

GUJARAT TECHNOLOGICAL UNIVERSITY

Structure for second semester syllabus of Degree Pharmacy course

SEMESTER II

Sr. No	Subject Code	Subjects	Teaching Scheme		
			Theory	Practical	Credits
1	220001	Applied Mathematics (Biostatistics)	2	-	2
2	220002	Pharmaceutics –II	3	3	6
3	220003	Pharm. Chemistry-II	3	3	6
4	220004	Anatomy Physiology and Health Education (APHE-II)	3	2	5
5	220005	Pharmacognosy - I	2	3	5
6	220006	Physical Pharmacy	3	3	6
		Total	16	14	30

Applied Mathematics (Biostatistics)
(2 hours/week; 2 credits, 30 hours)

- 1. Sample and sampling methods** **06**
Introduction, sample and population, importance of sampling, sample and its characteristics. Sampling methods - Simple random sampling – lottery method and random number tables; stratified random sampling; systematic sampling; multistage sampling; cluster sampling. Sampling with and without replacement, sampling distribution, standard error. Example of – simple random sample and stratified random sampling.
- 2. Statistical inference – tests of hypothesis** **08**
Introduction, testing of hypothesis – hypothesis, statistical hypothesis, null hypothesis, alternative hypothesis, test of a hypothesis, critical region, types of errors in testing of a hypothesis, level of significance, two-tailed and one-tailed tests, degrees of freedom. Tests of significance – large sample tests; small sample tests – t-test for testing the significance of a single mean, t-test for testing the significance of difference between two means, paired t-test. T-test for testing the significance of an observed correlation coefficient, F-test for equality of two variances, Chi-square test for goodness of fit, Chi-square test for testing independence of attributes, Chi-square test for homogeneity. Example for all types of tests.
- 3. Correlation and Regression** **04**
Introduction, types of correlation – positive or negative, simple, multiple or partial. Coefficient of correlation, methods of studying correlation – scatter diagram method, karl pearson’s product moment method, spearman’s rank correlation method. Regression, lines of regression, methods of finding regression lines - scatter diagram method, method of least squares. Examples of all methods for correlation and regression.
- 4. Analysis of variance** **04**
Introduction, assumptions of analysis of variance, analysis of variance for one-way classification, analysis of variance for two-way classification. Example of one-way and two-way classifications.
- 5. Non-parametric tests** **04**
Introduction, advantages of non-parametric tests, the wilcoxon signed-rank test, the wilcoxon rank-sum test, the kruskal-wallis test. Example of all three non-parametric tests.
- 6. Experimental designs in clinical research** **04**
Introduction, types of designs – parallel design, cross-over design – two-way cross-over and three-way cross-over, Replicate design. Merits and demerits of all methods. Wash-out period, carry-over effect.

**NOTE: PLEASE COVER PHARMACY APPLICATION RELATED
EXAMPLES FOR ALL TOPICS.**

Books recommended:

1. Business statistics - J K Sharma, PHI publication.
2. Statistical methods - S P Gupta, Sultan Chand & Sons.

Pharmaceutics-II
(3 hours/week; 3 credits; 45 hours)

1	Size Reduction	7
	Objectives, theory of size reduction, factors influencing size reduction, energy requirements in size reduction, study of various mills including ball mill, hammer mill, fluid energy mill, colloid mill, cutter mill, etc. Introduction to methods of generating nanoparticles	
2	Size Separation	4
	Principles of size separation, screens- types, pharmacopoeial standards, screening methods, screening equipments including shaking and vibrating screens, gyratory screens, sedimentation tank, elutriation and cyclone type separators etc. Application of size separation in pharmacy, angle of repose, carr's index, hausner ratio.	
3	Mixing	7
	Theory of mixing, mixing mechanisms, solid – solid, solid – liquid and liquid – liquid mixing equipments. Importance of content uniformity in solid dosage forms.	
4	Crystallization	9
	Objectives, crystal lattice, types of crystal, crystal form, size and habit, formation of crystals, supersaturation theory, factors affecting crystallization process, crystal growth. Study of various types of crystallizers including Swenson walker, tanks, circulating magma, vaccum and crystal cooling crystallizer, etc. Spherical crystallization and its application in ph, brief introduction of co-crystals, polymorphism and amorphous forms of drugs.	
5	Extraction	5
	Principle, theory, types of extraction, solvents used for extraction, leaching and extraction equipments, small scale and large scale extraction methods, special extraction techniques, application in pharmaceutical industry.	
6	Compaction and Compression	6
	Objectives, theory, process of compression, effect of compressional force on powders/granules. Kawakita equations. Applications in tablet dosage forms (direct compression, etc.) Hecker and Kawakita equations.	
7	Automated Process Control Systems	4
	Temperature, pressure, vacuum, flow level and their measurements. Elements of automatic process control systems.	
8	Industrial Hazards and Safety Precautions	3
	Mechanical, Chemical, Electrical, Fire and dust hazards. Introduction to waste water treatment in industry.	

Pharmaceutics-II
PRACTICALS
(3 hours/week, 3 credits, 45 hours)

Practicals related to topics mentioned in the theory should be carried out.

Books Recommended :

- 1 Elementary Chemical Engineering - Max S. Peters, Published by McGraw Hill Book Company, New York, 1954
- 2 Perry's Chemical Engineer's Handbook - Robert H Perry, Green D.W., Maloney J.O. 7th Edition, 1998, McGraw – Hill Inc., New York.
- 3 Tutorial Pharmacy by Cooper & Gunn, ed. S.J.Carter, CBS Publishers & Distributors, Delhi, 6th Edition, 2000.
- 4 Unit Operations of Chemical Engineering, 5th edition - McCabe, Smith & Harriott, McGraw – Hill Inc., New York.
- 5 Pharmaceutics: The Science of Dosage Form Design - M.E. Aulton.
- 6 The Theory & Practice of Industrial Pharmacy – Lachman L., Lieberman H.A. & Kanjig J.L., 3rd edition, 1990 Varghese Publishing House, Bombay.
- 7 Alfonso G. Remington: The Science & Practice of Pharmacy. Vol.I & II. Lippincott, Williams & Wilkins Philadelphia.

Pharmaceutical Chemistry – II
(3 hours/week; 3 credits, 45 hours)

1. **The liquid state:** **06**
Physical properties surface tension, parachor, viscosity, refractive index, optical rotation, dipole moment of chemical constituents.
2. **Solutions:** **07**
Ideal and real solutions, solutions of gases in liquids, colligative properties, partition co-efficient, conductance and its measurement, Debye-Huckel theory.
3. **Thermodynamics:** **08**
Basic principles, First, Second and Third laws, Zeroth Law, absolute temperature scale, thermochemical equations, phase equilibria and phase rule, One and two component systems.
4. **Adsorption:** **04**
Basic principles, Freundlich and Gibbs adsorption isotherms, Langmuir theory of adsorption.
5. **Photochemistry:** **06**
Basic principles, Consequence of light adsorption, Jablonski diagram, Lambert-Beer Law, Quantum efficiency.
6. **Chemical kinetics:** **10**
Zero, first and second orders reactions, complex reaction, theories of reaction kinetics, characteristics of homogeneous and heterogeneous catalysts, acid-base enzyme catalysis.
7. **Radioactivity:** **04**
Basic principles of Radioactivity, Radioactivity Rays and Measurements of Radioactivity, Applications.

Pharmaceutical Chemistry-II
PRACTICALS
(3 hours/week, 3 credits, 45 hours)

Experiments on surface tension and viscosity, partition coefficient, adsorption, order of reaction (First and Second), refractive index and molar refraction.

Books Recommended:

1. Text book of Physical Chemistry: Samuel Glasstone, Macmillan India Limited, 2nd Ed. 1995.
2. Elements of physical chemistry; Peter Atkins, Julio de paula, Oxford University Press, 4th Ed. 2007.

Anatomy Physiology and Health Education-II
(3 hours/week, 3 credits, 45 hours)

1. **Cardiovascular System:** **09**
Anatomy of the heart, Circulatory system including Arterial and Venous system with special reference to the names and positions of main arteries and veins, Properties of Cardiac muscle, Electrocardiogram (ECG), Blood pressure and its regulation, Coronary circulation, Basic understanding of Cardiac cycle and Heart sounds, Renin Angiotensin system and its significance, Cardiac output, Brief introduction to cardiovascular disorders.
2. **Respiratory System:** **04**
Anatomy of Respiratory organs, Physiology (mechanism and regulation) of respiration, Physiology of Internal Respiration, Brief overview of measuring lung functions i.e. respiratory volumes, Vital capacity, Respiratory disorders.
3. **Nervous System:** **13**
Neurons and Nerve Fibers, Physiology of Nerve excitation and conduction, Overview of Neurotransmitters, Divisions of Nervous System, Central Nervous System (Brain & Spinal Cord), Function of different parts of brain and spinal cord, Reflex action, Electroencephalogram (EEG), Specialized functions of the brain including Limbic system and Reticular activation and Inhibiting System, Peripheral Nervous System (PNS) (Cranial nerves & spinal nerves): Description of spinal and cranial nerves, Physiology and functions of the Autonomic Nervous System, brief introduction to CNS disorders.
4. **Special Senses:** **05**
Basic anatomy of the Eye and the Ear, Physiology of Vision, Hearing and Equilibrium Balance. Organs of Taste (tongue), Olfaction, Touch, Pressure, etc., Structure and Functions of Skin. Regulation of Body Temperature, Disorders.
5. **Urinary System:** **04**
Various parts of urinary system and their functions, Structure and functions of Nephron, Physiology of Urine formation, Brief outline of renal diseases, Acid-base balance.
6. **Endocrine System:** **05**
Role of Endocrine Glands in Regulation and Integration of various functions of the Body, Anatomy and Physiology of pituitary gland, thyroid, parathyroid, adrenals, Pancreas, testes and ovary, their hormones and functions with brief outlines of their disorders.
7. **Reproductive System:** **04**
Gross Anatomy and Histology of Male and female reproductive Organs and their Functions, Physiology of Menstruation, Coitus and Fertilization, Sex differentiation, Oogenesis and spermatogenesis, implantation of embryo, pregnancy and its maintenance, parturition.
8. **Physiology of Ageing** **01**

Anatomy Physiology and Health Education-II
PRACTICALS
(2 hours/week, 2 credits, 30 hours)

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|---|-----------|
| 1. Biochemical Analysis of Urine
Physical Characteristics, Normal Constituents, Abnormal Constituents | 02 |
| 3. Study with the help of charts and models of the Anatomy of
following systems:
Heart, Arterial System, Venous System, Respiratory System, Urinary System,
Male and Female Reproductive System, Eye and Ear, Nervous System | 07 |
| 3. Histology of Various organs of above mentioned Systems | 02 |
| 4. Determination of body temperature, pulse rate, blood pressure, listening to
heart sounds, demonstration of ECG | 01 |
| 5. Determination of Lung Volumes and Vital Capacity | 01 |
| 6. Study of Reflexes, Vision and Hearing capacity | 02 |

Books Recommended (Latest Editions) :

- 1 William J. Larsen: Anatomy – Development, function, Clinical Correlations –Saunders (Elsevier Science)
- 2 Guyton A.C. and Hall J.E. : Textbook of Medical Physiology – 10th Edition– W.B.Saunders
- 3 Seeley R.R., Stephens T.D. and Tate P.: Anatomy and Physiology 2000 – McGraw Hill Co.
- 4 Waugh A. and Grant A.: Ross and Wilson’s Anatomy and Physiology in Health & illness — Churchill Livingstone
- 5 Sobotta : Atlas of Human Anatomy (2 Volumes) –Edited by Putz and R. Pabst, Lippincott, Williams and Wilkins
- 6 Anne M.R.Agur & Ming J. Lee: Grant’s Atlas of Anatomy –Lippincott, Williams and Wilkins
- 7 Gosling T.A., Harris P.F., Whitmore I., William, Human Anatomy: Color Atlas and Text — Mosby
- 8 Bullock B.L. & Henze R.L., Focus on Pathophysiology –Lippincott
- 9 Martini, F. Fundamentals of Anatomy and Physiology (Prentice Hall)
- 10 West, J.B. Best and Taylor’s physiological Basis of Medical Practice (Williams and Wilkins, Baltimore)
- 11 Tortora G.J. and Anagnodokos, N.P. Principles of Anatomy and Physiology (Harper and Colling Publishers, New York)
- 12 Chatterjee, C.C.Human Physiology (Medical Allied Agency, Calcutta)
- 13 Lesson, C.R. et al.: Text Book of Histology (W.B.Saunders Company)

Pharmacognosy-I
(2 hours/week, 2 credits, 30 hours)

1. Definition, history, scope and development of Pharmacognosy. **01**
2. Sources of drugs: **03**
Plant, biological, marine, and mineral. Tissue culture as source of drugs.
3. Classification of drugs: **02**
Alphabetical, Morphological, Taxonomical, Chemical and Pharmacological.
4. Morphology: **08**
Seed, root, stem, leaf, bark, wood, flower and fruit. Modification of root and stem. Histology of dicot and monocot root, stem and leaf.
5. Cultivation, collection, processing and storage of crude drugs. **04**
Factors influencing cultivation of medicinal plants. Types of soils and fertilizers of common use. Plant hormones and their applications. Polyploidy, mutation and Hybridization with reference to medicinal plants.
6. Quality control of crude drugs: **04**
Adulteration of crude drugs and their detection by organoleptic, microscopic, physical, chemical, biological and other method of evaluation.
7. An introduction to active constituents of drugs and their classification and properties. **01**
8. Systemic pharmacognostic study of the following: **07**
 - a) Carbohydrates and derived products: Agar, Guar gum, Acacia, Honey, Isabgol, Pectin, Starch, Stercuila, Tragacanth and sodium alginate.
 - b) Lipids: Beeswax, castor oil, coca butter, cod liver oil, hydrocarpus oil, sesame oil and wool fat, kokum butter, lard, linseed oil, rice bran oil, shark liver oil.

Pharmacognosy-I
PRACTICAL
(3 hours/week, 3 credits, 45 hours)

1. Morphology of plant parts indicated in theory.
2. Microscopy of monocot and dicot root, stem and leaf.
3. Microscopic measurements of cell and cell contents: starch grains, calcium oxalate crystals and phloem fibers.
4. Identification of crude drugs belonging to carbohydrates and lipids.
5. Preparation of herbarium sheets.

Books recommended:

1. Botany for degree students: A. C. Dutta, Calcutta Oxford University Press, New Delhi, 6th Edition, 2002.
2. College botany Vol-I-III, Ganguly H.C., Das K.S., and Dutta C., New Central Book Agency [P] Lt., 2006.
3. Pharmacognosy: C. K. Kokate, A. P. Purohit, S. B. Gokhale, Nirali Prakashan Pune, 9th edition, 1998.
4. Pharmacognosy: V. E. Tyler, L. R. Brady, J. E. Habbers, Lea and Febiger Philadelphia, 9th edition, 1988.
5. A Text book of pharmacognosy: C. S. Shah, J. S. Quadry, B. S. Shah Prakashan, Ahmedabad, 13th revised edition, 2007-08.
6. Trease and Evan's Pharmacognosy: W. C. Evans, W. B. Saunders Company, Singapore 14th edition, 1997.
7. Textbook of Pharmacognosy: T.E. Wallis, CBS Publishers and Distributors, New Delhi, 5th Edition, reprinted, 2003.

Practical Books:

1. Practical Pharmacognosy by C. K. Kokate, Vallabh Prakashan, Delhi, 4th edition, 1997.
2. Practical Pharmacognosy, Technique and Experiment by C. K. Kokate and S. B. Gokhale, Nirali Prakashan, Pune, 3rd edition, 1996.

Physical Pharmacy
(3 hours/week, 3 credits, 45 hours)

1. **States of Matter:** **5**
Introduction, binding forces between molecules, states of matter-solids, liquids, gases, liquid crystals, glassy state, phase equilibrium and phase rule, condensed systems

2. **Buffers:** **3**
Buffer equation, buffer capacity, buffers in pharmaceuticals systems, preparation, stability, buffered, isotonic solutions, tonicity calculations, and methods of adjusting isotonicity.

3. **Solubility and Distribution Phenomenon:** **7**
General principles, solvent-solute interactions, solubility of gases in liquids, solubility of liquids in liquids, solubility of solids in liquids, distribution of solutes between immiscible solvents.

4. **Surface and Interfacial phenomenon :** **6**
Liquid interface, adsorption at liquid interfaces, adsorption at solid interface, applications of surface active agents, electrical properties of interfaces.

5. **Disperse systems :** **10**
 - a. Colloidal dispersions : Definition, types, properties of colloids, protective colloids, applications of colloids in pharmacy.
 - b. Suspensions and Emulsions : Interfacial properties of suspended particles/globules, settling in suspensions, theory of sedimentation, effect of Brownian movement, sedimentation of flocculated particles, sedimentation parameters, wetting of particles, controlled flocculation, flocculation in structured vehicle, rheological considerations, emulsions ; types, theories, physical stability.

6. **Micromeritics:** **8**
Particle size and distribution, methods for determining particle size, particle shape and surface area, methods for determining surface area, derived properties of powders.

7. **Rheology :** **6**
Newtonian system, Non-Newtonian systems, thixotropy in formulation, determination of rheological properties, applications in pharmacy.

Physical Pharmacy
PRACTICALS
(3 hours/week, 3 credits, 45 hours)

Practicals demonstrating any theoretical aspects of above topics may be carried out.

Experiments on application of phase rule, two component systems, estimation of buffer capacity, preparation of various buffer solutions and their use, experiments on tonicity adjustment, Solubility determination of solids. Determination of surface / interfacial tension, HLB value and CMC of surfactants. Estimation of partition coefficient, Determination of viscosity using different viscometers, Demonstration of Brookfield viscometer, Determination particle size and surface area, derived properties of powders like density porosity, compressibility angle of repose etc. Study on polymorphs, their identification & properties. Studies of different types of colloids and their properties, Determination of sedimentation parameters for suspensions and emulsions, work done in emulsification, etc.

Books Recommended :

1. Martin's Physical pharmacy by Patrick J. Sinko, 5th edition, Lippincott Williams & Wilkins, New York, 2006.
2. Pharmaceutics: The Science of Dosage Form Design, 2nd edition, Aulton, Michael E., Churchill Livingstone, London, 2002.
3. Remington: The Science and Practice of Pharmacy, Vol-I & II, 20th edition, Gennaro, Alfonso R., Lippincott Williams & Wilkins, New York, 2002.
4. Physicochemical Principles of Pharmacy, 3rd edition, Florence, A. T. Atwood, D. Macmillan Press Ltd., London 1998.
5. Pharmaceutical Dosage Forms and Drug Delivery Systems, Ansel, Howard. C., Allen, Loyd V., Popovich, Nicholas G., Lippincott Williams & Wilkins, New York, 2002.
6. Cooper and Gunn's Tutorial Pharmacy, ed. Carter, S. J., 6th edition, CBS Publishers & Distributors, Delhi, 2000.
7. Bentley's textbook of Pharmaceutics by E. A. Rawlins