

# West Bengal University of Technology

## Pharmaceutical Technology Syllabus

### STRUCTURE

#### SEMESTER-I

<u>A. THEORY</u>							
SL. NO.	CODE	THEORY	CONTACTS (PERIODS/WEEK)				CREDITS
			L	T	P	TOTAL	
1	HU 101	ENGLISH LANGUAGE & COMMUNICATION	2	1	-	3	3
2	PT 101	PHARMACEUTICAL ANALYSIS	3	-	-	3	3
3	M 103 HU 102	REMEDIAL MATHEMATICS OR ENVIRONMENT & ECOLOGY	3	-	-	3	3
4	PT 102	PHARMACOGNOSY	3	-	-	3	3
5	PT 103	PHARMACEUTICAL CHEMISTRY (INORGANIC PHARMACEUTICAL CHEMISTRY)	3	1	-	4	4
6	CS 103	BASIC ELECTRONICS & COMPUTER APPLICATIONS	3	1	-	4	4
<b>Total of Theory</b>						<b>20</b>	<b>20</b>
<u>B. PRACTICAL</u>							
1	PT 191	PHARMACEUTICAL ANALYSIS	-	-	3	3	2
2	PT 192	PHARMACOGNOSY	-	-	3	3	2
3	PT 193	PHARMACEUTICAL CHEMISTRY	-	-	3	3	2
4	CS 193	BASIC ELECTRONICS & COMPUTER APPLICATIONS	-	-	3	3	2

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Total of Practical				12	8
<b>Total of Semester</b>				32	28

**SEMESTER-II**

<b><u>A. THEORY</u></b>							
Sl. No.	CODE	THEORY	CONTACTS (PERIODS/WEEK)				CREDITS
			L	T	P	TOTAL	
1	PT 203	PHARMACEUTICAL CHEMISTRY (PHYSICAL CHEMISTRY)	3	1	-	4	4
2	M 203	ADVANCED MATEHMATICS & ENGINEERING MECHANICIS	3	1	-	4	4
3	PT 204	PHARMACEUTICAL CHEMISTRY (ORGANIC CHEMISTRY)	3	1	-	4	4
4	PTB 201 HU 202	REMEDIAL BIOLOGY OR ENVIRONMENT & ECOLOGY	3	-	-	3	3
5	PT 205	ANATOMY, PHYSIOLOGY & HEALTH EDUCATION (APHE)	2	1	-	3	3
6	PT 206	PHARMACEUTICS (DISPENSING & COMMUNITY PHARMACY)	2	1	-	3	3
Total of Theory						21	21
<b><u>B. PRACTICAL</u></b>							

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1	PT 293	PHARMACEUTICAL CHEMISTRY (PHYSICAL CHEMISTRY)	-	-	3	3	2
2	PT 294	PHARMACEUTICAL CHEMISTRY (ORGANIC CHEMISTRY)	-	-	3	3	2
3	PTB 291	REMEDIAL BIOLOGY	-	-	3	3	2
4	PT 296	PHARMACEUTICS (DISPENSING & HOSPITAL PHARMACY)	-	-	3	3	2
Total of Practical						12	8
<b>Total of Semester</b>						33	29

- Note:** (i) PTB 291 is compulsory for all the students.  
(ii) Students passed with PCM will take Environment & Ecology in the 1<sup>st</sup> Semester and students with PCB will take Environment & Ecology in the 2<sup>nd</sup> Semester.

**SEMESTER-III**

<b><u>A. THEORY</u></b>							
Sl. No.	CODE	THEORY	CONTACTS (PERIODS/WEEK)				CREDITS
			L	T	P	TOTAL	
1	PT 304	PHARMACEUTICAL CHEMISTRY (ORGANIC CHEMISTRY)	3	1	-	4	4
2	PT 301	PHARMACEUTICAL ANALYSIS	3	1	-	4	4
3	PT 305	PHYSIOLOGY	3	-	-	3	3
4	PT 306	PHARMACEUTICS (PHYSICAL PHARMACY)	3	1	-	4	4
5	PT 307	PHARMACEUTICAL ENGINEERING	3	1	-	4	4

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Total of Theory						19	19
<b><u>B. PRACTICAL</u></b>							
1	PT 394	PHARMACEUTICAL CHEMISTRY (ORGANIC CHEMISTRY)	-	-	3	3	2
2	PT 391	PHARMACEUTICAL ANALYSIS	-	-	3	3	2
3	PT 395	PHYSIOLOGY	-	-	3	3	2
4	PT 396	PHARMACEUTICS (PHYSICAL PHARMACY)	-	-	3	3	2
5	PT 397	ENGINEERING DRAWING	-	-	3	3	2
Total of Practical						15	10
<b>Total of Semester</b>						34	29

**SEMESTER-IV**

<b><u>A. THEORY</u></b>							
Sl. No.	CODE	THEORY	CONTACTS (PERIODS/WEEK)				CREDITS
			L	T	P	TOTAL	
1	PT 406(1)	PHARMACEUTICS (PHARMACEUTICAL TECHNOLOGY-I)	3	1	-	4	4
2	PT 402	PHARMACOGNOSY	3	1	-	4	4
3	PT 404	PHARMACEUTICAL CHEMISTRY (BIO-CHEMISTRY)	3	1	-	4	4

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4	PT 405	PHYSIOLOGY	3	1	-	4	4
5	PT 406(2)	PHARMACEUTICS (PHARMACEUTICAL TEHCNOLOGY-II)	3	1	-	4	4
Total of Theory						20	20
<b><u>B. PRACTICAL</u></b>							
1	PT 497	PHARMACEUTICAL ENGINEERING	-	-	3	3	2
2	PT 492	PHARMACOGNOSY	-	-	3	3	2
3	PT 496(1)	PHARMACEUTICS (PHARMACEUTICAL TEHCNOLOGY-I)	-	-	3	3	2
4	PT 494	PHARMACEUTICAL CHEMISTRY (BIO-CHEMISTRY)	-	-	3	3	2
Total of Practical						12	8
<b>Total of Semester</b>						32	28

**SEMESTER-V**

<b><u>A. THEORY</u></b>							
Sl. No.	CODE	THEORY	CONTACTS (PERIODS/WEEK)				CREDITS
			L	T	P	TOTAL	
1	PT 507	PHARMACEUTICAL ENGINEERING	3	1	-	4	4
2	PT 508	PHARMACOLOGY	3	-	-	3	3

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3	PT 509	PHARMACEUTICAL MICRO-BIOLOGY	3	-	-	3	3
4	PT 503	PHARMACEUTICAL CHEMISTRY (MEDICINAL CHEMISTRY)	3	1	-	4	4
5	PT 506	PHARMACEUTICS (HOSPITAL PHARMACY)	3	-	-	3	3
6.	PT 504	PHARMACEUTICAL CHEMISTRY (BIO-CHEMISTRY)	3	-	-	3	3
Total of Theory						20	20
<b><u>B. PRACTICAL</u></b>							
1	PT 596(2)	PHARMACEUTICS (PHARMACEUTICAL TECHNOLOGY-II)	-	-	3	3	2
2	PT 597	PHARMACEUTICAL ENGINEERING	-	-	3	3	2
3	PT 599	PHARMACEUTICAL MICRO-BIOLOGY	-	-	3	3	2
4	PT 593	PHARMACEUTICAL CHEMISTRY (MEDICINAL CHEMISTRY)	-	-	3	3	2
5	PT 596	PHARMACEUTICS (HOSPITAL PHARMACY)	-	-	3	3	2
Total of Practical						12	8
<b><u>C. SESSIONALS</u></b>							
Practical Training (PT 581)			-		3		
<b>Total of Semester</b>			33		31		

**SEMESTER-VI**

<b><u>A. THEORY</u></b>				
Sl. No.	CODE	THEORY	CONTACTS (PERIODS/WEEK)	CREDITS

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			L	T	P	TOTAL	
1	PT 603	PHARMACEUTICAL CHEMISTRY (MEDICINAL CHEMISTRY)	3	1	-	4	4
2	PT 606	PHARMACEUTICS (PHARMACEUTICAL TECHNOLOGY)	3	-	-	3	3
3	PT 611	PHARMACEUTICS (BIO-PHARMACEUTICS & PHARMACOKINETICS)	3	1	-	4	4
4	PT 608	PHARMACOLOGY	3	-	-	3	3
5	PT 609	PHARMACEUTICAL BIO-TECHNOLOGY & INDUSTRIAL MICOR-BIOLOGY	3	-	-	3	3
6.	PT610A/B	ELECTIVE-I	3	-	-	3	3
Total of Theory						20	20
<b><u>B. PRACTICAL</u></b>							
1	PT 693	PHARMACEUTICAL CHEMISTRY (MEDICINAL CHEMISTRY)	-	-	3	3	2
2	PT 696	PHARMACEUTICS (PHARMACEUTICAL TECHNOLOGY)	-	-	3	3	2
3	PT 697	PHARMACUTICS (BIO-PHARMACEUTICS & PHARMACOKINETICS)	--	-	3	3	2
4	PT 698	PHARMACOLOGY	-	-	3	3	2
Total of Practical						12	8
<b><u>C. SESSIONALS</u></b>							
Seminar (PT 682)			3		2		
<b>Total of Semester</b>			35		30		

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**SEMESTER-VII**

<u><b>A. THEORY</b></u>							
Sl. No.	CODE	THEORY	CONTACTS (PERIODS/WEEK)				CREDITS
			L	T	P	TOTAL	
1	PT 706	PHARMACEUTICS (PHARMACEUTICAL TECHNOLOGY)	3	-	-	3	3
2	PT 703	PHARMACEUTICAL CHEMISTRY (MEDICINAL CHEMISTRY)	3	-	-	3	3
3	PT 707	PHARMACEUTICAL ENGINEERING	3	-	-	3	3
4	PT 702	PHARMACOGNOSY	3	-	-	3	3
5	PT 708	PHARMACOLOGY	3	-	-	3	3
6.	PT709A/B/C	ELECTIVE-II	3	-	-	3	3
Total of Theory						18	18
<u><b>B. PRACTICAL</b></u>							
1	PT 796	PHARMACEUTICS (PHARMACEUTICAL TECHNOLOGY)	-	-	3	3	2
2	PT 793	PHARMACEUTICAL CHEMISTRY (MEDICINAL CHEMISTRY)	-	-	3	3	2
3	PT 798	PHARMACOLOGY	-	-	3	3	2
4	PT799A/B/C	ELECTIVE-II	-	-	3	3	2
Total of Practical						12	8
<u><b>C. SESSIONALS</b></u>							
1	Practical Training (PT 781)		-			3	
2	Seminar on assigned topic (PT 782)		3			2	
	Total of sessionals		3			5	
<b>Total of Semester</b>			33			31	



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**SEMESTER-VIII**

<b><u>A. THEORY</u></b>							
Sl. No.	CODE	THEORY	CONTACTS (PERIODS/WEEK)				CREDITS
			L	T	P	TOTAL	
1	PT 812	PHARMACEUTICAL INDUSTRIAL MANAGEMENT	3	-	-	3	3
2	PT 813	PHARMACEUTICAL JURISPRUDENCE & ETHICS	3	-	-	3	3
3	PT 808	PHARMACOLOGY	3	-	-	3	3
4	PT 801	PHARMACEUTICAL ANALYSIS	3	-	-	3	3
5	PT 802	PHARMACOGNOSY	3	-	-	3	3
6	PT809A/B	ELECTIVE-III	3	-	-	3	3
Total of Theory						18	18
<b><u>B. PRACTICAL</u></b>							
1	PT 891	PHARMACEUTICAL ANALYSIS	-	-	3	3	2
2	PT 892	PHARMACOGNOSY	-	-	3	3	2
3	PT 883	PROJECT	-	-	8	8	6
4	PT 884	VIVA-VOCE	-	-	-		2
Total of Practical						14	12
<b>Total of Semester</b>						32	30

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### PRECIES OF TOTAL GRADES IN B. PHARMACY PROGRAMME

SEMESTER	MINIMUM	MAXIMUM
SEM I		28
SEM II		29
SEM III		29
SEM IV		28
SEM V		31
SEM VI		30
SEM VII		31
SEM VIII		30
<b>TOTAL CREDIT</b>		236

**NOTE:** PHARMACEUTICAL TECHNOLOGY IS A MULTI-DISCIPLINARY SUBJECT THAT'S WHY THE STRUCTURE GIVEN BY THE WEST BENGAL UNIVERSITY OF TECHNOLOGY HAS BEEN DEVIATED IN SOME POINTS. THE TOTAL COURSE HAS BEEN DESIGNED ON THE BASIS OF BURDWAN UNIVERSITY, AICTE & JADAVPUR UNIVERSITY COURSE STRUCTURE. THIS IS TO BE CONSIDERED GENEROUSLY AT THE TIME OF FINALISATION OF THE CURRICULUM.

Convenor/Co-ordinator :

( DR. PRANABESH CHAKRABORTY )  
Principal,  
Gupta College of Technological Sciences, Asansol

( PROF. B. K. GUPTA )

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## Pharmaceutical Technology Syllabus

Professor(Rtd.), Deptt. of Pharm. Technology, J.U.  
Chariman, Gluconate-Health Ltd. (Govt. of W.B. Undertaking)  
President, Pharmacy Council of India (W.B.)

(PROF. MALAYA GUPTA)  
Dept. of Pharmaceutical Technology  
Jadavpur University, Kolkata

(PROF. ARUNABHA NANDA)  
Dept. of Pharmaceutical Technology  
Jadavpur University, Kolkata

### SYLLABUS FOR B. PHARMACY

#### SEMESTER-I

#### ENGLISH LANGUAGE & COMMUNICATION

**Code : Hu 101**

**Contact : 2L + I T = 3**

**Credits: 3**

#### **Guidelines for Course Execution**

#### *Objective of the Course*

To impart basic skills of communication in English through intensive practice to the first year UG students of Engineering so as to enable them to function confidently and effectively in that language in the professional sphere of their life.

#### *Desired Entry Behaviour*

The student must have some basic command of English that is must be able to :

1. write reasonably grammatically
2. understand ( if not use ) at least some 2500 general purpose words of English to express himself in writing and 1500 words to talk about day-to-day events and experiences of life.
3. understand slowly-delivered spoken material in Standard Indian English , and
4. speak reasonably clearly ( if not fluently ) on routine matters with his fellow students.

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### Strategies for Course Execution

- The topics must be conveyed through plenty of examples. Lecture classes must be conducted as lecture-cum-tutorial classes.
- It is a course that aims to develop skills. It is therefore “practical” in orientation. Plenty of exercises of various kinds must be done by the students both inside and outside the classroom.
- The teacher must not depend on a single or a set of two or three text books. He must choose his materials from diverse sources.
- Keeping in view the requirements of his students , the teacher may have to prepare some teaching and exercise material.
- For practice in listening , good tape recorders can be used if the more advanced facilities ( for example , language laboratory ) are not available. In fact they can be used very fruitfully.
- The teacher must function as a creative monitor in the class-room.
- Minimum time should be spent in teaching phonetic symbols , stress , intonation , etc. The aim should be to enable the students to find out for himself the correct pronunciation of a word from a learner’s dictionary. In teaching speaking, emphasis should be on clarity , intelligibility and reasonable fluency rather than on “ correct “ pronunciation of words. Classroom presentation and group discussion sessions should be used to teach speaking.

### **End Results from the Course**

#### **Some Key Concepts**

Communication as sharing; context of communication; the speaker / writer and the listener / reader; medium of communication; barriers to communication; brevity, clarity and appropriateness in communication.

#### **Writing**

Selecting material for expository, descriptive , and argumentative pieces, business letters; formal report; summarizing and abstracting ; expressing ideas within a restricted word limit; paragraph division; the introduction and the conclusion; listing reference material; use of charts, graphs and tables ; punctuation and spelling; semantics of connectives, modifiers and modals; variety in sentences and paragraphs.

#### **Reading Comprehension**

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Reading at various speeds ( slow , fast , very fast ) ; reading different kinds of texts for different purposes (for example , for relaxation , for information , for discussion at a later stage , etc.) ; reading between the lines.

### **Speaking**

Achieving desired clarity and fluency ; manipulating paralinguistic features of speaking ( voice quality , pitch , tone , etc. ) pausing for effectiveness while speaking ; task-oriented , interpersonal , informal and semiformal speaking ; task-oriented, interpersonal , informal and semiformal speaking; making a short , classroom presentation.

### **Group Discussion**

Use of persuasive strategies including some rhetorical devices ( for emphasizing , for instance; being polite and firm; handling questions and taking in criticism of self; turn-taking strategies and effective intervention ; use of body language.

Telephonic Conversation.

### **Listening Comprehension**

Achieving ability to comprehend material delivered at relatively fast speed; comprehending spoken material in Standard Indian English, British English and American English ; intelligent listening in institutions such as an interview in which one is a candidate.

### **Syllabus Details:**

Grammar – Structure of sentences – Active / Passive Voice – Direct / Indirect Narration  
( 5 lectures)

Essay – Descriptive – Comparative – Argumentative – Thesis statement-  
Structure of opening / concluding paragraphs – Body of the essay  
( 7 lectures)

Reading Comprehension – Global – Contextual – Inferential – Select passages from  
recommended text ( 8 lectures)

Business Correspondence – Letter Writing – Formal. Drafting. Biodata-  
Resume'- Curriculum Vitae  
(7 lectures)

Report Writing – Structure , Types of report – Practice Writing  
( 8 lectures)

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Communication / Public Speaking skills , Features of effective speech, verbal-nonverbal

( 7 lectures)

Group discussion – principle – practice

( 6 lectures)

### References / Books:

1. Mark McCormack : “Communication”
2. John Metchell “ How to write reports”
3. S R Inthira & V Saraswathi “ Enrich your English – a) Communication skills b) Academic skills “ Publisher CIEFL & OUP
4. R.C. Sharma and K.Mohan , “Business Correspondence and Report Writing “ , Tata McGraw Hill , New Delhi , 1994
5. L.Gartside , “Model Business Letters” , Pitman , London , 1992
6. Longman , “Longman Dictionary of Contemporary English” ( or ‘Oxford Advanced Learner’s Dictionary of Current English’ , OUP , 1998.
7. Maxwell Nurnberg and Rosenblum Morris , “All About Words” , General Book Depot, New Delhi , 1995

**Code :** PT 101

**Contacts:** 3

**Credits :** 3

### *Pharmaceutical Analysis*

#### **1<sup>st</sup> Half**

1. Significance of quantitative analysis in quality control, Different techniques of analysis, Preliminaries and definitions, Significant figures, Rules for retaining significant digits, Types of errors, Mean deviation, Standard deviation, Statistical treatment of small data sets, Selection of sample, Precision and accuracy, Fundamentals of volumetric analysis, methods of expressing concentration, primary and secondary standards.
2. **Acid Base Titrations** : Acid base concept, Selection of solvents, strengths of acids and bases, Ionization, Law of mass action, Common Ion effect, Ionic product of water, pH, Hydrolysis of salts, Henderson-Hasselbach equation, Buffer solutions, Neutralization curves, Acid-base indicators. Theory of indicators, Choice of indicators, Mixed indicators, Polyprotic system, Polyamine and amino acid systems, Amino acid titration, applications in assay of  $H_3PO_4$ , NaOH,  $CaCO_3$ , etc.
3. **Precipitation Titrations** : Precipitation reactions, Solubility products, Effect of acids, temperature and solvent upon the solubility of a precipitate, Argentometric titrations and titrations involving ammonium or potassium thiocyanate, mercuric

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nitrate, and barium sulphate, Indicators, Gay-Lussac method, Mohr's method, Volhard's method and Fajan's method.

### 2<sup>nd</sup> Half

4. **Oxidation Reduction Titration:** Concepts of oxidation and reduction, Redox reactions, Strengths and equivalent weights of oxidising and reducing agents. Theory of redox titration, Redox indicators, Cell representations, Measurement of electrode potential, oxidation-reduction curves, Iodimetry and Iodimetric Titrations involving ceric sulphate, potassium iodate, potassium bromate, potassium permanganate; titanous chloride and Sodium 2, 6-dichlorophenol indophenol.
5. **Gravimetric analysis:** Precipitation techniques, Solubility products, The colloidal state, supersaturation co-precipitation, Post-precipitation, Washing of the precipitate, Filtration, Filter papers and crucibles, Ignition, Thermogravimetric curves, Specific examples like barium sulphate, aluminium as aluminium oxide, calcium as calcium oxalate and magnesium as magnesium sulphate.

### Practical

Code: PT 191  
Contacts: 3  
Credits: 2

The students should be introduced to the main analytical tools through demonstrations. They should have a clear understanding of a typical analytical balance, the requirements of a good balance, weights, care and use of balance, methods of weighing and errors in weighing. The students should also be acquainted with the general apparatus required in various analytical procedures.

1. Standardization of analytical weights and calibration of volumetric apparatus.
2. Acid base Titration: Preparation and standardization of acids and bases, some exercises related with determination of acids and bases separately or in mixture form, some official assay procedures e.g. boric acid should also be covered.
3. Oxidation Reduction Titrations: Preparation and standardization of some redox titrants e.g. potassium permanganate, potassium dichromate, iodine, sodium thiosulphate, etc. some exercises related to determination of oxidizing and reducing agents in the sample shall be covered. Exercises involving potassium iodate, potassium bromate, iodine solution, stannous chloride, sodium 2, 6-dichlorophenol indophenol, and ceric ammonium sulphate.
4. Precipitation titrations: Preparation and standardization of titrants like silver nitrate and ammonium thiocyanate, Titrations according to Mohr's, Volhard's and Fajan's methods.
5. Gravimetric analysis: Some exercises related to gravimetric analysis are to be covered (at least 3 experiments).

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*Remedial Mathematics*

Theory

**Code:** M 103

**Contacts:** 3

**Credits:** 3

**1<sup>st</sup> Half**

1. **Algebra:** Equations reducible to quadratics, simultaneous equations (linear and quadratic), Determinants, properties of solution of simultaneous equations by Cramer's rule, matrices, definition of special kinds of matrices, arithmetic operations on matrices, inverse of a matrix, solution of simultaneous equations by matrices, pharmaceutical applications of determinants and matrices. Mensuration and its pharmaceutical applications.
2. **Calculus:**  
**Differential:** Limits and functions, definition of differential coefficient, differentiation of standard functions, including function of a function (Chain rule). Differentiation of implicit functions, logarithmic differentiation, parametric differentiation, successive differentiation, Leibnitz Theorem, Rolle's Theorem (statement only), Mean value theorem, Taylor's Theorem, Maclaurin's series, Indeterminate forms by L' Hoptial's theorem, functions of two variables, partial differentiation, Euler's theorem on homogeneous function, Maxima and minima.

**2<sup>nd</sup> Half**

3. **Calculus :**  
**Integral:** Integration as inverse of differentiation, indefinite integrals of standard forms, integration by parts, substitution and partial fractions, formal evaluation of definite integrals.
4. **Differential Equations:** Definition and formation of differential equations, equations of first order and first degree, variable separable, homogeneous and linear differential equations and equations reducible to such types, linear differential equations of order greater than one with constant coefficients, complementary function and particular integral, pharmaceutical applications.



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**ENVIRONMENT AND ECOLOGY**

**Code:** HU- 102  
**Contacts:** 3  
**Credits:** 3

**General**

Introduction , components of the environment, environmental degradation

**Ecology**

Elements of Ecology ; Ecological balance and consequences of change, principles of environmental impact assessment

**Air Pollution and Control**

Atmospheric composition, energy balance, climate, weather , dispersion, sources and effects of pollutants , primary and secondary pollutants, green house effect, depletion of ozone layer, standards and control measures.

**Water Pollution and Control**

Hydrosphere, natural water, pollutants : their origin and effects , river / lake / ground water pollution, standards and control.

**Land Pollution**

Lithosphere , pollutants ( municipal, industrial, commercial, agricultural, hazardous solid wastes ) ; their origin and effects, collection and disposal of solid waste, recovery and conversion methods.

**Noise Pollution**

Sources, effects, standards and control.

**References / Books:**

1. Masters , G.M., “Introduction to Environmental Engineering and Science”, Prentice –Hall of India Pvt. Ltd. , 1991
2. Nebel , B.J., “Environmental Science”, Prentice –Hall Inc., 1987
3. Odum , E.P., “Ecology: The Link between the natural and social sciences” , IBH Publishing Com. , Delhi

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*Pharmacognosy*

Theory

**Code: PT 102**

**Contacts: 3**

**Credits: 3**

**1<sup>st</sup> Half**

1. Definition, history and scope of pharmacognosy including indigenous system of medicine.
2. Various system of classification of drugs of natural origin.
3. Adulteration and drug evaluation; significance of pharmacopoeial standards.
4. Occurrence, distribution, organoleptic evaluation, microscopical evaluation, chemical constituents including tests wherever applicable and therapeutic efficacy of following categories of drugs.
  - a) Laxatives: Aloes, Rhuburb, Castor oil, Ispaghula, Senna
  - b) Cardiotonics – Digitalis, Arjuna
  - c) Carminatives & G.I. regulators – Umbelliferous fruits, Coriander, Fennel, Ajowan, Cardamom, Ginger, Black pepper, Asafoetida, Nutmeg, Cinnamon, Clove.
  - d) Astringents – Catechu

**2<sup>nd</sup> Half**

5. Occurrence, distribution, organoleptic evaluation, microscopical evaluation, chemical constituents including tests wherever applicable and therapeutic efficacy of following categories of drugs.
  - a) Drugs acting on nervous system – Hyoscyamus, Belladonna, Aconite, Ashwagandha, Ephedra, Opium, Cannabis, Nux vomica.
  - b) Antihypertensives – Rauwolfia
  - c) Antitussives – Vasaka, tolu balsam, Tulsi
  - d) Antirheumatics – Guggul, Colchicum
  - e) Antitumour – Vinca
  - f) Antileprotics – Chaulmoogra Oil
  - g) Antidysenterics – Ipecacuanha
  - h) Antiseptics and disinfectants - Benzoin, Myrrh, Neem, curcuma.
  - i) Antimalarials – Cinchona
  - j) Oxytocics – Ergot
  - k) Vitamins – Shark liver oil and Amla

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- 1) Enzymes – Papaya, diastase yeast
6. Gross anatomical studies of: Senna, Cinchona, Fennel, Clove, Ginger, Nuxvomica & Ipecacuanha.
7. Brief outline of occurrence, distribution outline of isolation, identification tests, therapeutic effects and pharmaceutical applications of alkaloids, terpenoids' glycosides, volatile oils tannins and resins.

### Practical

Code: 192  
Contacts: 3  
Credits: 2

1. Identification of crude drugs (containing carbohydrate, lipid, glycosides, volatile oil, alkaloid etc.) by morphological characters.
2. Physical and chemical tests for evaluation of crude drugs wherever applicable
3. Microscopic studies of Senna leaf, Rauwolfia root, Cinamon bark, Datura flower and stem.
4. Identification of fibres, surgical dressings and pharmaceutical aids.

### *Pharmaceutical Chemistry* *(Inorganic Pharmaceutical Chemistry)*

### Theory

Code: PT 103  
Contacts: 3L + 1T  
Credits: 4

An outline of methods of preparation, uses, sources of impurities, tests for purity and identity, including limit tests for iron, arsenic, lead, heavy metals, chloride, sulphate and special tests if any, of the following classes of inorganic pharmaceuticals included in **Indian Pharmacopoeia**.

### **1<sup>st</sup> Half**

1. Acids and Bases: Buffers, Water
2. Gastrointestinal Agents: Acidifying agents, Antacids, Protectives and Adsorbents, Cathartics.
3. Major Intra-and Extra-cellular electrolytes: Physiological ions, Electrolytes used for replacement therapy, acid-base balance and combination therapy.
4. Essential and Trace Elements: Transition elements and their compounds of pharmaceutical importance: Iron and haematinics, mineral supplements.
5. Cationic and anionic components of inorganic drugs useful for systemic effects.

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6. Inorganic Radio pharmaceuticals: Nuclear radio pharmaceuticals. Reactions, Nomenclature, Methods of obtaining their standards and units of activity, measurement of activity, clinical applications and dosage, hazards and precautions.

#### **2<sup>nd</sup> Half**

7. Topical Agents: Protectives, Astringents and Anti-infectives
8. Gases and Vapours: Oxygen, Anesthetics and Respiratory stimulants
9. Dental Products: Dentifrices, Anti-caries agents
10. Complexing and chelating agents used in therapy
11. Miscellaneous Agents: Sclerosing agents, expectorants, emetics, poisons and antidotes, sedatives etc. Pharmaceutical Aids used in Pharmaceutical Industry. Anti-oxidants, preservatives, filter aids, adsorbents, diluents, excipients, suspending agents, colorants etc.

#### Practicals

Code: PT 193  
Contacts: 3  
Credits: 2

The background and systematic qualitative analysis of inorganic mixtures of upto four radicals, Six Mixtures to be analysed, preferably by semi-micro methods. All identification tests for pharmaceutical/inorganic pharmaceuticals and qualitative tests for cations and anions should be covered.

### ***Basic Electronics and Computer Applications***

#### Theory

Code: CS 103  
Contacts: 3L + 1T  
Credits: 4

#### **1<sup>st</sup> Half**

1. Basic Electronics: Semiconductors, p-n junction diode. LED. Photodiode and its uses. Rectifiers (half wave, full wave/with filter) Transistors configurations, Transistor amplifiers. Introduction to Integrated circuits, photocells and photomultiplier tubes.
2. **Computers:**
  - 2.1 Introduction to Computers. History of Computer development and respective generation: Abacus, Napier's – Bones, Slide rule, Pascal's Calculator, Need to use computers, applications in pharmacy and in general.

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## Pharmaceutical Technology Syllabus

- 2.2 Computer Classification: Mainframe, Mini and Micro Computers, comparison of Analog & Digital Computers. Hardware and Software, Calculator and Computer.
  - 2.3 Operating Systems: Introduction to types of operating systems, UNIX, etc. RAM, ROM, Virtual Memory etc.
  - 2.4 Type of Languages: Conventional languages, their advantages, limitations, C, Programming of this language.
  - 2.5 Introduction to Data Structure: Like Queues, list, trees, Binary trees algorithms, Flow chart, Structured Systems, analysis and development, Ingress-SQL, Gateways etc. Statistics, methodologies.
  - 2.6 Computer Graphics.
- 2<sup>nd</sup> Half**
- 2.7 **Operating Systems:** Introduction to types of operating systems, MS-DOS .
  - 2.8 **Type of Languages:** FORTRAN, FOXPRO, Programming of this language.
  - 2.9 **Basic Language:** Constants and Variables; Character set, constants, variables, Naming the variables getting data into memory, LET, INPUT, READ DATA, Print Statement.  
**Expressions:** Arithmetic expression, Hierarchy of operations, Rules of Arithmetic, Evaluation of expressions, Relational expressions, Logical operations, Library functions.  
**Printer Control:** Comma and semicolon control, the TAB functions, PRINT, L PRINT.  
**Functions and subroutines:** User defined functions, subroutines, subscripted variables.
  - 3. Computer applications in pharmaceutical and clinical studies.

### Practicals

Code: CS 193  
Contacts: 3  
Credits: 2

Exercises based on the following are to be dealt :

- 1. Computer operating systems like Unix, MS-DOS, FOXPRO, FORTRAN
- 2. Simple program in BASIC
- 3. Study of soft-ware packages like WORD-STAR, LOTUS-123, etc.

# West Bengal University of Technology

## Pharmaceutical Technology Syllabus

### SEMESTER -II

#### *Pharmaceutical Chemistry* *(Physical Chemistry)*

Theory

**Code:** PT 203  
**Contacts:** 3L + 1T  
**Credits:** 4

#### **1<sup>st</sup> Half**

1. **Behaviour of Gases:** Kinetic theory of gases, deviation from ideal behaviours and explanation.
2. **The Liquid State:** Physical properties (surface tension, parachor, viscosity, refractive index, optical rotation, dipole moments and chemical constituents).
3. **Solutions:** Ideal and real solutions, solutions of gases in liquids, colligative properties, partition coefficient, conductance and its measurement, Debye Huckel theory.
4. **Thermodynamics:** First law of thermodynamics : Energy, Work, Heat, Enthalpy, Thermochemistry.

Second law of Thermodynamics : Entropy, Free Energy Net Work, deduction of important equations Clausius-calpeyron equation Helomrholtz equation, Vant Hoff equation.

Phase equilibria and phase rule.

#### **2<sup>nd</sup> Half**

5. **Adsorption :** Freudlich and Gibbs adsorption isotherms, Langmuir theory of adsorption.
6. **Photochemistry :** Consequences of light adsorption, Jablenski diagram, Lambert-Beer's Law, Quantum efficiency.
7. **Chemical Kinetics:** Zero, first and second order reactions, complex reactions, theories of reaction kinetics, Arrhenius equation, characteristics of homogeneous and heterogeneous catalysis, acid-base and enzyme catalysis. Molecularity and order of reaction
8. **Quantum Mechanics:** Postulates of quantum mechanics, operators in quantum mechanics, the schrodinger wave equation.

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## Pharmaceutical Technology Syllabus

### Practical

Code: PT 293  
Contacts: 3  
Credits: 2

1. To determine molar mass by Rast method and Cryoscopic method.
2. Experiment based on heat of solution, heat of vibration, heat of neutralization
3. To determine the refractive index of given liquids
4. To determine the molar mass of volatile liquids by Victor-Meyer method
5. To determine the specific rotation of sucrose at various concentration and determine the intrinsic rotation.
6. To determine the rate constant of simple reaction
7. Determination of partition co-efficient of drugs
8. Experiments on adsorption and colorimetry
9. Determination of transition temperature of a salt.
10. Determination of adsorption coefficient.

### *Advanced Mathematics & Engineering Mechanics*

### Theory

Code: M 203  
Contacts: 3L + 1T  
Credits: 4

#### 1<sup>st</sup> Half

1. **Biometrics** : Significant digits and rounding of numbers, data collection, random and non-random sampling methods, sample size, data organization, diagrammatic representation of data, bar, pie, 2-D and 3-D diagrams, measures of central tendency, measures of dispersion, Standard Deviation and standard error of means, coefficient of variation, confidence (fiducial) limits, probability and events. Bayes' theorem, probability theorems, probability distributions, elements of binomial and Poisson distribution, normal distribution curve & properties, kurtosis and skewness, correlation and regression analysis, method of least squares, statistical reference, Student's and paired t-test and F-test, applications of statistical concepts in Pharmaceutical Sciences.

#### 2<sup>nd</sup> Half

2. **Laplace Transforms** : Definition, transforms of elementary functions, properties of linearity and shifting, inverse laplace transforms, transforms of derivatives, solution of ordinary simultaneous differential equations.
3. **Engineering Mechanics** : Equilibrium, Concurrent forces, Composition and resolution of forces, Polygon of forces, Friction, Sliding friction Centre of gravity and applications, Relative velocity Motion under gravity, Motion on inclined planes, Force, Work, Power, Energy, conservation of Energy.

# West Bengal University of Technology

## Pharmaceutical Technology Syllabus

### *Pharmaceutical Chemistry* (Organic Chemistry)

Theory

Code: PT 204  
Contacts: 3L + 1T  
Credits: 4

The subject of organic chemistry will be treated in its modern perspective keeping for the sake of conveniences, the usual classification of organic compounds :

#### 1<sup>st</sup> Half

1. **Structure and Properties** : Atomic structure, Atomic orbitals. Molecular orbital theory, wave equation, Molecular orbitals, Bonding and Antibonding orbitals, Covalent bond, Hybrid orbitals, Intramolecular forces, Bond dissociation energy, Polarity of bonds, Polarity of molecules, structure and physical properties, Intermolecular forces, Acids and bases.
2. **Structure, Nomenclature, Preparation and Reactions of** Alkanes, Alkenes, Alkynes, Cycloalkanes, Dienes, Benzene, Polynuclear aromatic compounds, Arenes, alkyl halides.

#### 2<sup>nd</sup> Half

3. **Stereochemistry**: Isomerism and nomenclature and associated physicochemical properties, optical activity, stereoisomerism, specification of configuration, Reactions involving stereoisomers, chirality, chiral reagents conformations.
4. **Structure, Nomenclature, Preparation and Reactions of**: Alcohols, Ethers, Epoxides, Amines, Phenols, Aldehydes and ketones, Carboxylic acids, functional derivatives of carboxylic acids, Reactive intermediates – carbocations, carbanions, carbenes, nitrene and nitrenium ions.

Practicals

Code: PT 294  
Contacts: 3  
Credits: 2

1. The students should be introduced to the various laboratory techniques, through demonstrations involving synthesis of selected organic compounds (e.g. aspirin, p-bromoacetanilide, anthraquinone from, anthracene, reduction of nitrobenzene etc.)
2. Identification of organic compounds and their derivatisation.
3. Introduction to the use of stereomodels.



**West Bengal University of Technology**  
**Pharmaceutical Technology Syllabus**  
*Remedial Biology*

Theory

Code: PTB 201  
Contacts: 3  
Credits: 3

**1<sup>st</sup> Half**

1. Methods of classification of plants.
2. **Plant Cell** : It's structure and non-living inclusions, mitosis and meiosis, different types of plant tissues and their functions.
3. Morphology and histology of root, stem, bark, wood, leaf, flower, fruit and seed, Modification of root and stem.
4. General Survey of animal kingdom, Structure and life history of parasites as illustrated by amoeba, entamoeba, trypanosoma, plasmodium, taenia, ascaris, schistosom, oxyuris, and ancylostoma.
5. General Structure and life history of insects like mosquito, housefly, mites and silkworm.

Practical

Code: PTB 291  
Contacts: 3  
Credits: 2

1. Morphology of plant parts indicated in theory.
2. Care, use and type of microscopes.
3. Gross identification of slides of structure and life cycle of lower plants, animals mentioned in theory.
4. Morphology of plant parts indicated in theory.
5. Preparation, microscopic examination of stem, root and leaf of monocot and dicot plants.
6. Structure of human parasites and insects mentioned in theory with the help of specimens.

**OR**

**ENVIRONMENT AND ECOLOGY**

**Code: HU 202**  
**Contacts: 3L + 1 T = 4**  
**Credits: 3**

**General**

# West Bengal University of Technology

## Pharmaceutical Technology Syllabus

Introduction , components of the environment, environmental degradation

### **Ecology**

Elements of Ecology ; Ecological balance and consequences of change, principles of environmental impact assessment

### **Air Pollution and Control**

Atmospheric composition, energy balance, climate, weather , dispersion, sources and effects of pollutants , primary and secondary pollutants, green house effect, depletion of ozone layer, standards and control measures.

### **Water Pollution and Control**

Hydrosphere, natural water, pollutants : their origin and effects , river / lake / ground water pollution, standards and control.

### **Land Pollution**

Lithosphere , pollutants ( municipal, industrial, commercial, agricultural, hazardous solid wastes ) ; their origin and effects, collection and disposal of solid waste, recovery and conversion methods.

### **Noise Pollution**

Sources, effects, standards and control.

#### **References / Books:**

4. Masters , G.M., "Introduction to Environmental Engineering and Science", Prentice –Hall of India Pvt. Ltd. , 1991
5. Nebel , B.J., "Environmental Science", Prentice –Hall Inc., 1987
6. Odum , E.P., "Ecology: The Link between the natural and social sciences" . IBH Publishing Com. . Delhi

# West Bengal University of Technology

## Pharmaceutical Technology Syllabus

### *Anatomy, physiology and health education ( APHE )*

Theory

**Code:** PT 205  
**Contacts:** 2L + 1T = 3  
**Credits:** 3

#### **1<sup>st</sup> Half :**

1. **Elementary Tissues of the Human Body** : Epithelial, connective, muscular and nervous tissues, their sub-types and their characteristics.
2. **Osseous System** : Structure, composition and functions of skeleton. Classification of joints, types of movements of joints, disorders of joints.
3. **Skeletal Muscles** : Gross anatomy, physiology of muscle, contraction, physiological properties of skeletal muscles and their disorders.
4. **Haemopoietic system** : Composition and functions of blood and its elements, their disorders, blood groups and their significance, mechanism of coagulation, disorders of platelets and coagulation.

#### **2<sup>nd</sup> Half :**

5. **Lymph and Lymphatic system:** Composition, formulation and circulation of lymph; disorders of lymph and lymphatic system. Basic physiology and functions of spleen.
6. **Digestive System** : General, anatomical outline of gastrointestinal tract, function of different parts including those of liver, pancreas and gall bladder.
7. **Respiratory System** : Anatomy of respiratory system and organs.
8. **Nervous System** : General outline of central nervous system and autonomic nervous system.
9.
  - a) **Concepts of health and disease** : Disease causing agents and prevention of disease.
  - b) **Classification of food requirements** : Balanced diet, nutritional deficiency disorders, their treatment and prevention, specifications for drinking water.
  - c) **Demography and family planning** : Medical termination of pregnancy.
  - d) **Communicable diseases:** Brief outline, their causative agents, modes of transmission and prevention (Chicken pox, measles, influenza, diphtheria, whooping cough, tuberculosis, poliomyelitis, helminthiasis, malaria, filariasis, rabies, trachoma, tetanus, leprosy, syphilis, gonorrhoea and AIDS.
  - e) **First Aid** : Emergency treatment of shock, snake bites, burns, poisoning, fractures and resuscitation methods.

# West Bengal University of Technology

## Pharmaceutical Technology Syllabus

### *Pharmaceutics* (Dispensing and Community Pharmacy)

Theory

**Code:** PT 206  
**Contacts:** 2L + 1T = 3  
**Credits:** 3

#### 1<sup>st</sup> Half

1. Introduction to pharmacopoeia and different types of pharmaceutical formulations ( definition ).
2. **Prescription** : Handling of prescription, source of errors in prescription, care required in dispensing procedures including labelling of dispensed products.
3. General dispensing procedures including labelling of dispensing products.
4. **Pharmaceutical calculations** : Posology, calculation of doses for infants, adults and elderly patients; calculation involving percentage solution, allegation method, alcohol dilution, proof spirit, isotonicity adjustment.

#### 2<sup>nd</sup> Half

5. **Principles involved and procedures adopted in dispensing of** : Typical prescriptions like mixtures, emulsions, ointments, powders, ophthalmics, pastilles, lozenges, pills, tablet triturates etc.
6. **Incompatibilities** : Physical, chemical and therapeutic incompatibilities. Correction of incompatibilities.
7. **Community Pharmacy** : Organisation and structure of retail and whole sale drug store-types of drug store and design, legal requirement for establishment, maintenance and drug store-dispensing of proprietary products, maintenance of records of retail and wholesale, patient counselling, role of pharmacist in community health care and education.

Practical

**Code:** PT 296  
**Contacts:** 3  
**Credits:** 2

1. **Dispensing of prescription falling under the categories** : Mixture, solutions, emulsions, ointments, powders, suppositories, ophthalmics, paste, paints, tablet triturates, lotions, liniments, etc.
2. Identification of various types of incompatibilities in prescription, correction thereof and dispensing of such prescriptions.
3. Dispensing of prescription involving adjustment of tonicity and process calculation for paediatric and geriatric patients.

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## Pharmaceutical Technology Syllabus

4. Project report on Visit to the nearby Community for Counseling on the rational use of drugs and aspects of health care.

### SEMESTER – III

#### *Pharmaceutical Chemistry (Organic Chemistry)*

Theory

Code: PT 304  
Contacts: 3L + 1T = 4  
Credits: 4

#### **1<sup>st</sup> Half :**

**Nucleophilic aromatic substitutions:** —,  $\text{C}=\text{C}$ -unsaturated carbonyl compounds; Conservation of orbital symmetry and rules. Electrocyclic, Cycloaddition and sigmatropic reactions; Neighbouring group effects; Catalysis by transition metal complexes, Stereoselective and stereospecific reactions; New organic reagents used in drug synthesis.

Chemistry of lipids, Carbohydrates, Proteins and Nucleic acids.

#### **2<sup>nd</sup> Half :**

**Heterocyclic Compounds :** Chemistry, preparations and properties of some important heterocyclics containing 3,4,5,6 & 7 atoms with one or two heteroatoms like O,N,S.

Practical

Code: PT 394  
Contacts: 3  
Credits: 2

At least five exercises in synthesis involving various heterocyclic ring systems. An exercise involving stereoselective synthesis of a compound. Resolution of racemic DL-alanine or any other example. Workshop on molecular modelling of primary, secondary and tertiary structures of proteins, molecular modelling on double helical structure of nucleic acid showing hydrogen bonding.

#### *Pharmaceutical Analysis*

Theory

Code: PT 301  
Contacts: 3L + 1T = 4  
Credits: 4

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## Pharmaceutical Technology Syllabus

Theoretical considerations, and application in drug analysis and quality control of the following analytical techniques :

### 1<sup>st</sup> Half :

1. **Non-aqueous titrations**
2. **Complexometric titrations.**
3. **Miscellaneous Methods of Analysis :** Diazotisation titrations, Kjeldahl method of nitrogen estimation, Karl-Fischer titration, Oxygen flask combustion, gasometry.
4. **Extraction procedures including separation of drugs from excipients.**
5. **Chromatography :** The following techniques will be discussed with relevant examples of Pharmacopoeial products. TLC, HPLC, GLC, HPTLC, Paper Chromatography and Column Chromatography.

### 2<sup>nd</sup> Half :

Theoretical considerations, and application in drug analysis and quality control of the following analytical techniques :

6. Potentiometry
7. Conductometry
8. Coulometry
9. Polarography
10. Amperometry

### Practical

Code: PT 391  
Contacts: 3  
Credits: 2

1. **Non aqueous Titrations :** Preparation and standardization of perchloric acid and sodium/potassium/lithium methoxides solutions; Estimations of some pharmacopoeial products.
2. **Complexometric Titrations :** Preparation and standardization of EDTA solution, some exercises related to pharmacopoeial assays by complexometric titration.
3. **Miscellaneous Determinations :** Exercises involving Karl-Fischer, Oxygen flask combustion methods, Determination of alcohol content in liquid galenical.
4. Experiments involving separation of drugs from excipients.
5. Chromatographic analysis of some pharmaceutical products.
6. Exercises based on acid base titration in aqueous and non-aqueous media, oxidation-reduction titration using potentiometric technique. Determination of acid-base dissociation constants and plotting of titration curves using pH meter.
7. Exercises involving polarimetry.
8. Exercises involving conductometric and polarographic techniques.

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## Pharmaceutical Technology Syllabus

### *Physiology*

Theory

**Code:** PT 305

**Contacts:** 3

**Credits:** 3

#### **1<sup>st</sup> Half**

1. Blood and cardiovascular system :
  - a) The physiological properties, Physical characters, composition and functions of blood.
  - b) The Erythrocytes, Hemoglobin, Hemolysis and suspension stability of the blood, leukocytes and platelets.
  - c) The blood volume, The lymph and tissue fluids.
  - d) Transfusion, blood groups, The coagulation of blood.
  - e) The blood pressure.
  - f) Cardiac muscle and its properties, special junctional tissues of heart. Cardiac cycle, cardiac output, Electrocardiogram, regulation of heart's action.
  - g) Special features of the circulation of different regions.
  
2. Respiratory system :
  - a) The mechanism of respiration, the air of the lungs, the physical principles governing the respiratory exchanges, the transport and delivery of Oxygen to the tissues. Intracellular oxidations and energy transfer, the carriage of carbon dioxide.
  - b) The control of respiration, periodic respiration, dyspnea, anoxia and other abnormal forms of respiration.

#### **2<sup>nd</sup> Half**

3. Excretory System :
  - a) Renal circulation, Functions of kidney, Functions of glomerulus, Functions of renal tubules, Renal function tests.
  - b) Composition of Urine and the factors affecting the formation of urine, factors controlling the volume of urine.
  - c) Glycosuria, Micturition.
4. Endocrine glands : Disorders and functions.

Practical

**Code:** PT 395

**Contacts:** 3

**Credits:** 2

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## Pharmaceutical Technology Syllabus

1. Study of human skeleton and identification of different visceral organs
2. Study of different system with the help of charts and models.
3. Microscopic studies of different tissues and organs
4. Estimation of TC, DC, Hb, ESR, clotting time, bleeding time.
5. Recording of body temperature, pulse rate, blood pressure and brief understanding of ECG-PQRST waves and their significance.
6. Experimental physiology : Handling, weighing, numbering, anaesthetising and injection of mice/rat/rabbit.

### *Pharmaceutics* *(Physical Pharmacy)*

Theory

**Code:** PT 306  
**Contacts:** 3L + 1T = 4  
**Credits:** 4

**1<sup>st</sup> Half :**

1. **Matter, Properties of Matter :** State of matter, change in the state of matter, Latent heat and vapor pressure, sublimation critical point, Eutectic mixtures, gases, aerosols-inhalers, relative humidity, liquid complexes, liquid crystals, glassy state, solids-crystalline, amorphous and polymorphism.
2. **Micromeritics and Powder Rheology :** Particle size and distribution, average particle size, number and weight distribution, particle number, methods for determining particle volume, optical microscopy, sieving, sedimentation, measurement, particle shape, specific surface, methods for determining surface area, permeability, adsorption, derived properties of powders, porosity, packing arrangement, densities, bulkiness & flow properties.
3. **Surface and Interfacial Phenomenon:** Liquid interface, surface and interfacial tensions, surface free energy, measurement of surface and interfacial tensions, spreading coefficient, adsorption at liquid interfaces, surface active agents, HLB classification, solubilization, detergency, adsorption at solid interfaces, solid gas and solid-liquid interfaces, complex films, electrical properties of interface.
4. **Viscosity and Rheology :** Newtonian systems, Law of flow, kinematic viscosity, effect of temperature, non-Newtonian systems, pseudoplastic, dilatant, plastic, thixotropy, thixotropy in formulation, determination of viscosity, capillary, falling ball, rotational viscometers.

**2<sup>nd</sup> Half :**

5. **Dispersion systems :** Colloidal dispersions : Definition, types, properties of colloids, protective colloids, applications of colloids in pharmacy; Suspensions and Emulsions: Interfacial properties of suspended particles, settling in suspensions,



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theory of sedimentation, effect of Brownian movement, sedimentation of flocculated particles, sedimentation parameters, wetting of particles, controlled flocculation, flocculation in structured vehicles, rheological considerations, Emulsions-types, theories, physical stability.

6. **Complexation and Protein Binding** : Classification of complexes, methods of preparation and analysis, applications. Protein binding, binding equilibrium, analysis, Thermodynamic treatment to stability constant.
7. **Kinetics and Drug Stability** : Half-life determination, Influence of temperature, light, solvent, catalytic species and other factors, Accelerated stability study, expiration dating, decomposition and stabilisation of medicinal agent.
8. **Polymer Sciences** : Historical background, pharmaceutical application of polymers, definition, molecular weight average and determination of molecular weight from solution viscosity; polymer as thickening agent, gel formation, coacervation and microencapsulation, properties, plasticization.

### Practicals

Code: PT 396  
Contacts: 3  
Credits: 2

1. Determination of particle size, Particle size distribution and surface area using various methods of Particle size analysis.
2. Determination of derived properties of powders like density, porosity, compressibility, angle of repose etc.
3. Determination of surface/interfacial tension. HLB value and critical micellar concentration of surfactants.
4. Study of rheological properties of various types of systems using different Viscometers.
5. Studies of different types of colloids and their properties.
6. Preparation of various types of suspensions and determination of their sedimentation parameters.
7. Preparation and stability studies of emulsions.
8. Studies on different types of complexes and determination of their stability constants.
9. Determination of half-life, rate constant and order of reaction.
10. To study the influence of various factors on the rate of reaction.
11. Accelerated stability testing, shelf-life determination and expiration dating of pharmaceuticals.
12. Determination of dissolution rate of tablets.
13. The effect of pH of the solubility on a slightly soluble weak acid.

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## Pharmaceutical Technology Syllabus

### *Pharmaceutical Engineering*

Theory

**Code:** PT 307  
**Contacts:** 3L + 1T = 4  
**Credits:** 4

**1<sup>st</sup> Half :**

1. **Stoichiometry :** Units and their conversions, molecular units, basic laws, mole fraction, problems on stoichiometry, material balance and related problems, energy balance and related problems. Dimensional analysis, different types of graphic representations.
2. **Fluid Flow :** Different manometers and their application, types of flow, boundary layer concept, Reynold's number, Bernoulli's theorem, fluid friction, flow measuring devices, non-Newtonian fluid flow – basic concept.

**2<sup>nd</sup> Half :**

3. **Material Handling:**
  - a) Liquid handling – Different types of pumps.
  - b) Gas handling-Variou types of fans, blowers and compressors.
  - c) Solid handling – Bins, Bunkers, Conveyers, Other solid transport systems.
4. **Filtration and Centrifugation :** Theory of filtration, industrial filters like leaf filters, rotary filter, filter press edge filter etc. filter aids, and resistances, mathematical problems. Principles of centrifugation, centrifugal filters and sedimentors, Pharmaceutical applications.
5. **Industrial Hazards & Safety precautions :** Different types of hazards like mechanical, electrical, chemical, dust, fire etc. Preventive methods and precautions. First Aid – shock, fainting, wounds, Acid and Alkali burns, poison antidotes, artificial respiration etc.

### **Engineering Drawing**

**Code:** PT 397  
**Contacts:** 3  
**Credits:** 2

I.S. Conventions of drawing – lettering, scales etc. , Orthographic Projection – first and third angle concepts Isometric drawing and Dimensioning.

Sections and Sectional Views

Bolted and rivetted joints

Welded joints

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Pipe joints and fittings

Types of flanges and working drawing of pulley, key etc. Pressure vessel and auxiliaries – skirt, saddle etc.

Line drawing of agitator, ball mill, mixer, filter press, Centrifuge, dryer, evaporator Calandria, granulator, sieving machine, tablet compressing machine etc.

Concept of flow diagram.

### SEMESTER – IV

#### *Pharmaceutics* ( *Pharmaceutical Technology-I* )

Theory

**Code:** PT 406(1)  
**Contact:** 3L + 1T = 4  
**Credits:** 4

**1<sup>st</sup> Half :**

1. **Liquid dosage forms :** Introduction, types of additives used in formulation, vehicles, stabilization, preservatives, suspending agents, emulsifying agents, solubilisers, colours, flavours and others; Manufacturing, packaging, physico-chemical and biopharmaceutical aspects of drug release and efficacy are to be dealt with individual dosage form and evaluation of clear liquids, suspensions and emulsions.
2. **Semisolid dosage forms:** Definition, types, mechanism of drug penetration, factors influencing penetration, semi-solid bases and their selection, general formulation of semi-solids, clear gels manufacturing procedure, evaluation and packaging.
3. **Suppositories :** Definition, size, shape and doses, ideal requirements, factors affecting drug absorption, type of bases, manufacturing procedure, storage, packaging, stability of suppositories.

**2<sup>nd</sup> Half :**

4. **Extraction and Galenical Products :** Principle and method of extraction, factors affecting extraction rate, choice extraction procedure, preparation of infusion, tinctures, dry and soft liquid extracts.
5. **Blood products and plasma substitutes :** Collection, processing and storage of Whole human blood and all fractions individually. Plasma substitutes – ideal requirements, PVP, dextran etc. for control of blood pressure as per I.P.
6. **Pharmaceutical Aerosol :** Mode of operation, Definition, propellants, manufacturing and packaging methods, container with all parts, pharmaceutical application and testing.
7. **Ophthalmic preparation :** Requirements, eye drops, eye lotions, eye ointments, formulation, additives, preparation, sterilization, packaging, evaluation, contact lens solution.

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## Pharmaceutical Technology Syllabus

Practical

**Code:** PT 496(1)  
**Contacts:** 3P  
**Credits:** 2

1. Preparation, evaluation and packaging of liquid orals like solution, suspension, emulsion; Eye drops, eye ointments, ointments, creams, suppositories.
2. Preparation of pharmacopoeal extracts and galenical products utilizing various methods of extraction.

### *Pharmacognosy*

Theory

**Code:** PT 402  
**Contacts:** 3L + 1T = 4  
**Credits:** 4

**1<sup>st</sup> Half :**

1. **Resins** : Study of Drugs Containing Resins and Resin Combination like Colophony, podophyllum, jalap, cannabis, capsicum, myrrh, asafoetida, balsam of tolu, balsam of peru, benzoin, turmeric, ginger.
2. **Tanins** : Study of tannins and tannin containing drugs like Gambir, gall and myrobalan.
3. **Volatile Oils** : General methods of obtaining volatile oils from plants; Study of volatile oils of Mentha, Cassia, Lemon peel, Orange peel, Lemon grass, Citronella, Caraway, Dill, Spearmint, Eucalyptus, Chenopodium, Valerian, Musk, Gaultheria, Sandal wood.
4. **Fibers** : Study of fibres used in pharmacy such as cotton, silk, wool, nylon, glass-wool, polyester and asbestos.

**2<sup>nd</sup> Half :**

5. **Pharmaceutical aids** : Study of pharmaceutical aids like talc, diatomite, kaolin, bentonite, gelatine and natural colours.
6. Study of the biological sources, commercial varieties, chemical constituents, substitutes, adulterants, uses, diagnostic macroscopic and microscopic features and specific chemical tests of following groups of drugs containing glycosides :
  - i) **Saponins**: Ginseng, dioscorea, sarsaparilla and senega
  - ii) **Cardioactive sterols** : squill, strophanthus and thevetia
  - iii) **Anthraquinone cathartics** : cascara
  - iv) **Others** : Psoralea, Ammi majus, Ammi visnaga, gentian, saffron, chirata, quassia.

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7. Studies of traditional drugs, Common vernacular names, botanical sources, morphology, chemical nature of chief constituents, pharmacology, categories and common uses and marketed formulations of following indigenous drugs :  
Amla, Kantkari, Satavari, Tylophora, Bhilawa, Kalijiri, Bach, Rasna, Punarnava, Chitrack, Apamarg, Gokhru, Shankhapushpi, Brahmi, Adusa, Arjuna, Ashoka, Methi, Lahrun, Palash, Guggal, Gyumnema, Shilajit, Nagarmotha and Neem.
8. The holistic concept of drug administration in traditional systems of medicine, Introduction to ayurvedic preparations like Arishta, Asvas, Gutikas, Tailas, Churnas, Lehyas, Bhasmas.

#### Practical

Code: PT 492  
Contacts: 3  
Credits: 2

1. Microscopic study of powdered crude drugs containing volatile oil, glycosides, alkaloids etc.
2. Laboratory experiments on isolation, separation and purification of various groups of constituents present in crude drugs of pharmaceutical significance.
3. Chemical tests for alkaloids, glycosides, steroids, flavonoids, tannins and resins etc.

#### *Pharmaceutical Chemistry* (Bio-chemistry)

#### Theory

**Code:** PT 404  
**Contacts:** 3L + 1T = 4  
**Credits:** 4

#### 1<sup>st</sup> Half :

1. Biochemical organisation of the cell and transport processes across cell membrane.
2. The concept of free energy, determination of change in free energy from equilibrium constant and reduction potential, bioenergetics, production of ATP and its biological significance.
3. Introduction to 3D structure of protein, stability and denaturation of protein, allosteric proteins.
4. **Enzymes** : Nomenclature, enzyme kinetics and its mechanism of action, mechanism of inhibition, enzymes and iso-enzymes in clinical diagnosis.
5. **Co-enzymes** : Vitamins as co-enzymes and their significance, Metals as co-enzymes and their significance.

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### 2<sup>nd</sup> Half :

6. **Carbohydrate Metabolism** : Conversion of polysaccharide to glucose – 1 – phosphate, Glycolysis and fermentation and their regulation, Gluconeogenesis and glycogenolysis, Metabolism of galactose and galactosemie, Role of sugar nucleotides in biosynthesis and Pentosephosphate pathway.
7. **The Citric Acid Cycle** : Significance, reactions and energetic of the cycle, Amphibolic role of the cycle, and Glyoxalic acid cycle.
8. **Lipids Metabolism** : Oxidation of fatty acids,  $\alpha$ -oxidation & energetic,  $\omega$ -oxidation,  $\mu$ -oxidation, Biosynthesis of ketone bodies and their utilization, Biosynthesis of saturated and unsaturated fatty acids, Control of lipid metabolism, Essential fatty acids & eicosanoids (prostaglandins, thromboxanes and leukotrienes) phospholipids, and sphingolipids.
9. **Biological Oxidation** : Redox-Potential, enzymes and co-enzymes involved in oxidation reduction & its control, The respiratory chain, its role in energy capture and its control, Energetic of oxidative phosphorylation, Inhibitors of respiratory chain and oxidative phosphorylation, Mechanism of oxidative phosphorylation.

### Practical

Code: PT 494  
Contacts: 3  
Credits: 2

1. Experiments of sugar – test for reducing sugar, colorometric estimation of sugar, chromatographic separation of sugars.
2. Titration curve for amino acids
3. Separation of amino acids by two-dimensional paper chromatography and gel electrophoresis.
4. Experiments on lipids – saponification no., iodine no., separation of lipids by TLC.
5. Quantitative estimation of amino acids, protein,
6. Experiments on clinical bio-chemistry – blood glucose estimation, cholesterol in blood, separation of plasma proteins by paper electrophoresis, non-protein N<sub>2</sub> – in blood, estimation of SGOT, SGPT and ALP in the serum.
7. Experiments on enzymes – effect of pH, effect of temperature and use of inhibitors.

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### *Physiology*

Theory

**Code:** PT 405  
**Contacts:** 3L + 1T = 4  
**Credits:** 4

#### **1<sup>st</sup> Half :**

1. Nervous system, Central nervous system : Nerve impulse; Synapse Reflex arc, Receptor, organs, reflex action; Physiological mechanism governing the posture and equilibrium; The spinal cord and brain stem; The extra-pyramidal system, the thalamus and hypothalamus; Condition reflex, sleep; Cerebrum; cerebrospinal fluid. Autonomic nervous system : Classification, general arrangement, dual supply, drugs action on ANS, Structure of autonomic ganglia, Sympathetic system and parasympathetic system.

#### **2<sup>nd</sup> Half :**

2. Special sense : Taste (gustation). Smell (olfaction), vision and hearing
3. Body temperature and its regulation, pyrexia and hypotherms.
4. Membranes and excitable tissues.

### *Pharmaceutics* *(Pharmaceutical Technology-II)*

Theory

**Code:** PT 406(2)  
**Contacts:** 3L + 1T = 4  
**Credits:** 4

#### **1<sup>st</sup> Half**

1. **Tablets :**
  - a) Formulation of different types of tablets, granulation technology on large scale by various techniques, physics of tablets making, different types of tablet compression machinery and equipment employed, evaluation of tablet, Manufacturing area design and layout flow diagram of tablet manufacturing.
  - b) Coating of tablets : Types of coating, sugar coating, film coating, film forming materials, formulation of coating solution, equipment for coating, coating process, evaluation of coated tablets, Physiological availability and tablet coating.
  - c) Stability Kinetics and quality assurance.

#### **2<sup>nd</sup> Half :**

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2. **Capsules :** Advantages and disadvantages of capsule dosage form, material for production of hard gelatine capsules, size of capsules, method of capsule filling, sealing and packaging, Soft gelatine capsules shell and its content, important of base adsorption and factors, quality control, stability testing and storage.
3. **Cosmetology and Cosmetic preparation :** Fundamentals of cosmetic science, structure and function of skin and hair, formulation, preparation, packaging and evaluation of cosmetic products for skin, hair, eye, denitrifies and preparations like nail polish, lipstick; baby care products; shaving cream, after-shave lotions, etc.

#### *Pharmaceutical Engineering*

Practical

Code: PT 497  
Contacts: 3P  
Credits: 2

1. Measurement of flow of fluids and their pressure, determination of Reynold's number and calculation of Frictional losses.
2. Evaluation of filter media, determination of rate of filtration and study of factors affecting filtration.
3. Determination of humidity – use of Dry Bulb and Wet Bulb.
4. Determination of overall heat transfer co-efficient.
5. Determination of rate of evaporation.
6. Determination of rate of drying, free moisture content and bound moisture content.
7. Experiments to illustrate principles of size reduction, Laws governing energy and power requirements of size Reduction.
8. Experiments on batch distillation and to verify Reileigh's equation, study of the performance of different dryers.

#### **SEMESTER - V**

#### *Pharmaceutical Engineering*

Theory

**Code:** PT 507  
**Contacts:** 3L + 1T = 4  
**Credits:** 4

**1<sup>st</sup> Half :**

1. **Heat Transfer :** Heat transfer by conduction, problems on steady state heat conduction; heat transfer by convection, heat transfer coefficient, heat exchangers, problems on convection, heat transfer by radiation, Stefan's and Kirchoff's Laws, pharmaceutical applications.
2. **Evaporation :** Principles of evaporation, different evaporators like short and long tubes, forced convective and agitated film evaporators. Factors affecting



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evaporation rate. Multiple effect evaporation, pharmaceutical applications, Mathematical problems.

### 2<sup>nd</sup> Half :

3. **Size Reduction and Size Separation :** Utility of size reduction and separation, Laws of crushing and grinding, different crushers and grinders like Roll crusher, ball mill, hammer mill, colloid mill, fluid energy mill etc.; fluid classifiers, Stoke's Law, laws of sedimentation, Powder characterisation, particle size analysis.
4. **Mixing :** Sampling and statistics of mixing, Different mixers: solid-solid, solid-liquid and liquid-liquid, Problems of mixing and mixer selection.
5. **Crystallisation:** Introduction – Crystal characteristics, solubility curves, supersaturation theory, nucleation, crystal growth etc., Industrial crystallisers like Swenson-Walker, tank type, agitated type and vacuum type etc. Different problems of crystallisation like caking etc.
6. **Materials of construction:** Introduction – Corrosion, material properties, metals, non-metals and alloys for fabrication, specially stainless steel, aluminium, glass, polymers, rubber, ceramics and different Ni, Cr, Mn, Mo, Al, Fe, Si alloys. Different linings and surface coatings.

Practical

3 hrs./week

**Practicals will be conducted as per the subject content in theory (at least 7 experiments)**

### *Pharmacology*

Theory

Code: PT 508  
Contacts: 3L = 3  
Credits: 3

### 1<sup>st</sup> Half :

1. **General Pharmacology :** Introduction to Pharmacology, Sources of drugs, Dosage forms and routes of administration, mechanism of action, Combined effect of drugs, Factors modifying , Drug action, tolerance and dependence,
2. Pharmacogerotics, Absorption, Distribution, Metabolism and Excretion of drugs, Principals of Basic and Clinical pharmacokinetics, Adverse Drug Reactions and treatment of poisoning , ADME, drug interaction, Bioassay of Drugs and Biological Standardisation, Discovery and development of new drugs.
3. **Pharmacology of Peripheral Nervous System :**
  - a) Neurohumoral transmission (autonomic and Somatic)
  - b) Parasympathomimetics, Parasympatholytics, Sympathomimetics, Adrenergic Receptor and neuron blocking agents, Ganglionic, stimulants and blocking agents.
  - c) Neuromuscular blocking agents
  - d) Local anaesthetic Agents.

### 2<sup>nd</sup> Half :

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4. **Pharmacology of Central Nervous System :**
- a) Neurohumoral transmission in the C.N.S.
  - b) General Anesthetics
  - c) Alcohols and disulfiram
  - d) Sedatives, hypnotics, Anti-anxiety agents and Centrally action, muscle relaxants.
  - e) Psychopharmacological agents and psychotics) anti-depressants and maniacs and hallucinogens)
  - f) Anti-epileptics drugs
  - g) Anti-Parkinsonian Drugs
  - h) Analgesics, Antipyretics, Anti-inflammatory and Anti-gout drugs
  - i) Narcotic analgesics and antagonists
  - j) C.N.S. stimulants
  - k) Drug-Addiction and Drug Abuse.

### *Pharmaceutical Microbiology*

Theory

Code: PT 509

Contacts: 3L

Credits: 3

#### **1<sup>st</sup> Half :**

- 1. Introduction to the scope of microbiology
- 2. Structure of bacterial cell.
- 3. Classification of microbes and their taxonomy. Actinomycetes bacteria, rickettsiae, spirochetes and viruses.
- 4. Identification of Microbes : Stains and types of staining techniques, electron microscope.
- 5. Nutrition, cultivation, isolation of bacteria, actinomycetes, fungi, viruses, etc.
- 6. Microbial genetics and variation.

#### **2<sup>nd</sup> Half :**

- 7. Control of microbes by physical and chemical methods.
  - a) Disinfection, factors influencing disinfectants, dynamics of disinfection, disinfectants and antiseptics and their evaluation.
  - b) Sterilization, different methods, validation of sterilization methods & experiments.
- 8. Sterility testing of all Pharmaceutical products.
- 9. Immunity, primary and secondary, defensive mechanisms of body, microbial resistance, interferon.
- 10. Microbial assays of antibiotics, Vitamins (Vitamin B<sub>12</sub> & Niacin), amino acids.

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11. Diseases and disease-producing microorganisms, like *Staphylococcus aureus*, *Streptococcus pyrogenes*, *E. coli*, *Salmonella typhi*, *Vibrio cholerae* and *Yersinia pestis*; virulence factors.

### Practical

Code: PT 599  
Contacts: 3  
Credits: 2

Experiments devised to prepare various types of culture media, sub-culturing of common aerobic and anaerobic bacteria, fungus and yeast, various staining methods, various methods of isolation and identification of microbes, sterilization techniques and their validation of sterilizing techniques, evaluation of antiseptics and disinfectants, testing the sterility of pharmaceutical products as per I.P. requirements, microbial assay of antibiotics and vitamins etc.

### *Pharmaceutical Chemistry (Medicinal Chemistry)*

### Theory

**Code:** PT 503  
**Contacts:** 3L + 1T = 4  
**Credits:** 4

### 1<sup>st</sup> Half :

1. **Basic Principles of Medicinal Chemistry :** Physico-chemical aspects (Optical, geometric and bioisosterism) of drug molecules and biological action, Drug-receptor interaction including transduction mechanisms.
2. **Synthetic procedures of selected drugs :** Mode of action, uses, structure activity relationship including physico-chemical properties of the following classes of drugs :

#### **Drugs acting at Synaptic and neuro-effector junction sites :**

- i) Cholinergics and Anticholinesterases
- ii) adrenergic drugs
- iii) Antispasmodic and anti-ulcer drugs
- iv) Neuromuscular blocking agents.

### 2<sup>nd</sup> Half :

3. **Principles of Drug Design (Theoretical Aspects) :** Traditional analog (QSAR) and mechanism based approaches (Introduction to graph theory, applications of quantum mechanics, Computer aided drug designing (CADD) and molecular modelling.

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4. **Synthetic procedures of selected drugs** : Mode of action, uses, structure activity relationship including physicochemical properties of the following classes of drugs :
- a) **Autocoids**
    - i) Antihistamines
    - ii) Elcosancids
    - iii) Analgesic-antipyretics, anti-inflammatory (non-steroids) agents.
  - b) **Drugs affecting uterine motility** :  
Oxytocics (including oxytocin, ergot alkaloids and prostaglandins)  
Biochemical approaches in drug designing wherever applicable should be discussed.

### Practicals

Code: PT 593  
Contacts: 3  
Credits: 2

1. Exercises based on QSAR : Hansch & Free-Wilson methods.
2. Synthesis of selected drugs from the course content.
3. Special analysis of the drugs synthesized.
4. Establishing the pharmacopocial standards of the drugs synthesized.
5. Determination of partition coefficient, dissociation constant and molar refractivity of compounds for QSAR analysis.

### *Pharmaceutics (Hospital Pharmacy)*

### Theory

Code: PT 506  
Contacts: 3  
Credits: 3

### 1<sup>st</sup> Half :

1. **Organisation and Structure** : Organisation of a hospital and hospital pharmacy, Responsibilities of a hospital pharmacist, Pharmacy and therapeutic committee, Budget preparation and implementation.
2. **Hospital Formulary** : Contents, preparation and revision of hospital formulary.
3. **Drug Store Management and Inventory Control** :
  - a) Organisation of drug store, Types of materials stocked, storage conditions.
  - b) Purchase and Inventory Central-principles, purchase procedures, Purchase order, Procurement and stocking.
4. **Drug distribution Systems in Hospitals** :
  - a) Organisation of drug store, Types of materials stocked, storage conditions.
  - b) Purchase and Inventory, Control-principles, purchase procedures, Purchase order, Procurement and stocking.

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5. **Drug distribution Systems in Hospitals :**
- Out-patient dispensing, methods adopted.
  - Dispensing of drugs to in-patients. Types of drug distribution systems, Charging policy, labelling.
  - Dispensing of drugs to ambulatory patients
  - Dispensing of controlled drugs.

### 2<sup>nd</sup> Half :

6. **Manufacture of Sterile and Nonsterile Products :** Policy making of manufacturable items, demand and costing, personnel requirements, manufacturing practice. Master formula Card, production control, Manufacturing records.
7. **Drug Information Services :** Sources of Information on drugs, disease, treatment schedules, procurement of information, Computerized services (e.g. MEDLINE), Retrieval of information, Medication error.
1. **Records and Reports :** Prescription filling, drug profile, patent medication profile, cases on drug interaction and adverse reactions, idiosyncratic cases etc.
9. **Nuclear Pharmacy :** Introduction to Radio pharmaceuticals, radio-active half-life, Units of radio-activity Production of radio-pharmaceuticals, methods of isotopic tagging, preparation of radio-isotopes in laboratory using radiation dosimetry, radio-isotope generators, Permissible radiation dose level, Radiation hazards and their prevention, specifications for radio-active laboratory.

### Practical

**Code:** PT 596  
**Contacts:** 3  
**Credits:** 2

- Experiments based on Sterilization of various types of materials used in Hospitals.
- Practicals designed on the use of computers in Drug Information Centre, prescription filling, documentation of information on drug interaction.

### *Pharmaceutical Chemistry (Bio-chemistry)*

### Theory

**Code:** PT 504  
**Contacts;** 3  
**Credits:** 3

### 1<sup>st</sup> Half :

- Nitrogen & Sulphur cycle ;** Nitrogen fixation, ammonia assimilation, nitrification and nitrate assimilation, Sulphate activation, sulphate reduction. Incorporation of sulphur in organic compounds, Release of sulphur from organic compounds.

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2. **Metabolism of Ammonia and Nitrogen Containing Monomers** : Nitrogen balance, Biosynthesis of amino acids, Catabolism of amino acids, Conversion of amino acids to specialised products, Assimilation of ammonia, Urea cycle, metabolic disorders of urea cycle, Metabolism of sulphur containing amino acids, Porphyrin biosynthesis, formation of bile pigments, hyperbilirubinemia, Purine biosynthesis, Purine nucleotide interconversion, Pyrimidine biosynthesis, and Formation of deoxyribonucleotides.

#### **2<sup>nd</sup> Half :**

3. **Biosynthesis of Nucleic Acids** : Brief introduction of genetic organization of the mammalian genome, alteration and rearrangements of genetic material, Biosynthesis of DNA and its replication, Mutation, Physical & chemical mutagenesis/carcinogenesis, DNA repair mechanism, Biosynthesis of RNA.
4. **Genetic Code and Protein Synthesis** : Genetic code, Components of protein synthesis, and Inhibition of protein synthesis, Brief account of genetic engineering and polymerase chain reactions.
5. **Regulation of gene expression.**

#### *Pharmaceutics* *Pharmaceutical Technology*

Practical

**Code:** PT 596  
**Contacts:** 3  
**Credits:** 2

1. Formulation of various types of cosmetics for skin, hair, eye and different type of preparations.
2. Preparation, evaluation and packaging of tablets and tablet coating
3. Preparation , evaluation and packaging of hard gelatine capsules.

#### **SEMESTER – VI**

#### *Pharmaceutical Chemistry* *(Medicinal Chemistry)*

Theory

**Code:** PT 603  
**Contacts:** 3L + 1T = 4  
**Credits:** 4

**1<sup>st</sup> Half :**

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## Pharmaceutical Technology Syllabus

Synthetic procedures of selected drugs, mode of action, uses, structure activity relationship including Physico-Chemical properties of the following classes of drugs :

1. **Drugs acting on the Central Nervous System :** General Anesthetics, Local Anesthetics, Hypnotics and Sedatives, Opioid analgesics, anti-tussives, anti-convulsants, Antiparkinsonism drugs, CNS stimulants, Psychopharmacological agents(neuroleptics,antidepressants, anxiolytics).

### 2<sup>nd</sup> Half :

Synthetic procedures of selected drugs, mode of action, uses, structure, activity relationship including Physico-Chemical properties of the following classes of drugs :

2. **Diuretics, Cardiovascular drugs, Anticoagulant and anti-platelet drugs.** Biochemical approaches in drug designing wherever applicable should be discussed.
3. **Steroids and related drugs :** Steroidal nomenclature and stereochemistry, androgens and anabolic agents, estrogens and progestational agents, adrenocorticoids.

### Practical

Code: PT 693  
Contacts: 3  
Credits: 2

1. Workshop on stereomodel use of some selected drugs.
2. Synthesis of selected drugs from the course content involving two or more steps and their special analysis.
3. Establishing the Pharmacopoeial standards of the drugs synthesized

### *Pharmaceutics* *(Pharmaceutical Technology)*

### Theory

Code: PT 606  
Contacts: 3  
Credits: 3

### 1<sup>st</sup> Half :

1. **Parenteral Products :**
  - a) Pre-formulation factors, routes of administration, water for injection, pyrogenicity, non-aqueous vehicle, isotonicity and methods of its adjustment.
  - b) Formulation details; containers, closures and their selections.

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- c) Pre-filling treatment, washing of containers and closures, preparation of solution and suspension, filling and closing of ampoules, vials, infusion fluids, lyophilization and preparation of sterile powders, equipment for large scale manufacture and evaluation of parenteral products.
  - d) Aseptic Techniques : source of contamination and methods of prevention, design of aseptic area, laminar flow bench services and maintenance.
  - e) Sterility testing of pharmaceuticals.
2. **Surgical Products** : Definition, primary wound dressing, absorbents, surgical cotton, surgical gauze etc., bandages, adhesive tape, protective cellulosic hemostatics, official dressing, absorbable and non-absorbable sutures, ligatures and catguts, preparation and sterilization of surgical catguts.

### 2<sup>nd</sup> Half :

3. **Packaging of Pharmaceutical Products** : Packaging components, types, specifications and methods of evaluation, stability aspect of packaging, packaging equipment, factors influencing choice of containers, legal and other official requirements for containers, packaging testing.
4. **Novel drug delivery system** : Introduction to novel drug delivery systems like micro-capsule and micro-pellet parenteral and implantable therapeutic systems, transdermal therapeutic systems, micro-particulate drug carrier system, micro-encapsulation – types, method of preparation and evaluation.

### Practical

Code: PT 696  
Contacts: 3  
Credits: 2

1. Experiments to illustrate preparation, stabilisation, physical and biological evaluation of pharmaceutical products like parenterals, micro-capsules, sustained action dosage forms.
2. Evaluation of materials used in pharmaceutical packaging.

### *Pharmaceutics (Biopharmaceutics and Pharmacokinetics)*

### Theory

Code: PT 611  
Contacts: 3L + 1T = 4  
Credits: 4

### 1<sup>st</sup> Half :

1. Introduction to Biopharmaceutics and Pharmacokinetics and their role in formulation development and clinical setting.
2. **Biopharmaceutics** :



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- 2.1 Passage of drugs across biological barrier (passive diffusion, active transport, facilitated diffusion and pinocytosis)
- 2.2 Factors influencing absorption-Physicochemical, physiological and pharmaceutical.
- 2.3 Drug distribution in the body, plasma protein binding.
3. **Bioavailability and bioequivalence :**
  - a) Measures of bioavailability,  $C_{max}$ ,  $t_{max}$  and area under the curve (AUC).
  - b) Design of single dose bio-equivalence study and relevant statistics.
  - c) Review of regulatory requirements for conduction of bio-equivalent studies.

### 2<sup>nd</sup> Half :

- 4) **Pharmacokinetics :**
  - a) Significance of plasma drug concentration measurement
  - b) Compartment model-Definition and Scope
  - c) Pharmacokinetics of drug absorption-Zero order and first order absorption rate constant using Wagner – Nelson and Loo-Reigelman method.
  - d) Volume of distribution and distribution coefficient.
  - e) Compartment kinetics-One compartment and two compartment models. Determination of pharmacokinetic parameters from plasma and urine data after drug administration by intravascular and oral route.
  - f) Curve fitting(method of Residuals), regression procedures.
  - g) Clearance concept, Mechanism of renal clearance, clearance ratio, determination of renal clearance.
  - h) Extraction ratio, hepatic clearance, biliary excretion, Extrahepatic circulation.
  - i) Non-linear pharmacokinetics with special reference to one compartment model after I.V. drug administration, Michaelis Menten Equation, detection of non-linearity (Saturation mechanism).
5. **Clinical Pharmacokinetics :**
  - a) Definition and scope
  - b) Dosage adjustment in patients with and without renal and hepatic failure.
  - c) Design of single dose bio-equivalence study and relevant statistics.
  - d) Pharmacokinetic drug interactions and their significance in combination therapy.

### Practical

Code: PT 697  
Contacts: 3P  
Credits: 2

1. Experiments designed for the estimation of various pharmacokinetics parameters with given data.
2. Analysis of biological specifications for drug content and estimation of the pharmacokinetic parameters.
3. In vitro evaluation of different dosage forms for drug release.
4. Absorption studies – in vitro and in situ
5. Statistical treatment of pharmaceutical data.

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**Pharmaceutical Technology Syllabus**  
*Pharmacology*

Theory

Code: PT 608  
Contacts: 3  
Credits: 3

**1<sup>st</sup> Half :**

1. **Pharmacology of Cardiovascular System :**
  - a) Digitalis and cardiac glycosides
  - b) Antihypertensive drugs
  - c) Antianginal and Vasodilator drugs, including calcium channel blockers and beta adrenergic antagonists.
  - d) Antiarrhythmic drugs
  - e) Antihyperlipedemic drugs
  - f) Drugs used in the therapy of shock
2. **Drugs Acting on the Hemopoetic System :**
  - a) Hematinics
  - b) Anticoagulants, Vitamin K and hemostatic agents.
  - c) Fibrinolytic and anti-platelet drugs
  - d) Blood and plasma volume expanders.
3. Bioassay: Definition; merits and demerits of bioassay, biological standardisation; threshold dose, bracketing, four point and other assays; bioassay of acetylcholine, hydroxytryptamine, adrenaline, noradrenaline, sedative agents, oxytocin, digitalis, different hormones, anesthetics, local anesthetics, etc.
4. Drugs that act on the blood and on blood forming tissues:
  - a) Iron: Absorption and utilization of iron, iron deficiency, anaemia, therapeutic uses and side effect of iron.
  - b) Hemostatics and coagulants
  - c) Anticoagulant drugs
5. Drugs that acts on the cardiovascular system:
  - a) Antiarrhythmic drugs: Origin of arrhythmia in different sites; pharmacological properties, classification, therapeutic uses and side effects of antiarrhythmic drugs
  - b) Cardiotonic drugs: Pharmacological properties, therapeutic uses, side effects of different cardiac glycosides.
  - c) Antianginal drugs: Pharmacological properties, therapeutic uses and side effects on antianginal drugs
  - d) Vasodilator and vasoconstrictor agents: Pharmacological properties, therapeutic uses and side effects of vasodilator and vasoconstrictor agents

**2<sup>nd</sup> Half :**

6. **Drugs acting on urinary system :**
  - a) Fluid and electrolyte balance
  - b) Diuretics
7. **Autocoids :**

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- a) Histamine, 5-HT and their antagonists
  - b) Prostaglandins, thromboxanes and leukotrienes
  - c) Pentagastrin, Cholecystokinin, Angiotensin, Bradykinin and Substance P.
8. **Drugs Acting on the Respiratory System :**
- a) Anti-asthmatic drugs including bronchodilators
  - b) Anti-tussives and expectorants
  - c) Respiratory stimulants

Practical

Code: PT 698

Contacts: 3

Credits: 2

1. **Introduction to Experimental Pharmacology :**  
Preparation of different solutions for experiments.

Drug dilutions, use of molar and w/v solutions in experimental pharmacology.

Common laboratory animals and anaesthetics used in animal studies.

Commonly used instruments in experimental pharmacology.

Some common and standard techniques.

Bleeding and intravenous injection, intra-gastric administration

Procedures for rendering animals unconscious-stunning of rodents, pithing of frogs, chemical anaesthesia.

2. **Experiments on intact preparations :**  
Study of different routes of administration of drugs in mice/rats.

To study the effect of hepatic microsomal enzyme inhibitors and induction on the pentobarbitonic sleeping time in mice.

3. **Experiments on Central Nervous system :**  
Recording of spontaneous motor activity, stereotype, analgesia, anticonvulsant activity, and inflammatory activity and muscle relaxant activity of drugs using simple experiments.

4. **Effects of autonomic drugs on rabbit's eye :**

5. Effects of various agonists and antagonists and their characterization using isolated preparations like frog's rectus abdominis muscle and isolated ileum preparations of rat guinea pig and rabbit.

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6. In-vitro (LAL Test) and In-vivo Test for pyrogen.
7. **Experiments on Isolated Preparations :**
  - a) To record the concentration response curve (CRC) of acetylcholine using rectus abdominis muscle preparation of frog.
  - b) To study the effects of physostigmine and d-tubocurarin on the CRC of acetylcholine using rectus abdominis muscle preparation of frog.
  - c) To record the CRC of 5-HT on rat uterus preparation.
  - d) To record the CRC of histamine on guineapig ileum preparation
  - e) To record the CRC of noradrenaline on rat anococcygeus muscle preparation.
  - f) To record the CRC of oxytocin using rat uterus preparation
8. **Pharmacology of Cardiovascular System :**
  - a) To study the ionotropic and chronotropic effects of drugs on isolated frog heart.
  - c) To study the effects of drugs on normal and hypodynamic frog heart.

### *Pharmaceutical Biotechnology & Industrial Microbiology*

Theory

Code: PT 609  
Contacts: 3  
Credits: 3

**1<sup>st</sup> Half :**

1. **Immunology and Immunological Preparations :** Principles, antigens and Haptens, Immune system, cellular humoral immunity, immunological tolerance, antigen-antibody reactions and their applications. Hypersensitivity, active and passive immunization, Vaccines – preparation, standardization and storage.
2. **Genetic Recombination :** Transformation, conjugation, transduction, protoplast fusion and gene cloning and their applications, Development of hybridoma for monoclonal antibodies, Study of drugs produced by biotechnology such as Activase, Humulin, Humatrope, HB etc
3. **Antibiotics :** Historical development of antibiotics, Antimicrobial spectrum and methods used for their standardization, Screening of soil for organisms producing antibiotics, fermenter, its design, control of different parameters. Isolation of mutants, factors influencing rate of mutation. Design of fermentation process. Isolation of fermentation products with special reference to penicillins, streptomycins tetracyclines and vitamin B12.

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### 2<sup>nd</sup> Half :

4. **Microbial Transformation** : Introduction, types of reactions mediated by microorganisms, design of biotransformation processes, selection of organisms, biotransformation process and its improvements with special reference to steroids.
5. **Enzyme immobilization** : Techniques of immobilization of enzymes, factors affecting enzyme kinetics. Study of enzymes such as hyaluronidase, penicillinase, streptokinase and streptodornase, amylases and proteases etc. Immobilization of bacteria and plant cells.
6. Fermentative Production of alcohol

### *Elective-I*

### Elective - I

### Advanced Pharmacognosy

**Paper code : 610A**

### THEORY

F.M. - 100 marks

Classes- 3 period / week

### 1<sup>st</sup> Half

1. Indigenous systems of medicines with emphasis on Ayurveda.
2. Ethnobotany & Ethnopharmacology
  - a. Ethnobotany in Herbal Drug Evaluation.
  - b. Impact of Ethnobotany in Traditional Medicine
  - c. Ethnopharmacology in Herbal Drug Evaluation
  - d. New Developments in Herbals.
  - e. Drug Discovery from natural Products
1. Some important techniques associated with quality control of Herbal Drugs :-
  - a. Adulteration & deterioration
  - b. Factors affecting Herbs quality
  - c. TLC / HPTLC
  - d. Sampling procedures
  - e. Morphological examination
  - f. Microscopical evaluation
  - g. Chemical evaluation

### 2<sup>nd</sup> half

1. Pharmacological Screening of herbal drugs.
2. Quality assurance & stability testing of herbal drugs.
3. Extraction of herbal drugs
  - a. Basic principle
  - b. Preextraction operation for crude drugs
  - c. Effect of solvent, solvent mixture & solution of extraction
  - d. Procedure of extraction
- e) Treatment of dry residue after extraction

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## Pharmaceutical Technology Syllabus

### Elective –I Packaging Technology Paper code : 610B

#### THEORY

##### **1<sup>st</sup> Half**

1. Packaging of pharmaceutical dosage form
  - a. Introduction, Definition and function, regulatory requirement, Nature of package evaluation
  - b. Packaging of solid oral dosage form : scope, Packaging, stability and shelf life containers and Closures, Unit dosage packaging.
  - c. Packaging of parenteral and ophthalmic: scope, regulatory requirements, containers, Closures.
  - d. **Packaging of semisolids and topicals: scope, Closures and containers for different liquid and semisolid formulations, transdermal devices.**
  - e. Packaging of aerosols: scope, pressurized containers, metered dose inhalers, non-pressurized containers, spray pumps, drug powder inhalers.
  - f. Influence of packaging components on dosage form stability.
1. Packaging materials science
  - a. Glass packaging materials - containers and Closures  
Glass as a packaging material, composition, types, manufacture of glass.
  - b. Plastic packaging materials - containers and Closures  
Introduction, methods of preparation, classification of materials, Drug-plastic considerations, Selection of proper materials, drug plastic considerations, selection of proper materials.
  - c. Metal packaging materials - containers and Closures  
Introduction, Modern packaging metal, Tinfoil and associated materials aluminum, Types of metal containers.

##### **2<sup>nd</sup> half**

1. Tamper – Resistant packaging  
Introduction, Film Wrapper, Blister package, strip package, Bubble pack, Shrink bonding, foil, paper of plastic pouches, bottle seals, tape seals, breakable caps, sealed tubes, aerosol containers, sealed containers.
2. Quality control and storage of packaging materials.
3. Designing packages for disposability (Wastage control)

### **SEMESTER - VII** ***Pharmaceutics*** ***(Pharmaceutical Technology)***

# West Bengal University of Technology

## Pharmaceutical Technology Syllabus

Theory

Code: PT706  
Contacts: 3  
Credits: 3

### 1<sup>st</sup> Half :

#### 1. **Preformulation studies :**

- a) Study of physical properties of drug like physical form, particle size, shape, density, wetting dielectric constant, Solubility, dissolution and organoleptic property and their effect on formulation, stability and bioavailability.
  - b) Study of chemical properties of drugs like hydrolysis, oxidation, reduction, racemization, polymerization etc. and their influence on formulation and stability of products.
  - c) Study of pro-drugs in solving problems related to stability bioavailability and elegance of formulations.
2. Design, development and process validation methods for pharmaceutical operations involved in the production of pharmaceutical products with special reference to tablets, suspensions.
  3. Stabilization and stability testing protocol for various pharmaceutical products.

### 2<sup>nd</sup> Half :

#### 4. **Performance evaluation methods :**

- a) *In vitro* dissolution studies for solid dosage forms method interpretation of dissolution data
  - b) Bioavailability studies and bioavailability testing protocol and procedures.
  - c) *In vivo* methods of evaluation and statistical treatment.
5. GMP and quality assurance, Quality audit.
  6. Design, development, production and evaluation of controlled released formulations.

Practical

Code: PT 796  
Contacts: 3  
Credits: 2

1. Preformulation studies including drug-excipient compatibility studies, effect of stabilizers, preservatives etc. in dosage form design.
2. Experiments demonstrating improvement in bioavailability through prodrug concept.
3. Stability evaluation of various dosage forms and their expiration dating.
4. Dissolution testing and data evaluation for oral solid dosage forms.
5. Evaluation of Bioequivalence of some marketed products.

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### Pharmaceutical Technology Syllabus

6. *In vivo* bioavailability evaluation from plasma drug concentration and urinary excretion curves.
7. Design, development and evaluation of controlled release formulations.

#### *Pharmaceutical Chemistry (Medicinal Chemistry)*

Theory

Code: PT 703  
Contacts: 3  
Credits: 3

#### **1<sup>st</sup> Half :**

1. Synthetic procedures of selected drugs, mode of action, uses, structure, activity relationship including physicochemical aspects of the following classes of drugs. (Biochemical approaches in drug designing wherever applicable should be discussed).
  - i) Antimetabolites (including sulphonamides)
  - ii) Chemotherapeutic agents used in Protozoal, Parasitic and other infections.
  - iii) Antineoplastic agents
  - iv) Anti-viral including anti-HIV agents.
  - v) Immunosuppressives and immunostimulants.

#### **2<sup>nd</sup> Half :**

2. Amino acids, peptide, nucleotides and related drugs :
  - a) Thyroid and anti-thyroid drugs
  - b) Insulin and oral hypoglycaemic agents
  - c) Peptidomimetics and nucleotidomimetics
3. Drug metabolism and Concepts of Prodrugs

Practical

**Code: PT 793**  
**Contacts: 3P**  
**Credits: 2**

1. Synthesis of selected drugs.
2. Establishing the pharmacopoeal standards and spectral studies.

#### *(Pharmaceutical Engineering)*

Theory

Code: PT 707  
Contacts: 3  
Credits: 3



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## Pharmaceutical Technology Syllabus

### 1<sup>st</sup> Half :

1. **Molecular Diffusion and Interphase Mass Transfer:** Molecular diffusion in gas and liquid systems. Introduction to interphase mass-transfer, mathematical problems
2. **Distillation:** Batch distillation, rectification of binary mixtures, bubble cap, sieve plate and packed bed columns, design method of plate columns, steam, vacuum, molecular and azeotropic distillations, problems (Mathematical problems)
3. **Extraction:** Solvent extraction (liquid-liquid) and leaching, parallel current and cross-treatment method, equipments like batch extractor, centrifugal extractor, continuous leacher etc. problems (mathematical problems)

### 2<sup>nd</sup> Half:

4. **Drying :** Mechanism of drying, theory of drying, concept of EMC, CMC, FMC, drying rate curves, drying problems, pharmaceutical dryers like tray, vacuum, rotary, fluidized-bed, pneumatic, spray, freeze and infrared dryers, mathematical problems.
5. **Humidification and Refrigeration:** Dry and wet bulb thermometry, Psychometric chart, humidity measurement, Equipments for humidification and dehumidification, pharmaceutical application and mathematical problems, principles of refrigeration, units of refrigeration, refrigerants, application in pharmacy.
6. **Process control system:** Basic instrumentation and control in pharmaceutical industries, measurement of temperature, pressure, flow rate, humidity, vacuum and level by automatic process control systems.
7. **Unit Process and fundamentals of reactor design:** The design aspects of the reactors for the production of pharmaceutical chemicals by the unit process like alkylation, amination, esterification, halogenation, hydrolysis, nitration, oxidation and reduction, polymerisation and complex reactions (fermentation).

### *Pharmacognosy*

#### Theory

Code: PT 702  
Contacts: 3  
Credits: 3

### 1<sup>st</sup> Half :

1. Chemistry, biogenesis and pharmacological activity of medicinally important monoterpenes, sesquiterpenes, diterpenes and triterpenoids.
2. **Carotenoids :**  $\alpha$ -carotenoids,  $\beta$ -carotinoids, Vitamin A, Xanthophylls of medicinal important.
3. **Glycosides :** Chemistry and bio-synthesis of digitoxin, digoxin, hecogenin, sennosides, diosgenin and sarasapogenin.

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4. **Alkaloids** : Chemistry, biogenesis and pharmacological activity of atropine and related compounds; quinine, reserpine, morphine, papaverine, ephedrine, ergot and vinca alkaloids.

### 2<sup>nd</sup> Half :

5. Historical development of plant tissue culture, types of cultures, nutritional requirements, growth and their maintenance, Applications of plant tissue culture in pharmacognosy.
6. Chemotaxonomy of medicinal plants.
7. Marine pharmacognosy, novel medicinal agents from marine sources.
8. Natural allergens and photosensitizing agents and fungal toxins.
9. Herbs as health foods.
10. Herbal cosmetics.

### *Pharmacology*

Theory

Code: PT 708  
Contacts: 3  
Credits: 3

### 1<sup>st</sup> Half :

1. **Pharmacology of Endocrine System :**
  - a) Hypothalamic and pituitary hormones
  - b) Thyroid hormones and anti-thyroid drugs, parathormone, calcitonin and Vitamin D.
  - c) Insulin, oral hypoglycaemic agents & glucagon
  - d) ACTH and corticosteroids
  - e) Androgens and anabolic steroids
  - f) Estrogens, progesterone and oral contraceptives.
  - g) Drugs acting on the uterus.
2. **Principles of Toxicology :**
  - a) Definition of poison, general principles of treatment of poisoning with particular reference to barbiturates, opioids, organophosphorous and atropine poisoning.
  - b) Heavy metals and heavy metal antagonists.

### 2<sup>nd</sup> Half :

3. **Chemotherapy ;**
  - a) General Principles of Chemotherapy

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- b) Sulfonamides and cotrimoxazole
  - c) Antibiotics-Penicillins, Cephalosporins, Chloramphenicol, Erythromycin, Quinolones and Miscellaneous Antibiotics.
  - d) Chemotherapy of tuberculosis, leprosy, fungal diseases, viral diseases, urinary tract infections and sexually transmitted diseases.
  - e) Chemotherapy of malignancy and Immunosuppressive Agents
4. **Drugs Acting on the Gastrointestinal Tract :**
- a) Antacids, Anti Secretory and Anti-ulcer drugs
  - b) Laxatives and anti-diarrhoeal drugs.
  - c) Appetite Stimulants and Suppressants
  - d) Emetics and anti-emetics
  - e) Miscellaneous-Carminatives, demulcents, protectives, adsorbents, astringents, digestants, enzymes and mucolytics.

### Practical

Code: PT 798

Contacts: 3

Credits: 2

1. **Experiments on Isolated Preparations :**
  - a) To calculate the pA, value of atropine using acetylcholine as an agonist on rat ileum preparation.
  - b) To calculate the pA, value of mepyramine or chlorpheniramine using histamine as agonist on guinea pig ileum.
  - c) To estimate the strength of the test sample of agonist/drug (e.g. Acetylcholine, Histamine, 5-HT, Oxytocin, etc.) using a suitable isolated muscle preparation employing Matching bioassay, Bracketing assay, Three point assay and Four point bioassay.
2. **Pharmacology of the Gastrointestinal Tract :**

To study the Anti-secretory and anti-ulcer activity using pylorus ligated rats.
3. **Clinical pharmacology :**

To determine the effects of certain clinically useful drugs on human volunteers like

  - a) Antihistaminics
  - b) Anti-anxiety and sedative drugs
  - c) Analgesics
  - d) Beta blockers.

*Elective -II*  
**Elective - II**

# West Bengal University of Technology

## Pharmaceutical Technology Syllabus

### Computer application in Pharmaceutical Technology & Clinical Pharmacy

**THEORY**

**Paper Code :PT 709A**

3 hr / week

#### **1<sup>st</sup> half**

1. Statistical analysis using standard package;
  - a) Introductory statistical concept, basic definitions,
  - b) Introduction to probability—binomial distribution, normal distribution, t-distribution, the chi-square distribution and the F- distribution.
  - c) Statistical inference, confidence intervals, hypothesis testing
  - d) Estimation of these parameters by using computer
- 2) Analysis of variance and experimental design .One way analysis of variance, multiple comparison, two way analysis of variance, a comparison of dissolution of various tablet formulation in two way ANOVA study. Using a standard package.
- 3) Experimental design in clinical trial principles, parallel design, crosses over design.

#### **2<sup>nd</sup> half**

- 4) Linear Regression and Correlation: Introduction, Fitting lines, confidence label, Analysis of residuals, nonlinear regression. Studies of this parameter through computer package.
- 5) Computer aided drug design:- A preliminary approach to QSAR and combinatorial chemistry,
- 6) Data base management: Data type, How information is stored by fox-pro relational Data base system, Use of this system in clinical drug interaction and drug information services.

#### **Elective-II**

### Computer application in Pharmaceutical Technology & Clinical Pharmacy

**Practical**

**Paper Code :PT 799A**

Exercised based on topics like :

1. Statistical analysis using a standard package system.
2. Linear regression
3. Quantitative structure activity relationship
4. Data base system and use of this system using FOXPRO or Microsoft Access in clinical drug interaction and drug information services

#### **Elective-II**

### **Pharmaceutical Marketing Management**

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## Pharmaceutical Technology Syllabus

**THEORY**

**Paper Code :PT 709B**

3 hrs. / week

### 1<sup>st</sup> Half

#### **Understanding of Pharmaceutical Marketing Management**

##### Defining Marketing

- i) Marketing Task – Demand States & Marketing task, Scope of Marketing, Different Markets.
- ii) Concept of Marketing – Definition of marketing, Distinction between marketing & Selling, Core Marketing Concept, Marketing Place, Marketing Space, Target Market, Segmentation of Market, Needs, wants & Demands, Product offering, value & satisfaction, Relationship net work, Supply chain competition, Marketing Environment, Marketing Mix ( 4 P Components), Other concept's name under marketing activities.

##### Marketing Opportunities

- 1) Market Oriented Strategic Planning – SWOT Analysis, Strategic Formulation, Product Planning,
- 2) Gathering Information & Measuring Demand – MIS, Market Research, Behavioural Research, Marketing Research, Forecasting & Demand Measurement.
- 3) Analyzing Consumer Markets & Buyer Behaviour – Influencing Buyer Behaviour,  
Buying Decision Process, Motivation of Physician towards Brand.
- 4) Dealing With the Competition - Identifying Competitors, Analysing Competitors,  
Strategies, Strength & Weakness. Designing Competitive Strategies.

### 2<sup>nd</sup> Half

##### Developing Market Strategies & Marketing Mix, Product Strategy

- 1) Positioning & Differentiating the Market Offering (Product) - Positioning to Promote,
- 2) Product Life Cycle marketing Strategies- Product Life Cycle
- 3) New Market Offering – Which markets to Enter, How to Enter the Market, Product Development, Market Testing.
- 4) Setting the Product Strategy – Product & Product Mix., Product Line analysis, Brand Decision, Packaging & Labeling.

##### Managing & Delivering Marketing Programs

- 1) Value Net- Work & Marketing Channels – Channel Functions, Channel Levels, Channel Management, Decisions, Selecting, Training, Motivating & Evaluating Channels Members, Channel Dynamics, Conflicts, Co-operation & Competitions.
- 2) Managing Retailing, Wholesaling & Market Logistics - Types of Retailing, Types of Wholesaling.

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- 3) Managing Advertising, Sales Promotion & Public Relations - Advertising Objective, Choosing the Advertising Message, Measuring Effectiveness of Advertisement. Sales Promotion & Purpose, Public Relations.
- 4) Managing Sales Force- Recruitment & Selecting Representative, Training sales Representative, Supervising, Norms for Customer Calls, Motivating Sales representative, Evaluating Sales representative.

### Elective-II *Marketing Management* **Paper Code :PT 799B**

#### Practical

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(Practical Work will focus attention more on problems faced in live situations by way of case discussions)

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Practical Work on :-

- 1) SWOT Analysis
- 2) Forecasting & Demand Analysis
- 3) Product Life Cycle
- 4) Analyzing Competitors Strength & Weakness & Strategies.

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- 5) **Evaluating Qualities of Successful Salesman.**
- 6) **Effective Utilisation / Measuring Effectiveness of Advertisement**

Effective Channels Distribution & Transport Analysis.

### Elective-II Advanced Bio-technology **Paper Code :PT 709C**

#### THEORY

##### 1<sup>st</sup> Half

#### 1. Introduction & historical background

- a) Scientific & Technological foundations
- b) Micro & nano-technology for medicine

#### 2. Bio-technology & Medicines

- |                |                      |
|----------------|----------------------|
| a) Vitamins    | b) Steroids          |
| c) Amino acid  | d) Proteins          |
| e) Antibiotics | f) Natural compounds |
- a) **Gene farming**
- i) Animals
  - iii) Plants

##### 2<sup>nd</sup> Half

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### 3. Recombinant DNA Technology

- a) Concept
- b) Cutting and rejoining of DNA
- c) DNA segregating
- d) PCR in gene amplification
- e) Isolation and amplification of gene

### 4. Bio-informatics

- a) Molecular pharmaceutical biotechnology  
Moral and ethical questions (safety – medical, biological, chemical)

### Elective-II

#### Advanced Bio-technology

**Paper Code :PT 799C**

#### PRACTICAL

1. Protein separation by gel electrophoresis
  - a) Preparation of Electrophoresis apparatus.
  - b) Stacking of Gel & Well Preparation.
  - c) Estimation of total Protein content from sample & preparation of standard curve.
  - d) Sample preparation & loading of sample into sample wells & running of Gel.
  - e) Staining.
2. Quantitative estimation of specific antigen/antibody in human serum by ELISA immunoassay.
3. Preparation of permanent section of Animal Tissue by micro-techniques.
4. Serum Glutamate Oxaloacetate Transaminase(SGOT) Test.
5. Serum Glutamate Pyruvate Transaminase(SGPT) Test.
6. Estimation of Protein with standard curve by Ninhydrine method.
7. Estimation of Protein with standard curve by Biuret method.
8. Estimation of water pollution by BOD method.
9. Enzyme estimation.
10. Action of inhibitor on enzyme
11. DNA separation.

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## Pharmaceutical Technology Syllabus

### SEMESTER – VIII

#### *Pharmaceutical Industrial Management*

Theory

**Code:** PT 812

**Contacts:** 3

**Credits:** 3

#### **1<sup>st</sup> Half :**

1. **Concept of Management :** Administrative Management (Planning, Organizing, Staffing, Directing and Controlling), Entrepreneurship development, Operative Management (Personnel, Materials, Production, Financial, Marketing, Time/space, Margin/Morale). Principles of Management (Co-ordination, Communication, Motivation, Decision-making, leadership, Innovation, Creativity, Delegation of Authority/Responsibility, Record Keeping). Identification of Key points to give maximum thrust for development and perfection.
2. **Accountancy :** Principles of Accountancy, Ledger posting and book entries, preparation of trial balance, columns of a cash book, Bank reconciliation statement, rectification of errors, Profits and loss account, balance sheet, purchase, keeping and pricing of stocks, treatment of cheques, bills of exchange, promissory notes and hundies, documentary bills.
3. **Economics :** Principles of economics with special reference to the laws of demand and supply, demand schedule, demand curves, labour welfare, general principles of insurance and inland and foreign trade, procedure of exporting and importing goods.
4. **Pharmaceutical Marketing :** Functions, buying, selling, transportation, storage, finance, feedback, information, channels of distribution, wholesale, retail, departmental store, multiple shop and mail order business.

#### **2<sup>nd</sup> Half :**

- 5) **Salesmanship :** Principles of sales promotion, advertising, ethics of sales, merchandising, literature, detailing, Recruitment, training, evaluation, compensation to the pharmacist.
9. **Market Research :**
  - a) Measuring & Forecasting, Market Demands, Major conception, demand measurement, Estimating current demand, Geo-demographic analysis, Estimating industry sales, Market share & Future demand.
  - b) Market Segmentation & Market Targeting.
10. **Materials Management :** A brief exposure or basic principles of materials management-major areas, scope, purchase, stores, inventory control, an evaluation of material management.
11. **Production Management :** A brief exposure of the different aspects or Production, Management-Visible and Invisible inputs, Methodology of Activities. Performance Evaluation Technique, Process-Flow, Process Know-how, Maintenance Management.



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## Pharmaceutical Technology Syllabus

### *Pharmaceutical Jurisprudence & Ethics*

Theory

**Code:** PT 813

**Contacts:** 3

**Credits:** 3

#### **1<sup>st</sup> Half :**

1. Introduction
  - a) Pharmaceutical legislation – A brief review.
  - b) Drugs & Pharmaceutical Industry – A brief review.
  - c) Pharmaceutical Education – A brief review.
2. An elaborate (practical oriented) study of the following
  - a) Pharmaceutical Ethics
  - b) Pharmacy Act 1948
  - c) Drugs and Cosmetics Act 1940 and Rules 1945

#### **2<sup>nd</sup> Half :**

3. An elaborate (practical oriented) study of the following
  - d) Medicinal & Toilet Preparations(Excise Duties) Act 1955
  - e) Narcotic Drugs & Psychotropic Substances Act 1955 & Rules
  - f) Drugs Price Control Order.
4. A brief study of the following with special reference to the main provisions.
  - a) Poisons Act 1919
  - b) Drugs and Magic Remedies(Object Advertisements Act 1954)
  - c) Medical Termination of Pregnancy Act 1970 & Rules 1975.
  - d) Prevention of Cruelty to Animals Act 1960.
  - e) States Shops & Establishments Act & Rules.
  - f) Insecticides Act 1968.
  - g) AICTE Act 1987.
  - h) Factories Act 1948.
  - i) Minimum Wages Act 1948.
  - j) Patents Act 1970.
  - k) Central Excise and State Excise Acts & Rules

Note: The teaching of all the above Acts should cover the latest amendments.

**West Bengal University of Technology**  
**Pharmaceutical Technology Syllabus**  
*Pharmacology*  
*( Clinical Pharmacy and Drug Interactions )*

Theory

Code: PT 808

Contacts: 3

Credits: 3

**1<sup>st</sup> Half :**

1. Introduction to Clinical Pharmacy.
2. **Important Disorders of Organ Systems and their Management :**
  - a) Cardiovascular Disorders-Hypertension, Congestive Heart Failure, Angina, Acute Myocardial Infraction, Cardiac arrhythmia.
  - b) CNS Disorders : Epilepsy, Parkinsonism, Schizophrenia, Depression.
  - c) Respiratory Disease-Asthma
  - d) Gastrointestinal Disorders-Peptic ulcer, Ulcerative colitis, Hepatitis, Cirrhosis.
  - e) Endocrine Disorders-Diabetes mellitus and Thyroid Disorders.
  - f) Infectious Diseases-Tuberculosis, Urinary Tract Infection, Enteric Infections, Upper Respiratory Tract Infections.
  - g) Hematopoietic disorders-Anemias
  - h) Joint and Connective Tissue Disorders-Rheumatic Diseases, Gout and Hyperuricemia.
  - i) Neoplastic Diseases-Acute Leukaemias, Hodgkin's disease.

**2<sup>nd</sup> Half :**

3. **Basic Concepts of Pharmacotherapy.**
  - a) Clinical Pharmacokinetics and individualization of Drug Therapy
  - b) Drug Delivery Systems and their Biopharmaceutic & Therapeutic Considerations.
  - c) Drug used during Infancy and in the Elderly (Paediatrics & Geriatrics)
  - d) Drug use during Pregnancy
  - e) Drug induced Diseases
  - f) The Basics of Drug Interactions
  - g) General Principles of Clinical Toxicology
  - h) Interpretation of Clinical Laboratory Tests.
4. Therapeutic Drug Monitoring
5. Concept of Essential Drugs and Rational Drug use.

**West Bengal University of Technology**  
**Pharmaceutical Technology Syllabus**  
*Pharmaceutical Analysis*

Theory

Code: PT 801  
Contacts: 3  
Credits: 3

**1<sup>st</sup> Half :**

- A. The theoretical aspects, basic instrumentation, elements of interpretation of spectra and applications of the following analytical techniques would be discussed :
1. Ultraviolet and visible spectrophotometry
  2. Fluorimetry
  3. Infrared spectrophotometry
  4. Nuclear Magnetic resonance spectroscopy including <sup>13</sup>C NMR
  5. Mass Spectrometry
  6. Flame Photometry

**2<sup>nd</sup> Half :**

- B. **Quality assurance :**
1. GLP, ISO 9000, TQM, Quality Review and Quality Documentation.
  2. Regulatory control, regulatory drug analysis, interpretation of analytical data.
  3. Validation, quality audit : quality of equipment, validation of equipment, validation of analytical procedures.
- C. The theoretical aspects, basic instrumentation, elements of interpretation of spectra and applications of the following analytical techniques would be discussed
1. Emission Spectroscopy
  2. Atomic absorption Spectroscopy
  3. X-ray Diffraction
  4. Radio immunoassay

Practical

Code: PT 891  
Contacts: 3  
Credits: 2

1. Quantitative estimation of at least ten formulations containing single drug or more than one drug, using instrumental techniques.
2. Estimation of Na<sup>+</sup>, K<sup>+</sup>, Ca<sup>++</sup> ions using flame photometry.
3. IR of samples with different functional groups ( -COCH, -COOR, -CONHR; -NH<sub>2</sub>, -NHR, -OH, etc.)

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## Pharmaceutical Technology Syllabus

### *Pharmacognosy*

Theory

Code: PT 802

Contacts: 3

Credits: 3

#### **1<sup>st</sup> Half :**

1. Systematic study of source, cultivation, collection, processing, commercial varieties, chemical constituents, substitutes, adulterants, uses, diagnostic macroscopic and microscopic features and specific chemical tests of following alkaloid containing drugs :
  - a) Pyridine – piperidine : Tobacco, areca and lobelia.
  - b) Tropane : Belladonna, hyoscyamus, datura, duboisia, coca and withania
  - c) Quinoline and isoquinoline : Opium
  - d) Indole : Catharanthus and physostigma
  - e) Imidazole : Pilocarpus
  - f) Steroidal : Veratrum and kurchi
  - g) Alkalodial amine : Ephedra and colchicum
  - h) Glycoalkaloid : Solanum
  - i) Purines : Coffee, tea and cocoa
2. Plant bitters and sweeteners.

#### **2<sup>nd</sup> Half :**

3. **Phytochemical Screening :**
  - a) Preparation of extracts
  - b) Screening of alkaloids, saponins, cardenolides and bufadienolides, flavonoids and leucoanthocyanidins, tannins and polyphenols, anthraquinones, cynogeneticglycosides, amino acids in plant extracts.
4. Brief introduction to biological sources, preparation, identification studies and basic metabolic pathways, biogenesis of secondary metabolites of pharmaceutical importance.
5. Introduction, classification and study of different chromatographic methods and their applications in evaluation of herbal drugs.

Practical

Code: PT 892

Contacts: 3P

Credits: 2

1. Chromatographic study of phytoconstituents present in crude drugs.
2. Standardization of traditional drug formulation
3. Experiments on plant tissue culture.

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## Pharmaceutical Technology Syllabus

### ELECTIVE – III

#### Advanced Pharmaceutical Chemistry

**Paper Code : 809**

#### THEORY

##### First Half

1. Natural Products as leads for new Pharmaceuticals :-  
Introduction,  
Drugs affecting the central nervous system like morphine alkaloids,  
Conotoxins,  
Cannabinoids  
Anti-Cancer drugs, catharanthus (Vinca) alkaloids,
2. A brief introduction to -  
Mixture synthesis strategy & Combinatorial Chemistry

##### 2<sup>nd</sup> Half

1. Synthetic procedures of selected drugs, mode of action, uses, structure activity relationship including physico-chemical aspects of the following class of drugs ( Bio-chemical approaches in drug designing wherever applicable should be discussed )
  - a) Antimycobacterial Agents
  - b) Antifungal Agents

### Elective – III

#### Advanced Pharmacology

**Paper Code : 809**

#### THEORY

##### 1<sup>st</sup> Half

1. **Receptor** :  
Classification, Adenylcyclase, CAMP pathway, Phospholipase C, IP<sub>3</sub>, DAQ pathway
2. **Bioassay** :  
Histamine, Insulin, Sexhormone, oxytocin, acetylcholine
3. **Neurological disorder** :  
Myasthenia gravis, alzheimer's disease, parkinsonism

##### 2<sup>nd</sup> Half

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## Pharmaceutical Technology Syllabus

4. Drug interaction, Biotransformation
5. **Immunopharmacology** :  
Introduction, immunomodulator, immunosuppressive agents and immunostimulant
6. Chemoprevention : Apoptosis, cell cycle

### Elective - III

### ADVANCED PHARMACEUTICS

**Paper Code: 809B**

#### **THEORY**

##### **1<sup>st</sup> Half :**

1. The Pharmaceutical Pilot Plant :

Introduction, General considerations, Types of organisational structure responsible for pilot operation, educational background of pilot plant personnel, product consideration – solid dosage forms, liquid dosage forms, suspensions, emulsion, semisolid products.

2. Target oriented Drug-Delivery System :

Introduction, rationale for targeted drug delivery, biological process involved, systems - prodrugs, drug carrier delivery system (particulate drug delivery system, microparticles, nanoparticles and liposomes).

3. Biotechnology based pharmaceuticals :

Introduction, background, protein structure, mechanism and causes of protein de-stabilisation methods used to evaluate protein pharmaceuticals, formulation approached to protein stabilization. Development in protein drug delivery.

##### **2<sup>nd</sup> Half :**

4. Interactions of moisture with solids:

Reaction orders, kinetics in dry versus moist state, types of surface moisture, excess water, The Lesson-Mattocks model, kinetically unavailable (Bound) water, micro-environmental pH, very low moisture contents, dosage level and toxicity consideration, non-stoichiometric interactions with water, parenteral solid products, oxidation.

5. Principles of Improved tablet production system design :

Introduction, advantages, consideration, validation.

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6. Tablet Compression :

Introduction, Physics of compression, properties of tablets influenced by compression, measurement of compressional force, energy expenditure, transmission of force, nature of material.

#### **INSTRUCTIONS**

1. Each Semester will consist of a minimum of 15 weeks instructions :
2. Internal assessment of Theoreticals (30%) will be based on two class tests of 10 marks in each of the theory subject during each semester and 10 marks for class attendance of student in each subject.
3. Internal assessment of practicals (30%) will be based on day to day attendance, viva, laboratory record etc. There will be no separate class test in practicals. The question papers of university examinations shall be set by both the internal and external examiners. The choice in question papers shall be restricted to 25% only. Complete coverage of prescribed syllabus in university question papers is desired.
4. A minimum of 75% attendance in theory and practical classes is compulsory.
5. In view of the fact that B. Pharm is a professional degree course with diverse employment potential, the university degree certificate may continue to remain the same with no

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mention of elective subjects. However, the mark-list should indicate the elective(s) opted by the candidate.

6. A student has to get minimum 45% mark in theory and 50% marks in practical separately to pass the subject.
7. Pass mark in aggregate will be 50% of the total marks.
8. A student will secure 1<sup>st</sup> class if he/she obtains 60% of total marks and 1<sup>st</sup> class with honours, if he/she obtains 75% of the total marks.
9. A student will be promoted to next higher semester with a maximum of two back papers (including practical).
10. Student has to clear back paper(s), if any, of 1<sup>st</sup> and 2<sup>nd</sup> Semester before appearing in the 5<sup>th</sup> Semester Examination and the same of 3<sup>rd</sup> and 4<sup>th</sup> Semester before appearing in the 7<sup>th</sup> Semester Examination.S
11. A student will get a maximum of 8 yrs. time from the date of admission to complete the degree course.