutions in Cartesian Coordinates.

TEXT BOOKS


REFERENCES


PTCH233 ELECTRICAL MACHINES AND DRIVES

1. ELECTRIC CIRCUITS

- Definition – ohm’s law – series parallel circuit – parallel circuit – Division of current – Kirchhoff’s law; Superposition and Thulvenin’s Theorem; Star-delta transformation; Simplification of networks.

- Alternating Voltage; Need for A.C. Voltage; Sinusoidal A.C. Voltage; RRL and RLC networks; Impedance angle; Power and Power factor; Actual and apparent power; Resonance in A.C. Circuits; Series, parallel and series-parallel resonance; Vector Diagram (Phasor Diagram); Complex algebra applied to sinusoids; Three phase circuits; Three phase loading; Balanced loads; Simple problems.

3. D.C. MACHINES

Lenz’s law of electromagnetic induction; Fleming’s rule, Principle of operation of D.C. Machines; Kinds of D.C. machines; Emf equation of D.C. generators; Speed control of D.C. motor; Starters; Application of D.C. Machines.

4. A.C. MACHINES

Principle of operation of A.C. Machines: Transformer; single and three phase induction motors; Alternators; Synchronous motors; Equivalent circuit, Regulation and efficiency of single phase transformer; Slip—torque characteristics induction motors; starting of induction motors. Emf equation, Regulation and synchronisation of alternators; Synchronous condenser; Hunting in synchronous motor; Single phase induction motors and their applications.

5. DRIVES

Industrial requirements and Ward Leonard System of Drives. Servo—Motors; Basic theory and applications.

TOTAL 45

TEXT


PTCH234 MECHANICAL ENGINEERING

1. LAWS OF THERMODYNAMICS
Basic concepts and hints; Zeroth law; First Law of Thermodynamics — Statement and application; Steady flow energy equation; Second law of Thermodynamics — Statement; Limitations; Heat Engine; Heat Pump, Available energy, Kelvin—Plank statement and Clausius statement; Equivalence; Entropy; Reversibility; Entropy charts; Third law of Thermodynamics — Statement.

2. HEATING AND EXPANSION OF GASES
Expressions for: work done; Internal energy; Hyperbolic and polytropic processes; Free expansion and Throttling.

3. AIR STANDARD EFFICIENCY
Carnot cycle; Stirlings Cycle; Joule Cycle; Otto Cycle; Diesel Cycle; Dual combustion Cycle.

4. I.C. ENGINES
Engine nomenclature and classifications; SI Engine; DI Engine; Four Stroke cycle; Two stroke cycle; Performance of I.C. Engine; Braked thermal efficiency; Indicated Thermal Efficiency; Specific fuel consumption.

5. STEAM AND ITS PROPERTIES
Properties of steam; Dryness fraction; Latent heat; Total heat of wet steam; Superheated steam. Use of steam tables; volume of wet steam; Volume of superheated steam; External work of evaporation; Internal energy; Entropy of vapour, Expansion of vapour, Rankine cycle; Modified Rankine cycle.

6. STEAM ENGINES AND TURBINES
Hypothetical indicator diagram of steam engine; Working of a simple steam engine; steam turbines—Impulse and Reaction types—Principles of operation.

7. SIMPLE MECHANISM
Kinematic Link, Kinematic Pair Kinematic Chain; Slider Crank mechanism and inversions; Double slider crank mechanism and inversions.

8. FLY WHEEL
Turning moment Diagram; Fluctuation of Energy; Design of fly wheel.

9. DRIVES
Belt and rope drives; Velocity ratio; slip; Ratio of tensions; Length of belt; Maximum HP; simple compound and Epicyclic gear trains.

10 BALANCING
Balancing of rotating masses in same plane; Balancing of masses rotating in different planes.

TOTAL 45

TEXT

PTCH235 MECHANICS OF SOLIDS

1. STRESS, STRAIN AND DEFORMATIONS OF SOLIDS
   - Rigid bodies and deformable solids - forces on solids and supports - equilibrium and stability - strength and stiffness - tension, compression and shear stresses - Hooke's law and simple problems - compound bars - thermal stresses - elastic constants and Poisson's ratio - welded joints - design.

2. TRANSVERSE LOADING ON BEAMS
   - Beams - support conditions - types of beams - transverse loading on beams - shear force and bending moment in beams - analysis of cantilevers, simply supported beams and overhanging beams - relationships between loading, S.F., and B.M. in beams and their applications - S.F. & B.M. diagrams.

3. DEFLECTIONS OF BEAMS
   - Double integration method - Macaulay's method - Area - moment theorems for computation of slopes and deflections in beams - conjugate beam method.

4. STRESSES IN BEAMS

5. TORSION
   - Torsion of circular shafts - derivation of torsion equation (T/J = C/R = Gg/L) - stresses and deformation in circular and hollow shafts - stresses and deformation in circular and hollow shafts - stepped shafts - shafts fixed at both ends - stresses in helical springs - deflection of springs - spring constant.

6. COLUMNS
   - Axially loaded short columns - columns of unsymmetrical sections - Euler's theory of long columns - critical loads for prismatic columns, with different end conditions - effect of eccentricity.

TOTAL 45

TEXT


PTCH236 ORGANIC CHEMISTRY

1. CARBOHYDRATES
   - Introduction - Mono and Disaccharides - Important reactions - Polysaccharides - Starch and Cellulose - Derivatives of...
2. ORGANO METALLIC COMPOUNDS
Grignard reagents and their synthetic utility – Organo Silicon compounds

3. OILS, FATS AND WAXES
Analysis of oils and fats – classification of waxes

4. HETEROCYCLIC COMPOUNDS
Furan, Thiophene, Pyrrole, Pyridine, and Indole – Their important derivatives

5. DYES AND DYEING
Color and constitution
- Synthesis of some important azo dyes (Methyl orange, Methylene blue, and Congo red)
- Synthesis of Triphenylmethane dyes (Malachite green, Para Rosaniline Anthraquinone dyes (Alizarin)
- Prthalein dyes - Eosin preparation
- Introduction to Natural and Reactive dyes

6. AMINO ACIDS AND PROTEINS

7. PHARMACEUTICAL CHEMISTRY
Synthesis of antimalarial drugs - isopentaquine and chloroquine - Antibacterial drugs - Synthesis of sulphanilamide, sulphapyridine

TOTAL 45
4. POLYMERIC MATERIALS

5. PROCESSING ADDITIVES AND METHODS
Nucleating agents, UV stabilisers, anti-microbials, anti-statics, blowing agents, coupling agents, flame retardants, heat stabilizers, release agents, viscosity control additives. Extrusion - Film extrusion - extrusion coating powder coating - spinning method.

REFERENCE:

PTT335 PHYSICAL STRUCTURE AND PROPERTIES OF FIBRE
1. STRUCTURE OF FIBRES:
Structure of Textile natural and man-made fibres physical, chemical and morphology.

TOTAL 45

PTT222 SPUN YARN TECHNOLOGY:

1. GINNING
Description and working of different types of gins; selection of right type of gins; Ginning performance on yarn quality.

2. BLOWROOM MACHINES:
Objects, principle and description of opening, cleaning and blending machines used in blowroom.

3. CARD:
Objects and principle of carding; detailed study of flat cart, card clothing; drives and production calculation.

4. DRAWFRAME:
Task of drawframe; drafting systems used in modern drawframes; draft and production calculation.

5. COMBER:
Comber preparation; objects and principle of combing; sequence of combing operation; combing efficiency and production calculation.

6. SPEEDFRAME:
Objects of speed frame; working of speed frame; bobbin builder mechanism; draft, twist and production calculations.

7. YARN SPINNING:
Principle of yarn production in ring, rotor, friction and air-jet spinning machines; working of ringframe; cop building; design features of important elements used in ring spinning; draft, twist and production calculations in ringframe.

8. YARN TWO-FOLDING:
Merits of two-folding of yarns; methods followed for two-folding; selection of twist level for two-folding; calculation of resultant count of two-folded yarns.

REFERENCE:


PTTT233 TECHNOLOGY OF WEAVING PREPARATION

1. WINDING


2. WARPING


3. SIZING


4. DRAWING-IN


TOTAL 45

REFERENCE:


PTTT234 MAN-MADE FIBRE PRODUCTION

1. INTRODUCTION

2. POLYMER MANUFACTURE
   - Introduction on fundamentals of polymer chemistry. Production of viscose, polyester, nylon 6, nylon66, polyacrylonitrile and polypropylene polymers.

3. PRODUCTION OF MELT SPUN FILAMENT YARNS
   - Fluid flow and melt spinning. Manufacture of PET polyester, nylon6 and polypropylene filament yarns.

4. PRODUCTION OF WET AND DRY SPUN FILAMENT YARNS
   - Manufacture of viscose Rayon. Wet and dry spinning of polyacrylonitrile filament yarns.

5. POST SPINNING PROCESS
   - Spin finishes. Drawing and heat setting. Texturization - False twist texturing. Staple fibre production. Tow to top converters

REFERENCE:


PTTT335 PROCESS CONTROL IN SPINNING

1. LEVELLING:
   Different levelling methods adopted in the spinning machines to achieve better uniformity of the products; influences of the uniformity of the intermediate products on the yarn quality; effect of machine and processing parameters on product uniformity; importance of fibre-mix homogeneity on yarn quality; types and levels of mixing in the preparatory processes; assessment of fibre-blend variations.
2. NEP AND HOOK REMOVAL:
Cases of nep and hook formation in the fibre opening processes; removal of neps in the carding and combing machines; fibre hook straightening during the preparatory operations; measurement of neps and hooks.

3. WASTE CONTROL:
Control of waste in blowroom, card and combers; influence of machine and processing parameters on waste removal; controlling the lint content in waste; cleaning efficiency and cleaning intensity.

4. STATIC GENERATION:
Generation of static generation; its influence on spinning processing; control of static generation.

5. PRODUCTION CONTROL:
Factors affecting the production limits of the spinning machinery; achieving maximum production in the given machinery; new concepts in achieving higher production in the spinning machinery; role of machinery maintenance and humidity control on production efficiency; computation of the productivity indices.

6. YARN QUALITY ANALYSIS:
Analysis of within length and between length variations and spectrogram; yarn faults classifications; causes and remedies for yarn defects.

7. MAN-MADE FIBRE PROCESSING:
Processing conditions required for man-made fibres like polyester, viscose in the spinning machinery; static electricity, its influence on processing and the control of static generation.

TOTAL 45
4. SECONDARY AND AUXILIARY MOTIONS
Take up and lat - off motions used in power looms. Clip formation, Warp protector and weft fork motion. Plain loom accessories.

5. PROCESS CONTROL IN WEAVING

REFERENCE:

PTTT035 TEXTURED YARN TECHNOLOGY
1. Need for bulkiness of synthetic fibres -texturing basic definition and classifications-Development in high speed spinning - poy
2. Heat setting-need-factors involved-types of setting-effects on fibre morphology and mechanical properties-

fundamentals of thermo-mechanical texturing -Helanca process.
4. Basic of air jet texturing -types of yarns produced-feed material structure and properties of air-jet texturing machines, nozzles, evaluation of air-jet textured yarn Vs spun, and filament false twist textured yarns.
5. Stuffer box and edge crimping methods-principles, limitations, and applications-knit-de-knit and gear crimping methods, Bicomponent filament texturing - texturing of polypropylene and jute fibres-Chemomechanical and thermo-mechanical texturing.

REFERENCE:
6. Workshop on Texturisation' Book of papers Anna University Textile Dept. Dec' 81

PTTT339 CHEMICAL PROCESSING OF TEXTILE MATERIALS I
1. STRUCTURE AND PROPERTIES
   Chemical structure and chemical properties of textile fibres

2. PREPARATION FOR COLOURATION AND FINISHING
   Singeing, desizing-hydrolytic and oxidative techniques, scouring, mercerization, bleaching and heat setting

3. PROCESSING MACHINES
   Loose stock processing machines, hank and package processing machines, yam singeing machines, gas singeing machines for woven and tubular knits, shearing and raising machines, kiers, mangles, jigger, winch, jet and soft flow machines, yam mercerizer, chain and chainless mercerizers, circular mercerizing machine, continuous scouring and bleaching machines, washing ranges, hydro extractors, denwsters, dryers, stenters and stretching devices.

4. IDENTIFICATION AND ESTIMATION OF BLEND PROPORTION

REFERENCE:

TOTAL 45


PTTT337 FABRIC STRUCTURE
1. INTRODUCTION
   Cloth geometry, cover factor, Theory of colour use of point paper.

2. STANDARD WEAVES
   Plain and it derivatives, Twill and derivatives, Satin and sateen, honey comb, brighton honeycomb, mock leno, huck-a-back,
crepe distorted weaves, Bedford cords, wefts and piques, backed fabrics.

3. SPECIAL WEAVES
Extra warp, Extra weft, Double cloth, Gauze and Leno, pile fabrics, Damasks, ply fabrics.

4. SPECIAL JACQUARDS
Application of special jacquards

5. PRINCIPLES OF ORNAMENTATION
Various types of ornamentation, Designing pattern for weaving on jacquards, Lappet and swivel system for ornamentation.

TOTAL 45

REFERENCE:

PTTT344 NEW SPINNING TECHNOLOGIES
1. CONDENSED YARN SPINNING:
Principle of condensed yarn spinning; working of different models of condensed yarn spinning; advantages of this method over conventional ring spinning method.

2. Rotor Spinning:
Description of the working of the rotor spinning method; requirements of the raw materials; preparation of the sliver for rotor spinning; yarn formation and its structure; yarn withdrawal and winding; rotor design and its implications on production and yarn quality; production limits; comparison with ring spinning.

3. FRICTION SPINNING:
Detailed study of the DREF-2, DREF-3 and the master spinner machines working on the principle of friction spinning; the use of raw materials; application of these machines for different end products; the economics; technological limitations.

4. AIR-JET SPINNING:
Description of the yarn production in air-jet spinning machine; feasibility of higher draft applied in this machine; structure and quality of the air-jet spun yarn; raw material requirement; production of yarn in PLYR spinning process applying similar principle; comparison with other spinning methods.

5. OTHER SPINNING TECHNOLOGIES:
Working details of the production of double-rove yarns and wrap yarns; use of raw materials; economics of these methods of yarn production; yarn characteristics and their applications.

TOTAL 45

REFERENCE:

PTTT341 TECHNOLOGY OF FABRIC MANUFACTURE II

1. PREPARATIONS FOR HIGH SPEED WEAVING
Yarns quality requirements for high speed automatic shuttle
looms and shuttle less looms. Warp and weft preparation for
high speed looms.

2. AUTOMATIC SHUTTLE LOOMS
Automatic weft replenishment in shuttle looms – prim changing
and shuttle changing looms. Mechanisms involved in automatic
weft replenishment – feeders, cutters, design of shuttle, three
try motions, Warp stop motions, lift off motions. Multi shuttle
looms, Pile fabric weaving looms, tape looms.

3. SHUTTLELESS LOOMS
Principles of weft insertion in shuttle less looms. Weft
accumulators and selvedges used in shuttleless looms. Mechanism of weft insertion by projectile, rapier, air jet and
water jet. Techno economics of shuttleless weft insertion
systems. Multi face weaving systems. Quick style change.

4. WEAVING WITH DIFFERENT TYPES OF YARNS
Preparation and weaving of open end yarns, blended yarns,
filament yarns. Data systems.

5. BONDED FABRICS
Production of bonded fabrics by mechanical, chemical and
thermal methods. Production of spun bonded and melt blown
fabrics. End uses of bonded fabrics.

REFERENCES:
1. Marks, R and Robinson, T.C., Principles of weaving, The
2. Talukdar, M.K., Sinamulu, P.K. and Agaonkar, D.B., Weaving:
Machines, Mechanisms, Management, Mahajan Publishers,
3. Lord, P.R. and Mohamed, M.H., Weaving: Conversion of yarn
4. L.Vangheluwe., Air- jet weft insertion, Textile progress, Vol 29,
5. Jr. I. gluten, W.Albrecht and David Sharp., Non-woven
Bonded Fabrics, Ellis Horwood Ltd, New York, 1985, ISBN: 0-
85312-636-4.
6. Weaving: The knowledge in technology, Textile Institute,

PTTT342 CHEMICAL PROCESSING OF TEXTILE MATERIALS II

1. DYING
Introduction to theory of dyeing, properties and application of
direct, azoic, vat, sulphur, reactive, acid, mordant, metal-
complex, disperse and basic dyes. Dyeing of blends.
2. PRINTING
   Methods and styles of printing, printing machines, printing paste constituents, printing with direct, reactive, and disperse dyes and pigments.

3. FINISHING
   Introduction. Calendering, starching, creping, softening, crease proofing, anti-shrinking, felting, non-felting.

4. TESTING
   Fastness properties of dyed and printed goods. Assessment of finishes imparted to textiles.

5. FINISHING OF KNITS, GARMENT PROCESSING

   TOTAL 45

REFERENCE:


PTT343 QUALITY ASSESSMENT OF TEXTILES

1. INTRODUCTION
   The aims of quality assessment. Online and off line testing techniques.

2. THE THEORY OF QUALITY CONTROL SYSTEMS
   The design of experiments. Statistical tools for quality control. Testing according to end use. Quality control systems for the shop floor.

3. FIBER TESTING
   Fiber testing - Length & Length Uniformity - Fineness - Strength - Maturity - Trash content - Moisture content. Traditional methods and modern high volume testing instruments and techniques.

4. YARN TESTING

5. FABRIC TESTING

   TOTAL 45

REFERENCE:


**PTT354 GARMENT TECHNOLOGY**

1. **GARMENT CLASSIFICATION:**
   Men, Women, Children - Uniforms selection - Specifications.

2. **DRESS AND DESIGNING:**
   Pattern development - Marker planning - requirements - methods - spreading and cutting methods - Grading.

3. **SEWING:**
   Seams - Stitches - Sewing machine feeding systems - Sewing needles - Sewing threads - Fibre types - construction - finishes - Thread sizes - Thread packages - Basic sewing machine and its associated work aids.

**REFERENCE:**
3. Draft and production calculations in Drawframe.
4. Study of comber preparatory machines and comber.
5. Draft and twist calculations of speed frame and ring frame.
6. Study of weaving preparatory machines
7. Study of primary motions
8. Study of secondary motions
9. Study of Auxiliary motions
10. Study of circular and flat knitting machine.
11. Scouring and bleaching of cotton
12. Dyeing of cotton with different classes of dyes
13. Depuming and dyeing of silk
14. Dyeing of synthetic fibre
15. Printing of cotton fabrics

PTT0038 MECHANICS OF STAPLE-FIBRE DRAFTING

1. IDEAL DRAFTING:
   Definition of ideal drafting; conditions required to achieve ideal drafting in a roller drafting system; deviations from ideal drafting situation during actual drafting conditions.

2. DRAFTING WAVE:
   Definition of drafting wave; condition for drafting wave formation during roller drafting; estimation of the magnitude of the irregularity caused by the occurrence of the drafting wave; forces acting on a fibre during drafting at different positions in a drafting zone; methods to avoid drafting wave formation; role of apron in controlling drafting wave formation.

3. ROLLER SLIP:
   Definition of roller slip; conditions for the formation of forward and backward slips in the roller drafting systems; measures to avoid roller slip occurrence.

4. OTHER DRAFTING IRREGULARITIES:
   The causes for roller nip movement and roller speed variation during drafting and their effect on irregularity formation; control of the irregularity formed from these sources.

5. COMPARISON:
   Comparison of roller drafting system with wire point drafting system; application of wire point drafting in card and rotor spinning machine; comparison of roller drafting in drawframe, comber preparatory, combing, ringframe, ringcan spinning, condensed yarn spinning and in air-jet spinning machine; influence of draft on spinning triangle size and the subsequent effect on machine performance and product quality.

TOTAL 45

REFERENCE:
PTT043  PROCESS CONTROL IN WEAVING

1. INTRODUCTION
   Scope of process control in weaving and preparation to weaving.

2. WINDING
   Quality of joints, Fault removal, Winding performance, Productivity, Maintenance, Quality control, Material handling.

3. WARPIING
   End breaks, Quality of warpers beam, Hard waste, Norms, Productivity, Maintenance, Quality control, Material handling.

4. SIZING
   Choice of size recipe and pick up, Size preparation and storage. Control of size pick up, yarn stretch and moisture, Quality of sized beam. Dead loss, Hard waste, Norms, Productivity, Maintenance, Quality control, Material handling.

5. DRAWING-IN
   Selection and care of reeds, healds and drop pins. Control of cross ends and extra ends.

6. WEAVING
   Control of loom speed efficiency. Stops, Hard waste, Norms, Productivity, Maintenance, Quality control, Material handling.

TOTAL 45

REFERENCE:

44

PTT448  KNITTING TECHNOLOGY

1. INTRODUCTION
   Comparison between knitted and woven fabrics. Warp knitting and weft knitting. Knitting needles.

2. CIRCULAR KNITTING

TOTAL 25

REFERENCE:

45

PTT231 COMPUTER APPLICATION IN TEXTILE TECHNOLOGY

1. THE BASICS OF SYSTEMS ANALYSIS

   Study of systems and the development of system requirements

2. SYSTEMS ANALYSIS IN TEXTILE MANUFACTURING

   The scope for the application of computers to the processes of Spinning, Weaving and Chemical treatment. Identification of areas for the application of computers in finance and administration.

3. EXISTING SOFTWARE

   Overview of spreadsheets, word processing programs and data base management software and their application to the field of Technology. Software for colour matching, cotton blending, product mix decisions, PERT, CPM, LP etc.

4. DESIGNING APPLICATIONS

   Design and development of programs for various Textile applications

5. COMPUTER PRACTICALS

   Design and development of programs for various Textile applications

TOTAL 48

REFERENCE:
1. Enrick, N.L., Work study and Time study in Textiles


PTT355 QUALITY ASSURANCE LABORATORY

1. Fibre length and length uniformity.
2. Fibre fineness and maturity.
3. Fibre strength.
4. Fibre moisture study.
5. Yarn count and strength.
6. Yarn twist.
7. Yarn evenness.
8. Fabric Tensile, tear and bursting strength.
11. Fabric Air Permeability.
12. Fabric Drape.
13. Fibre identification and blend analysis
14. Dye identification
15. Fabric colour fastness

PTCH421 PROCESS ECONOMICS AND INDUSTRIAL MANAGEMENT

PART A

1. PRINCIPLES OF MANAGEMENT AND ORGANISATION
   Planning, organisation, staffing, coordination, directing, controlling, communicating, organised as a process and a structure; types of organisations.

2. PRODUCTION AND MANAGEMENT
   Method study; work measurement techniques; basic procedure; motion study; motion economy; principles of time study; elements of production control; forecasting; planning, routing; scheduling; despatching; costs and costs control, inventory and inventory control.

3. QUALITY AND QUALITY CONTROL
   Elements of quality control, role of control charts in production and quality control.

PART B

4. ENGINEERING ECONOMICS FOR PROCESS ENGINEERS

5. INTEREST, INVESTMENT COSTS AND COST ESTIMATION
   Time value of money; capital costs and depreciation, estimation of capital cost, manufacturing costs and working capital; invested capital and profitability.

6. PROFITABILITY, INVESTMENT ALTERNATIVE AND REPLACEMENT
   Estimation of project profitability, sensitivity analysis; investment alternatives; replacement policy; forecasting sales; inflation and its impact.
7. ANNUAL REPORTS AND ANALYSIS OF PERFORMANCE
   Principles of accounting; balance sheet; income statement; financial ratios; analysis of performance and growth.

8. ECONOMIC BALANCE
   Different unit operations with single and multiple variables.

REFERENCE:


PTTT553 TEXTILE MILL PLANNING AND MANAGEMENT

1. PRINCIPLES OF MANAGEMENT:
   Planning, organisation, coordination, directing, controlling

2. PROJECT REPORT:
   Preparation of projects, location layout; selection of site for textile mills, Building structure: balancing of machinery for spinning and weaving

3. MAINTENANCE OF MACHINERIES:
   Schedule for maintenance, lubricants; type and characteristics of lubricants.

REFERENCE:

1. Shukla M.C Business Organisation and Management, sultan chand and sons 1975

PTTT453 PROJECT WORK

Each student is required to submit a report on the project assigned to him by the department. The report should be
based on the information available in the literature or data obtained in the laboratory/industry.

The object of the project is to make use of the knowledge gained by the student at various stages of the degree course. This helps to judge the level of proficiency, originality and capacity for application of the knowledge attained by the student at the end of the course.

LIST OF ELECTIVE SUBJECTS

PTTT034 FIBRE AND TEXTILE COMPOSITES
5. Manufacture of high performance fibres.
TOTAL 45

REFERENCE:

PTTT037 THEORY OF STAPLE- FIBRE INDIVIDUALIZATION
1. FIBRE INDIVIDUALIZATION:
   The necessity of fibre individualization in the fibre opening processes; effect of fibre-group size on yarn uniformity; minimum requirements to achieve fibre individualization; basic approach for fibre individualization in the opening machines.
2. PRINCIPLE OF FIBRE OPENING IN BLOWROOM:
   The principle of fibre opening in the blowroom machines; calculation of tuft size reduction in openers based on machine and processing parameters; limitation of fibre opening in blowroom machinery; control of tuft size variation and fibre rupture during opening.
3. ROLE OF CARDING MACHINE:
   The function of licker-in in card; degree of opening in licker-in; the mechanics of fiber opening in the carding area; study of effect of fundamental factors like wire point design and density, speeds, settings and transfer coefficient on fibre individualization; calculation of useful parameters to assess the carding performance; card grinding on carding efficiency.
4. CARDING PRODUCTIVITY:

Relationship between carding productivity and degree of fibre individualization; limiting factors of carding productivity; new concepts to improve carding productivity.

5. CLEANING:

Role of fibre opening on fibre cleaning; the factors affecting fibre cleaning in the blowroom and carding machines; control of air suction for efficient cleaning.

REFERENCE:


TTT039 TECHNOLOGY OF STAPLE-FIBRE YARN TWISTING

1. FUNDAMENTALS OF TWISTING:

Mechanics of imparting strength to a staple-fibre strand by twisting; meaning of twist multiplier and the basis of selection of required twist; principle of false twisting; fundamental requirements to create real twist in the strand.

2. TWISTING IN RING SPINNING:

Principle of twist insertion in ring spinning; limitations of ring twisting; mechanics of balloon formed during twisting; influence of twisting on spinning triangle size and the subsequent effect on yarn quality and spinning performance; design features of rings and travellers used for twisting different types of yarns.

3. TWISTING IN OPEN-END SPINNING:

Principle of twist insertion in open-end spinning; application of this principle in rotor spinning and friction spinning machines; advantages of this method of twisting over ring twisting method; comparison of yarn tension developed during twisting in these two machines.

4. TWISTING IN AIR-JET SPINNING:

Principle of twist formation in air-jet spinning; advantage of using two air nozzles; the merits and demerits of this method of twisting; application of this method of twisting in Plyfil yarn production.

5. TWO-FOR-ONE TWISTING:

Principle of two-for-one twisting; the advantages of this method of twisting; working of two-for-one twistar.

6. OTHER TWISTING METHODS:

Twisting of yarns in double-rove fed spinning machines; operating principle involved in the twisting of wrap-span yarns; technological and economic interrelationships in these methods of twisting; role of twisting in fancy yarn production.

REFERENCE:


PTOT41 MECHANICS OF TEXTILE STRUCTURES

1. YARN GEOMETRY
   The idealized helical yarn structure; yarn count and twist factors; twist contraction, packing of fibres in yarns; measurement of yarn diameter; ideal migration; tracer fibre technique; characterisation of migration behaviour; migration in blended yarns; mechanism of migration, effect of various parameters on migration behaviour.

2. MECHANICS OF CONTINUOUS FILAMENT YARNS
   Analysis of tensile behaviour; prediction of breakage; analysis of yarn mechanics by energy method; observed extension and breakage of continuous filament yarns; mechanics of torque in filament yarns.

3. MECHANICS OF STAPLE FIBRE YARNS
   Theoretical analysis; fibre obliquity and slippage; influence of fibre length, fineness and friction; strength of blended yarns - Hamburger's model.

4. WOVEN FABRIC GEOMETRY AND DEFORMATION
   Elements of woven fabric geometry; Pierce and Olsson models; jamming of threads; cover factor; crimp interchange in woven fabrics; modification to Pierce model - race track, sawtooth and bilinear models; form factor; degree of set; extension behaviour of woven fabric; prediction of modulus; tensile properties in bias direction; other fabric deformation - shear, buckling, bending and compression; fabric handle; use of finite element analysis.

5. NONWOVENS AND KNITTED STRUCTURES
   Geometry of plain knitted structure; mechanics of nonwoven fabrics.

REFERENCE:


PTOT54 CAD AND CAM IN TEXTILE MANUFACTURE

1. BASIC CONCEPTS
   Overview of CAD and CAM - their application in various fields of textiles.

2. COMPUTER HARDWARE
   Centralised vs distributed computer systems, CPUs and memory - video terminals - graphic work stations - digitisers
and scanners - 24 bit colour technology - storage devices -
printers and plotters.

3. DESIGN SOFTWARE
Autocad and its emulators - specific programmes for textile
applications - The CIE colour system and the true colour
representation - concepts of image processing.

4. DESIGN FUNDAMENTALS
Weave patterns, their generation on computer monitors -
printable designs screen and printer display - software.

5. COMPUTER AIDED MANUFACTURING
Pattern generation and cutting in tailoring - shade tolerance
testing computer controlled machines - stock control, statistical
quality control, process costing.

REFERENCE:

1. Phiroz Dastoor, Application of CAD in the Industrial Fabrics,
2. Groover, M.P. and Zinimers, E.W., CAD/CAM Computer
3. Vesant, C. E., 'Computer aided design and manufacture', Ellis
4. Aldrich, W. (Ed.), 'CAD in clothing and textiles : A collection of
5. Jayaratman, S, "Computer Science and Textile Science", T.P,
   integrated manufacturing and total quality management,
   Textile Progress Vol 27, No 4, Textile Institute, Manchester,

   ISBN: 056607673X
8. Instrumentation in the textile Industry, Instrument society of

PTT048 SYNTHETIC FIBRE COLOURATION
1. Mechanism of dyeing synthetic fibres; effect of fibre structure
   on dye up-take. Dyeing of PET polyester, nylon,
   polyacrylonitrile and polypropylene.
   10
2. Mass colouration
   10
3. Dyeing of polyester blends
   8
4. Developments in synthetic fibre fabric dyeing machine applied
   on synthetic fibres
   6
5. Fastness properties of dyes applied on synthetic fibres.
   Auxiliaries used for dyeing synthetic fibres.
   11

TOTAL 45

REFERENCE:

1. Gutarajani M.L., Dyeing Polyester and its blends, IIT, Delhi,
   1987.
   090196446740

PTT049 ECO - FRIENDLY DYES AND CHEMICALS
1. Constitution of dyes and finishing agents - German legislation -
   list of banned dyes - groups azo dyes - benzidine
   - pentachlorophenol.
   12
3. Finishes - banned items - allowable dosages - alternatives to finishes. 9
4. Dry cleaning agents - pigments - bleaching - solvents - guidelines to dyestuff manufacturers. 12

TOTAL 45

REFERENCE:

PTT050 WORK STUDY IN TEXTILE INDUSTRY
1. Method study, procedure process chart, Flow and handling of materials, movement of workers, string diagram, method and movements in the work place. 12
2. Principles of motion economy; SIMO chart, work measurement procedures; time study-equipment and forms - Job breaking down into units. 18
3. Rating, Scales, Factors, human Factor; Working condition - allowances-use of time standards-estimating - standardisation. 15

TOTAL 45

REFERENCE:

PTT045 BONDED FABRICS
1. INTRODUCTION 5
Definitions and classification of bonded fabrics. Historical development. Fibres used. Production and sales.


REGULATIONS AND SYLLABUS

(REGULATIONS 2002)

(B.TECH., Degree Programme Part - time 7 Semesters)

CHEMICAL ENGINEERING

ANNA UNIVERSITY
CHENNAI - 600 025
CURRICULUM AND SYLLABI

B. TECH DEGREE PROGRAMME
(7 SEMESTERS - PART TIME)

CHEMICAL ENGINEERING
(Under Regulations 2002)

ANNA UNIVERSITY
Chennai - 600 025.
ANNA UNIVERSITY
REGULATIONS 2002
B.E. / B.TECH DEGREE PROGRAMME
(PART-TIME - SEVEN SEMESTERS)
[APPROVED IN THE 47TH MEETING OF THE ACADEMIC
COUNCIL HELD ON 15.12.2001 (ITEM NO. 47.3)]
(Applicable For Students Admitted
From January 2002 Onwards)

1. CONDITIONS FOR ADMISSION:

1.1 QUALIFICATIONS
Candidates for admission to the first semester, also known as Bridge semester of the seven semester part-time B.E. / B.Tech degree programme shall be required to have passed the Diploma Examination in Engineering / Technology in the relevant branch of specialization of the State Board of Technical Education, Tamil Nadu or any other equivalent examination already recognized by Anna University.

1.2 ELIGIBILITY
Candidate seeking admission shall satisfy the following conditions:

i) Eligibility conditions such as class, marks, number of attempts shall be as prescribed by the syndicate of the University from time to time.

ii) Shall have completed one year after qualifying for the Diploma, the period being counted as on first January of the year of which admission is sought.

iii) Notwithstanding the qualifying examination the candidate might have passed (vide clause 1.1.) he / she shall have a minimum level of proficiency in Mathematics, Physics, Chemistry and the
relevant branch of study as may be prescribed by the University.

iv) Shall be employed within a zone of 65km radius from the study campus of the University.

v) Shall satisfy the conditions of physical fitness as prescribed by the syndicate of the university.

2. DURATION OF PROGRAMME

The duration of the programme shall be seven consecutive semesters, spread over 3.5 academic years, two semesters constituting an academic year. Each semester shall have a minimum of 75 working days excluding the end-semester examination.

3. BRANCHES OF STUDY

A candidate may be offered, at the time of admission, one of the following branches of study.

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<thead>
<tr>
<th>S. No.</th>
<th>Degree and branch</th>
<th>Qualification for admission</th>
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<tr>
<th>S. No.</th>
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<tr>
<td>6.</td>
<td>B.E. Mechanical Engg.</td>
<td>Diploma in Mechanical Engineering / Metallurgy / Automobile Engineering / Mechanical and Rural Engineering / Machine Tool Maintenance and Repairs / Machine Design and Drafting / Refrigeration and Air-conditioning / Production Engineering / Tool and Die Design</td>
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<tr>
<td>7.</td>
<td>B.E. Manufacturing Engg.</td>
<td>Diploma in Mechanical Engineering / Metallurgy / Automobile Engineering / Mechanical and Rural Engineering / Machine Tool Maintenance and Repairs / Machine Design and Drafting / Refrigeration and Air-conditioning / Production Engineering / Tool and Die Design</td>
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<td>8.</td>
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<td>Course of Study</td>
<td>Diploma in Chemical Engg. / Chemical Technology / Chemical Technology (SW) / Petroleum Engineering / Petro Chemical Technology / Plastic Engineering(SW)/ Plastic Mould Technology / Polymer Technology / Polymer (SW) / Pulp and Paper Technology / Sugar Technology.</td>
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### 4. COURSE OF STUDY

The course of study shall include theory and practicals as detailed in the respective curriculum.

The medium of instruction shall be English.

### 5. EVALUATION OF CANDIDATES PERFORMANCE

#### 5.1

The maximum marks for each theory and practical course (subject) shall be 100 comprising of 20 marks for continuous assessment and 80 marks for the examinations conducted by the University. The examinations shall ordinarily be conducted in November / December or in April / May depending on odd or even semesters. For practical examinations (including Project work), both internal and external examiners shall be appointed by the University.

#### 5.2 PROCEDURES FOR AWARDS MARKS FOR CONTINUOUS ASSESSMENT

#### 5.2.1 Theory Subjects

Three tests each carrying 100 marks shall be conducted by the department / institution. The total marks obtained in all the tests put together out of 300, shall be reduced to 20 marks and rounded to nearest integer (This implies equal weightage to all the three tests).
5.2.2 Practical subjects
Every practical exercise / experiment shall be evaluated based on conduct of experiment / exercise and records maintained. There shall be at least one mid-semester test. The criteria for arriving at the internal assessment marks shall be decided by the Head of the institution and shall be announced at the beginning of every semester.

5.2.3 Theory Subjects with Laboratory component:
If there is a theory subject with laboratory component, there shall be three tests; the first two tests (each 100 marks) will be from theory portions and the third test (maximum mark 100) will be for laboratory component. The sum of marks of first two tests shall be reduced to 10 marks and the third test mark shall be reduced to 10 marks. The sum of these for 20 marks may then be arrived at and rounded to nearest integer.

5.2.4 Project Work:
There shall be three assessments (each 100 marks) during the semester by a review committee. The student shall make presentation on the progress made before the committee. The Head of the institution shall constitute the review committee for each branch of study. The total marks obtained in the three assessments shall be reduced to 20 marks and rounded to the nearest integer.

6. DISCIPLINE
6.1 Every student is required to be disciplined and to have decorous behavior both inside and outside the campus and not to indulge in any activity, which will tend to bring down the prestige of the university.

6.2 Any act of indiscipline of a student reported to the Dean / Head of Institution will be referred to a Discipline and Welfare Committee nominated by the Syndicate from time to time, for taking appropriate action.

7. REQUIREMENT FOR COMPLETION OF A SEMESTER
7.1 A candidate who fulfills the following conditions shall be deemed to have satisfied the requirements for the completion of a semester.

i. He / she secures not less than 70% overall attendance taking into account the total number of periods attended by the candidate in all the courses put together as against the total number of periods in all the courses offered during the semester.

ii. He / she earns a progress certificate from the Head of the Department and the Dean / Head of Institution for having satisfactorily completed the programme of study in all the courses pertaining to that semester.

iii. His / her conduct is found to be satisfactory as certified by the Head of the Department and the Dean / Head of Institution.

7.2 Candidates who do not complete the semester (as per clause 7.1), will not be permitted to write the end-semester examination and are not permitted to go to next semester. They are required to repeat the incomplete semester in the next academic year.

8. REQUIREMENTS FOR APPEARING FOR END SEMESTER EXAMINATION
A candidate shall normally be permitted to appear for the end semester examination of the current semester. If he / she has satisfied the semester completion requirements (vide clause 7) and has registered for examination in all the courses of that semester.

9. REQUIREMENT FOR PROCEEDING TO A HIGHER SEMESTER
A candidate shall be permitted to proceed from the current semester to the next semester, irrespective of the annual courses he / she may have in the earlier semester only if
10.4 A candidate who qualifies for the award of the degree (vide clause 14) passing the examination in all the courses in all the seven semesters in his / her first appearance within seven consecutive semesters (3.5 academic years) and in addition secures an aggregate of not less than 75% of the total marks (continuous assessment plus semester examination marks) for all the courses in the semester II to VII put together shall be declared to have passed the examination in First Class with Distinction. For this purpose, the withdrawal from examination (vide clause 11) shall not be construed as an appearance. Further any authorized break of study will be excluded from the total duration while finding the period of completion (vide clause 12.3).

10.5 A candidate who qualifies for the award of the degree (vide clause 14) passing the examination in all the courses in the semester II to VII within a period of seven consecutive semesters after his / her commencement of study in the second semester and in addition secures an aggregate of not less than 60% of the total marks (continuous assessment plus semester examination marks) for all the courses in the semesters II to VII put together shall be declared to have passed the examination in First Class. For this purpose the period of completion will be arrived at by excluding any authorized break of study (vide clause 12.3).

10.6 All other candidates who qualify for the award of the degree (vide Clause 14) shall be declared to have passed the examination in Second Class.

10.7 A candidate who absents in the end semester examination in a course / project work after having registered for the same, shall be considered to have appeared in that examination for the purpose of classification.
11. PROVISION FOR WITHDRAWAL FROM SEMESTER EXAMINATION

11.1 A candidate, may for valid reasons and on prior application, be granted permission to withdraw from appearing for the examination of any one course or consecutive examinations of more than one course in a semester examination.

11.2 Such withdrawal shall be permitted only once during the entire period of study of the degree programme.

11.3 Withdrawal application is valid only if it is made within the prescribed number of days prior to the commencement of the examination in that course or courses and recommended by the Head of Department and the Dean/Head of the Institution.

11.4 Withdrawal shall not be construed as an appearance for the eligibility of a candidate for First Class with Distinction.

11.5 The candidate shall reappear in the examination only when the examination in the withdrawn course or courses is conducted subsequently.

12. PROVISION FOR BREAK OF STUDY

12.1 Break of study shall not normally be permitted. However, if a candidate intends to temporarily discontinue the programme in the middle, for valid reasons, and to rejoin the programme in a later semester, permission may be granted based on the merits of the case provided he/she applies to the university in advance, but not later than the last date for registering for the end semester examination of the semester in question, through the Head of the Department and the Dean/Head of Institution stating the reasons therefore and the probable date of rejoining the course.

12.2 The candidate rejoining the programme after the authorized break of study shall be covered by the rules and regulations in force at the time of rejoining.

12.3 The duration specified for passing all the courses for the purpose of classification (vide clause 10.3 and 10.4) shall be increased by the period of such authorized break of study.

12.4 The total period for completion of the programme reckoned from the commencement of the first semester to which the candidate was admitted shall not in any case exceed the prescribed maximum period (vide clause 14), irrespective of the period of break of study.

12.5 If any student is either detained in a semester for want of requisite attendance progress and good conduct or suspended from the programme by Discipline and Welfare Committee, the resulting period of break of study shall not be considered as an authorized break of study for purpose of classification and clause 12.3 is not applicable in this case.

13. PROVISION FOR IMPROVING CONTINUOUS ASSESSMENT MARKS

If a candidate wishes to improve his/her continuous assessment marks in any course or courses, he/she shall apply through the Head of the Department and the Dean/Head of Institution for permission to rejoin and repeat that course or courses. Permission may be granted on the merits of the case subject to the following conditions:

i. Such candidate can rejoin the regular semester or semesters when these courses are offered and shall repeat the programme of study in these courses satisfying all requirements (vide clause 7).

ii. The maximum period for completion of the programme shall remain as prescribed in clause 14.

iii. He/she shall be eligible to rejoin and repeat all the courses in any one semester or up to a maximum of five courses, if the regular semester time table accommodates.
iv. He/she will be eligible for repeating a course or courses while undergoing a regular semester course of study, if the same is offered by the concerned Head of the Department.

v. The continuous assessment marks and semester examination marks earned during the repeat semester(s) shall alone be valid subsequently.

vi. The candidate will not be eligible for first class with distinction if he/she repeats courses or semester(s) other than the first semester even if he/she is eligible otherwise for the same (vide clause 10.3 and 10.4).

vii. For the purpose of attendance requirement (vide clause 7(i), the attendance will be considered course wise for each course, if the candidate does not repeat all the courses in a semester.

14. ELIGIBILITY FOR THE AWARD OF THE DEGREE

A candidate shall be declared to be eligible for the award of the Degree if he/she has:

i. Undergone the programme for a period of seven semesters.

ii. Passed the examination in all the courses prescribed in the perspective curriculum within maximum period of 8 years reckoned from the commencement of the first semester to which the candidates was admitted. This maximum period shall be 10 years in the case of women candidates.

iii. No disciplinary action pending against him/her.

The award of the degree must be approved by the syndicate.

15. REVISION OF REGULATIONS AND CURRICULUM

The University may from time to time revise, amend or change the regulations, courses of study, syllabi and assessment procedure if found necessary.
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<tr>
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### SEMESTER VI

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### LIST OF ELECTIVE SUBJECTS

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</tbody>
</table>
1. MATRICES
   Characteristic equation – Eigen values and Eigen vectors of a real matrix – Cayley Hamilton theorem – Reduction of a real symmetric matrix to diagonal form.

2. FUNCTIONS OF SEVERAL VARIABLES

3. ORDINARY DIFFERENTIAL EQUATIONS
   Linear equations of second order with constant coefficients – Euler’s equation – Simultaneous equations of first order with constant coefficients.

4. ANALYTIC FUNCTIONS
   Cauchy – Riemann equations – Properties – Finding harmonic conjugates and analytic functions – Conformal mappings of \( w = z + a, 1/z, k_2, z, \sin z, \cos z, e \) and bilinear transformations.

5. COMPLEX INTEGRATION
   Cauchy’s theorem – Cauchy’s integral formula – Taylor and Laurent’s series, singularities and residues – Cauchy’s residue theorem – Contour integration around circular and semi-circular contours.

REFERENCE:
UNIT IV: MODERN PHYSICS
Quantum Nature of energy – Dual nature of matter – Einstein's mass-energy relation – Nuclear fission – Controlled chain reaction – Nuclear power reactor – Nuclear fusion – Crystalline and non-crystalline solids – Unit cell and Bravais lattices – Miller Indices – Packing factor of SC, BCC and FCC.
UNIT V: NON-DESTRUCTIVE TESTING
Different steps involved in non-destructive testing – Principle of X-ray radiographic technique – Comparison between X-ray radiography and gamma ray radiography – Liquid penetrant method – Ultrasonic method – Magnetic and electrical methods.

REFERENCE BOOKS:

TOTAL 45

PTCM130 CHEMISTRY
1. WATER

2. ENERGY SOURCES:

3. CORROSION AND ITS CONTROL

4. POLYMERIC MATERIALS

5. POLLUTION AND ITS CONTROL
Causes of air and water pollution – primary and secondary pollutants – assessment of water pollution – definition and

TEXT


PTEC130 BASIC ELECTRONICS

1. SEMICONDUCTOR DEVICES
   PN Junction diode – Zener diode – Bipolar junction – Transistor, JEET, MOSFET, Thyristors – UJT – Photo diode and LED.

2. ELECTRONIC CIRCUITS

3. INTEGRATED CIRCUITS
   IC technology – Operational Amplifier and its applications

4. DIGITAL INTEGRATED CIRCUITS

5. COMMUNICATION
   AM – FM Modulation and demodulation, Concept of Tuned Amplifier, AM – FM Receivers: Characteristics and Types.

TOTAL 45

TEXT BOOK

2. G.Kennedy and Fernand Davis, "Electronic Communication Systems"

REFERENCES


PTGE130 COMPUTER PROGRAMMING

1. COMPUTER FUNDAMENTALS
   Hardware and Software – Typical specification of a computer system – concepts of networking, e-mail, internet – Operating systems: Windows, UNIX fundamentals.

2. GENERAL APPLICATION SOFTWARE
   Word processing, Database Management system, spreadsheet package, presentation software.

3. C-PROGRAMMING

4. LABORATORY PRACTICE

TOTAL 45
REFERENCES

PTMA231 MATHEMATICS – II

1. FOURIER SERIES:
Dirchlet’s conditions - general Fourier series - half range sine and cosine series - Parseval’s identity - harmonic analysis.

2. FOURIER TRANSFORMS:
Fourier integral representation - Fourier transform pairs, properties - Fourier sine and cosine transforms - transforms of simple functions - transforms of derivatives - the convolution integrals of Fourier - application to one-dimensional wave and diffusion equations.

3. LAPLACE TRANSFORMS:
Transforms of simple functions - basic operational properties - transforms of derivatives and integrals - periodic functions - convolution theorem - inverse transforms - initial and final value theorems - applications of Laplace transforms to linear ordinary differential equations.

4. PARTIAL DIFFERENTIAL EQUATIONS:
Formation - solution of standard types of first order equation and LaGrange’s Linear Equation - linear partial differential equations of second and higher order with constant coefficients.

5. BOUNDARY VALUE PROBLEM:
Classification of second order partial differential equations, transverse vibrations of a string, One-dimensional heat equation and Two-dimensional heat flow, Fourier series solutions in Cartesian coordinates.

REFERENCES:

TEXT BOOKS:
PTCH233 ELECTRICAL MACHINES AND DRIVES

1. ELECTRIC CIRCUITS
   Definition – ohm’s law – series parallel circuit – parallel circuit –
   Division of current – Kirchoffs law; Superposition and
   Thevenin’s Theorem; Star-delta transformation; Simplification
   of networks.

2. A.C.CIRCUITS
   Alternating Voltage; Need for A.C.Voltage; Sinusoidal A.C.
   Voltage; R.L and R.L.C networks; Impedance angle; Power
   and Power factor; Actual and apparent power; Resonance in
   A.C.Circuits; Series, parallel and series-parallel resonance;
   Vector Diagram (Phasor Diagram); Complex algebra applied to
   sinusoids; Three phase circuits; Three phase loading;
   Balanced loads; Simple problems.

3. D.C.MACHINES
   Lenz’s law of electromagnetic induction; Fleming’s rule,
   Principle of operation of D.C.Machines; Kinds of
   D.C.machines; Emf equation of D.C. generators; Speed control
   of D.C. motor; Starters; Application of D.C. Machines.

4. A.C.MACHINES
   Principle of operation of A.C.Machines : Transformer; single
   and three phase induction motors. Alternators: Synchronous
   motors; Equivalent circuit, Regulation and efficiency of single
   phase transformer; Slip—torque characteristics induction
   motors; starting of induction motors. Emf equation, Regulation
   and synchronisation of alternators; Synchronous condensers;
   Hunting in synchronous motor; Single phase induction motors
   and their applications.

5. DRIVES
   Industrial requirements and Ward Leonard System of Drives.
   Servo—Motors; Basic theory and applications.

TEXT BOOKS
   Publishers, (1975)
   publishers (1995)
4. Marimuthu, P., Basic Electrical and Electronic Engg., Prathiba
   Publishers, (1990)

PTCH234 MECHANICAL ENGINEERING

1. LAWS OF THERMODYNAMICS
   Basic concepts and hints; Zeroth law; First Law of
   Thermodynamics – Statement and application; Steady flow
   energy equation; Second law of Thermodynamics—Statement;
   Limitations Heat Engine; Heat Pump, Available energy,
   Kelvin—Plank statement and Clausius statement;
   Equivalence of entropy; Reversibility: Entropy charts; Third law of
   Thermodynamics—Statement.

2. HEATING AND EXPANSION OF GASES
   Expressions for; work done; Internal energy, Hyperbolic and
   polytropic processes; Free expansion and Throttling.

3. AIR STANDARD EFFICIENCY
   Carnot cycle; Stirling Cycle; Joule Cycle; Otto Cycle; Diesel
   Cycle; Dual combustion Cycle.

TOTAL 45
4. I.C. ENGINES
   Engine nomenclature and classifications; Si Engine; Ci Engine; Four Stroke cycle; Two stroke cycle; Performance of I.C. Engine; Brake thermal efficiency; Indicated Thermal Efficiency; Specific fuel consumption.

5. STEAM AND ITS PROPERTIES
   Properties of steam; Dryness fraction; latent heat; Total heat of wet steam; Superheated steam. Use of steam tables; volume of wet steam; Volume of superheated steam; External work of evaporation; Internal energy; Entropy of vapour, Expansion of vapour, Rankine cycle; Modified Rankine cycle.

6. STEAM ENGINES AND TURBINES
   Hypothetical indicator diagram of steam engine; Working of a simple steam engine; steam turbines—Impulse and Reaction types—Principles of operation.

7. SIMPLE MECHANISM
   Kinematic Link, Kinematic Pair, Kinematic Chain; Slider Crank mechanism and inversions; Double slider crank mechanism and inversions.

8. FLY WHEEL
   Turning moment Diagram; Fluctuation of Energy; Design of fly wheel.

9. DRIVES
   Belt and rope drives; Velocity ratio; slip; Ratio of tensions; Length of belt; Maximum HP; simple compound and Epicyclic gear trains.

10. BALANCING
    Balancing of rotating masses in same plane; Balancing of masses rotating in different planes.

TOTAL 45
sections - leaf springs - flitched beams - shear stress distribution in beams - determination of shear stress in flanged beams.

5. TORSION
Torsion of circular shafts - derivation of torsion equation \( T = \frac{C}{R} - GtL \) - stresses and deformation in circular and hollow shafts - stresses and deformation in circular and hollow shafts - stepped shafts - shafts fixed at both ends - stresses in helical springs - deflection of springs - spring constant.

6. COLUMNS
Axially loaded short columns - columns of unsymmetrical sections - Euler's theory of long columns - critical loads for prismatic columns, with different end conditions - effect of eccentricity.

TOTAL 45

TEXT BOOKS

PTCH236 ORGANIC CHEMISTRY
1. CARBOHYDRATES
Introduction - Mono and Disaccharides - Important reactions - Polysaccharides - Starch and Cellulose - Derivatives of

Cellulose - Carboxy Methyl cellulose and gun cotton - structural aspects of cellulose

2. ORGANO METALLIC COMPOUNDS
Grignard reagents and their synthetic utility - Organo Silicon compounds

3. OILS, FATS AND WAXES
Analysis of oils and fats - classification of waxes

4. HETERO CYClic COMPOUNDS
Furan, Thiophene, Pyrrole, Pyridine, and Indole - Their important derivatives

5. DYES AND DYING
- Colour and constitution
- Synthesis of some important azodyes (Methyl orange, Methyl red and Congo red)
- Synthesis of Triphenylmethane dyes (Malachite green, Para Rosaniline Anthraquinone dyes (Alizarin)
- Phthalein dyes - Eosin preparation
- Introduction to Natural and Reactive dyes

6. AMINO ACIDS AND PROTEINS
Classification of proteins - Tests for proteins - Denaturation - structural aspects of wool.

7. PHARMACEUTICAL CHEMISTRY
Synthesis of antimalarial drugs - Isopentaquine and chloroquine - Antibacterial drugs - Synthesis of sulphadimidine, sulphapyridine

TOTAL 45
REFERENCE BOOKS


PTCH241 COMPUTER APPLICATIONS IN CHEMICAL ENGINEERING

1. INTRODUCTION
   Review on Programming languages, Basic, Fortran, Review on operating system commands.

2. SPREAD SHEETS
   Application in Density, molecular weight, mole and percentage compositions, Empirical and Molecular formula calculations, Heat of mix, Gas laws, Vapour pressure, Chemical Kinetics calculations.

3. SPREAD SHEETS (DATA ANALYSIS)
   Application in data processing, Statistical analysis of data, Regression Analysis of variance, Interpolation, Graphical representations.

4. DATABASE
   Design and developments of simple databases on Chemical and Physical properties of substances. Retrieval and Databases in report, query and other formats, Interfacing with other softwares.

5. MATHEMATICAL PROGRAMMING
   Linear Programming, Transportation, Assignment, Dynamic Programming in Chemical Engineering, Formulation and solution through PC based programmes.

TOTAL 45

REFERENCES :


PTCH242 PHYSICAL CHEMISTRY

1. ELECTROCHEMISTRY
2. CHEMICAL KINETICS

3. PHASE RULE
Definition – Derivation – Application of phase rule to water system – Thermal Analysis – Cooling curves – Two Component system – Eutectic and compound formation.

4. ADSORPTION AND CATALYSIS
Physical and chemical adsorption – Types of adsorption isotherm, BET method, Giba equation, Homogeneous catalysis – Heterogeneous catalysis, acid – base catalysis, Enzyme catalysis – Applications of catalysts in industries.

5. COLLOIDS

6. PHOTOCHEMISTRY
Laws of Photochemistry, Quantum efficiency, Photochemical reactions, Actinometry, Kinetics and mechanism of Hydrogen – Bromine reaction.

REFERENCES

TOTAL 45

PTCH243 MATERIALS TECHNOLOGY

1. NATURE OF MATERIALS
Micro and macro structures, properties and definitions; mechanical, thermal, chemical, electrical and magnetic properties, processing of metals and alloys – casting – hot and cold rolling – extrusion – forging – deep drawing – plastic deformation of metal, single crystals and polycrystalline metals – recovery and recrystallization of plastically deformed metals.

2. FERROUS METALS
Pure iron; cast iron; mild steel, stainless steels, special steels and alloys; high temperature steels; iron – iron carbide phase diagram; heat treatment of plain – carbon steels. Manufacture, properties and application in chemical industries

3. NON-FERROUS METALS
Lead, tin and magnesium; manufacturing methods, properties and application in process industries.

4. NON-METALS

I. POLYMERIC MATERIALS

II. COMPOSITE MATERIALS

III. CERAMIC MATERIALS
Ceramic crystal and silicate structures processing of ceramics – properties – glasses – enamels.
4. INORGANIC MATERIALS
Manufacture of cement and its properties; special cement; cement concrete; reinforced and prestressed concrete: their properties and applications; mixing and curing.

5. CORROSION
Definition and scope; basic theories and mechanism of corrosion; types of corrosion; application of corrosion theories in equipment design and fabrication – anti – corrosion methods.

6. COATINGS
Organic paints and coatings; metal coatings; ceramic coatings; lining.

7. SELECTION OF MATERIALS
General criteria for selection of materials of construction in process industries.

REFERENCES

TOTAL 45
8. NITROGEN INDUSTRIES  
Synthesis ammonia and nitric acid.

9. FERTILISER INDUSTRIES  
Growth elements, function, nitrogenous fertilisers ammonium sulphate, ammonium nitrate and urea phosphoric fertilisers, single and triple super phosphate, ammonium phosphate, nitro phosphate, potassic fertilisers, potassium chloride, potassium nitrate and phosphate, compound fertilisers and bio-fertilisers.

10. AGRICHEMICAL INDUSTRIES  
Insecticides, pesticides, herbicides, plant nutrients and regulators.

11. NUCLEAR INDUSTRIES  
Production of uranium, thorium and zirconium from ores and minerals, separation of isotopes, waste disposal.

12. ELECTROLYTIC AND ELECTROTHERMAL INDUSTRIES  
Explosives, types and characteristics, industrial and military explosives, propellants for rockets.

13. EXPLOSIVES AND PROPELLANTS INDUSTRIES  
Paints, pigments, varnishes, lacquers, industrial and marine coatings.

14. SURFACE COATING INDUSTRIES  
Paints, pigments, varnishes, lacquers, industrial, and marine coatings.

15. PHOTOGRAPHIC CHEMICALS  
Photographic chemicals, manufacture of films, plates and papers, recovery.

TOTAL 45

REFERENCES

PTCE245 INSTRUMENTAL METHODS OF ANALYSIS

1. INTRODUCTION TO SPECTROSCOPICAL METHODS OF ANALYSIS  
ELECTROMAGNETIC RADIATION: Various ranges, Dual properties, Various energy levels, Interaction of photons with matter, absorbance & transmittance and their relationship, Permitted energy levels for the electrons of an atom and simple molecules, Classification of instrumental methods based on physical properties.

QUANTITATIVE SPECTROSCOPY: Beer – Lambert's law, Limitations, Deviations (Real, Chemical, instrumental), Nesslerometry, Duboscq colourimetry, Estimation of inorganic ions such as Fe, Ni and estimation of Nitrate using Beer – Lambert's Law.

2. MOLECULAR SPECTROSCOPY  
Various electronic transitions in organic and inorganic compounds effected by UV, Visible and infra red radiations, Various energy level diagrams of saturated, unsaturated and carbonyl compounds, excitation by UV and Visible radiations,
Woodward-Fischer rules for the calculation of absorption maxima (dienes and carbonyl compounds). Effects of auxochromes and effects of conjugation on the absorption maxima, Instrumentation for UV, VISIBLe and IR spectroscopies (Source, Optical parts and Detectors), Multicomponent analysis, Photometric titration (Experimental set-up and various types of titrations), Applications of UV, VISIBLe AND IR spectroscopies.

3. ATOMIC SPECTROSCOPY
Atomic absorption spectrophotometry: Principle, Instrumentation and Applications, Various interferences observed in AAS (Chemical radiation and excitation).

4. POLARIMETRY AND REFRACTOMETRY
Principle, Instrumentation and Applications.

5. ELECTROMETRIC METHODS OF ANALYSIS
Introduction to electrometric methods, difference between redox and acid–base reactions, types of cells, schematic representation of cells, single electrode potential, laboratory reference electrodes (Standard hydrogen, saturated calomel, Ag–AgCl and inert electrodes), ion-selective electrodes. Potentiometry: Nernst equation, experimental set-up and measurement of pH, Conductometry: Measurement of conductance, experimental set-up and various titrations (strong and weak acid/base).

6. XRD ANALYSIS
Introduction, Moseley’s law, Different emission and diffracton methods, various X-ray detectors.

7. THERMAL METHODS
Thermogravimetry: Instrumentation, factors affecting the shapes of thermograms, applications, thermograms of some important compounds (CuSO₄·5H₂O, CaC₂O₄·2H₂O etc.). Differential thermal analysis: Principle, Instrumentation and applications, differences between DSC and DTA. Applications of DSC (Inorganic and Polymer samples).

8. CHROMATOGRAPHIC METHODS
Classification of chromatographic methods, Column, Thin layer, Paper, Gas, High Performance Liquid Chromatographical methods (Principle, mode of separation and Technique). Separation of organic compounds by column and Thin layer, mixture of Cu, Co and Ni by Paper, separation of amino acids by paper, estimation of organic compounds by GC and HPLC.

REFERENCES
thermodynamic formulations, thermodynamic properties of an ideal gas, entropy change in reversible and irreversible process.

5. THERMODYNAMIC PROPERTIES OF REAL GASES

The PVT behaviour of fluids, laws of corresponding states and equation of states approaches to the PVT relationships of non ideal gas problems, compressibility factors, generalised equations of state, property estimation via generalised equation of state, fugacity and fugacity coefficients of real gases.

6. COMPRESSION OF FLUIDS

Thermodynamic aspects of compression process, classification of compression processes, basic equation for change of state of gases, the work expression for different situations, the effect of clearance volume, multistage compression, convergent divergent flow, Ejectors.

TOTAL 45

REFERENCES


1. **UNITS AND DIMENSIONS**
   Basic and derived units, use of model units in calculations, methods of expression, compositions of mixture and solutions.

2. **GAS CALCULATIONS**
   Ideal and real gas laws, gas constant calculations of pressure, volume and temperature using ideal gas law, use of partial pressure and pure component volume in gas calculations, application of real gas relationship in gas calculation.

3. **MATERIAL BALANCE**
   Stoichiometric principles, application of material balance to unit operations like distillation, evaporation, crystallisation, drying etc., material balance with chemical reaction, limiting and excess reactants, recycle, by pass and purging.

4. **HUMIDITY AND SATURATION**
   Calculation of absolute humidity, molar humidity, relative humidity and percentage humidity, use of humidity in condensation and drying, humidity chart, dew point.

5. **FUELS AND COMBUSTION**
   Determination of Orsat analysis of products of combustion of solid, liquid and gas fuels, calculation of excess air from orsat technique, problems on sulphur and sulphur burning compounds.

6. **THERMO PHYSICS**
   Heat capacity of solids, liquids, gases and solutions, use of mean heat capacity in heat calculations, problems involving sensible heat and latent heats, evaluation of enthalpy.

7. **THERMOCHEMISTRY**
   Standard heat of reaction, heats of formation, combustion, solution, mixing etc., calculation of standard heats of reaction, effect of pressure and temperature on heat of reaction, energy balance for systems with and without chemical reaction.

8. **UNSTEADY STATE MATERIAL AND ENERGY BALANCES**
   Problems on unsteady state material and energy balances.

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**REFERENCES**

2. PRESSURE DISTRIBUTION IN A FLUID
Pressure and pressure gradient, equilibrium of fluid element, hydrostatic pressure distributions applications to manometry hydrostatic forces on planed and curved submerged surfaces, laws of buoyancy and stability considerations for bodies in flotation.

3. INTEGRAL RELATIONS FOR A CONTROL VOLUME
Basic laws of fluid mechanics, concept of system and control volume concept, the Reynold's transport theorem, continuity equation, the linear momentum equation, the angular momentum theorem, steady flow energy equation, friction less flow, Bernoulli equation, relation between the Bernoulli and steady flow energy equation.

4. DIFFERENTIAL RELATIONS FOR A FLUID PARTICLE
The acceleration field of a fluid, the differential of conservation of mass, the differential equation of linear momentum, the Euler's and Navier-Stoke's equations, differential equation of energy, boundary conditions for the basic equations, the stream function, vorticity and irrotationality.

5. DIMENSIONAL ANALYSIS AND SIMILITUDE
The principle of dimensional homogeneity, the Pi-theorem, non-dimensional action of the basic equations, similitude, relationship between dimensional analysis and similitude, use of dimensional analysis for scale up studies.

6. VISCOUS FLOW IN DUCTS AND BOUNDARY LAYER FLOW
Reynolds number regimes, internal versus external viscous flow, flow in circular pipe and head loss, minor losses in pipe systems, multiple-pipe systems, boundary layer concepts, functions and pressure drag, flow through fixed and fluidised beds.

7. FLOW MEASUREMENT AND TURBO MACHINERY
Constant and variable headmeters, classification of turbo machines, pumps performance curves and similitude, mixed and axial pumps, matching pumps to system characteristics, compressors and its efficiency.

8. COMPRESSIBLE FLOW
Adiabatic and isentropic flow with the area changes, shock waves, operation of convergence and divergence nozzles, compressible duct flow with friction.

9. COMPUTATIONAL FLUID MECHANICS
Introduction, numerical operations for differentiation and integration, fluid flow problems represented by partial differential equation.

REFERENCES

PTCH334 CHEMICAL PROCESS INDUSTRIES II

1. WOOD-DERIVED CHEMICALS, PULP AND PAPER INDUSTRIES
   Hardwood distillation and extraction products saccharification of wood, cellulose derivatives, pulp, paper and boards.

2. SUGAR AND STARCH INDUSTRIES
   Raw and refined sugar, by products of sugar industries, starch and starch derivatives.

3. OILS, FATS, SOAP AND DETERGENT INDUSTRIES
   Vegetable oils and animal fats, their nature, analysis and extraction methods, hydrogenation of oils, fatty acids and alcohols, waxes, soap, synthetic detergents.

4. COAL CHEMICAL INDUSTRIES
   Destructive distillation of coal and coal tar products, coal chemicals.

5. PETROLEUM AND PETROCHEMICAL INDUSTRIES
   Petroleum refining, physical and chemical conversion products, lubricating oils, petrochemical precursors, methanes, olefins, acetylenes and aromatics and products obtained from them by various unit processes.

6. PLASTICS RUBBER AND LEATHER INDUSTRIES
   Raw materials, classification of polymers, synthetic and polymers, polyethylene, polystyrene, PVC, polyester, ABS, teflon, formaldehyde and epoxides, polyurethanes and silicones, rubber, natural rubber, synthetic rubber monomers, SBR, polystyrene, polyisoprene, polychloroprene, acrylic and silicone rubber, reclaiming of rubber, compounding of rubber, leather tanning and finishing.

7. SYNTHETIC FIBRE AND FILM INDUSTRIES
   Viscose rayon, cuprammonium and cellulosic acetate, nylons, polyesters, acrylics, monoacrylics polypropylene.

8. DYES AND INTERMEDIATE INDUSTRIES
   Raw materials, important unit process, various types of dye intermediates and dyes.

9. DRUGS AND PHARMACEUTICAL INDUSTRIES
   Raw materials, classification, basic drugs by simple and complex unit processes, formulated products.

10. FOOD AND FOOD BYPRODUCT INDUSTRIES
    Types of foods, food additive products, food processing and preservation methods, food by products.

TOTAL 45

REFERENCES


PTCH335 MECHANICAL OPERATIONS

1. PARTICLE CHARACTERISTICS AND SIZE ANALYSIS
   General characteristics of solids, their behaviour under different external forces, agglomeration, techniques for size analysis.

2. SIZE REDUCTION
   Laws of size reduction, classification of equipment, methods of size reduction, disintegration, preparation of colloids.

3. MECHANICAL SEPARATIONS
   Screening and screening equipment, effectiveness of screens, gravity settling, sedimentation, thickening, centrifugal separation, impingement methods, industrial dust removing equipment with special reference to electrostatic and magnetic separators, heavy media separations, flotation.

4. FILTRATION
   Theory of filtration, Batch and continuous filters, centrifuges, membrane and ultra filtration.

5. MIXING AND AGITATION
   Equipment for blending and kneading, dispersion, power for agitation, correlations.

6. STORAGE AND CONVEYING OF SOLIDS
   Conveyors, elevators, pneumatic conveying. Different methods for storage of solids.

TOTAL 45

REFERENCES

PTCH338 CHEMICAL ENGINEERING THERMODYNAMICS II

1. PROPERTIES OF SOLUTIONS
   Partial molar properties, ideal and non-ideal solutions, standard states definition and choice, Gibbs-Duhem equation, excess properties of mixtures.

2. PHASE EQUILIBRIA
   Criteria for equilibrium between phases in multi component non-reacting systems in terms of chemical potential and fugacity, application of phase rule, vapour-liquid equilibrium, phase diagrams for homogeneous systems and for systems with a miscibility gap, effect of temperature and pressure on azetope composition, liquid - liquid equilibrium, ternary liquid - liquid equilibrium.

3. CORRELATION AND PREDICTION OF PHASE EQUILIBRIA
   Activity coefficient-composition models, thermodynamic consistency of phase equilibria, application of the correlation and prediction of phase equilibria in systems of engineering interest particularly to distillation and liquid extraction processes.

4. CHEMICAL REACTION EQUILIBRIA
   Definition of standard state, standard free energy change and reaction equilibrium constant, evaluation of reaction equilibrium constant, prediction of free energy data, equilibria in chemical reactors, calculation of equilibrium compositions for homogeneous chemical reactors, thermodynamic analysis of simultaneous reactions.
5. REFRIGERATION

TOTAL 45

REFERENCES

PTCH339 CHEMICAL REACTION ENGINEERING
1. REACTION KINETICS
Law of mass action, rate equation, elementary, non-elementary reactions and their mechanisms, theories of reaction rate and temperature dependency, analysis of experimental reactor data, evaluation of rate equation, integral and differential analysis for constant variable volume system, fitting of data to complex reaction mechanism.

TOTAL 12

2. IDEAL REACTORS
Design for homogeneous systems, batch, stirred tank and tubular flow reactor, design of reactors for multiple reactions, combination reactor system, size comparison of reactors.

3. CHOICE OF REACTORS
Factors affecting choice, optimum yield and conversion, selectivity, reactivity and yield problems, consecutive, parallel and mixed reactions, recycle.

TOTAL 9

4. HEAT EFFECTS IN REACTORS
Isothermal and nonisothermal homogeneous reactor systems, adiabatic reactors, rates of heat exchanges for different reactors, design for constant rate heat input and constant heat transfer coefficient, operation, batch and continuous reactors, optimum temperature progression.

TOTAL 9

5. REACTOR STABILITY
Criteria for stability of reactors, limit cycles and oscillating reaction, parameter sensitivity.

TOTAL 4

6. REACTION EQUILIBRIA
Equilibrium in chemically reactive systems, evaluation of reaction equilibrium constant, effect of temperature on equilibrium, application to system involving gaseous components, computation of equilibrium composition.

TOTAL 5

REFERENCE
PTCH340 MASS TRANSFER I

1. DIFFUSION
Molecular and eddy diffusion in gases and liquids, steady state diffusion under stagnant and laminar flow conditions. Diffusivity measurement and prediction, multicomponent diffusion, diffusion in solids and its applications.

2. MASS TRANSFER COEFFICIENTS
Concept of mass transfer coefficients, mass transfer under laminar and turbulent flow past solids, boundary layers, mass transfer at fluids surfaces, correlation of mass transfer coefficients, JD, HTU and NTU concepts, theories of mass transfer and their applications, interphase mass transfer and over all mass transfer coefficients in binary, and multicomponent systems, application to gas-liquid and liquid-liquid systems.

3. HUMIDIFICATION AND AIR CONDITIONING
Basic concepts, psychrometric chart construction, humidification and dehumidification operations, design calculations, cooling tower principle and operation, types of equipment, design calculation.

4. DRYING
Theory and mechanism of drying, drying characteristics of materials, batch and continuous drying, calculation for continuous drying, drying equipment, design and performance of various drying equipments.

5. CRYSTALLISATION
Nuclei formation and crystal growth, theory of crystallisation, growth coefficients and the factors affecting these in crystallisation, batch and continuous industrial crystallisers, principle of design of equipment.

TOTAL 45

PTCH341 HEAT TRANSFER

1. BASIC PRINCIPLES
Importance of heat transfer in Chemical Engineering operations, Modes of heat transfer, Mean temperature difference.

2. CONDUCTION
Concept of heat conduction, Fourier’s law of heat conduction, one dimensional steady state heat conduction equation for flat
plate, hollow cylinder, hollow sphere heat conduction through a series of resistances, analogy between flow of heat and flow of electricity, thermal conductivity measurement, effect of temperature on thermal conductivity, conduction through liquids.

3. FILM COEFFICIENTS AND THEIR APPLICATION

Individual and overall heat transfer coefficients and the relationship between them, conduction with heat source, two dimensional steady conduction, analytical and graphical methods, transient heat conduction.

4. CONVECTION

Concept of heat transfer by convection, natural and forced convection, application of dimensional analysis for convection, equations for forced convection under laminar, transition and turbulent conditions, equations for natural convection, heat transfer from condensing vapours, heat transfer to boiling liquids, influence of boundary layer on heat transfer, heat transfer to molten metals, heat transfer in packed and fluidised beds.

5. HEAT EXCHANGERS

Parallel and counter flow heat exchangers, log mean temperature difference, single pass and multipass heat exchangers, plate heat exchangers, use of correction factor charts, heat exchangers effectiveness, number of transfer unit chart for different configurations, fouling factors and Wilson's plot, various types of heat exchangers design, design of furnaces, design of condensers, effect of non-condensibles design of tubular reactors.

6. RADIATION

Concept of thermal radiations, Black body concept-Stefan-Boltzmann's law, concept of grey body, radiation between surfaces, radiation from gases, luminous flames, radiation error in temperature measurement, tubular furnaces and applications.

7. EVAPORATION

Types of evaporation, single effect and multiple effect evaporation, calculation for single and multiple effect evaporation.

REFERENCES


PTCH342 PROCESS INSTRUMENTATION DYNAMICS & CONTROL

UNIT-1

Laplace transformation, transform of standard functions, derivatives and integrals, inversion, theorems in Laplace transformation, application, Open-loop systems, first order systems and their transient response for standard input
functions, first order systems in series, linearization and its application in process control, second order systems and their dynamics, transfer function for chemical reactors and dynamics.

UNIT-2
Closed loop control systems, development of block diagram for feed-back control systems, servo and regulator problems, Transfer function for controllers and final control element, principles of pneumatic and electronic controllers, transportation lag, transient response of closed-loop control systems and their stability.

UNIT-3
Introduction to frequency response of closed-loop systems, control system design by frequency, Bode diagram, stability criterion, Nyquist diagram; tuning of controller settings.

UNIT-4
Controller mechanism, introduction to advanced control systems, cascade control, feed forward control, control of distillation towers and heat exchangers, introduction to microprocessors and computer control of chemical processes.

UNIT-5
Principles of measurements and classification of process control instruments, measurements of temperature, pressure, fluid flow, liquid weight and weight flow rate, viscosity and consistency, ph, concentration, electrical and thermal conductivity, humidity of gases, composition by physical and chemical properties and spectroscopy.

TOTAL 45

REFERENCES

PTCH337 FLUID MECHANICS LAB

LIST OF EXPERIMENTS
1. Jaw crusher
2. Crushing rolls
3. Ball mill
4. Size analysis by sieving
5. Size analysis by subsieving
6. Filter press
7. Leaf filter
8. Cyclone separator
9. Sedimentation
10. Elutriator
11. Rotary Drum filter
12. Effectiveness of screen

TOTAL 45
PTCH432 CHEMICAL REACTION ENGINEERING II

1. NON-IDEAL REACTORS
   The residence time distribution as a factor performance; residence time functions and relationship between them in reactor; basic models for non-ideal flow; conversion in non-ideal reactors.

2. HETEROGENEOUS PROCESS AND SOLID CATALYSIS
   Rate equations for heterogeneous reactions nature of catalysis, adsorption isothermal and rates of adsorption desorption and surface reaction analysis of rate equation and rate controlling steps, surface area and pore-volume distribution, catalyst preparation.

3. GAS-SOLID CATALYTIC REACTORS
   Diffusion within catalyst particle effective thermal conductivity mass and heat transfer within catalyst pellets; effective factors, Tinie Modulus, fixed-bed reactors.

4. GAS-SOLID NON-CATALYTIC REACTORS
   Models for explaining the kinetics; volume and surface models; controlling resistances and rate controlling steps; time for complete conversion for single and mixed sizes, fluidised and static reactors.

5. GAS-LIQUID REACTIONS
   Absorption combined with chemical reactions; mass transfer coefficients and kinetic constants; application of film penetration and surface renewal theories; Hatta number and enhancement factor for first order reaction tower reactor design.

TOTAL 45

REFERENCES

PTCH433 MASS TRANSFER - II

1. ABSORPTION
   Equilibrium and operating line concept in absorption calculations; types of contactors; design of packed and plate type absorbers; Operating characteristics of stagewise and differential contactors; concepts of NTU, HTU and overall volumetric mass transfer coefficients; multicomponent absorption; mechanism and model of absorption with chemical reaction; thermal effects in absorption process.

2. DISTILLATION
   Vapour-liquid equilibria, Raoult's law and deviations from ideality, methods of distillation; fractionation of binary and multicomponent system; design calculations by McCabe-Thiele and Ponchon-Savarit methods; continuous contact distillation tower (packed tower) design; extractive and azotropic distillation; low pressure distillation; steam distillation.

3. LIQUID-LIQUID EXTRACTION
   Equilibrium in ternary systems; equilibrium stagewise contact calculations for batch and continuous extractors, differential contact extraction equipment-spray, packed and mechanically agitated contactors and their design calculations; pulsed extractors; centrifugal extractors.

4. SOLID-LIQUID EXTRACTION (LEACHING)
   Solid-liquid equilibria; leaching Equipment-batch and continuous types; calculation of number of stages.
5. ADSORPTION AND ION EXCHANGE
Theories of adsorption of gases and liquids; industrial adsorbents, adsorption equipment for batch and continuous operation; design calculation of ion-exchange resins; principle of ion-exchange; industrial equipment.

6. MISCELLANEOUS SEPARATION PROCESSES
Membrane separation process; solid and liquid membranes; concept of osmosis; reverse osmosis; electrodialysis; their applications; foam separation process; thermal and sweep diffusion process.

REFERENCES
4. C.Judson King Separation Processes, Tata McGraw-Hill '74

TOTAL 45

PTCH434 TRANSPORT PHENOMENA

1. PHILOSOPHY AND FUNDAMENTALS OF TRANSPORT PHENOMENA
Importance of transport phenomena; analogous nature of transfer process; basic concepts, conservation laws; continuous concept, field, reference frames, substantial derivative and boundary conditions; methods of analysis; differential, integral and experimental methods.

2. TRANSPORT BY MOLECULAR MOTION
Phenomenological laws of transport properties newtonian and non newtonian fluids; rheological models; theories of transport properties of gases and liquids; effect of pressure and temperature.

3. ONE DIMENSIONAL TRANSPORT IN LAMINAR FLOW (SHELL BALANCE)
General method of shell balance approach to transfer problems; Choosing the shape of the shell; most common boundary conditions; momentum flux and velocity distribution for flow of Newtonian and non-Newtonian fluids in pipes for flow of Newtonian fluids in pipes, slits and annulus heat flux and temperature distribution for heat sources such as electrical, nuclear viscous and chemical; forced and free convection; mass flux and concentration profile for diffusion in stagnant gas, systems involving reaction and forced convection.

4. EQUATIONS OF CHANGE AND THEIR APPLICATIONS
Conservation laws and equations of change; Development of equations of continuity motion and energy in single multicomponents systems in rectangular co-ordinates and the forms in curvilinear co-ordinates; simplified forms of equations for special cases, solutions of momentum mass and heat transfer problems discussed under shell balance by...
applications of equation of change, scale factors; applications in scale-up.

5. TRANSPORT IN TURBULENT AND BOUNDARY LAYER FLOW
Turbulent phenomena; phenomenological relations for transfer fluxes; time smoothed equations of change and their applications for turbulent flow in pipes; boundary layer theory; laminar and turbulent hydrodynamics thermal and concentration boundary layer and their thicknesses; analysis of flow over flat surface.

6. ANALOGIES BETWEEN TRANSPORT PROCESSES
Importance of analogy; development and applications of analogies between momentum and mass transfer; Reynolds, Prandtl, Von Karman and Colburn analogies.

TOTAL = 45

REFERENCES

PTCH448 ENERGY MANAGEMENT IN CHEMICAL INDUSTRIES

1. ENERGY RESOURCES - A GLOBAL VIEW
Energy sources; coal oil, natural gas; nuclear energy; hydro electricity, other fossil fuels; geothermal; supply and demand; depletion of resources; need for conservation; uncertainties; national and international issues.

2. PLANNING FOR ENERGY NEEDS
Forecasting techniques; energy demand; magnitude and pattern; input and output analysis; energy modelling and optimal mix of energy sources.

3. ENERGY AND ENVIRONMENT
Energy; various forms; energy storage; structural properties of environment; bio-geo-chemical cycles; society and environment; population and technology.

4. ENERGY AND TECHNOLOGICAL SOCIETY
Energy and evolution; growth and change; patterns of consumption in developing and advanced countries; commercial generation of power requirements and benefit.

5. MANAGEMENT OF ENERGY CONSERVATION IN CHEMICAL INDUSTRIES
Chemical industries; classification; conservation in unit operation such as separation; cooling tower; drying; conservation applied to refineries, petrochemical, fertilisers, cement, pulp and paper, food industries, chloro-alkali industries; conservation using optimisation techniques.
6. ENERGY ALTERNATIVES
Sources of continuous power; wind and water; geothermal; tidal and solar power; MHD, fuel cells; hydrogen as fuel.

7. ECONOMIC BALANCE IN ENERGY CONSUMPTION
Cost analysis; capacity; production rate; system rate; system cost analysis; corporate models; production analysis and production using fuel inventories; input-output analysis; economics; tariffs.

REFERENCES

PTCH44 SAFETY IN CHEMICAL PROCESS INDUSTRIES
1. INTRODUCTION
Safety in industries; need for development; importance safety consciousness in Indian chemical industry; social environmental setup; tolerance limit of the society; psychological attitude towards safety programmes.

2. SAFETY PROGRAMMES
Elements of safety programme; effective realisation; economic and social benefits; effective communication training at various levels of production and operation.

3. INDUSTRIAL SAFETY
Chemical process industries; potential hazards; chemical and physical job safety analysis; high pressure; high temperature operation; dangerous and toxic chemicals; highly radioactive materials; safe handling and operation of materials and machineries; planning and layout.

4. SAFETY PERFORMANCE
Appraisal; effective steps to implement safety procedures; periodic inspection and study of plant layout and constant maintenance; periodic advice and checking to follow safety procedures; proper selection and replacement of handling equipments; personal protective equipments.

5. ACCIDENTS

6. POLLUTION
Atmospheric pollution - chemicals and dust - toxicity toxic materials and gases - environmental pollution by effluent and industrial wastes - treatment.

7. HEALTH HAZARDS AND LEGAL ASPECTS

8. PROMOTION OF INDUSTRIAL SAFETY
Role of Government, safety organisations, management and trade unions in promoting industrial safety.

TOTAL 45
REFERENCES

PTCH436 HEAT & M.T. LAB
LIST OF EXPERIMENTS
1. Air heater
2. Laminar flow heat exchanger
3. Heat loss in pipes.
4. Jacketed pan
5. Jacketed kettle
6. Steam jet ejector
7. Horizontal heat exchanger
8. Liquid-liquid heat exchanger
9. Film type evaporator
10. Study of step response
11. Time constant in measuring instruments.

TOTAL 60

PART A
1. PRINCIPLES OF MANAGEMENT AND ORGANISATION
   Planning, organisation, staffing, coordination, directing, controlling, communicating, organisation as a process and a structure, types of organisations.
2. PRODUCTION AND MANAGEMENT
   Method study; work measurement techniques; basic procedure; motion study; motion economy; principles of time study; elements of production control; forecasting; planning, routing; scheduling; despatching; costs and costs control, inventory and inventory control.
3. QUALITY AND QUALITY CONTROL
   Elements of quality control, role of control charts in production and quality control.

PART B
1. ENGINEERING ECONOMICS FOR PROCESS ENGINEERS
2. INTEREST, INVESTMENT COSTS AND COST ESTIMATION
   Time value of money; capital costs and depreciation, estimation of capital cost, manufacturing costs and working capital; invested capital and profitability.
3. PROFITABILITY, INVESTMENT ALTERNATIVE AND REPLACEMENT
   Estimation of project profitability, sensitivity analysis; investment alternatives; replacement policy; forecasting sales; inflation and its impact.

4. ANNUAL REPORTS AND ANALYSIS OF PERFORMANCE
   Principles of accounting; balance sheet; income statement; financial ratios; analysis of performance and growth.

5. ECONOMIC BALANCE
   Different unit operations with single and multiple variables.

TOTAL 45

REFERENCES

PTCH451 CHEMICAL PROCESS EQUIPMENT DESIGN – II

1. STORAGE VESSELS FOR NON-VOLATILE AND VOLATILE FLUIDS
   Design of the following equipments as per ASME, ISI, TEMA codes and drawing according to scale.

2. PRESSURE VESSELS AND AUTOCLAVES
   Monobloc and multilayer vessels

TOTAL 56

7. DISTILLATION TOWER
   Plate and packed towers

8. DRYERS
   Rotary and spray dryers

9. FILTERS
   Filter presses and filtering type centrifuge.

REFERENCES
PTCH 438 PROJECT WORK

Each student is required to submit a report on the project assigned to him by the department. The report should be based on the information available in the literature or data obtained in the laboratory/industry.

The object of the project is to make use of the knowledge gained by the student at various stages of the degree course. This helps to judge the level of proficiency, originality and capacity for application of the knowledge attained by the student at the end of the course.

LIST OF ELECTIVE SUBJECTS

PTCH 034 FERTILISER TECHNOLOGY

1. AN OVERVIEW

Role of organic manures and chemicals fertiliser, types of chemical fertiliser, growth of fertiliser industry in India; their location; energy consumption in various fertiliser processes; materials of various fertiliser processes; materials of consumption in fertiliser industry.

2. NITROGENOUS FERTILISER

Feed stock for production of ammonia-natural gas, associated gas, coke-oven gas, naptha, fuel oil, petroleum heavy stock, coal, electricity etc; processes for gasification and methods of production of ammonia and nitric acid; nitrogenous fertiliser-ammonium sulphate, nitrate, urea and calcium ammonium nitrate; ammonium chloride and their methods of production, characteristics and specifications, storage and handling.

3. PHOSPHATIC FERTILISERS

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

4. POTASSIC FERTILISER

Methods of production of potassium chloride, potassium soroinite, their characteristics and specifications.

5. COMPLEX AND NPK FERTILISERS

Methods of production of ammonium phosphate, sulphate, diammonium phosphate, nitrophosphates, urea, ammonium phosphate, mono-ammonium phosphate and various grades of NPK fertilisers produced in the country.

6. MISCELLANEOUS FERTILISERS

Mixed fertiliser and granulated mixtures; biofertilisers, nutrients, secondary nutrients and micro nutrients; fluid fertilisers, controlled release fertilisers.

7. POLLUTION FROM FERTILISER INDUSTRY

Solid, liquid and gaseous pollution standards laid down for them.

REFERENCES


PTCH035 PETROCHEMICAL TECHNOLOGY

1. IMPORTANCE AND GROWTH

Importance of petrochemical industry; Growth in India, Economics.

2. PETROCHEMICAL PRECURSORS

Principal raw materials and their sources; petrochemical precursors and their production methods - methane synthesis gas - ethane, ethylene, acetylene, propane - propylene, butanes, butenes, petane and pentanes - benzene, toluene - xylene - naphthaenes. Pentane and pentenes; benzene, toluene, xylene, Naphthaenes.

3. CHEMICALS FROM METHANE AND SYNTHESIS GAS

Ammonia, oxo products - methanol - formaldehyde, chlorinated methanes; carbon-di-sulphide; hydrogen cyanide.

4. CHEMICALS FROM ETHANE, ETHYLENE AND ACETYLENE

Synthetic ethanol; acetaldehyde dehyde and acetic acid; vinyl acetate; butyraldehyde, 2-ethyl hexanol and dop; ethylene oxide; ethylene glycols; acrylonitrile, polyethers, ethanolamines; ethylichloride; ethylene dichloride; vinyl chloride, ethylbenzene; styrene.

5. CHEMICALS FROM PROPANE AND PROPYLENE

Isopropanol, acetone, glycerol, propyleneoxide, propylene glycols; polyethers, acetychloride; epichlorhydrin, isopropane, cumene.

6. CHEMICALS FROM BUTANES, BUTANES, PENTANES AND PENTENES

Butadiene; butane epoxides and butanolamines butanol; butyl acetate; methyl ethyl ketone; isoprene; amy alcohol.

7. CHEMICALS FROM AROMATICS

Mono-chloro and dichlorobenzene; BHC; nitrobenzene; phenol; aniline; decyl benzene; benzaldehyde; benzoic acid; nitrotoluene; toluene diamines and toluene disocyanate; phthalic anhydride; isophthalic acid, terephthalic acid and dimethyl terephthalic; maleic anhydride; caprolactum; adipic acid; hexamethylen, diamine.

REFERENCES


PTCH036 DRUGS AND PHARMACEUTICAL TECHNOLOGY

1. INTRODUCTION

Development of drugs and pharmaceutical industry; organic therapeutic agents uses and economics.
2. DRUG METABOLISM AND PHARMACO KINETICS
Drug metabolism; physico chemical principles; radio activity; pharma kinetics-action of drugs on human bodies.

3. IMPORTANT UNIT PROCESSES AND THEIR APPLICATIONS
Chemical conversion processes; alkylation; carboxylation; condensation and cyclisation; dehydration; esterification; halogenation, oxidation, sulfonation; complex chemical conversions fermentation.

4. MANUFACTURING PRINCIPLES
Compressed tablets; wet granulation; dry granulation or slugging; direct compression; tablet presses formulation; coating pills; capsules sustained action dosage forms; parenteral solutions, oral liquids; injections; ointments; standard of hygiene and manufacturing practice.

5. PHARMACEUTICAL PRODUCTS
Vitamins; cold remedies; laxatives; analgesics; nonsteroidal contraceptives; external antiseptics; antacids and others.

6. MICROBIOLOGICAL AND ANIMAL PRODUCTS
Antibiotics; biologicals; hormones; vitamins; preservation.

7. PHARMACEUTICAL ANALYSIS
Analytical methods and tests for various drugs and pharmaceuticals.

8. PACKING AND QUALITY CONTROL
Packing; packing techniques; quality control.

TOTAL 45

REFERENCES

PTCH037 POLYMER AND PLASTIC TECHNOLOGY

1. INTRODUCTION TO POLYMERS
Monomer; functionality and degree of polymerisation; polymers and their classification; polymer coatings; adhesive rubber; plastic and fibres; distinction; polymeric reaction; addition; condensation and copolymerisation.

Methods of polymerisation - bulk, solution emulsion and suspension polymerisations; structure of polymers linear, branched and cross linked; characterization of polymers; molecular weight, crystallinity, glass transition and mechanical properties; testing of polymers; destructive and non destructive methods.

2. PROCESSING OF PLASTICS
Processing additives; filters, plasticisers; anti-oxidants; colourants; stabilisers and other related additives. Injection; compression transfer and moulding methods calendaring; extrusion; thermo forming; powder coating.

3. POLYMERIC MATERIALS
Polyethylene; poly propylene; polystyrene, polymethyl methacrylate; polyvinyl chloride; polytetra fluoro ethylene.
polyglycolate; nylon 6, nylon 6,6 and polyesters; Phenol formaldehyde urea formaldehyde and melamine formaldehyde; epoxy; urethanes and silicones.

4. SPECIAL POLYMERS
Polyurethanes; poly sulphones; aromatic polyamides; aromatic polyester; photo conductive, piezoelectric and ion exchange polymers.

5. NATURAL POLYMERS
Wool, silk and cellulose derivatives.

TOTAL 45

REFERENCES

PTCH038 FOOD TECHNOLOGY

1. AN OVERVIEW
General aspects of food industry; world food needs and Indian situation.

2. FOOD CONSTITUENTS, QUALITY AND DERIVATIVE FACTORS
 Constituents of food; quality and nutritive aspects; food additives; standards; deteriorative factors and their control.

TOTAL 45

REFERENCES

PTCH039 SURFACE COATING TECHNOLOGY

1. PREPARATION OF PIGMENTS; WHITE PIGMENTS
Red pigments; orange and yellow pigments; green, blue and black pigments.
2. DRYING OILS AND DRIERS; SOLVENTS AND PLASTICISERS
Resins, gums; waxes and bitumens varnishes and lacquers; paints and enamels; cellulose ester products; synthetic resins and finishes; paint chemistry.

3. PAINTS PLANT; VARNISH PLANT; MANUFACTURE OPERATION; FACTORY COST ACCOUNTING; RESEARCH, DEVELOPMENT AND CONTROL; FIRE PROTECTION; SAFETY AND HEALTH.

TOTAL 45

REFERENCES
1. Noel Heaton; Outlines of Paint Technology, Charles Griffin and Co. Ltd., W.C.2. 1976

PTCH040 ELECTROCHEMICAL ENGINEERING

1. BASICS OF ELECTROCHEMISTRY
   Faraday's law; Nernst potential; galvanic cells; polarograph.

2. THE ELECTRICAL DOUBLE LAYER
   Its role in electrochemical processes; electro capillary curve; Helmholtz layer; Guoy-steven's layer; fields at the interface.

3. METAL FINISHING
   Electro-deposition; electro-firing; electroforming; electrolysis; anodising; selective soler coatings.

4. ELECTROCHEMICALS
   Inorganic: perchlorates; chlorates; permanganates; persulphates. Organic: p-Aminoguanidine bicarbonate; dia'hyde starch; calcium gluconate etc.

5. ELECTRODES USED IN DIFFERENT ELECTROCHEMICAL INDUSTRIES
   Metals; Graphite; lead dioxide; titanium substrate insoluble electrodes; iron oxide; semiconducting type etc.

6. BATTERIES
   Primary and secondary batteries; Leclanche drycell; Alkaline manganese cell; mercury cell; airdepolared cell; sea-water cell; reserve electrolyte cells like Mg-CU1+ ; Zn-PbO2; Secondary cells like lead acid; Ni-Cd; Ni-Fe; AgO-Zn; Aqo-Cd. Sodium Sulphur; Li-S, Fuel cells.

7. ELECTROMETALLURGY
   - Fused salt electrolysis for Al, Na, Mg, etc., CaCl2, hydrometallurgy, Zn Cu, Pb etc.

8. CORROSION
   Introduction, metallic surface preparation; phosphating; inhibitors in acid media; in engine cooling systems; control measures; industrial boiler water corrosion control; protective coatings, vapour phase inhibitors; cathodic protection; sacrificial anodes; paint removers.
9. CHLORALKALI INDUSTRY
Electrodes used; membranes, electrical efficiency; modern trends.

REFERENCES

PTCH041 ENVIRONMENTAL ENGINEERING

1. POLLUTANTS AND ITS EFFECTS
Sources of air pollution; effect of air pollution on the environment; on materials on human health; on animals; meteorological effects; visibility factors.

2. LEGISLATIVE ASPECTS AND MANAGEMENT
Legislative and regulatory trends; air pollutants; waste water treatment and recycle.

3. INDUSTRIAL WASTE AND EFFLUENT TREATMENT
Gaseous, solid liquid waste disposal, air pollution considerations in solid and liquid waste disposal.

4. ANALYSIS AND CONTROL
Analytical techniques in air pollution; design aspects of pollution control systems.

TOTAL 45

REFERENCES

PTCH042 BIOCHEMICAL ENGINEERING

1. CONVENTIONAL CHEMICAL PROCESSES AND BIOCHEMICAL PROCESS
An overview of industrial biochemical processes with typical examples, comparing chemical and biochemical processes, development and scope of biochemical engineering as a discipline.

2. ROLE OF MICROORGANISMS
Industrially important microbial strains; their classification; structure; cellular genetics; typical examples of microbial synthesis of biologicals.

3. ENZYMES AND ENZYME KINETICS
Enzyme used in industry medicine and food. Their classification with typical examples of industrially important enzymes; mechanism of enzymatic reactions; michaelis-menten kinetics; enzymes inhibition; factors affecting the reaction rates; industrial production purification and immobilisation; enzyme reactors with typical examples.

4. MICROBIAL KINETICS
Typical growth characteristics of microbial cells; factors affecting growth; Monod model; modelling of batch and
continuous cell growth; immobilised whole cells and their characteristics; free cell and immobilised cell reactors; typical industrial examples; transport in cells.

5. TRANSPORT IN MICROBIAL SYSTEMS
Newtonian and Non-Newtonian behaviour of broths; agitation and mixing; power consumption; gas/liquid transport in cells; transfer resistances; mass transfer coefficients and their role in scaleup of equipments; enhancement of \( O_2 \) transfer; heat transfer correlation; sterilization cycles and typical examples of heat addition and during biological production.

6. BIOREACTORS
Batch and continuous types; immobilised whole cell and enzyme reactors; high performance bioreactors; sterile and non-sterile operations; reactors in series with and without recycle; design of reactors and scaleup with typical examples.

7. DOWNSTREAM PROCESSES AND EFFLUENT TREATMENT
Different unit operations in down streaming with special reference to membrane separations; extractive fermentation; anaerobic treatment of effluents; typical industrial examples for downstream processing and effluent disposal.

REFERENCES
8. BIOPOLYMERS

Introduction: nature and composition of polymers used as prosthetic devices with special reference to heart valves; artificial bones; denatures; sutures etc.

9. TRANSPORT PHENOMENA IN HUMAN BIOLOGY

Introduction to renal and respiratory system; lung oxygenator and their design characteristics; artificial kidney and their design features.

10. MEDICAL ENZYMIOLOGY

Role of enzyme in clinical tests; their role as therapeutic agents; Role of enzyme electrodes in chemical testing; extracorporeal shunts using immobilised enzymes.

11. RECENT TRENDS IN MEDICAL FIELD

Role of computers in medical data logging and diagnosis; CAT and NMR scanning; transplants; introduction to aviation and space medicine specialty drugs and their mode of action.

TOTAL 45

REFERENCES


4. PTCH044 PROCESS AUTOMATION

1. INTRODUCTION

Principles of measurement and classification of process control instruments; temperature, pressure fluid flow, liquid level, velocity, fluid density, viscosity, conductivity etc; instrument scaling; sensors; transmitters and control valves; instrumentation symbols and labels.

2. PROCESS AUTOMATION

Basic concepts; terminology and techniques for process control; control modes; Tuning process controllers.

3. ADVANCED CONTROL

Advanced control techniques; feed forward and ratio control; controller design; adaptive control systems; statistical process control; expert systems; multivariable control techniques; supervisory control.

4. DIGITAL CONTROL

Digital control techniques; z transforms; sampling and filtering; response of discrete time systems; sampled data control systems; design of digital controllers.

5. OPTIMAL CONTROL

Optimisation and simulation; optimisation techniques; single and multivariable constrained optimisation; dynamic simulation of distillation columns and reactors.

TOTAL 45

REFERENCES


2. ENZYME KINETICS

3. IMMOBILISED ENZYME
   Immobilization - Effects on Immobilised catalysts - IMTR - INTR - EFF DUffUSIVITIES

4. INDUSTRIAL APPLICATIONS
   For recovery of HM - For Resource Recovery - Kinetics for Process - Experiments - E. Assay - Sugar Assay - Protein Assay

5. CELL CULTIVATION

6. CELL KINETICS & FERMENTER DESIGN

7. STERILISATION
   Death Kinetics - Design criteria - Cont Sterilisation

8. AGITATION & AERATION
   Tr. Coeff. - Interfacial Atta Measurement - Gas HOLD UP - Power consumption - OTRATE & O2, ESTIMATION - K, a CORRELATIONS - Shear - Scalfup

9. BIO ACCUMULATION & PRECIPITATION OF METALS

10. PROBLEMS IN RECOVERY OF METALS WITH CHEM. ENGG APPROACH

REFERENCES: