ANNA UNIVERSITY, CHENNAI

AFFILIATED INSTITUTIONS

R-2013

B. TECH. PHARMACEUTICAL TECHNOLOGY

PROGRAMME OBJECTIVES:

The aim of this programme is to enable the students to learn basic and advanced facts in Pharmaceutical technology and to develop an understanding of the biological-efficacy of drugs.

- This programme will provide students with a solid foundation in Chemical engineering, Pharmaceutics, Pharmaceutical Chemistry, Pharmacology and Pharmacognosy as per the requirement of Pharmaceutical Industries, and also to pursue higher studies.
- This programme will facilitate the students to acquire knowledge in fields such as genetic engineering, protein engineering and recombinant DNA technology enabling their application through pharmacogenomic approaches. It will also empower the students to have advanced focus on the molecular pathogenesis of infectious diseases and necessary pharmacological approach
- This programme will aid the students to know the significance of Bioethical standards and an extensive understanding of the regulatory guidelines of Drugs and its dosage forms aided by the advantages and risks in the statistical evaluation of Drugs through Clinical trials. It will also help the students to know about the pharmacokinetics of drug, its metabolism and its immunopharmacological response through in-depth understanding about the Human physiology.

PROGRAMME OUTCOME:

Graduates of the program will be having fundamental knowledge in biosciences, chemical engineering and strong background in pharmaceutical technology and be able to use these tools in industry and/or institutes where ever necessary.

ANNA UNIVERSITY, CHENNAI

AFFILIATED INSTITUTIONS

R -2013

B. TECH. PHARMACEUTICAL TECHNOLOGY

I – VIII SEMESTERS CURRICULUM AND SYLLABUS

SEMESTER - I

CODE	COURSE TITLE	L	T	P	C
THEORY					
HS6151	Technical English - I	3	1	0	4
MA6151	Mathematics – I	3	1	0	4
PH6151	Engineering Physics – I	3	0	0	3
CY6151	Engineering Chemistry – I	3	0	0	3
GE6151	Computer Programming	3	0	0	3
GE6152	Engineering Graphics	2	0	3	4
PRACTICAL					
GE6161	Computer Practices Laboratory	0	0	3	2
GE6162	Engineering Practices Laboratory	0	0	3	2
GE6163	Physics and Chemistry Laboratory - I	0	0	2	1
	TOTAL	**17**	**2**	**11**	**26**

SEMESTER – II

CODE	COURSE TITLE	L	T	P	C
THEORY					
HS6251	Technical English - II	3	1	0	4
MA6251	Mathematics - II	3	1	0	4
PH6252	Physics of Materials	3	0	0	3
GE6253	Engineering Mechanics	3	1	0	4
BT6201	Biochemistry	3	0	0	3
PY6201	Fundamentals of Human Anatomy and Physiology	3	0	0	3
PRACTICALS					
BT6211	Biochemistry Laboratory	0	0	4	2
PY6212	Experimental Physiology Laboratory	0	0	4	2
	TOTAL	**18**	**3**	**8**	**25**

SEMESTER – III

CODE	COURSE TITLE	L	T	P	C
THEORY					
GE6351	Environmental Science and Engineering	3	0	0	3
MA6468	Probability and Statistics	3	1	0	4
PY6301	Pharmaceutical Chemistry	3	0	0	3
PY6302	Microbiology	3	0	0	3
PY6303	Fluid Flow Operations	3	0	0	3
PY6304	Mass Transfer Operations	3	0	0	3
PRACTICALS					
PY6311	Pharmaceutical Chemistry Laboratory	0	0	4	2
PY6312	Microbiology Laboratory	0	0	4	2
	TOTAL	**18**	**1**	**8**	**23**

SEMESTER – IV

CODE	COURSE TITLE	L	T	P	C
THEORY					
PY6401	Unit Operations in Pharmaceutical Industry	3	1	0	4
PY6402	Heat Transfer	3	0	0	3
PY6403	Cell and Molecular Biology	3	0	0	3
PY6404	Physical Pharmaceutics	3	0	0	3
PY6405	Engineering Thermodynamics	3	0	0	3
PY6406	Pharmacology	3	0	0	3
PRACTICALS					
PY6411	Fluid Flow Operations and Heat Transfer Laboratory	0	0	4	2
PY6412	Physical Pharmaceutics Laboratory	0	0	4	2
	TOTAL	**18**	**1**	**8**	**23**

SEMESTER – V

CODE	COURSE TITLE	L	T	P	C
THEORY					
PY6501	Biochemical Engineering	3	0	0	3
PY6502	Analytical Methods of Pharmaceuticals	3	0	0	3
PY6503	Regulatory Requirements in Pharmaceutical Industries	3	0	0	3
PY6504	Medicinal Chemistry	3	1	0	4
	Elective I	3	0	0	3
	Elective II	3	0	0	3
PRACTICALS					
BT6561	Bioprocess Laboratory	0	0	4	2
BT6562	Analytical Methods of Pharmaceuticals Laboratory	0	0	4	2
	TOTAL	**18**	**1**	**8**	**23**

SEMESTER – VI

CODE	COURSE TITLE	L	T	P	C
THEORY					
GE6757	Total Quality Management	3	0	0	3
PY6601	Pharmaceutical Dosage Forms	3	1	0	4
PY6602	Process Equipment Design	3	1	0	4
BT6703	Creativity Innovation and New Product Development	3	0	0	3
	Elective III	3	0	0	3
	Elective IV	3	0	0	3
PRACTICALS					
PY6611	Pharmaceutical Dosage Forms Laboratory	0	0	4	2
GE6562	Employability Skills	0	0	2	1
	TOTAL	**18**	**2**	**6**	**23**

SEMESTER – VII

CODE	COURSE TITLE	L	T	P	C
THEORY					
BT6604	Chemical Reaction Engineering	3	0	0	3
PY6701	Advanced Drug Delivery System	3	1	0	4
PY6702	Biopharmaceutics and Pharmacokinetics	3	0	0	3
	Elective V	3	0	0	3
	Elective VI	3	0	0	3
	Elective VII	3	0	0	3
PRACTICALS					
PY6711	Advanced Drug Delivery System Lab	0	0	4	2
PY6712	Biopharmaceutics and Pharmacokinetics Lab	0	0	4	2
	TOTAL	**18**	**1**	**8**	**23**

SEMESTER – VIII

CODE	COURSE TITLE	L	T	P	C
PRACTICALS					
PY6811	Project Work	0	0	12	6
	TOTAL	**0**	**0**	**12**	**6**

TOTAL NO OF CREDITS : 172

LIST OF ELECTIVES

B. TECH. PHARMACEUTICAL TECHNOLOGY

SEMESTER V

ELECTIVES I AND II

CODE	COURSE TITLE	L	T	P	C
MG6091	Industrial Management	3	0	0	3
PY6001	Pharmaceutical Production Management	3	0	0	3
PY6002	Unit Process in Organic Synthesis	3	0	0	3
PY6003	Validation in Pharmaceutical Industries	3	0	0	3
PY6004	Genetic Engineering and Pharmacogenomics	3	0	0	3
PY6005	Pharmacognosy	3	0	0	3

SEMESTER VI

ELECTIVES III AND IV

CODE	COURSE TITLE	L	T	P	C
PY6006	Chemistry of Natural Products	3	0	0	3
PY6007	Pharmaceutical Packaging Technology	3	0	0	3
PY6008	Safety and Risk Management	3	0	0	3
PY6009	Computer aided drug design	3	0	0	3
PY6010	Experimental design and Biostatistics	3	0	0	3
PY6011	Introduction to Biomaterials and Tissue Engineering	3	0	0	3

SEMESTER VII

ELECTIVES V, VI AND VII

CODE	COURSE TITLE	L	T	P	C
PY6012	Downstream Processing	3	0	0	3
GE6081	Fundamentals of Nanoscience	3	0	0	3
BT6013	Bioconjugate Technology and Applications	3	0	0	3
PY6013	Technology of Fine Chemicals and Bulk Drugs	3	0	0	3
PY6014	Herbal Technology	3	0	0	3
PM6603	Water Treatment and Management	3	0	0	3
PY6016	Bioinformatics and Computational Biology	3	0	0	3
PC6601	Process Instrumentation Dynamics and Control	3	0	0	3
PY6017	Process Calculations	3	0	0	3

HS6151 **TECHNICAL ENGLISH – I** **L T P C**
3 1 0 4

OBJECTIVES:

- To enable learners of Engineering and Technology develop their basic communication skills in English.
- To emphasize specially the development of speaking skills amongst learners of Engineering and Technology.
- To ensure that learners use the electronic media such as internet and supplement the learning materials used in the classroom.
- To inculcate the habit of reading and writing leading to effective and efficient communication.

UNIT I **9+3**

Listening - Introducing learners to GIE - Types of listening - Listening to audio (verbal & sounds); Speaking - Speaking about one's place, important festivals etc. – Introducing oneself, one's family / friend; Reading - Skimming a reading passage – Scanning for specific information - Note-making; Writing - Free writing on any given topic (My favourite place / Hobbies / School life, etc.) - Sentence completion - Autobiographical writing (writing about one's leisure time activities, hometown, etc.); Grammar - Prepositions - Reference words - Wh-questions - Tenses (Simple); Vocabulary - Word formation - Word expansion (root words / etymology); E-materials - Interactive exercises for Grammar & Vocabulary - Reading comprehension exercises - Listening to audio files and answering questions.

UNIT II **9+3**

Listening - Listening and responding to video lectures / talks; Speaking - Describing a simple process (filling a form, etc.) - Asking and answering questions - Telephone skills – Telephone etiquette; Reading – Critical reading - Finding key information in a given text - Sifting facts from opinions; Writing - Biographical writing (place, people) - Process descriptions (general/specific) - Definitions - Recommendations – Instructions; Grammar - Use of imperatives - Subject-verb agreement; Vocabulary - Compound words - Word Association (connotation); E-materials - Interactive exercises for Grammar and Vocabulary - Listening exercises with sample telephone conversations / lectures – Picture-based activities.

UNIT III **9+3**

Listening - Listening to specific task - focused audio tracks; Speaking - Role-play – Simulation - Group interaction - Speaking in formal situations (teachers, officials, foreigners); Reading - Reading and interpreting visual material; Writing - Jumbled sentences - Coherence and cohesion in writing - Channel conversion (flowchart into process) - Types of paragraph (cause and effect / compare and contrast / narrative / analytical) - Informal writing (letter/e-mail/blogs) - Paraphrasing; Grammar - Tenses (Past) - Use of sequence words - Adjectives; Vocabulary - Different forms and uses of words, Cause and effect words; E-materials - Interactive exercises for Grammar and Vocabulary - Excerpts from films related to the theme and follow up exercises - Pictures of flow charts and tables for interpretations.

UNIT IV **9+3**

Listening - Watching videos / documentaries and responding to questions based on them; Speaking - Responding to questions - Different forms of interviews - Speaking at different types of interviews; Reading - Making inference from the reading passage - Predicting the content of a reading passage; Writing - Interpreting visual materials (line graphs, pie charts etc.) - Essay writing – Different types of essays; Grammar - Adverbs – Tenses – future time reference; Vocabulary - Single word substitutes - Use of abbreviations and acronyms; E-materials - Interactive exercises for Grammar and Vocabulary - Sample interviews - film scenes - dialogue writing.

UNIT V **9+3**

Listening - Listening to different accents, Listening to Speeches/Presentations, Listening to broadcast and telecast from Radio and TV; Speaking - Giving impromptu talks, Making

presentations on given topics; Reading - Email communication - Reading the attachment files having a poem/joke/proverb - Sending their responses through email; Writing - Creative writing, Poster making; Grammar - Direct and indirect speech; Vocabulary - Lexical items (fixed / semi fixed expressions); E-materials - Interactive exercises for Grammar and Vocabulary - Sending emails with attachment – Audio / video excerpts of different accents - Interpreting posters.

TOTAL (L:45+T:15): 60 PERIODS

OUTCOMES:

Learners should be able to

- speak clearly, confidently, comprehensibly, and communicate with one or many listeners using appropriate communicative strategies.
- write cohesively and coherently and flawlessly avoiding grammatical errors, using a wide vocabulary range, organizing their ideas logically on a topic.
- read different genres of texts adopting various reading strategies.
- listen/view and comprehend different spoken discourses/excerpts in different accents

TEXTBOOKS:

1. Department of English, Anna University. Mindscapes: English for Technologists and Engineers. Orient Blackswan, Chennai. 2012
2. Dhanavel, S.P. English and Communication Skills for Students of Science and Engineering. Orient Blackswan, Chennai. 2011

REFERENCES:

1. Raman, Meenakshi & Sangeetha Sharma. Technical Communication: Principles and Practice. Oxford University Press, New Delhi. 2011.
2. Regional Institute of English. English for Engineers. Cambridge University Press, New Delhi. 2006.
3. Rizvi, Ashraf. M. Effective Technical Communication. Tata McGraw-Hill, New Delhi. 2005
4. Rutherford, Andrea. J Basic Communication Skills for Technology. Pearson, New Delhi. 2001.
5. Viswamohan, Aysha. English for Technical Communication. Tata McGraw-Hill, New Delhi. 2008.

EXTENSIVE Reading (Not for Examination)

1. Kalam, Abdul. Wings of Fire. Universities Press, Hyderabad. 1999.

WEBSITES:

1. http://www.usingenglish.com
2. http://www.uefap.com

TEACHING METHODS:

- Lectures
- Activities conducted individually, in pairs and in groups like self introduction, peer introduction, group poster making, grammar and vocabulary games, etc.
- Discussions
- Role play activities
- Short presentations
- Listening and viewing activities with follow up activities like discussion, filling up worksheets, writing exercises (using language lab wherever necessary/possible) etc.

EVALUATION PATTERN:

Internal assessment: 20%

3 tests of which two are pen and paper tests and the other is a combination of different modes of assessment like

- Project
- Assignment
- Reviews

- Creative writing
- Poster making, etc.

All the four skills are to be tested with equal weightage given to each.

- ✓ Speaking assessment: Individual speaking activities, Pair work activities like role play, Interview, Group discussions
- ✓ Reading assessment: Reading passages with comprehension questions graded from simple to complex, from direct to inferential
- ✓ Writing assessment: Writing paragraphs, essays etc. Writing should include grammar and vocabulary.
- ✓ Listening/Viewing assessment: Lectures, dialogues, film clippings with questions on verbal as well as audio/visual content.

End Semester Examination: 80%

MA6151 MATHEMATICS – I L T P C
3 1 0 4

OBJECTIVES:

- To develop the use of matrix algebra techniques this is needed by engineers for practical applications.
- To make the student knowledgeable in the area of infinite series and their convergence so that he/ she will be familiar with limitations of using infinite series approximations for solutions arising in mathematical modeling.
- To familiarize the student with functions of several variables. This is needed in many branches of engineering.
- To introduce the concepts of improper integrals, Gamma, Beta and Error functions which are needed in engineering applications.
- To acquaint the student with mathematical tools needed in evaluating multiple integrals and their usage.

UNIT I MATRICES 9+3

Eigenvalues and Eigenvectors of a real matrix – Characteristic equation – Properties of eigenvalues and eigenvectors – Statement and applications of Cayley-Hamilton Theorem – Diagonalization of matrices – Reduction of a quadratic form to canonical form by orthogonal transformation – Nature of quadratic forms.

UNIT II SEQUENCES AND SERIES 9+3

Sequences: Definition and examples – Series: Types and Convergence – Series of positive terms – Tests of convergence: Comparison test, Integral test and D'Alembert's ratio test – Alternating series – Leibnitz's test – Series of positive and negative terms – Absolute and conditional convergence.

UNIT III APPLICATIONS OF DIFFERENTIAL CALCULUS 9+3

Curvature in Cartesian co-ordinates – Centre and radius of curvature – Circle of curvature – Evolutes – Envelopes - Evolute as envelope of normals.

UNIT IV DIFFERENTIAL CALCULUS OF SEVERAL VARIABLES 9+3

Limits and Continuity – Partial derivatives – Total derivative – Differentiation of implicit functions – Jacobian and properties – Taylor's series for functions of two variables – Maxima and minima of functions of two variables – Lagrange's method of undetermined multipliers.

UNIT V MULTIPLE INTEGRALS 9+3

Double integrals in cartesian and polar coordinates – Change of order of integration – Area enclosed by plane curves – Change of variables in double integrals – Area of a curved surface - Triple integrals – Volume of Solids.

TOTAL (L:45+T:15): 60 PERIODS

OUTCOMES:

- This course equips students to have basic knowledge and understanding in one fields of materials, integral and differential calculus.

TEXT BOOKS:

1. Bali N. P and Manish Goyal, "A Text book of Engineering Mathematics", Eighth Edition, Laxmi Publications Pvt Ltd., 2011.
2. Grewal. B.S, "Higher Engineering Mathematics", 41st Edition, Khanna Publications, Delhi, 2011.

REFERENCES:

1. Dass, H.K., and Er. Rajnish Verma," Higher Engineering Mathematics", S. Chand Private Ltd., 2011.
2. Glyn James, "Advanced Modern Engineering Mathematics", 3rd Edition, Pearson Education, 2012.
3. Peter V. O'Neil," Advanced Engineering Mathematics", 7th Edition, Cengage learning, 2012.
4. Ramana B.V, "Higher Engineering Mathematics", Tata McGraw Hill Publishing Company, New Delhi, 2008.
5. Sivarama Krishna Das P. and Rukmangadachari E., "Engineering Mathematics", Volume I, Second Edition, PEARSON Publishing, 2011.

PH6151 ENGINEERING PHYSICS – I L T P C
3 0 0 3

OBJECTIVES:

- To enhance the fundamental knowledge in Physics and its applications relevant to various streams of Engineering and Technology.

UNIT I CRYSTAL PHYSICS 9

Lattice – Unit cell – Bravais lattice – Lattice planes – Miller indices – d spacing in cubic lattice – Calculation of number of atoms per unit cell – Atomic radius – Coordination number – Packing factor for SC, BCC, FCC and HCP structures – Diamond and graphite structures (qualitative treatment) - Crystal growth techniques –solution, melt (Bridgman and Czochralski) and vapour growth techniques (qualitative)

UNIT II PROPERTIES OF MATTER AND THERMAL PHYSICS 9

Elasticity- Hooke's law - Relationship between three modulii of elasticity (qualitative) – stress -strain diagram – Poisson's ratio –Factors affecting elasticity –Bending moment – Depression of a cantilever –Young's modulus by uniform bending- I-shaped girders

Modes of heat transfer- thermal conductivity- Newton's law of cooling - Linear heat flow – Lee's disc method – Radial heat flow – Rubber tube method – conduction through compound media (series and parallel)

UNIT III QUANTUM PHYSICS 9

Black body radiation – Planck's theory (derivation) – Deduction of Wien's displacement law and Rayleigh – Jeans' Law from Planck's theory – Compton effect. Theory and experimental verification – Properties of Matter waves – G.P Thomson experiment -Schrödinger's wave equation – Time independent and time dependent equations – Physical significance of wave function – Particle in a one dimensional box - Electron microscope - Scanning electron microscope - Transmission electron microscope.

UNIT IV ACOUSTICS AND ULTRASONICS 9

Classification of Sound- decibel- Weber–Fechner law – Sabine's formula- derivation using growth and decay method – Absorption Coefficient and its determination –factors affecting acoustics of buildings and their remedies.

Production of ultrasonics by magnetostriction and piezoelectric methods - acoustic grating - Non Destructive Testing – pulse echo system through transmission and reflection modes - A,B and C –scan displays, Medical applications - Sonogram

UNIT V PHOTONICS AND FIBRE OPTICS 9

Spontaneous and stimulated emission- Population inversion -Einstein's A and B coefficients - derivation. Types of lasers – Nd:YAG, CO_2, Semiconductor lasers (homojunction & heterojunction)- Industrial and Medical Applications.

Principle and propagation of light in optical fibres – Numerical aperture and Acceptance angle - Types of optical fibres (material, refractive index, mode) – attenuation, dispersion, bending - Fibre Optical Communication system (Block diagram) - Active and passive fibre sensors- Endoscope.

TOTAL: 45 PERIODS

OUTCOMES:

- The students will have knowledge on the basics of physics related to properties of matter, optics, acoustics etc., and they will apply these fundamental principles to solve practical problems related to materials used for engineering applications.

TEXT BOOKS:

1. Arumugam M. Engineering Physics. Anuradha publishers, 2010
2. Gaur R.K. and Gupta S.L. Engineering Physics. Dhanpat Rai publishers, 2009
3. Mani Naidu S. Engineering Physics, Second Edition, PEARSON Publishing, 2011.

REFERENCES:

1. Searls and Zemansky. University Physics, 2009
2. Mani P. Engineering Physics I. Dhanam Publications, 2011
3. Marikani A. Engineering Physics. PHI Learning Pvt., India, 2009
4. Palanisamy P.K. Engineering Physics. SCITECH Publications, 2011
5. Rajagopal K. Engineering Physics. PHI, New Delhi, 2011
6. Senthilkumar G. Engineering Physics I. VRB Publishers, 2011.

CY6151 ENGINEERING CHEMISTRY - I L T P C
3 0 0 3

OBJECTIVES:

- To make the students conversant with basics of polymer chemistry.
- To make the student acquire sound knowledge of second law of thermodynamics and second law based derivations of importance in engineering applications in all disciplines.
- To acquaint the student with concepts of important photophysical and photochemical processes and spectroscopy.
- To develop an understanding of the basic concepts of phase rule and its applications to single and two component systems and appreciate the purpose and significance of alloys.
- To acquaint the students with the basics of nano materials, their properties and applications.

UNIT I POLYMER CHEMISTRY 9

Introduction: Classification of polymers – Natural and synthetic; Thermoplastic and Thermosetting. Functionality – Degree of polymerization. Types and mechanism of polymerization: Addition (Free Radical, cationic and anionic); condensation and copolymerization. Properties of polymers: Tg, Tacticity, Molecular weight – weight average, number average and polydispersity index. Techniques of polymerization: Bulk, emulsion, solution and suspension. Preparation, properties and uses of Nylon 6,6, and Epoxy resin.

UNIT II CHEMICAL THERMODYNAMICS 9

Terminology of thermodynamics - Second law: Entropy - entropy change for an ideal gas, reversible and irreversible processes; entropy of phase transitions; Clausius inequality. Free energy and work function: Helmholtz and Gibbs free energy functions (problems); Criteria of spontaneity; Gibbs-Helmholtz equation (problems); Clausius-Clapeyron equation; Maxwell relations – Van't Hoff isotherm and isochore(problems).

UNIT III PHOTOCHEMISTRY AND SPECTROSCOPY 9

Photochemistry: Laws of photochemistry - Grotthuss–Draper law, Stark–Einstein law and Lambert-Beer Law. Quantum efficiency – determination- Photo processes - Internal Conversion, Inter-system crossing, Fluorescence, Phosphorescence, Chemiluminescence and Photo-sensitization. Spectroscopy: Electromagnetic spectrum - Absorption of radiation – Electronic, Vibrational and rotational transitions. UV-visible and IR spectroscopy – principles, instrumentation (Block diagram only).

UNIT IV PHASE RULE AND ALLOYS 9

Phase rule: Introduction, definition of terms with examples, One Component System- water system - Reduced phase rule - Two Component Systems- classification – lead-silver system, zinc-magnesium system. Alloys: Introduction- Definition- Properties of alloys- Significance of alloying, Functions and effect of alloying elements- Ferrous alloys- Nichrome and Stainless steel – heat treatment of steel; Non-ferrous alloys – brass and bronze.

UNIT V NANOCHEMISTRY 9

Basics - distinction between molecules, nanoparticles and bulk materials; size-dependent properties. Nanoparticles: nano cluster, nano rod, nanotube(CNT) and nanowire. Synthesis: precipitation, thermolysis, hydrothermal, solvothermal, electrode position, chemical vapour deposition, laser ablation; Properties and applications

TOTAL :45 PERIODS

OUTCOMES:

- The knowledge gained on polymer chemistry, thermodynamics. spectroscopy, phase rule and nano materials will provide a strong platform to understand the concepts on these subjects for further learning.

TEXT BOOKS:

1. Jain P.C. and Monica Jain, “Engineering Chemistry”, Dhanpat Rai Publishing Company (P) Ltd., New Delhi, 2010
2. Kannan P., Ravikrishnan A., “Engineering Chemistry”, Sri Krishna Hi-tech Publishing Company Pvt. Ltd. Chennai, 2009

REFERENCES:

1. Dara S.S, Umare S.S, “Engineering Chemistry”, S. Chand & Company Ltd., New Delhi 2010
2. Sivasankar B., “Engineering Chemistry”, Tata McGraw-Hill Publishing Company, Ltd., New Delhi, 2008.
3. Gowariker V.R. , Viswanathan N.V. and JayadevSreedhar, “Polymer Science”, New Age International P (Ltd.,), Chennai, 2006.
4. Ozin G. A. and Arsenault A. C., “Nanochemistry: A Chemical Approach to Nanomaterials”, RSC Publishing, 2005.

GE6151 COMPUTER PROGRAMMING L T P C
3 0 0 3

OBJECTIVES:

The students should be made to:

- Learn the organization of a digital computer.
- Be exposed to the number systems.
- Learn to think logically and write pseudo code or draw flow charts for problems.
- Be exposed to the syntax of C.
- Be familiar with programming in C.
- Learn to use arrays, strings, functions, pointers, structures and unions in C.

UNIT I INTRODUCTION 8

Generation and Classification of Computers- Basic Organization of a Computer –Number System – Binary – Decimal – Conversion – Problems. Need for logical analysis and thinking – Algorithm – Pseudo code – Flow Chart.

UNIT II C PROGRAMMING BASICS 10

Problem formulation – Problem Solving - Introduction to ' C' programming –fundamentals – structure of a 'C' program – compilation and linking processes – Constants, Variables – Data Types – Expressions using operators in 'C' – Managing Input and Output operations – Decision Making and Branching – Looping statements – solving simple scientific and statistical problems.

UNIT III ARRAYS AND STRINGS 9

Arrays – Initialization – Declaration – One dimensional and Two dimensional arrays. String- String operations – String Arrays. Simple programs- sorting- searching – matrix operations.

UNIT IV FUNCTIONS AND POINTERS 9

Function – definition of function – Declaration of function – Pass by value – Pass by reference – Recursion – Pointers - Definition – Initialization – Pointers arithmetic – Pointers and arrays- Example Problems.

UNIT V STRUCTURES AND UNIONS 9

Introduction – need for structure data type – structure definition – Structure declaration – Structure within a structure - Union - Programs using structures and Unions – Storage classes, Pre-processor directives.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of the course, the student should be able to:

- Design C Programs for problems.
- Write and execute C programs for simple applications.

TEXTBOOKS:

1. Anita Goel and Ajay Mittal, "Computer Fundamentals and Programming in C", Dorling Kindersley (India) Pvt. Ltd., Pearson Education in South Asia, 2011.
2. Pradip Dey, Manas Ghosh, "Fundamentals of Computing and Programming in C", First Edition, Oxford University Press, 2009
3. Yashavant P. Kanetkar. " Let Us C", BPB Publications, 2011.

REFERENCES:

1. Byron S Gottfried, "Programming with C", Schaum's Outlines, Second Edition, Tata McGraw-Hill, 2006.
2. Dromey R.G., "How to Solve it by Computer", Pearson Education, Fourth Reprint, 2007.
3. Kernighan,B.W and Ritchie,D.M, "The C Programming language", Second Edition, Pearson Education, 2006.

GE6152 ENGINEERING GRAPHICS L T P C
2 0 3 4

OBJECTIVES:

- To develop in students, graphic skills for communication of concepts, ideas and design of Engineering products.
- To expose them to existing national standards related to technical drawings.

CONCEPTS AND CONVENTIONS (Not for Examination) **1**

Importance of graphics in engineering applications – Use of drafting instruments – BIS conventions and specifications – Size, layout and folding of drawing sheets – Lettering and dimensioning.

UNIT I PLANE CURVES AND FREE HAND SKETCHING **5+9**

Basic Geometrical constructions, Curves used in engineering practices: Conics – Construction of ellipse, parabola and hyperbola by eccentricity method – Construction of cycloid – construction of involutes of square and circle – Drawing of tangents and normal to the above curves, Scales: Construction of Diagonal and Vernier scales.

Visualization concepts and Free Hand sketching: Visualization principles –Representation of Three Dimensional objects – Layout of views- Free hand sketching of multiple views from pictorial views of objects

UNIT II PROJECTION OF POINTS, LINES AND PLANE SURFACES **5+9**

Orthographic projection- principles-Principal planes-First angle projection-projection of points. Projection of straight lines (only First angle projections) inclined to both the principal planes - Determination of true lengths and true inclinations by rotating line method and traces Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method.

UNIT III PROJECTION OF SOLIDS **5+9**

Projection of simple solids like prisms, pyramids, cylinder, cone and truncated solids when the axis is inclined to one of the principal planes by rotating object method and auxiliary plane method.

UNIT IV PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES **5+9**

Sectioning of above solids in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other – obtaining true shape of section. Development of lateral surfaces of simple and sectioned solids – Prisms, pyramids cylinders and cones. Development of lateral surfaces of solids with cut-outs and holes

UNIT V ISOMETRIC AND PERSPECTIVE PROJECTIONS **6+9**

Principles of isometric projection – isometric scale –Isometric projections of simple solids and truncated solids - Prisms, pyramids, cylinders, cones- combination of two solid objects in simple vertical positions and miscellaneous problems. Perspective projection of simple solids-Prisms, pyramids and cylinders by visual ray method .

COMPUTER AIDED DRAFTING (Demonstration Only) **3**

Introduction to drafting packages and demonstration of their use.

TOTAL : 75 PERIODS

OUTCOMES:

On Completion of the course the student will be able to

- perform free hand sketching of basic geometrical constructions and multiple views of objects.
- do orthographic projection of lines and plane surfaces.
- draw projections and solids and development of surfaces.
- prepare isometric and perspective sections of simple solids.
- demonstrate computer aided drafting.

TEXT BOOK:

1. Bhatt N.D. and Panchal V.M., “Engineering Drawing”, Charotar Publishing House, 50th Edition, 2010.

REFERENCES:

1. Gopalakrishna K.R., “Engineering Drawing” (Vol. I&II combined), Subhas Stores, Bangalore, 2007.

2. Luzzader, Warren.J. and Duff,John M., "Fundamentals of Engineering Drawing with an introduction to Interactive Computer Graphics for Design and Production, Eastern Economy Edition, Prentice Hall of India Pvt. Ltd, New Delhi, 2005.
3. Shah M.B., and Rana B.C., "Engineering Drawing", Pearson, 2nd Edition, 2009.
4. Venugopal K. and Prabhu Raja V., "Engineering Graphics", New Age International (P) Limited, 2008.
5. Natrajan K.V., "A text book of Engineering Graphics", Dhanalakshmi Publishers, Chennai, 2009.
6. Basant Agarwal and Agarwal C.M., "Engineering Drawing", Tata McGraw Hill Publishing Company Limited, New Delhi, 2008.

Publication of Bureau of Indian Standards:

1. IS 10711 – 2001: Technical products Documentation – Size and lay out of drawing sheets.
2. IS 9609 (Parts 0 & 1) – 2001: Technical products Documentation – Lettering.
3. IS 10714 (Part 20) – 2001 & SP 46 – 2003: Lines for technical drawings.
4. IS 11669 – 1986 & SP 46 – 2003: Dimensioning of Technical Drawings.
5. IS 15021 (Parts 1 to 4) – 2001: Technical drawings – Projection Methods.

Special points applicable to University Examinations on Engineering Graphics:

1. There will be five questions, each of either or type covering all units of the syllabus.
2. All questions will carry equal marks of 20 each making a total of 100.
3. The answer paper shall consist of drawing sheets of A3 size only. The students will be permitted to use appropriate scale to fit solution within A3 size.
4. The examination will be conducted in appropriate sessions on the same day

GE6161 COMPUTER PRACTICES LABORATORY L T P C
0 0 3 2

OBJECTIVES:

The student should be made to:

- Be familiar with the use of Office software.
- Be exposed to presentation and visualization tools.
- Be exposed to problem solving techniques and flow charts.
- Be familiar with programming in C.
- Learn to use Arrays, strings, functions, structures and unions.

LIST OF EXPERIMENTS:

1. Search, generate, manipulate data using MS office/ Open Office
2. Presentation and Visualization – graphs, charts, 2D, 3D
3. Problem formulation, Problem Solving and Flowcharts
4. C Programming using Simple statements and expressions
5. Scientific problem solving using decision making and looping.
6. Simple programming for one dimensional and two dimensional arrays.
7. Solving problems using String functions
8. Programs with user defined functions – Includes Parameter Passing
9. Program using Recursive Function and conversion from given program to flow chart.
10. Program using structures and unions.

TOTAL : 45 PERIODS

OUTCOMES:

At the end of the course, the student should be able to:

- Apply good programming design methods for program development.
- Design and implement C programs for simple applications.
- Develop recursive programs.

LIST OF EQUIPMENTS FOR A BATCH OF 30 STUDENTS:

Standalone desktops with C compiler 30 Nos.

(or)

Server with C compiler supporting 30 terminals or more.

GE6162 ENGINEERING PRACTICES LABORATORY L T P C
0 0 3 2

OBJECTIVES:

- To provide exposure to the students with hands on experience on various basic engineering practices in Civil, Mechanical, Electrical and Electronics Engineering.

GROUP A (CIVIL & MECHANICAL)

I CIVIL ENGINEERING PRACTICE 9

Buildings:

(a) Study of plumbing and carpentry components of residential and industrial buildings. Safety aspects.

Plumbing Works:

(a) Study of pipeline joints, its location and functions: valves, taps, couplings, unions, reducers, elbows in household fittings.
(b) Study of pipe connections requirements for pumps and turbines.
(c) Preparation of plumbing line sketches for water supply and sewage works.
(d) Hands-on-exercise:

Basic pipe connections – Mixed pipe material connection – Pipe connections with different joining components.

(e) Demonstration of plumbing requirements of high-rise buildings.

Carpentry using Power Tools only:

(a) Study of the joints in roofs, doors, windows and furniture.
(b) Hands-on-exercise:

Wood work, joints by sawing, planing and cutting.

II MECHANICAL ENGINEERING PRACTICE 13

Welding:

(a) Preparation of arc welding of butt joints, lap joints and tee joints.
(b) Gas welding practice

Basic Machining:

(a) Simple Turning and Taper turning
(b) Drilling Practice

Sheet Metal Work:

(a) Forming & Bending:
(b) Model making – Trays, funnels, etc.
(c) Different type of joints.

Machine assembly practice:

(a) Study of centrifugal pump
(b) Study of air conditioner

Demonstration on:

(a) Smithy operations, upsetting, swaging, setting down and bending. Example – Exercise – Production of hexagonal headed bolt.
(b) Foundry operations like mould preparation for gear and step cone pulley.
(c) Fitting – Exercises – Preparation of square fitting and vee – fitting models.

GROUP B (ELECTRICAL & ELECTRONICS)

III ELECTRICAL ENGINEERING PRACTICE 10

1. Residential house wiring using switches, fuse, indicator, lamp and energy meter.
2. Fluorescent lamp wiring.
3. Stair case wiring
4. Measurement of electrical quantities – voltage, current, power & power factor in RLC circuit.
5. Measurement of energy using single phase energy meter.
6. Measurement of resistance to earth of an electrical equipment.

IV ELECTRONICS ENGINEERING PRACTICE 13

1. Study of Electronic components and equipments – Resistor, colour coding measurement of AC signal parameter (peak-peak, rms period, frequency) using CR.
2. Study of logic gates AND, OR, EOR and NOT.
3. Generation of Clock Signal.
4. Soldering practice – Components Devices and Circuits – Using general purpose PCB.
5. Measurement of ripple factor of HWR and FWR.

TOTAL: 45 PERIODS

OUTCOMES:

- ability to fabricate carpentry components and pipe connections including plumbing works.
- ability to use welding equipments to join the structures.
- ability to fabricate electrical and electronics circuits.

REFERENCES:

1. Jeyachandran K., Natarajan S. & Balasubramanian S., “A Primer on Engineering Practices Laboratory”, Anuradha Publications, 2007.
2. Jeyapoovan T., Saravanapandian M. & Pranitha S., “Engineering Practices Lab Manual”, Vikas Puplishing House Pvt.Ltd, 2006.
3. Bawa H.S., “Workshop Practice”, Tata McGraw – Hill Publishing Company Limited, 2007.
4. Rajendra Prasad A. & Sarma P.M.M.S., “Workshop Practice”, Sree Sai Publication, 2002.
5. Kannaiah P. & Narayana K.L., “Manual on Workshop Practice”, Scitech Publications, 1999.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

CIVIL

1. Assorted components for plumbing consisting of metallic pipes, plastic pipes, flexible pipes, couplings, unions, elbows, plugs and other fittings.	15 Sets.
2. Carpentry vice (fitted to work bench)	15 Nos.
3. Standard woodworking tools	15 Sets.
4. Models of industrial trusses, door joints, furniture joints	5 each
5. Power Tools: (a) Rotary Hammer	2 Nos
(b) Demolition Hammer	2 Nos

(c) Circular Saw	2 Nos
(d) Planer	2 Nos
(e) Hand Drilling Machine	2 Nos
(f) Jigsaw	2 Nos

MECHANICAL

1. Arc welding transformer with cables and holders	5 Nos.
2. Welding booth with exhaust facility	5 Nos.
3. Welding accessories like welding shield, chipping hammer, wire brush, etc.	5 Sets.
4. Oxygen and acetylene gas cylinders, blow pipe and other welding outfit.	2 Nos.
5. Centre lathe	2 Nos.
6. Hearth furnace, anvil and smithy tools	2 Sets.
7. Moulding table, foundry tools	2 Sets.
8. Power Tool: Angle Grinder	2 Nos
9. Study-purpose items: centrifugal pump, air-conditioner	One each.

ELECTRICAL

1. Assorted electrical components for house wiring	15 Sets
2. Electrical measuring instruments	10 Sets
3. Study purpose items: Iron box, fan and regulator, emergency lamp	1 each
4. Megger (250V/500V)	1 No.
5. Power Tools: (a) Range Finder	2 Nos
(b) Digital Live-wire detector	2 Nos

ELECTRONICS

1. Soldering guns	10 Nos.
2. Assorted electronic components for making circuits	50 Nos.
3. Small PCBs	10 Nos.
4. Multimeters	10 Nos.
5. Study purpose items: Telephone, FM radio, low-voltage power supply	

GE6163 PHYSICS AND CHEMISTRY LABORATORY – I L T P C
0 0 2 1

PHYSICS LABORATORY – I

OBJECTIVES:

- To introduce different experiments to test basic understanding of physics concepts applied in optics, thermal physics and properties of matter.

LIST OF EXPERIMENTS

(Any FIVE Experiments)

1. (a) Determination of Wavelength, and particle size using Laser
   (b) Determination of acceptance angle in an optical fiber.
2. Determination of velocity of sound and compressibility of liquid – Ultrasonic interferometer.
3. Determination of wavelength of mercury spectrum – spectrometer grating
4. Determination of thermal conductivity of a bad conductor – Lee's Disc method.
5. Determination of Young's modulus by Non uniform bending method
6. Determination of specific resistance of a given coil of wire – Carey Foster's Bridge

OUTCOMES:

- The hands on exercises undergone by the students will help them to apply physics principles of optics and thermal physics to evaluate engineering properties of materials.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

1. Diode laser, lycopodium powder, glass plate, optical fiber.
2. Ultrasonic interferometer
3. Spectrometer, mercury lamp, grating
4. Lee's Disc experimental set up
5. Traveling microscope, meter scale, knife edge, weights
6. Carey foster's bridge set up

(vernier Caliper, Screw gauge, reading lens are required for most of the experiments)

CHEMISTRY LABORATORY- I

OBJECTIVES:

- To make the student to acquire practical skills in the determination of water quality parameters through volumetric and instrumental analysis.
- To acquaint the students with the determination of molecular weight of a polymer by vacometry.

LIST OF EXPERIMENTS

(Any FIVE Experiments)

1 Determination of DO content of water sample by Winkler's method.
2 Determination of chloride content of water sample by argentometric method.
3 Determination of strength of given hydrochloric acid using pH meter.
4 Determination of strength of acids in a mixture using conductivity meter.
5 Estimation of iron content of the water sample using spectrophotometer. (1,10- phenanthroline / thiocyanate method).
6 Determination of molecular weight of polyvinylalcohol using Ostwald viscometer.
7 Conductometric titration of strong acid vs strong base.

TOTAL: 30 PERIODS

OUTCOMES:

- The students will be outfitted with hands-on knowledge in the quantitative chemical analysis of water quality related parameters.

REFERENCES:

1. Daniel R. Palleros, "Experimental organic chemistry" John Wiley & Sons, Inc., New York 2001.
2. Furniss B.S. Hannaford A.J, Smith P.W.G and Tatchel A.R., "Vogel's Textbook of practical organic chemistry", LBS Singapore 1994.
3. Jeffery G.H., Bassett J., Mendham J.and Denny vogel's R.C, "Text book of quantitative analysis chemical analysis", ELBS 5th Edn. Longman, Singapore publishers, Singapore, 1996.
4. Kolthoff I.M., Sandell E.B. et al. "Quantitative chemical analysis", Mcmillan, Madras 1980.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

1.	Iodine flask	-	30 Nos
2.	pH meter	-	5 Nos
3.	Conductivity meter	-	5 Nos
4.	Spectrophotometer	-	5 Nos
5.	Ostwald Viscometer	-	10 Nos

Common Apparatus : Pipette, Burette, conical flask, percelain tile, dropper (each 30 Nos.)

HS6251 TECHNICAL ENGLISH II L T P C
3 1 0 4

OBJECTIVES:

- To make learners acquire listening and speaking skills in both formal and informal contexts.
- To help them develop their reading skills by familiarizing them with different types of reading strategies.
- To equip them with writing skills needed for academic as well as workplace contexts.
- To make them acquire language skills at their own pace by using e-materials and language lab components.

UNIT I 9+3

Listening - Listening to informal conversations and participating; Speaking - Opening a conversation (greetings, comments on topics like weather) - Turn taking - Closing a conversation (excuses, general wish, positive comment, thanks); Reading - Developing analytical skills, Deductive and inductive reasoning - Extensive reading; Writing - Effective use of SMS for sending short notes and messages - Using 'emoticons' as symbols in email messages; Grammar - Regular and irregular verbs - Active and passive voice; Vocabulary - Homonyms (e.g. 'can') - Homophones (e.g. 'some', 'sum'); E-materials - Interactive exercise on Grammar and vocabulary – blogging; Language Lab - Listening to different types of conversation and answering questions.

UNIT II 9+3

Listening - Listening to situation based dialogues; Speaking - Conversation practice in real life situations, asking for directions (using polite expressions), giving directions (using imperative sentences), Purchasing goods from a shop, Discussing various aspects of a film (they have already seen) or a book (they have already read); Reading - Reading a short story or an article from newspaper, Critical reading, Comprehension skills; Writing - Writing a review / summary of a story / article, Personal letter (Inviting your friend to a function, congratulating someone for his / her success, thanking one's friends / relatives); Grammar - modal verbs, Purpose expressions; Vocabulary - Phrasal verbs and their meanings, Using phrasal verbs in sentences; E-materials - Interactive exercises on Grammar and vocabulary, Extensive reading activity (reading stories / novels), Posting reviews in blogs - Language Lab - Dialogues (Fill up exercises), Recording students' dialogues.

UNIT III 9+3

Listening - Listening to the conversation - Understanding the structure of conversations; Speaking - Conversation skills with a sense of stress, intonation, pronunciation and meaning - Seeking information – expressing feelings (affection, anger, regret, etc.); Reading - Speed reading – reading passages with time limit - Skimming; Writing - Minutes of meeting – format and practice in the preparation of minutes - Writing summary after reading articles from journals - Format for journal articles – elements of technical articles (abstract, introduction, methodology, results, discussion, conclusion, appendices, references) - Writing strategies; Grammar - Conditional clauses - Cause and effect expressions; Vocabulary - Words used as nouns and verbs without any change in the spelling (e.g. 'rock', 'train', 'ring'); E-materials - Interactive exercise on Grammar and vocabulary - Speed Reading practice exercises; Language Lab - Intonation practice using EFLU and RIE materials – Attending a meeting and writing minutes.

UNIT IV 9+3

Listening - Listening to a telephone conversation, Viewing model interviews (face-to-face, telephonic and video conferencing); Speaking - Role play practice in telephone skills - listening and responding, -asking questions, -note taking – passing on messages, Role play and mock interview for grasping interview skills; Reading - Reading the job advertisements and the profile of the company concerned – scanning; Writing - Applying for a job – cover letter - résumé preparation – vision, mission and goals of the candidate; Grammar - Numerical expressions - Connectives (discourse markers); Vocabulary - Idioms and their meanings – using idioms in sentences; E-materials - Interactive exercises on Grammar and

Vocabulary - Different forms of résumés- Filling up a résumé / cover letter; Language Lab - Telephonic interview – recording the responses - e-résumé writing.

UNIT V **9+3**

Listening - Viewing a model group discussion and reviewing the performance of each participant - Identifying the characteristics of a good listener; Speaking - Group discussion skills – initiating the discussion – exchanging suggestions and proposals – expressing dissent/agreement – assertiveness in expressing opinions – mind mapping technique; Reading - Note making skills – making notes from books, or any form of written materials - Intensive reading; Writing – Checklist - Types of reports – Feasibility / Project report – report format – recommendations / suggestions – interpretation of data (using charts for effective presentation); Grammar - Use of clauses; Vocabulary – Collocation; E-materials - Interactive grammar and vocabulary exercises - Sample GD - Pictures for discussion, Interactive grammar and vocabulary exercises; Language Lab - Different models of group discussion.

TOTAL (L:45+T:15): 60 PERIODS

OUTCOMES:

Learners should be able to

- speak convincingly, express their opinions clearly, initiate a discussion, negotiate, argue using appropriate communicative strategies.
- write effectively and persuasively and produce different types of writing such as narration, description, exposition and argument as well as creative, critical, analytical and evaluative writing.
- read different genres of texts, infer implied meanings and critically analyse and evaluate them for ideas as well as for method of presentation.
- listen/view and comprehend different spoken excerpts critically and infer unspoken and implied meanings.

TEXTBOOKS:

1. Department of English, Anna University. Mindscapes: English for Technologists and Engineers. Orient Blackswan, Chennai. 2012
2. Dhanavel, S.P. English and Communication Skills for Students of Science and Engineering. Orient Blackswan, Chennai. 2011

REFERENCES:

1. Anderson, Paul V. Technical Communication: A Reader-Centered Approach. Cengage. New Delhi. 2008
2. Muralikrishna, & Sunita Mishra. Communication Skills for Engineers. Pearson, New Delhi. 2011
3. Riordan, Daniel. G. Technical Communication. Cengage Learning, New Delhi. 2005
4. Sharma, Sangeetha & Binod Mishra. Communication Skills for Engineers and Scientists. PHI Learning, New Delhi. 2009
5. Smith-Worthington, Darlene & Sue Jefferson. Technical Writing for Success. Cengage, Mason USA. 2007

EXTENSIVE Reading (Not for Examination)

1. Khera, Shiv. You can Win. Macmillan, Delhi. 1998.

Websites

1. http://www.englishclub.com
2. http://owl.english.purdue.edu

TEACHING METHODS:

- Lectures
- Activities conducted individually, in pairs and in groups like individual writing and presentations, group discussions, interviews, reporting, etc
- Long presentations using visual aids
- Listening and viewing activities with follow up activities like discussions, filling up worksheets, writing exercises (using language lab wherever necessary/possible) etc

- Projects like group reports, mock interviews etc using a combination of two or more of the language skills

EVALUATION PATTERN:

Internal assessment: 20%

3 tests of which two are pen and paper tests and the other is a combination of different modes of assessment like

- Project
- Assignment
- Report
- Creative writing, etc.

All the four skills are to be tested with equal weightage given to each.

- ✓ Speaking assessment: Individual presentations, Group discussions
- ✓ Reading assessment: Reading passages with comprehension questions graded following Bloom's taxonomy
- ✓ Writing assessment: Writing essays, CVs, reports etc. Writing should include grammar and vocabulary.
- ✓ Listening/Viewing assessment: Lectures, dialogues, film clippings with questions on verbal as well as audio/visual content graded following Bloom's taxonomy.

End Semester Examination: 80%

MA6251 MATHEMATICS – II L T P C
3 1 0 4

OBJECTIVES:

- To make the student acquire sound knowledge of techniques in solving ordinary differential equations that model engineering problems.
- To acquaint the student with the concepts of vector calculus needed for problems in all engineering disciplines.
- To develop an understanding of the standard techniques of complex variable theory so as to enable the student to apply them with confidence, in application areas such as heat conduction, elasticity, fluid dynamics and flow the of electric current.
- To make the student appreciate the purpose of using transforms to create a new domain in which it is easier to handle the problem that is being investigated.

UNIT I VECTOR CALCULUS 9+3

Gradient, divergence and curl – Directional derivative – Irrotational and solenoidal vector fields – Vector integration – Green's theorem in a plane, Gauss divergence theorem and Stokes' theorem (excluding proofs) – Simple applications involving cubes and rectangular parallelopipeds.

UNIT II ORDINARY DIFFERENTIAL EQUATIONS 9+3

Higher order linear differential equations with constant coefficients – Method of variation of parameters – Cauchy's and Legendre's linear equations – Simultaneous first order linear equations with constant coefficients.

UNIT III LAPLACE TRANSFORM 9+3

Laplace transform – Sufficient condition for existence – Transform of elementary functions – Basic properties – Transforms of derivatives and integrals of functions - Derivatives and integrals of transforms - Transforms of unit step function and impulse functions – Transform of periodic functions. Inverse Laplace transform -Statement of Convolution theorem – Initial and final value theorems – Solution of linear ODE of second order with constant coefficients using Laplace transformation techniques.

UNIT IV ANALYTIC FUNCTIONS 9+3

Functions of a complex variable – Analytic functions: Necessary conditions – Cauchy-Riemann equations and sufficient conditions (excluding proofs) – Harmonic and orthogonal properties of analytic function – Harmonic conjugate – Construction of analytic functions – Conformal mapping: $w = z+k$, kz, $1/z$, z^2, e^z and bilinear transformation.

UNIT V COMPLEX INTEGRATION 9+3

Complex integration – Statement and applications of Cauchy's integral theorem and Cauchy's integral formula – Taylor's and Laurent's series expansions – Singular points – Residues – Cauchy's residue theorem – Evaluation of real definite integrals as contour integrals around unit circle and semi-circle (excluding poles on the real axis).

TOTAL (L:45+T:15): 60 PERIODS

OUTCOMES:

- The subject helps the students to develop the fundamentals and basic concepts in vector calculus, ODE, Laplace transform and complex functions. Students will be able to solve problems related to engineering applications by using these techniques.

TEXT BOOKS:

1. Bali N. P and Manish Goyal, "A Text book of Engineering Mathematics", Eighth Edition, Laxmi Publications Pvt Ltd.,2011.
2. Grewal. B.S, "Higher Engineering Mathematics", 41st Edition, Khanna Publications, Delhi, 2011.

REFERENCES:

1. Dass, H.K., and Er. Rajnish Verma," Higher Engineering Mathematics", S. Chand Private Ltd., 2011
2. Glyn James, "Advanced Modern Engineering Mathematics", 3rd Edition, Pearson Education, 2012.
3. Peter V. O'Neil," Advanced Engineering Mathematics", 7th Edition, Cengage learning, 2012.
4. Ramana B.V, "Higher Engineering Mathematics", Tata McGraw Hill Publishing Company, New Delhi, 2008.
5. Sivarama Krishna Das P. and Rukmangadachari E., "Engineering Mathematics" Volume II, Second Edition, PEARSON Publishing, 2011.

PH6252 PHYSICS OF MATERIALS L T P C
3 0 0 3

UNIT I PREPARATION AND PROCESSING OF MATERIALS 9

Phases - Phase rule – binary systems – tie line rule – lever rule – phase diagram – invariant reactions – diffusion Fick's law - Nucleation – homogeneous and heterogeneous nucleation – Free energy of formation of a critical nucleus – crystal growth – Czochralski, Bridgman, Solution methods - Thin films – preparation: PVD method - Sol-gel method – heat treatment and hardening processes..

UNIT II PROPERTIES OF CONDUCTING AND SUPER CONDUCTING MATERIALS 9

Classical free electron theory of metals –Fermi function - Schrödinger wave equation - Time independent and time dependent equations. Physical significance of wave function, particle in a box (in one dimension) – electrons in a metal - Density of energy states – effect of temperature on Fermi energy – carrier concentration in metals - Superconducting Phenomena, Properties of superconductors – Meissner effect and Isotope effect. Type I and Type II superconductors, High Tc superconductors – Magnetic levitation and SQUIDS.

UNIT III ELECTRONIC MATERIALS 9

Elemental and compound semiconductors - Origin of band gap in solids (qualitative) - Concept of effective mass of electron and hole – carrier concentration in an intrinsic semiconductor (derivation) – Fermi level – Variation of Fermi level with temperature – electrical conductivity – band gap determination – carrier concentration in n-type and p-type semiconductors (derivation) – variation of Fermi level with temperature and impurity concentration – Compound semiconductors – Hall effect – Determination of Hall coefficient – LED and Solar cells.

UNIT IV INSULATING AND MAGNETIC MATERIALS 9

Dielectric, paraelectric and ferroelectric materials - Electronic, Ionic, Orientational and space charge polarization – Internal field and deduction of Clausius Mosotti equation – dielectric loss – different types of dielectric breakdown – classification of insulating materials and their applications - Introduction to magnetic materials - Domain theory of ferromagnetism, Hysteresis, Soft and Hard magnetic materials – Anti-ferromagnetic materials – Ferrites, Giant Magneto Resistance materials. Magnetic bubbles.

UNIT V CERAMIC AND NEW MATERIALS 9

Introduction to Ceramics and its applications - Ceramic Fibres - Fibre reinforced Plastics – Fibre reinforced Metal – Metallic glasses – Shape memory alloys – Copper base alloys – Nickel – Titanium alloys – Relaxor- Ferroelectric materials – Electro and magneto rheological fluids - Sensors and Actuators – polymer semiconductos – photoconducting polymers – liquid crystals - Bio-sensors - Scintillation detectors (Position sensitive) –Bio materials – hydroxyapatite – PMMA – Silicone.

TOTAL : 45 PERIODS

REFERENCES

1. Raghavan. V. Materials Science and Engineering, Prentice Hall of India, 2002.
2. Kumar.J, Moorthy Babu. S and Vasudevan. S., Engineering Physics, Vijay Nicole Imprints, 2006
3. Palanisamy.. P.K., Materials Science, Scitech., 2003.
4. Calister, W.D., Materials Science and Engineering an Introduction, John Wiley, 2003.
5. Raghavan, V., Physical Metallurgy, Prentice Hall of India, 2002.

GE6253 ENGINEERING MECHANICS L T P C
3 1 0 4

OBJECTIVES:

- To develop capacity to predict the effect of force and motion in the course of carrying out the design functions of engineering.

UNIT I BASICS AND STATICS OF PARTICLES 12

Introduction – Units and Dimensions – Laws of Mechanics – Lami's theorem, Parallelogram and triangular Law of forces –– Vectorial representation of forces – Vector operations of forces -additions, subtraction, dot product, cross product – Coplanar Forces – rectangular components – Equilibrium of a particle – Forces in space – Equilibrium of a particle in space – Equivalent systems of forces – Principle of transmissibility .

UNIT II EQUILIBRIUM OF RIGID BODIES 12

Free body diagram – Types of supports –Action and reaction forces –stable equilibrium – Moments and Couples – Moment of a force about a point and about an axis – Vectorial representation of moments and couples – Scalar components of a moment – Varignon's theorem – Single equivalent force -Equilibrium of Rigid bodies in two dimensions – Equilibrium of Rigid bodies in three dimensions

UNIT III PROPERTIES OF SURFACES AND SOLIDS 12

Centroids and centre of mass– Centroids of lines and areas - Rectangular, circular, triangular areas by integration – T section, I section, - Angle section, Hollow section by using standard formula –Theorems of Pappus - Area moments of inertia of plane areas – Rectangular, circular, triangular areas by integration – T section, I section, Angle section, Hollow section by using standard formula – Parallel axis theorem and perpendicular axis theorem –Principal moments of inertia of plane areas – Principal axes of inertia-Mass moment of inertia –mass moment of inertia for prismatic, cylindrical and spherical solids from first principle – Relation to area moments of inertia.

UNIT IV DYNAMICS OF PARTICLES 12

Displacements, Velocity and acceleration, their relationship – Relative motion – Curvilinear motion - Newton's laws of motion – Work Energy Equation– Impulse and Momentum – Impact of elastic bodies.

UNIT V FRICTION AND ELEMENTS OF RIGID BODY DYNAMICS 12

Friction force – Laws of sliding friction – equilibrium analysis of simple systems with sliding friction –wedge friction-. Rolling resistance -Translation and Rotation of Rigid Bodies – Velocity and acceleration – General Plane motion of simple rigid bodies such as cylinder, disc/wheel and sphere.

TOTAL : 60 PERIODS

OUTCOMES:

- ability to explain the differential principles applies to solve engineering problems dealing with force, displacement, velocity and acceleration.
- ability to analyse the forces in any structures.
- ability to solve rigid body subjected to dynamic forces.

TEXT BOOKS:

1. Beer, F.P and Johnston Jr. E.R., "Vector Mechanics for Engineers (In SI Units): Statics and Dynamics", 8th Edition, Tata McGraw-Hill Publishing company, New Delhi (2004).
2. Vela Murali, "Engineering Mechanics", Oxford University Press (2010)

REFERENCES:

1. Hibbeller, R.C and Ashok Gupta, "Engineering Mechanics: Statics and Dynamics", 11th Edition, Pearson Education 2010.
2. Irving H. Shames and Krishna Mohana Rao. G., "Engineering Mechanics – Statics and Dynamics", 4th Edition, Pearson Education 2006.
3. Meriam J.L. and Kraige L.G., " Engineering Mechanics- Statics - Volume 1, Dynamics- Volume 2", Third Edition, John Wiley & Sons,1993.
4. Rajasekaran S and Sankarasubramanian G., "Engineering Mechanics Statics and Dynamics", 3rd Edition, Vikas Publishing House Pvt. Ltd., 2005.
5. Bhavikatti, S.S and Rajashekarappa, K.G., "Engineering Mechanics", New Age International (P) Limited Publishers, 1998.
6. Kumar, K.L., "Engineering Mechanics", 3rd Revised Edition, Tata McGraw-Hill Publishing company, New Delhi 2008.

BT6201 **BIOCHEMISTRY** **L T P C**
3 0 0 3

OBJECTIVES

- To develop understanding and provide scientific basics of the life processes at the molecular level and explain the structure, function and inter-relationships of bio-molecules and their deviation from normal and their consequences for interpreting and solving clinical problems.

UNIT I BIOCHEMICAL ORGANIZATION AND BIOENERGETICS 10

Scope of clinical biochemistry, component of the cell, structure and biochemical functions, membrane structure and functions, transport through biological cell membrane, the concept of free energy, determination of change in free energy from equilibrium constant and reduction potential, bioenergetics and biological oxidation – general concept of oxidation and reduction, electron transport chain, oxidative phosphorylation, uncouplers and theories of biological oxidation and oxidative phosphorylation

UNIT II BIOMOLECULES 12

Carbohydrates – classification, properties.starch, glycogen, dextrin, inulin, cellulose, metabolism of carbohydrates – gluconeogenesis, glycogenolysis, glycolysis. citric acid cycle and its biological significance, role of sugar in nucleotide biosynthesis and pentose phosphate pathway. **Lipids** – Classification, properties. sterols, essential fatty acids, eicosanoids, phospholipids, sphingolipids, metabolism of lipids, oxidation of fatty acids, α,β - oxidation and biosynthesis of ketone bodies, cholesterol, porphyrin biosynthesis, metabolism of bile pigments. **Proteins and amino acids** – Classification, properties, biosynthesis of amino acids and proteins, essential amino acids, metabolism of amino acids and proteins, Nitrogen balance. **Nucleic acids** –genetic code, nucleic acids, and structure of DNA and RNA, purine biosynthesis and pyrimidine biosynthesis.

UNIT III BIOENERGETICS 5

High energy compounds, electronegative potential of compounds , respiratory chain, ATP cycle , Calculation of ATP during oxidation of glucose and fatty acids.

UNIT IV MACROMOLECULES, VITAMINS, HORMONES, ENZYMES 10

Physical and chemical properties, structure of haemoglobin, immunoglobulins and nucleoprotein, classification and their properties, occurrence, functions, requirements, deficiency manifestations and role of vitamins as coenzyme, chemical nature and properties, hormones, Nomenclature, enzyme kinetics, classification and their properties, mechanism of action, enzyme induction and inhibition, coenzyme significance and enzymes of clinical importance

UNIT V BIOCHEMISTRY OF CLINICAL DISEASES 8

Diabetes mellitus, atherosclerosis, fatty liver, and obesity, hormonal disorders, aging, inborn errors of metabolism organ function tests

TOTAL: 45 PERIODS

TEXTBOOKS

1. Lehninger A.L., Nelson D.L. and Cox M.M. Principles of Biochemistry. CBS publishers and distributers
2. Murray R.K., Granner D.K., Mayes P.A. and Rodwell V.W. Harpers Biochemistry. Appleton and Lange ,Stanford ,Conneticut.
3. Thomas M. Devlin.Textbook of Biochemistry with clinical correlations. Wiley Liss Publishers

REFERENCES

1. Burtis & Ashwood W.B. Tietz Textbook of Clinical chemistry. Saunders Company
2. Lubert Stryer W.H. Biochemistry. Freeman and company, New york.
3. Donald Voet & Judith G. Voet. Biochemistry. John Wiley and Sons ,Inc.
4. Rama Rao Textbook of Biochemistry.
5. Deb. Textbook of Biochemistry.

PY6201 FUNDAMENTALS OF HUMAN ANATOMY AND PHYSIOLOGY L T P C
3 0 0 3

OBJECTIVES

- To develop understanding about the structure (gross and histology) and functions of various organs of the human body; describe the various homeostatic mechanisms and their imbalances of various systems; identify the various tissues and organs of the different systems of the human body and appreciate coordinated working pattern of different organs of each system

UNIT I FOUNDATIONS OF PHYSIOLOGY, HOMEOSTASIS 7

Organization of the Human Body , Chemical Foundations – Atoms, Ions, Molecules, Bonds, Solutions, Classes of organic molecules; Physical Foundations – Morphology of the cell (plasma membrane, nucleus, cell organelles) Elementary tissues of the human body: epithelial, connective, Muscular and nervous tissues-their sub-types and characteristics, Cellular Transport – Intracellular movement, Intercellular movement, Movement of molecules across the plasma membrane, intercellular communication.

UNIT II NERVOUS AND MUSCULO-SKELETON SYSTEM 12

Anatomy and physiology of brain, blood-brain barrier, spinal cord, structure and types of the neuron, synapses neurotransmitters, organization of spinal and cranial nerves, central and peripheral nervous system, autonomic nervous system, receptors membrane potentials – graded potentials and action potentials, physiology of vision, audition, olfaction, taste and skin; anatomy and physiology of muscular system, types of muscle tissue – skeletal, smooth, cardiac, contraction, muscle fibre regulation, Osseous system - structure, composition and functions of the Skeleton, classification of joints, types of movements of joints and their disorders

UNIT III GASTROINTESTINAL AND RENAL SYSTEM 7

Anatomy and physiology of the gastrointestinal tract (secretion, motility, digestion and absorption), structure and function of the liver, spleen, gall bladder, pancreas; the renal system structure – Anatomy and physiology kidney; structure of the nephron and network of blood capillaries urinary tract, formation of urine, concentration of urine; regulation of acid-base balance; the chemical acid-base buffer systems of body fluids and disease conditions

UNIT IV CARDIOVASCULAR AND PULMONARY SYSTEM 9

Anatomy and physiology of the heart, lungs, cardiac cycle; circulation of blood, heart rate, blood pressure, ECG and heart sounds, lymphatic vessel, systemic and portal circulation; vascular system – arteries, arterioles, capillaries, venules. Anatomy of respiratory tract, mechanism and dynamics of respiration, lung volumes, transport of oxygen and carbon dioxide, disorders like cyanosis

UNIT V ENDOCRINE AND REPRODUCTIVE SYSTEM 10

Anatomy and physiology of Pituitary, thyroid, parathyroid, adrenal and pancreatic hormones and disorders of these glands, endocrine control of growth and metabolism; pineal, thymus, testes, ovaries, structure and physiology of reproductive systems, sex hormones, physiology of fertilization, menstruation, menopause, spermatogenesis and oogenesis, pregnancy and parturition and clinical disorders

TOTAL : 45 PERIODS

TEXT BOOKS

1. Guyton, A.C. and Hall, J.E., “Textbook of Medical Physiology”, 11th Edition, Saunders, 2006.
2. Ganong, W.F., “Review of Medical Physiology”, 22nd Edition (A Lange Medical book series) McGraw – Hill (International Ed.) 2005.
3. Khurana, Indu, “A Textbook of Medical Physiology” Elsevier, 2006.
4. Johnson, L.R., “Essential Medical Physiology”, 3rd Edition, Academic Press / Elsevier), 2003.

REFERENCES

1. Waugh, Anne and Allison Grant, "Ross and Wilson Anatomy and Physiology in Health and Illness", 10th Edition, Churchill – Livingstone / Elsevier), 2006.
2. Carola, R., Harley J.P. and Noback C.R., "Human Anatomy & Physiology", 2nd Edition, McGraw – Hill, 1992.
3. Vander, A.J., Sherman J.H. and Luciano D.S., "Human Physiology: The Mechanisms of Body Function", 5th Edition, McGraw – Hill, 1990.

BT6211	BIOCHEMISTRY LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES

- To learn and understand the principles behind the qualitative and quantitative estimation of biomolecules (proteins, carbohydrates, lipids, metabolites etc.,) and laboratory analysis of the same in the body fluids.

LIST OF EXPERIMENTS

1. Preparation and measurement of pH of standard buffers (phosphate, carbonate, borate, TRIS etc.,).
2. Qualitative analysis of carbohydrates (monosaccharides, disaccharides, polysaccharides etc.,)
3. Enzymatic hydrolysis of glycogen by α and β amylase
4. Qualitative analysis of proteins
5. Qualitative analysis of lipids (triglycerides, cholesterol, phospholipids etc.,)
6. Quantitative analysis of proteins (Lowrys method, Bradford, UV)
7. Quantitative analysis of carbohydrates (Benedict's method etc.,) lipids
8. Quantitative analysis of lipids (Benedict's method etc.,)
9. Quantitative estimation of blood glucose
10. Acid hydrolysis and action of salivary amylase on starch
11. Estimation of chloride, glucose, ammonia and creatinine in urine.
12. Quantitative analysis of urea in serum
13. Quantitative analysis of serum bilirubin
14. Quantitative estimation of serum cholesterol by Libermann Burchard's method
15. Isolation and assay of glycogen from the liver and skeletal muscle of mice

TOTAL : 60 PERIODS

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

1. UV-Visible Spectrophotometers
2. pH meter
3. Centrifuge

TEXT BOOKS:

1. Gupta R.C. and Bhargavan S. Practical Biochemistry.
2. David T. Phummer. Introduction of Practical Biochemistry (II Edition).

REFERENCES:

1. Murray R.K., Granner D.K., Mayes P.A. and Rodwell V.W. Harpers Biochemistry, Appleton and Lange ,Stanford ,Conneticut.
2. Thomas M. Devlin. Textbook of Biochemistry with clinical correlations. Wiley Liss Publishers

PY6212 EXPERIMENTAL PHYSIOLOGY LABORATORY L T P C
0 0 4 2

OBJECTIVES

- To learn the gross histology, structure and functions of various organs of the human body and perform the physiological tests and appreciate the interlinked mechanisms in the maintenance of normal functioning of human body

LIST OF EXPERIMENTS

1. Study of different systems with the help of models (axial skeleton, appendicular skeleton, cardiovascular system, respiratory system, digestive system, urinary system, nervous system, special senses, reproductive system)
2. Principles of mounting tissue, examination, preservation,
3. Microscopic study of different tissues, epithelial, muscular, connective tissue, nervous tissue
4. Determination of bleeding and clotting time
5. Determination of R.B.C. count of blood
6. Estimation of Haemoglobin
7. Enumeration of W.B.C. count of blood
8. Determination of differential count of blood
9. Determination of Erythrocyte Sedimentation Rate
10. Blood group determination
11. Heart rate and blood pressure recording
12. Identification of human bones and joints, anatomic features
13. Determination of vital capacity

TOTAL : 60 PERIODS

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

1. Microscope
2. Pippete aids
3. Haemocytometer
4. B.P.meter

TEXT BOOKS:

1. Goyal R. K., Natvar M.P, and Shah S.A, Practical anatomy, physiology and biochemistry, latest edition, Publisher: B.S Shah Prakashan, Ahmedabad.
2. Tortora Gerard J. and Nicholas P. Principles of anatomy and physiology Publisher Harpercollins college New York.

REFERENCES:

1. Ranade V.G. Text book of practical physiology, Latest edition, Publisher: PVG, Pune Anderson Experimental Physiology, Latest edition, Publisher: NA
2. Best and Tailor's "Physiological basis of Medical Practice".
3. Guyton A.C. Hall J.E. Text book of Medical Physiology.
4. Chatterjee C.C.. Human Physiology.
5. Cyril A. Keek, Eric Neil and Norman Joels. Samson Wright's Applied Physiology.
6. Park J.E. and Park K. Textbook of Preventive and Social Medicine.

GE6351 ENVIRONMENTAL SCIENCE AND ENGINEERING L T P C
3 0 0 3

OBJECTIVES:

To the study of nature and the facts about environment.

- To finding and implementing scientific, technological, economic and political solutions to environmental problems.
- To study the interrelationship between living organism and environment.
- To appreciate the importance of environment by assessing its impact on the human world; envision the surrounding environment, its functions and its value.
- To study the dynamic processes and understand the features of the earth's interior and surface.
- To study the integrated themes and biodiversity, natural resources, pollution control and waste management.

UNIT I ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY 12

Definition, scope and importance of Risk and hazards; Chemical hazards, Physical hazards, Biological hazards in the environment – concept of an ecosystem – structure and function of an ecosystem – producers, consumers and decomposers-Oxygen cycle and Nitrogen cycle – energy flow in the ecosystem – ecological succession processes – Introduction, types, characteristic features, structure and function of the (a) forest ecosystem (b) grassland ecosystem (c) desert ecosystem (d) aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries) – Introduction to biodiversity definition: genetic, species and ecosystem diversity – biogeographical classification of India – value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values – Biodiversity at global, national and local levels – India as a mega-diversity nation – hot-spots of biodiversity – threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – endangered and endemic species of India – conservation of biodiversity: In-situ and ex-situ conservation of biodiversity. Field study of common plants, insects, birds

Field study of simple ecosystems – pond, river, hill slopes, etc.

UNIT II ENVIRONMENTAL POLLUTION 10

Definition – causes, effects and control measures of: (a) Air pollution (Atmospheric chemistry- Chemical composition of the atmosphere; Chemical and photochemical reactions in the atmosphere - formation of smog, PAN, acid rain, oxygen and ozone chemistry;- Mitigation procedures- Control of particulate and gaseous emission, Control of SO_2, NO_X, CO and HC) (b) Water pollution : Physical and chemical properties of terrestrial and marine water and their environmental significance; Water quality parameters – physical, chemical and biological; absorption of heavy metals - Water treatment processes. (c) Soil pollution - soil waste management: causes, effects and control measures of municipal solid wastes – (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards–role of an individual in prevention of pollution – pollution case studies –

Field study of local polluted site – Urban / Rural / Industrial / Agricultural.

UNIT III NATURAL RESOURCES 10

Forest resources: Use and over-exploitation, deforestation, case studies- timber extraction, mining, dams and their effects on forests and tribal people – Water resources: Use and overutilization of surface and ground water, dams-benefits and problems – Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies – Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies – Energy resources: Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources. Energy Conversion processes – Biogas – production and uses, anaerobic digestion; case studies – Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification – role of an individual in conservation of natural resources – Equitable use of resources for sustainable lifestyles. Introduction to Environmental Biochemistry: Proteins – Biochemical degradation of pollutants, Bioconversion of pollutants.

Field study of local area to document environmental assets – river / forest / grassland / hill / mountain.

UNIT IV SOCIAL ISSUES AND THE ENVIRONMENT 7

From unsustainable to sustainable development – urban problems related to energy – water conservation, rain water harvesting, watershed management – resettlement and rehabilitation of people; its problems and concerns, case studies – role of non-governmental organization- environmental ethics: Issues and possible solutions – 12 Principles of green chemistry- nuclear accidents and holocaust, case studies. – wasteland reclamation – consumerism and waste products – environment production act – Air act – Water act – Wildlife protection act – Forest conservation act –The Biomedical Waste (Management and Handling) Rules; 1998 and amendments- scheme of labeling of environmentally friendly products (Ecomark). enforcement machinery involved in environmental legislation- central and state pollution control boards- disaster management: floods, earthquake, cyclone and landslides.

Public awareness.

UNIT V HUMAN POPULATION AND THE ENVIRONMENT 6

Population growth, variation among nations – population explosion – family welfare programme – environment and human health – human rights – value education – HIV / AIDS – women and child welfare –Environmental impact analysis (EIA)- -GIS-remote sensing-role of information technology in environment and human health – Case studies.

TOTAL : 45 PERIODS

OUTCOMES:

Environmental Pollution or problems cannot be solved by mere laws. Public participation is an important aspect which serves the environmental Protection. One will obtain knowledge on the following after completing the course.

- Public awareness of environmental is at infant stage.
- Ignorance and incomplete knowledge has lead to misconceptions
- Development and improvement in std. of living has lead to serious environmental disasters

TEXT BOOKS:

1. Gilbert M.Masters, 'Introduction to Environmental Engineering and Science', 2nd edition, Pearson Education (2004).
2. Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, (2006).

REFERENCES:

1. R.K. Trivedi, 'Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards', Vol. I and II, Enviro Media.
2. Cunningham, W.P. Cooper, T.H. Gorhani, 'Environmental Encyclopedia',Jaico Publ.,House, Mumbai, 2001.
3. Dharmendra S. Sengar, 'Environmental law', Prentice hall of India PVT LTD,New Delhi, 2007.
4. Rajagopalan, R, 'Environmental Studies-From Crisis to Cure', Oxford University Press (2005)

MA6468 PROBABILITY AND STATISTICS L T P C
3 1 0 4

OBJECTIVES:

- This course aims at providing the required skill to apply the statistical tools in engineering problems.

UNIT I RANDOM VARIABLES 9 + 3

Discrete and continuous random variables – Moments – Moment generating functions – Binomial, Poisson, Geometric, Uniform, Exponential, Gamma and Normal distributions.

UNIT II TWO - DIMENSIONAL RANDOM VARIABLES 9 + 3

Joint distributions – Marginal and conditional distributions – Covariance – Correlation and Linear regression – Transformation of random variables – Central limit theorem (for independent and identically distributed random variables).

UNIT III TESTING OF HYPOTHESIS 9 + 3

Sampling distributions - Estimation of parameters - Statistical hypothesis - Large sample test based on Normal distribution for single mean and difference of means -Tests based on t, Chi-square and F distributions for mean, variance and proportion - Contingency table (test for independent) - Goodness of fit.

UNIT IV DESIGN OF EXPERIMENTS 9 + 3

One way and Two way classifications - Completely randomized design – Randomized block design – Latin square design - 2^2 factorial design.

UNIT V STATISTICAL QUALITY CONTROL 9 + 3

Control charts for measurements (X and R charts) – Control charts for attributes (p, c and np charts) – Tolerance limits - Acceptance sampling.

TOTAL (L:45+T:15): 60 PERIODS

OUTCOMES:

- The students will have a fundamental knowledge of the concepts of probability. Have knowledge of standard distributions which can describe real life phenomenon. Have the notion of sampling distributions and statistical techniques used in engineering and management problems.

TEXT BOOKS:

1. Milton. J. S. and Arnold. J.C., "Introduction to Probability and Statistics", Tata McGraw Hill, 4th Edition, 2007.
2. Johnson. R.A. and Gupta. C.B., "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 7th Edition, 2007.
3. Papoulis. A and Unnikrishnapillai. S., "Probability, Random Variables and Stochastic Processes " Mc Graw Hill Education India , 4th Edition, New Delhi , 2010.

REFERENCES:

1. Devore. J.L., "Probability and Statistics for Engineering and the Sciences", Cengage Learning, New Delhi, 8th Edition, 2012.
2. Walpole. R.E., Myers. R.H., Myers. S.L. and Ye. K., "Probability and Statistics for Engineers and Scientists", Pearson Education, Asia , 8th Edition, 2007.
3. Ross, S.M., "Introduction to Probability and Statistics for Engineers and Scientists", 3rd Edition, Elsevier, 2004.
4. Spiegel. M.R., Schiller. J. and Srinivasan. R.A., "Schaum's Outline of Theory and Problems of Probability and Statistics", Tata McGraw Hill Edition, 2004.

PY6301	PHARMACEUTICAL CHEMISTRY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To inculcate understanding of the properties and principles of medicinal agents that originates from organic and inorganic sources and their application in pharmaceutical industry
- To provide the basic functional group identification, chemical bonding with their mechanism.
- To provide the basic principles involved in the identification and estimation of pharmaceutical substances.

UNIT I STRUCTURE AND PROPERTIES 9

Molecular orbital theory, hybrid orbitals, polarity of bonds and molecules, dipole moment, resonance, inductive, mesomeric and electromeric effects, intramolecular and intermolecular hydrogen bonding.

UNIT II CHEMISTRY OF ALIPHATIC AND AROMATIC COMPOUNDS 10

Characteristics of organic compounds, structure, nomenclature, preparation and reaction mechanism of alkyl and aryl halides (Mechanism of SN1, SN2, E1 and E2), Huckel rule, structures of benzenoid and nonbenzenoid compounds, mechanism of aromatic electrophilic and nucleophilic substitution, general mechanism of an aromatic electrophilic substitution reaction. alcohols, ethers, epoxides, amines, aldehydes, ketones, carboxylic acids and functional derivatives of carboxylic acids.

UNIT III PRINCIPLES OF TEST FOR PURITY IN PHARMACEUTICAL SUBSTANCES 9

Identification and characterization of impurities in Pharmaceutical substances, Limit tests: Definition, importance, general procedure for limit test for chlorides, sulphates, iron, arsenic, heavy metals, lead and modifications with suitable examples.

UNIT IV STUDY OF INORGANIC COMPOUNDS IN PHARMACOPOEIA 12

Method of preparation, assay, identification test, test for purity, official preparation, storage conditions and belonging to the following categories. Gastrointestinal agents and related compounds – Acidifiers, Antacids, Adsorbents and protectives, Saline cathartics; Topical Agents – Protectives, Astringents, Anti-microbials topical agents.

UNIT V PHARMACEUTICAL AIDS AND CO-ORDINATION COMPOUNDS 10

Definition, principles and properties of various agents such as – Sodium bisulphate, Sodium metabisulphate, Sulphurdioxide, Bentonite, Magnesium stearate, Zinc stearate, Aluminium sulphate, Sodium carboxy methyl cellulose, Sodium methylparaben Theory of co-ordination compounds with special reference to application in Pharmacy such as – EDTA, Dimercaprol, Penicillamine, 1, 10-Phenanthroline

TOTAL: 45 PERIODS

OUTCOMES:

The student will be able to

- Identify the functional groups in pharmaceutical substances and make predictions of chemical bonding along with their reaction mechanism.
- Identify and estimate the purity of drugs and its application.
- Involve in the development and synthesis of new drug molecule.

TEXT BOOKS:

1. AB.S. Bahl and Arun Bahl.ATextbook of Organic Chemistry 21 Edition, S.Chand and company pvt.Ltd, New Delhi.
2. Atherden, L.M. “Bentley and Driver’s Textbook of Pharmaceutical Chemistry”. Oxford University Press, 8th Edition, 1977.

REFERENCES:

1. Indian Pharmacopoeia (I.P.) 2007
2. A.I. Vogel, B.S. Furniss, A.J. Hannaford, P.W.G. Smith, and A.R. Tatchell, Vogels textbooks of practical organic chemistry,. 5th Ed., ELBS longman, 1994.
3. Morrison R.T., Boyd R.N., Organic Chemistry,Prentice- Hall of India, 6th ed., (1992)

PY6302	MICROBIOLOGY	L	T	P	C
		3	0	0	3

OBJECTIVES:

To enable the students to

- Acquire fairly good knowledge about the microbial pathogens and its impact upon health.
- Learn and understand the conceptual and experimental basics of microbiology to continue to develop a scientific attitude towards problem solving and the creation and testing of hypothesis to gain a greater appreciation, analyze logically about the interconnectedness of the general principles and concepts of microbiology in pharmaceutical sciences.

UNIT I INTRODUCTION 6

Basics of microbial existence; history of microbiology, classification and nomenclature of microorganisms,microscopicexaminationofmicroorganisms,lightandelectronmicroscopy; principles of different staining techniques like gram staining, acid fast, capsular staining, flagellar staining. Sterilization: Detail study of different methods of sterilization including their merits and demerits.

UNIT II MICROBES- STRUCTURE AND MULTIPLICATION 12

Structural organization and multiplication of bacteria, viruses, algae and fungi with special mention of life history of actinomycetes, yeast, mycoplasma and bacteriophages.

UNIT III MICROBIAL NUTRITION, GROWTH AND METABOLISM 12

Nutritional requirements of bacteria;differentmediausedfor bacterial culture;growthcurve and different methods to quantify bacterial growth; aerobic and anaerobic bioenergetics and utilization of energy for biosynthesis of important molecules.

UNIT IV CLINICAL MICROBIOLOGY 6

Physical and chemical control of microorganisms; host-microbe interactions; anti-bacterial, anti-fungal and anti-viral agents; mode of action and resistance to antibiotics; clinically important microorganisms.

UNIT V INDUSTRIAL AND ENVIRONMENTAL MICROBIOLOGY 9

Primary metabolites; secondary metabolites and their applications; preservation of food; production of penicillin, alcohol, vitamin B-12; biogas; bioremediation; leaching of ores by microorganisms; biofertilizers and biopesticides; microorganisms and pollution control; biosensors

TOTAL: 45 PERIODS

OUTCOMES:

The student will be able to

- Describe about the fundamental concepts, principles and clinical and environmental applications of Microbiology with special reference to Pharmaceutical Industries.
- Solve problems in the context of this understanding of microorganisms and the role they play in health and disease.

TEXT BOOKS:

1. Pelczar,M.J.“Microbiology”,5th Edition,TataMcGraw-Hill,1993.
2. Ananthanarayanan,R.andC.K.JayaramPaniker,“TextbookofMicrobiology”,4th Edition,Orient Longman,1990.
3. Stanier,R.Y.etal.,“GeneralMicrobiology”,5th Edition,Macmillan,1986.
4. Casida,L.E.“IndustrialMicrobiology”,NewAgeInternational,1968.

REFERENCES:

1. Nester,E.W.etal.,“Microbiology:AHumanPrespective”,4th Edition,McGraw-Hill,2004.
2. Talaro,K.T.and Arthur Talaro, “Foundations in Microbiology”, 2nd Edition, Wm. C. Brown Publisher, 1996.
3. Prescott, S.C. and Cecil G. Dunn “Industrial Microbiology”,Agrobios(India), 2005.

PY6303	FLUID FLOW OPERATIONS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To provide the basic fundamental knowable about the flow properties of different type of fluids and its momentum balance.
- To provide the knowledge about the various transporting and metering devices of fluid flow in bulk pharmaceutical manufacturing and in chemical process.

UNIT I PROPERTIES OF FLUIDS AND CONCEPT OF PRESSURE 9

Introduction – Physical properties of fluids – Types of fluids – Fluid statics and its applications - Pressure – Density – Height relationships – Pressure measurement –Units and dimensions – Dimensional analysis – Dimensionless numbers.

UNIT II MOMEMTUM BALANCE AND ITS APPLICATIONS 9

Kinematics of fluid flow – Stream line – Stream tube – Velocity potential – Newtonian and non-newtonian fluids – Time dependent fluids – Reynolds number experiment and significance –Continuity Equation – Momentum balance – Potential flow – Bernoulli's equation – Correction for fluid friction – Correction for pump work.

UNIT III FLOW OF INCOMPRESSIBLE FLUIDS THROUGH DUCTS 9

Flow of incompressible fluids in pipes – Laminar and turbulent flow through closedconduits – Velocity profile and friction factor for smooth and rough pipes – Heat loss due to friction in pipes and Fittings – Introduction to compressible flow – Isentropic flow through convergent and divergent nozzles and sonic velocity.

UNIT IV FLOW OF FLUIDS THROUGH SOLIDS 9

Form drag – Skin drag – Drag co-efficient – Flow around solids and packed beds – Friction factor for packed beds – Ergun's Equation – Motion of particles through fluids –Motion under gravitational and centrifugal fields – Terminal settling velocity – Fluidization – Mechanism – Types – General properties – Applications.

UNIT V TRANSPORTATION AND METERING 9

Measurement of fluid flow – Orifice meter – Venturi meter – Pitot tube – Rotameter –Weirs and notches – Hot wire anemometers – Transportation of fluids – Positive displacement pumps – Rotary and Reciprocating pumps – Centrifugal pumps –Performance and characteristics – Air lift and diaphragm pumps.

TOTAL: 45 PERIODS

OUTCOMES:

The student will be able to

- Understand fundamental concepts in fluids, such as density, viscosity, pressure and temperature.
- Apply the mass, energy and momentum balance equations in fluid flow problems.
- Analyze and solve the problems involving laminar and turbulent frictional flow, fluid drag on particles, packed beds and pumps involving Newtonian and non-Newtonian fluid flow in chemical engineering equipments.

TEXT BOOKS:

1. McCabe, W.L., Smith, J.C. and Harriott, P., "Unit operations of Chemical Engineering", Seventh Edition, McGraw-Hill, 2004.
2. Coulson, J.M., and Richardson, J.F., "Coulson and Richardson's Chemical Engineering", Vol. I, 3rd Edition, Butterworth Heinemann Publishers, 2004.

REFERENCES:

1. Bansal, R.K., "Fluid Mechanics and Hydraulic machines", Laxmi Publications (P) Ltd., 1995.
2. Nevers, N.D., "Fluid Mechanics for Chemical Engineers", McGraw-Hill, 1991.
3. De Nevers, L., "Fluid Mechanics for Chemical Engineers", McGraw-Hill, 1994.

PY6304 MASS TRANSFER OPERATIONS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To provide the fundamentals of diffusion and the analogies of mass transfer, leading up to mass transfer coefficients and their use in solving the problems.
- To provide the basic concepts of mass transfer operations for separation processes.
- Apply this knowledge to design a mass transfer equipment

UNIT I DIFFUSION 9

Diffusion in fluids: Molecular and eddy diffusion measurement and calculation of diffusivities – Ordinary diffusion in multi component gaseous mixtures – Interphase mass transfer – Mass transfer coefficients – Theories of mass transfer.

UNIT II ABSORPTION 9

Gas absorption: Principles of absorption and desorption – Selection of solvents for absorption – Tray tower absorber – Absorption factor – Calculation of number of theoretical stages – Murphree efficiency – Point efficiency – Tray efficiency and overall tray efficiency – Calculation of actual number of trays – Packed tower absorber – Tower packing and characteristics – Calculation of NTU- HTU- HETP and height of absorption towers.

UNIT III DISTILLATION 9

Basic concepts of distillation: Vapour-liquid equilibrium – Pressure – Temperature – Concentration – Phase diagram – Isothermal and isobaric equilibrium – Relative volatility– Ideal solutions – Raoult's law – Deviations from ideality – Minimum and maximum boiling azeotropes – Different methods of distillation: flash steam – Vacuum – Molecular– Azeotropic – Extractive distillations – Continuous fractionation: multistage tower –Bubble cap – Sieve tray and valve tray towers – McCabe Thiele method.

UNIT IV LEACHING 9

Solid-liquid extraction – Description of leaching operations and technologies –Applications of leaching – Preparation of solid – Methods of operation and classification of equipment – Solid-liquid equilibrium in leaching – Multi stage cross current and counter current leaching – Calculation of composition and number of stages.

UNIT V DRYING 9

Drying – Principle and definitions – Estimation of drying rates – Drying rate curve –Critical and equilibrium moisture content – Calculation of drying time under constant drying conditions – Different types of dryers.

TOTAL : 45 PERIODS

OUTCOMES:

The student will be able to

- Calculate the rate of mass transfer and its coefficients.
- Design mass transfer equipment for separation process.

TEXT BOOKS:

1. McCabe, W.L., Smith, J.C. and Harriot. P., "Unit Operations of Chemical Engineering", 6th Edition, McGraw-Hill Book Co., 2001.
2. Treybal, R.E., "Mass Transfer Operations", 3rd Edition, McGraw-Hill Book Co., 1980.

REFERENCES:

1. Coulson, J.M. and Richardson, J.F., "Chemical Engineering", Vol. I, II and III,Pergamon Press, 1977.
2. Bennett, C.O. and Myers, J.E., "Momentum Heat and Mass Transfer", 3rdEdition, McGraw Hill Book Company, 1983.
3. Geankoplis, C.J., "Transport Processes and Unit Operations", 3rd Edition, Prentice Hall of India Pvt. Ltd, 2000.

PY6311 PHARMACEUTICAL CHEMISTRY LAB

L	T	P	C
0	0	4	2

OBJECTIVES:

- To provide practical knowledge on the preparation and quality control of fine chemicals and bulk drugs by physical, chemical and qualitative analysis.

LIST OF EXPERIMENTS

1. Limit test for chlorides, sulphates, iron in some pharmacopoeial compounds
2. Determination of physical constants – melting point, boiling point and viscosity
3. Preparation and identification tests of the following official (IP) compounds:
   a. Magnesium sulphate, Calcium Carbonate
4. Preparation and identification tests of the following official (IP) compounds:
   Ferrous Sulphate, Boric acid
5. Synthesis of compounds involving benzoylation, acetylation, bromination, reduction & oxidation:

   1. Picric acid
   2. Aniline
   3. Acetanilide
   4. Aspirin

TOTAL: 60 PERIODS

OUTCOMES:

- Able to understand the objective of their chemical experiments, properly carry out the experiments, and appropriately record and analyze the results.
- Able to perform chemical synthesis of organic compounds.
- Able to carry out quality control tests for fine chemicals and bulk drugs

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

1. Melting point apparatus
2. Analytical balance
3. Oswald Viscometer
4. Reflux condenser
5. Electric water bath
6. Heating mantle

TEXTS BOOKS:

1. I.L.Finar, “Organic chemistry” Volume 2, 5th edition, Pearson education pvt.Ltd.1975
2. Atherden, L.M. “Bentley and Driver’s Textbook of Pharmaceutical Chemistry”. Oxford University Press, 8th Edition, 1977.
3. A.I. Vogel, B.S. Furniss, A.J. Hannaford, P.W.G. Smith, and A.R. Tatchell, Vogels textbooks of practical organic chemistry,. 5th Ed., ELBS longman, 1994.
4. Morrison R.T., Boyd R.N., Organic Chemistry,Prentice- Hall of India, 6th ed., (1992)
5. A.H. Beckett and J.B. Stenlake, Practical Pharmaceutical Chemistry, Part II, 4th Edition. Continuum, 1988.

PY6312	MICROBIOLOGY LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES:

- To conduct experiments on microbial isolation and identification techniques, microbe quantification, antibiotic sensitivity assay and growth curve of microbes.

LIST OF EXPERIMENTS

1. Introduction, Laboratory Safety, Use of Equipment; Sterilization Techniques.
2. Culture Media-Types and Use.
3. Preparation of Nutrient broth and agar
4. CultureTechniques,IsolationandPreservationofCultures-Broth:flask,testtubes;Solid:
5. Pour plates, streak plates, spread plates, slants and stabs.
6. Microscopy – Working and care of Microscope
7. Microscopic Methods in the Study of Microorganisms; Staining Techniques-Simple, Differential- Gram's, flagellar Staining and endospore staining.
8. Biochemical test for identification of Microorganisms – TSI Agar test, VP-MR Test, Citrate Utilization Test, Gelatin Test and Motility Test in Agar Stab.
9. Quantification of Microbes: Sampling and Serial Dilution; Bacterial count in Soil –TVC in agar plates
10. Effect of Disinfectants- Phenol Coefficient
11. Antibiotic Sensitivity Assay
12. Growth Curve in Bacteria and Yeast
13. Effect of pH, Temperature, UV radiation on Growth Bacteria
14. Isolation of clinically important pathogens – Urine, Blood, Serum and Sputum

TOTAL: 60 PERIODS

OUTCOMES:

- Students can able to handle the pathogenic microorganism with proper aseptic procedure in and out of the laboratory setting.
- The student will be able to explain the roles of microbes in elemental cycles on earth and waste decontamination methods based on microbial activities and thus its application in commercial industry.
- Students can able to produce the primary and secondary metabolites through microbial fermentation techniques.

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

1. Hot air oven
2. Autoclave
3. Incubator
4. Laminar flow hood
5. Colony counter
6. Calorimeter
7. Antibiotic zone reader
8. Antibiotic zone reader scale
9. Microbial shaker incubator
10. Refrigerator
11. -20◦ deep freezer
12. Compound Microscope
13. Multipoint inoculator
14. Micro plate reader
15. Lyophilizer
16. Liquid nitrogen(Cryo preservation)
17. UV-visible spectrophotometer

TEXTS BOOKS:

1. Laboratory Manual in Microbiology, P.Gunasekaran, New Age International Publishers New Delhi, 1st Edition 1995, Reprint 2005
2. Microbiology-A Laboratory Manual , James G.Cappucino, Benjamin/Cummings Science Publishing, California, 5th Edition, 2004 .
3. Laboratory manual in general Microbiology, Gilter & ward, Wiley Publishers, New York, 2009

PY6401 UNIT OPERATIONS IN PHARMACEUTICAL INDUSTRY

L	T	P	C
3	1	0	4

OBJECTIVE:

To provide the basic fundamentals and various unit operations such as filtration, centrifugation, crystallization, refrigeration, air-conditioning and evaporation.

UNIT I MATERIALS OF PHARMACEUTICAL PLANT CONSTRUCTION 9

Overview of composition, corrosion, resistance, properties and applications of the materials of construction with special reference to stainless steel and glass, Industrial Hazards and Safety Precautions – Mechanical, Chemical, Electrical, Fire and Dust hazards, Industrial dermatitis, Accident records, etc.

UNIT II FILTRATION AND CENTRIFUGATION 9

Theory of filtration, filter aids, filter media, industrial filters including filter press, rotary press, rotary filter, edge filter, etc. Factors affecting filtration, mathematical problems on filtration, optimum-cleaning cycle in batch filters. Principles of centrifugation, industrial centrifugal filters and centrifugal sedimenters,

UNIT III CRYSTALLIZATION 9

Characters of crystals like purity, size, shape, geometry, habit, forms, size and factors affecting them. Solubility curves and calculation of yields. Material and heat balances around Swenson Walker crystalliser, Super saturation theory, its limitations, nucleation mechanism and crystal growth. Study of various types of crystallisers. Caking of crystals and its prevention and numerical problems on yields.

UNIT IV HUMIDITY CONTROL, REFRIGERATION AND AIR- CONDITIONING 9

Basic concepts, definition, wet bulb and adiabatic saturation temperatures, psychometric chart and measurement of humidity, application of humidity measurement in pharmacy. Equipments for dehumidification operations, principle and applications of refrigeration and air conditioning.

UNIT V EVAPORATION 9

Basic concepts of phase equilibrium, factors affecting evaporation, evaporators, film evaporators, single effect and multiple effect evaporators and Mathematical problems on evaporation.

TOTAL (L:45 + T:15) : 60 PERIODS

OUTCOMES:

The student will be able to

- Understand the various categories of materials used in pharmaceutical industry.
- Understand the fundamental concepts of filtration, centrifugation, crystallization, refrigeration and air-conditioning, apply their applications in pharmaceutical industry.

TEXT BOOKS:

1. McCabe WL, Smith J.C and Harriott "Unit operations of Chemical Engineering" McGraw Hill International Book Co. London 2004.
2. Girish K.Jani, "Pharmaceutical Engineering I, Unit Operation I" B.S.Shah Prakashan, India, 2006.

REFERENCES:

1. Badger, W.L and Banchero, J.T "Introduction to Chemical Engineering" Tata McGraw Hill, 2002
2. Ballaney, "Refrigeration and Air conditioning" Tata McGraw Hill, 2000
3. Coulson, J.M. and Richardson, J.F."Chemical Engineering" 3rd Edition, Butterworth Heineman Publication, 2001.

PY6402	HEAT TRANSFER	L	T	P	C
		3	0	0	3

OBJECTIVE:

To provide the knowledge of various modes of heat transfer, calculations and applications of the different modes to design of heat transfer equipments.

UNIT I FUNDAMENTAL CONCEPTS AND CONDUCTIVE HEAT TRANSFER 9

Modes of heat transfer – Fourier's law – Newton's law– Thermal conductance and resistance – Temperature field and temperature gradient – Heat transfer by conduction –General heat conduction equation – Thermal diffusivity and equivalent thermal conductivity – One dimensional steady state conduction through thick cylindrical shells Critical thickness of insulation for cylindrical surfaces.

UNIT II CONVECTIVE HEAT TRANSFER AND BOUNDARY LAYER THEORY 9

Heat transfer coefficient – Forced convection – Free convection – Dimensional analysis and empirical correlation – Physical significance of dimensionless groups – Concept of hydrodynamic and thermal boundary layers.

UNIT III THERMAL RADIATION 9

Thermal radiation – Spectrum of electromagnetic radiation – Monochromatic emissive power of black body – Planck's distribution law – Kirchoff's law – Total emissive power –Problems of Stefan Boltzmann law and Weins displacement law – Configuration factor determination – Typical examples.

UNIT IV DESIGN OF HEAT EXCHANGERS 9

Heat exchangers – Types and variation in design – Overall heat transfer coefficient –LMTD – Correction factors for multiple pass heat exchanger – Illustrative examples –Number of transfer units and effectiveness of heat exchangers.

UNIT V HEAT TRANSFER IN EVAPORATORS 9

Evaporation – Type of evaporators – Single and multiple effect operation – Capacity and economy of multiple effect evaporators – Effect of liquid head and boiling point elevation– Duhrings rule – Material and energy balance in evaporators – Illustrative examples.

TOTAL : 45 PERIODS

OUTCOMES:

The student will be able to

- Identify different types of heat exchange equipment and understand the Principles of heat flow in fluids.
- Understand the various modes of heat transfer and detailed calculations of conduction, steady state and unsteady state.
- Test performance and measure heat transfer parameters in designing heat transfer equipment.

TEXT BOOKS:

1. Nesati, O.M., “Heat Transfer: A Basic Approach”, McGraw-Hill, 1985.
2. McCabe, W.L., Smith, J.C. and Harriot, P., “Unit Operations in Chemical Engineering”, 7th Edition, McGraw Hill, 2005.

REFERENCES:

1. Donald, Q.K., “Process Heat Transfer”, 1st Edition, Tata McGraw Hill Publishing Co, 1997.
2. Mikheyev, M., “Fundamentals of Heat Transfer”, Mir Publishers, 1968

PY6403 CELL AND MOLECULAR BIOLOGY

L	T	P	C
3	0	0	3

OBJECTIVES:

- To provide the molecular processes of DNA replication, transcription and translation in cells.
- To provide the basic concepts of protein and nucleic acid structure and its function in both prokaryotic and eukaryotic organisms.

UNIT I CELL STRUCTURE AND FUNCTION OF THE ORGANELLES 9

Prokaryotic, Eukaryotic cells, Sub-cellular organelles and functions. Purification of cell organelles, Principles of membrane organization of proteins, cytoskeleton proteins. Extra cellular matrix, cell-cell junctions, various types of transport across cell membrane.

UNIT II CELL DIVISION, CANCER, APOPTOSIS AND IMMORTALIZATION OF CELLS 9

Cell cycle – Mitosis, Meiosis, Molecules controlling cell cycle, cancer, role of Ras and Raf in oncogenesis and apoptosis. Stem cells, immortalization of cells and its applications.

UNIT III CHEMISTRY OF NUCLEIC ACIDS & DNA REPLICATION 12

Introduction to nucleic acids: Nucleic acids as genetic material, Structure and physicochemical properties of elements in DNA and RNA, Biological significance of differences in DNA and RNA. Structure of DNA: Primary, Secondary, Tertiary, DNA supercoiling; Overview of Central dogma; Organization of prokaryotic and eukaryotic chromosomes; DNA replication: Proteomics, Fidelity, Inhibitors and Overview of differences in prokaryotic and eukaryotic DNA replication; Telomere replication in eukaryotes.

UNIT IV TRANSCRIPTION & TRANSLATION 9

Structure and function of mRNA, rRNA and tRNA. Characteristics of promoter and enhancer sequences. RNA synthesis: Proteomics, Fidelity, Inhibitors of transcription, Differences in prokaryotic and eukaryotic transcription. Basic concepts in RNA world: Ribozymes, RNA processing: 5’- Capping, Splicing-Alternative splicing, Poly ‘A’ tail addition and base modification**.** Introduction to Genetic code: Elucidation of genetic code, Codon degeneracy, Wobble hypothesis and its importance, Prokaryotic and eukaryotic ribosomes. Steps in translation: Initiation, Elongation and termination of protein synthesis. Inhibitors of protein synthesis. Post- translational modifications and its importance.

UNIT V MUTAGENESIS, MUTATION AND MUTANTS 6

Biochemical basis of mutants, Mutagenesis-Base analogue mutagens, Chemical mutagens, Mutagenesis by intercalating substances, Site specific mutagenesis,Restriction Polymorphism to detect mutant sites in humans

TOTAL : 45 PERIODS

OUTCOMES:

The student will be able to

- Understand the various levels of gene regulation and protein function including signal transduction and cell cycle control.
- Interpret the outcome of experiments that involve the use of recombinant DNA technology and other common gene analysis techniques.
- Relate properties of cancerous cells to mutational changes in gene function.

TEXT BOOKS:

1. Friefelder, David, “Molecular Biology”, 2nd Edition, Narosa Publishing House, 1999.
2. Lewin Benjamin, “Genes IX” Jones and Bartlett, 2008.
3. Weaver, R.F. “Molecular Biology”, 3rd Edition, McGraw Hill, 2005.

REFERENCES:

1. Waston, J.D. “Molecular Biology of the Gene”, 5th Edition, Pearson Education, 2004.
2. Karp, Gerald. “Cell and Molecular Biology: Concepts and Experiments.”2nd Edition, John Wiley & Sons, 1999.
3. Lodish, Harvey etal., “ Molecular Cell Biology,” 6th Edition. W.H.Freeman, 2008.

PY6404	PHYSICAL PHARMACEUTICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To provide the fundamentals such as power characters and rheology.
- To provide the knowledge about the stability.

UNIT I MICROMERITICS AND POWDER RHEOLOGY 10

Particle size and distribution, average particle size, number and weight distribution, particle number, methods for determining particle volume, optical microscopy, sieving, sedimentation, measurement of particle shape, specific surface, methods for determining surface area, permeability, adsorption, derived properties of powders, porosity, packing arrangement, densities, bulkiness and flow properties.

UNIT II SURFACE, INTERFACIAL PHENOMENON, VISCOSITY AND RHEOLOGY 10

Liquid interface, surface and interfacial tension, surface free energy, measurement of surface and interfacial tensions, free energy, spreading coefficient, adsorption at liquid interfaces, surface active agents, HLB classification, solubilization, detergency, adsorption at solid interface, solid gas and solid-liquid interface, complex films, electrical properties of interface. Newtonian system, 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.

UNIT III DISPERSION SYSTEMS 10

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, 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.

UNIT IV DIFFUSION & DISSOLUTION 5

Definitions, Steady state diffusion, Procedures and apparatus, Dissolution, Drug release. Complexation and protein binding Metal complexes, organic molecular complexes, inclusion compounds, methods of analysis, protein binding, complexation and drug action, crystalline structures of complexes and thermodynamic treatment of stability constants.

UNIT V KINETICS AND DRUG STABILITY 10

General considerations and concepts, half-life determination, Influence of temperature, light, catalytic species, solvent and other factors, Accelerated stability study, expiration dating.

TOTAL: 45 PERIODS

OUTCOMES:

The student will be able to

- Deal the manufacturing problems in pharmaceutical formulations.
- Acquire the knowledge of drug stability and expiry date determination

TEXT BOOKS:

1. Sinko, Patrick J. "Martin's Physical Pharmacy and Pharmaceutical Sciences"5th edition, Wolters, Kluwer/ Lippincott Williams & Wilkins Publishing, 2006
2. Manavalan, R. and C. Ramasamy. "Physical Pharmaceutics" Vignesh Publishers, 2nd Ed., 2011.

REFERENCES:

1. Martin's Physical Pharmacy and Pharmaceutical Sciences, Fifth edition, Patrick J. Sinko (ED), Lippincott Williams & Wilkins 2006.
2. Laura Moore Fox, Remington: The science and practice of pharmacy, 21st Edition, Lippincott Williams and Wilkins, 2005
3. Monihan, Humphery and Abina Gean "The Physicochemical Basis of Pharmaceuticals" Oxford University Press, 2009.

PY6405	ENGINEERING THERMODYNAMICS	L	T	P	C
		3	0	0	3

OBJECTIVE:

To provide the knowledge on fundamentals of thermodynamics and the operation design of various thermodynamics systems.

UNIT I FUNDAMENTAL CONCEPTS AND FIRST LAW OF THERMODYNAMICS 9

Scope of thermodynamics – Basic concepts – Thermodynamic system – State and equilibrium – Process and cycles – Temperature and zeroth law of thermodynamics – Properties of pure substances – First law of thermodynamics – First law analysis of closed systems and control volumes and its application.

UNIT II ENTROPY AND THE SECOND LAW OF THERMODYNAMICS 9

The Clausius inequality – Entropy – Causes of entropy change – Entropy change of puresubstances – Thermal energy reservoirs – Heat engines – Perpetual motion machines – Reversible and irreversible processes – The Carnot cycle and principles – The CarnotHeat engine – The second law efficiency – Second law analysis of open and closedsystems.

UNIT III REFRIGERATION, VAPOR AND COMBINED POWER CYCLES 9

Refrigerators and Heat pumps – The Carnot refrigerator and heat pumps – The reversed Carnot cycle – Ideal and Actual vapor compression Refrigeration cycle – Selection of right refrigerants – Heat pumps – Absorption refrigerator system – The Carnot vapor cycle – Rankine cycle – Cogeneration – Second law analysis of vapor power cycles.

UNIT IV PVT RELATIONS AND THERMODYNAMIC RELATIONS 9

PVT relations for gases and liquids – Equations of state – Cubic equations of state – Thermodynamic properties from equations of state – Compressibility factor –Generalized properties of fluids – Law of corresponding state – Acentric factor – gasmixtures.Thermodynamic relations – Maxwell's relations – Estimation of thermodynamicproperties– Thermodynamic properties of homogeneous mixtures – Partial

molarproperties, Fugacity and fugacity coefficients – Lewis and Randall rule – Propertychanges of mixing, activity – Excess properties, activity coefficients.

UNIT V PHASE EQUILIBRIA AND CHEMICAL REACTION EQUILIBRIA 9

Phase equilibria – Pure component and mixtures – Van Laar, Margules equation –Group contribution method – Gibb's Duhem equation – Consistency tests – Partiallymiscible and immiscible systems – Azeotropes – Retrograde condensation –Thermodynamic diagrams.Chemical equilibria – Heat effects – industrial reactions – Free energy calculations –Homogeneous and heterogeneous reactions – Equilibrium composition.

TOTAL: 45 PERIODS

OUTCOMES:

The student will be able to

- Demonstrate the knowledge on various laws of thermodynamics and its concepts to assess the feasibility in thermodynamic process.
- Analyze and solve problems in thermodynamic systems
- Select appropriate thermodynamic processes and solutions to meet the specified needs.

TEXT BOOKS:

1. Smith, J.M. and Van Ness, "Introduction to Engineering Thermodynamics", 5th Edition, McGraw Hill, 1996.
2. Narayanan, K.V., "A Text Book of Chemical Engineering Thermodynamics", Prentice Hall of India, 2002.

REFERENCES:

1. Hougen and Watson, "Chemical Process Principles" Vol. II, CBS Publishers, 2002.
2. Kyle, "Chemical and Process Thermodynamics", 2nd Edition, Prentice Hall of India, 2000.
3. Rao,Y.V.C., "Chemical Engineering Thermodynamics", Universities Press, 1997.

PY6406 PHARMACOLOGY

L	T	P	C
3	0	0	3

OBJECTIVES:

- To provide the general pharmacological principles.
- To make understand the pharmacology of different types of drugs acting on various physiological systems.

UNIT I GENERAL PHARMACOLOGY 9

Routes of administration, Pharmacokinetics, Pharmacodynamics, Receptors, Mechanism of action of drugs, Factors modifying drug action, adverse drug reaction, drug interactions, Bioassay of drugs, drug discovery and development.

UNIT II PERIPHERAL AND CENTRAL NERVOUS SYSTEM 12

Mechanism of action, Pharmacology of parasympathomimetics, parasympatholytics, sympathomimetics, sympatholytics, neuromuscular blocking agent, general anaesthetics, antipsychotics, antidepressants, antiepileptic, analgesics, antipyretic, anti-inflammatory (NSAIDS), CNS stimulants.

UNIT III CARDIOVASCULAR PHARMACOLOGY 9

Classification, Mechanism of action, Pharmacology of cardiac glycosides, anti anginal, antihypertensive agents, vasodilators including calcium channel blockers, anti arrhythmic and anti hyperlipidemic agents.

UNIT IV ANTIMICROBIAL PHARMACOLOGY 10

General principles of chemotherapy, sulphonamides, antibiotics– penicillins, cephalosporins, chloramphenicol, macrolides, fluroquinolones. Chemotherapy of tuberculosis, leprosy, fungal, viral diseases, malignancy and immunosuppressive agents.

UNIT V GASTROINTESTINAL PHARMACOLOGY 5

Classification, Mechanism of action, Antacids, anti ulcer drugs, laxatives and anti diarrhoeal, emetics and antiemetics.

TOTAL: 45 PERIODS

OUTCOMES:

The student will be able to

- Understand the various principles of general pharmacology.
- Understand the pharmacology and mechanism of action of various categories of drugs such as nervous, cardiovascular, gastrointestinal and antimicrobial agents.

TEXT BOOKS:

1. Satoskar, R.S., Bhandarkar, S.D. and Rege, N.N., "Pharmacology and Pharmacotherapeutics", Popular Prakashan (P) Ltd., 2006.
2. Tripathi, K.D., "Essentials of Medical Pharmacology", 4th Edition, Jaypee BrothersMedical Publishers (P) Ltd, 1999.

REFERENCES:

1. Hardman, J.G. and Limbird, L.E., "Goodman and Gilman's: The Pharmacological Basis of Therapeutics" 10th Edition, Medical Publishing Division, 2001.
2. Das, M.M., "Pharmacology for Second Professional Students" 5th Edition, Books and Allied (P) Ltd, 2004.
3 . Katzung BG. Basic and clinical Pharmacology, Prentice Hall International.

PY6411 FLUID FLOW OPERATIONS AND HEAT TRANSFER LABORATORY

L	T	P	C
0	0	4	2

OBJECTIVE:

To gain the practical knowledge on fluid flow operations and Heat Transfer

LIST OF EXPERIMENTS

1. To relate Reynolds Number and Friction factor.
2. Experiment on Orifice meter.
3. Experiment on Venturi meter.
4. To evaluate the performance of centrifugal pump.
5. To characterize the behavior of Fluidized bed.
6. Performance of packed bed (Gas- Liquid).
7. To determine the conduction parameters using composite wall.
8. To determine individual heat transfer film coefficient in forced convection.
9. To determine condensing heat transfer coefficient in vertical condenser.
10. To determine overall heat transfer coefficient of double pipe heat exchanger by parallel flow.
11. To determine overall heat transfer coefficient of double pipe heat exchanger by counter flow.
12. To determine overall heat transfer coefficient of shell and tube heat exchanger.
13. To determine overall heat transfer coefficient of plate type heat exchanger by parallel flow.

TOTAL: 60 PERIODS

OUTCOMES:

The student will demonstrate ability to

- Select and operate the suitable instruments for the measurement of flow rate and rate of heat exchange.
- Differentiate laminar and turbulent flows
- Calculate and analyse the performance of various pumps and heat exchangers.

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

1. Venturimeter
2. Orifice meter
3. Packed bed
4. Turbulent flow
5. Rectangular notch
6. Triangular notch
7. Drag on sphere
8. Centrifugal pump
9. Laminar flow

TEXT BOOKS:

1. McCabe, W.L., Smith, J.C. and Harriott, P., "Unit operations of Chemical Engineering", Seventh Edition, McGraw-Hill, 2004.
2. Coulson, J.M., and Richardson, J.F., "Coulson and Richardson's Chemical Engineering", Vol. I, 3rd Edition, Butterworth Heinemann Publishers, 2004.
3. McCabe, W.L., Smith, J.C. and Harriot. P., "Unit Operations of Chemical Engineering", 6th Edition, McGraw-Hill Book Co., 2001.

REFERENCES:

1. Bansal, R.K., "Fluid Mechanics and Hydraulic machines", Laxmi Publications (P) Ltd., 1995.
2. Nevers, N.D., "Fluid Mechanics for Chemical Engineers", McGraw-Hill, 1991.
3. De Nevers, L., "Fluid Mechanics for Chemical Engineers", McGraw-Hill, 1994.
4. Coulson, J.M. and Richardson, J.F., "Chemical Engineering", Vol. I, II and III,Pergamon Press, 1977.
5. Bennett, C.O. and Myers, J.E., "Momentum Heat and Mass Transfer", 3rdEdition, McGraw Hill Book Company, 1983.
6. Geankoplis, C.J., "Transport Processes and Unit Operations", 3rd Edition,Prentice Hall of India Pvt. Ltd, 2000.

PY6412 PHYSICAL PHARMACEUTICS LABORATORY L T P C
0 0 4 2

OBJECTIVES:

- To practice the determination of fundamental properties of dosage forms.
- To study the kinetics and stability aspects of preparations.

LIST OF EXPERIMENTS

1) Determination of latent heat, vapor pressure, critical point.
2) Studies on polymorphs, their identification and properties.
3) Determination of particle size, particle size distribution and surface area using various methods of particle size analysis.
4) Determination of derived properties of powders like density, porosity, compressibility, angle of repose, etc.
5) Determination of surface/interfacial tension, HLB value and critical micellar concentration (CMC) of surfactants.
6) Study of rheological properties of various types of systems using different viscometers.
7) Study of different types of colloids and their properties.

8) Preparation of various types of suspensions and determination of their sedimentation parameters.
9) Preparation and stability studies of emulsions.
10) Studies on different types of complexes and determination of their stability constants.
11) Determination of half-life, rate constant and order of reaction.
12) Preparation of pharmaceutical buffers and determination of buffer capacity.
13) Experiments involving tonicity adjustments.

TOTAL: 60 PERIODS

OUTCOMES:

On completion of the course the students able to

- Characterize and evaluate the properties of powders by using suitable methods.
- Plan and carryout the stability studies and determine the stability of various dosage forms.
- Calculate the rate constants and determine the various order of reactions involved in the pharmaceutical systems and process.

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

- Optical Microscope
- Sieve shaker and sieve set
- Andreasen pippette
- Stalagmometer
- Ostwald's viscometer, Brookfield viscometer
- Stability chamber
- Specific gravity bottle
- Bulk density apparatus

TEXT BOOKS:

1. CVS Subrahmanyam, SG Vasantharaju, Laboratory Manual of Physical Pharmacy, 2 Ed., Vallabh Publications / Prakashan, 2009
2. Manavalan, R. and C. Ramasamy. "Physical Pharmaceutics" Vignesh Publishers, 2nd Ed., 2011.

REFERENCES:

1. Eugene L. Parrott, Witold Saski , Experimental Pharmaceutics, 4 ed, Burgess Pub. Co., 1977
2. Stocklosam J. Pharmaceutical calculation, Lea & Febiger, Philadelphia.
3. Liberman H.A., RiEgor M.M, & Banker GS. Pharmaceutical dosage forms – Disperse systems,Vol.1, 2 and 3, 2nd ed.,Marcel Dekker Inc, Newyork, 1996.

PY6501 BIOCHEMICAL ENGINEERING

L	T	P	C
3	0	0	3

OBJECTIVES:

- To provide the knowledge on fundamentals of Enzyme kinetics, Inhibition kinetics and Immobilization.
- To provide the concept of basic fermentation processes and its control systems during scale up operations.

UNIT I INTRODUCTION TO ENZYMES 9

Classification of enzymes. Mechanisms of enzyme action; Principles of catalysis – collision theory, transition state theory; role of entropy in catalysis. Enzyme Kinetics- Single substrate reactions; Estimation of Michaelis – Menten parameters, Multi substrate reactions - Enzyme Immobilization and kinetics.

UNIT II STERILIZATION KINETICS 9

Thermal death kinetics of microorganisms, batch and continuous heat sterilization of liquid media, filter sterilization of liquid media, air sterilization and design of sterilization equipment - batch and continuous.

UNIT III METABOLIC STOICHIOMETRY AND ENERGETICS 9

Stoichiometry of cell growth and product formation, elemental balances, degrees of reduction of substrate and biomass, available electron balances, yield coefficients of biomass and product formation, maintenance coefficients, energetic analysis of microbial growth and product formation, oxygen consumption and heat evolution in aerobic cultures, thermodynamic efficiency of growth.

UNITIV KINETICS OF MICROBIAL GROWTH AND PRODUCT FORMATION UNSTRUCTURED KINETIC MODELS 9

Modes of operation - batch, fed batch and continuous cultivation. Simple unstructured kinetic models for microbial growth, Monod model, growth of filamentous organisms. Types of reactor- Air Lift Reactor, Bubble Column Reactor, Immobilized enzyme reactors- packed bed, fluidized bed, membrane reactors.

UNIT V BIOREACTOR SCALE – UP 9

Regime analysis of bioreactor processes, oxygen mass transfer in bioreactors – Mass transfer Coefficient- methods for the determination of mass transfer coefficients; mass transfer correlations. Power requirements of Bioreactors. Scale-up considerations on heat transfer oxygen transfer, power consumption and impeller tip speed.

TOTAL: 45 PERIODS

OUTCOMES:

The student will be able to

- Understand the fundamentals of Enzyme kinetics, Inhibition kinetics and Immobilization
- Understand the concept of basic fermentation processes and its application during scale up operations.

TEXT BOOKS:

1. Shuler, M.L. and Kargi, F. “Bioprocess Engineering: Basic Concepts”, 2nd Edition, PHI, 2002.
2. Bailey, J.E. and Ollis, D.F. “Biochemical Engineering Fundamentals” 2nd Edition, McGraw – Hill, 1988.

REFERENCES:

1. Wiseman, Alan “Handbook of Enzyme Biotechnology”, 3rd Edition, Ellis Harwood Publications, 1999.
2. Moser, Anton. “Bioprocess Technology : Kinetics and Reactors”, Springer – Verlag, 1st Edition, 1988.
3. Stanbury, P.F. et al. “Principles of Fermentation Technology”, Butterworth – Heinemann/Elsevier, 2nd Edition, 1995.

PY6502 ANALYTICAL METHODS OF PHARMACEUTICALS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To provide the concept of pharmacopoeia monograph.
- To provide the fundamental and principles of various analytical instruments and its technique used in pharmaceutical industry.

UNIT I PHYSICAL METHODS 9

Pharmaceutical Analysis- Qualitative and quantitative analysis – Significance- Pharmacopoeia, Physical methods: Melting point- boiling point - refractive index - optical rotation-density- specific gravity-gravimetry-thermogravimetry - uses, limitations, advantages, and method of determination for each method.

UNIT II TITRATIONS 9

Acid base theory- Arrhenius, Bronsted-Lowry, Lewis acid- acid- base indicators, theory of, effective range and choice of, titration curves for acid-base titration, mixed solvents, non-aqueous titration, pharmacopoeial applications . Precipitation titration, Argentimetric titrations, Mohr's method, Vollhard's method, examples in pharmacopoeia, complexometric tritration, redox titrations, half reactions and half equations, redox equivalent weights, reduction potential, significance of reduction potential, standard reduction potentials, iodimetry, iodometry, iodine displacement reactions.

UNIT III ULTRAVIOLET SPECTROSCOPY 9

Theory of atomic and molecular spectra, Electronic transitions, Beer and Lambert's law, Derivation and deviations, Chromophores, Auxochromes, Spectral shifts, Solvent effect on absorption spectra.Instrumentation - Sources of radiation, wavelength selectors, sample cells, Detectors- Barrier layer cell, Photo tube, Photomultiplier tube, photodiode.Applications.

UNIT IV INFRARED AND NMR SPECTROSCOPY 9

Principles of vibrational spectroscopy – Instrumentation and sampling technique – Applications in pharmaceutical sciences – NMR principles – Instrumentation – Applications.

UNIT V CHROMATOGRAPHY 9

Thin Layer Chromatography Adsorbents, solvents, elutropic series, uses, limit test for impurities using TLC- known impurity, unknown impurity, HPLC High Performance Liquid Chromatography, technique, advantages, basic HPLC, Columns, Detectors, Qualitative analysis and Quantitative Analysis, Packing materials, Solvents, retention factor, symmetry factor, resolution, theoretical plate.

TOTAL: 45 PERIODS

OUTCOMES:

The student will be able to

- Understand the various techniques in the field of Pharmaceutical Analysis.
- Choose proper analytical method for qualitative and quantification of the pharmaceutical substances.

TEXT BOOKS:

1. Atherden, L.M. "Bentley and Driver's Textbook of Pharmaceutical Chemistry". Oxford University Press, 8th Edition, 1977.
2. Siddiqui, Anees A. "Pharmaceutical Analysis". Vol.I & II, CBS, 2006.

REFERENCES:

1. Kenneth A. Connors, "Text book of Pharmaceutical Analysis", 3rd Edition, John wiley and sons, Newyork.1982.
2. Ohannesian, Lena and Streeter, A.J. "Handbook of Pharmaceutical Analysis". Marcel Dekker, 2002.
3. Stahl, Egon "Thin – Layer Chromatography: A Laboratory Handbook". Springer, 2nd Edition, 2005.

PY6503	REGULATORY REQUIREMENTS IN PHARMACEUTICAL INDUSTRIES	L	T	P	C
		3	0	0	3

OBJECTIVE:

To provide the concept of the pharmaceutical industrial manufacturing practices, quality attributes of pharmacy products and patenting activities.

UNIT I REGULATORY CONCEPTS 9

Quality assurance – Quality control – Practice of cGMP – Schedule M – USFDA.

UNIT II REGULATORY ASPECTS 9

Pharmaceuticals – Bulk drug manufacture – Biotechnology derived products.

UNIT III INTELLECTUAL PROPERTY RIGHTS 9

Patent system – Different types of patents – Filing process of application for patent – infringement of patents – The patent rules 2003 as amended by the patents (amendment) rule 2006.

UNIT IV ICH GUIDELINES 9

Quality guidelines – Impurities in new drug substances (Q3A R) – Impurities in new drug products – Validation of analytical procedures text and methodology (Q2 R1).

UNIT V QUALITY AUDIT AND SELF INSPECTIONS 9

SOPs – Documentation – Loan license auditing – Common technical documentation (CTD) – Drug master file (DMF)**.**

TOTAL: 45 PERIODS

OUTCOMES:

The student will

- Familiarise with the pharmaceutical industrial manufacturing practices, quality attributes of pharmacy products, patenting activities, etc.,
- Uderstand the various quality guidelines of pharmaceutical products, patenting activities and the significance of its documentation.

TEXT BOOKS:

1. Robert, I.R., Nash, R.A., Wachter, A.H. and Swarbrick, J., “Pharmaceutical Process Validation”, 3rd Edition, Maarcel Dekker Inc., 2003.
2. Willig, H., Tuckeman, M.M. and Hitchings, W.S., “Good Manufacturing Practices for Pharmaceuticals”, 5th Edition, Marcel Dekker Inc., 2000.

REFERENCES:

1. Subbaram, N.R., “What Everyone Should Know About Patents”, 2nd Edition,Pharma Book Syndicate, 2005.
2. Banker, G.S. and Rhodes, C.T., “Modern Pharmaceutics”, 4th Edition, Marcel Dekker Inc., 2002.
3. Narendra kumar jain, Pharmaceutical Product Development, CBS Publishers & Distributors, 2006.

PY6504 **MEDICINAL CHEMISTRY** **L T P C**
3 1 0 4

OBJECTIVE:
To provide the basic knowledge such as physicochemical properties, classification, structure activity relationship and mechanism of action of various medicinal agents.

UNIT I PRINCIPLES OF MEDICINAL CHEMISTRY 9
Physicochemical properties in relation to biological action – Ionization, Drug distribution and pKa values, hydrogen bonding, protein binding, chelation, optical and geometrical isomerism, steric effect, redox potential and surface activity. Prodrugs –concepts/application of prodrug design.

UNIT II MEDICINAL CHEMISTRY OF DRUGS ACTING ON ANS AND CNS 9
Classification, biochemical/molecular basis of mechanism of action, structure activity relationship including stereo chemical aspects, physiochemical properties and synthesis of selected drugs belonging to the class of sympathomimetic agents. adrenergic antagonists, Antipsychotics, Anticonvulsants, Analgesics.

UNIT III MEDICINAL CHEMISTRY OF ANTI-INFECTIVE AGENTS 9
Structural basis of mechanism of action, structure activity relationship including stereo chemical aspects, physiochemical properties, and synthesis of selected drugs belonging to the class of sulphonamides, penicillins and cephalosporins, aminoglycosides and tetracyclines.

UNIT IV MEDICINAL CHEMISTRY OF DRUGS ACTING ON CVS 9
Structural basis of mechanism of action, structure activity relationship including stereo chemical aspects, physiochemical properties, and synthesis of selected drugs belonging to the class of anti-anginal, vasodilators, calcium channel blockers and cardiac glycosides.

UNIT V MEDICINAL CHEMISTRY OF ANTIHISTAMINIC AGENTS AND EICOSANOIDS 9
Classification, structure basis of mechanism of action, structure activity relationship including drugs acting on Histamine receptors, eicosanoids biosynthesis, drug action mediated by eicosanoids, design of eicosanoid drugs, antipyretics, anti-rheumatoid drugs and non-steroidal anti-inflammatory drugs.

TOTAL (L:45 + T:15) : 60 PERIODS

OUTCOMES:
The student will be able to
- Understand the molecular basis, biochemical, physiochemical properties and synthesis of medicinal agents.
- Understand the mechanism of action, structure activity relationship including stereo chemical aspects of the medicinal agents acting on various physiological systems.

TEXT BOOKS:

1. Ashutosh Kar, Medicinal Chemistry, New Age International (P) Ltd., Publishers, New Delhi, 2005.
2. GrahamL.Patrick An introduction to Medicinal Chemistry 5th edition , Oxford University Press.2013.

REFERENCES:

1. Berger, A. Burger's medicinal chemistry and Drug Discovery, Vol I to IV. 5thedition John Wiley and Sons,. (1991)
2. Foye W O, ed. Principles of Medicinal Chemistry, 2nd Ed. Philadelphia: Lea & Febiger, 1981.
3. Indian Pharmacopoeia, Vol 1&2, Indian Pharmacopoeia Commission 2010.

BT6561 **BIOPROCESS LABORATORY** **L T P C**
0 0 4 2

OBJECTIVES:

- To provide the concept of design and procedures to evaluate the performance of the bioreactor in bioprocess.
- To provide the basic concepts of an enzyme immobilized processes in bioprocess.

LIST OF EXPERIMENTS

1. Growth of bacteria – estimation of biomass, calculation of specific growth rate, yield coefficient
2. Medium optimization – Plackett Burman design, response surface methodology
3. Enzyme kinetics – Michelis Menton parameter, effect of temperature and pH
4. Enzyme immobilization – Gel entrapment,Cross linking
5. Preparation of bioreactor, Utilities for bioreactor operation
6. Thermal death kinetics
7. Batch sterilization design
8. Batch cultivation, Estimation of KLa – Dynamic gassing method, Exhaust gas analysis – Carbon balancing, Gas balancing
9. Fed batch cultivation, exhaust gas analysis – carbon balancing, gas balancing
10. Estimation of KLa – sulphite oxidation method
11. Estimation of overall heat transfer coefficient

TOTAL : 60 PERIODS

OUTCOMES:

The student will be able to apply the knowledge of biocatalysis in scaling up the commercial processes using bioreactors.

- The student will also be able to produce, analyze and interpret data from bioprocesses.

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

- Bio reactor (Fermentor)-lab scale
- Microbial shaker incubator
- Cooling centrifuge
- Refrigerator
- Incubator

REFERENCES:

1. Bailey, J.E. and Ollis, D.F. “Biochemical Engineering Fundamentals” 2nd Edition, McGraw – Hill, 1988.
2. Lee, James M. “Biochemical Engineering”, PHI, U.S.A.Stanbury, P.F. etal.
3. “Principles of Fermentation Technology”, 2nd Edition, Butterworth – Heinemann / Elsevier, 1995.
4. El-Mansi, E.M.T. etal., “Fermentation Microbiology and Biotechnology”, 2nd Edition,CRC / Taylor & Francis, 2007.
5. Peppler, H.J. and D. Perlman “ Microbial Technology” (vol. I Microbial Processes and Vol. I Fermentation Technology)” 2nd Edition, Academic Press / Elsevier, 2004.

BT6562	ANALYTICAL METHODS OF PHARMACEUTICALS LABORATORY	L T P C 0 0 4 2

OBJECTIVES:

To carry out analytical experiments related to titrimetric, chromatographic and spectrophotometric techniques.

LIST OF EXPERIMENTS

1. Standardization of analytical weights and calibration of volumetric apparatus.
2. Acid Base Titrations ; Preparation and standardization of acids and bases, some exercise related with determination of acids and bases separately in mixture form, some official assay procedure 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, titanous chloride, sodium 2,6,-di chlorophenol indophenol, ceric ammonium sulphate be designed.
4. Precipitation Titrations ; Preparation and standardization of titrants like silver nitrate and ammonium thiocyanate, titrations according to Mohrs Volhards and Fajans methods.
5. Gravimetric Analysis : Preparation of Gooch crucible for filtration and use of sintered glass crucible, determination of water of hydration, some exercises related to gravimetric analysis should be covered.
6. Non-aqueous Titrations ; Preparation and standardization of perchloric acid and sodium/ potassium/lithium methoxides solutions, Estimations of some pharmacopoeial products.
7. Complexometric titrations ; Preparations and standardization of EDTA solution, some exercises related to pharmacopoeial assays by complexometric titrations.
8. Separation & identification of amino acids by paper chromatography
9. Separation & identification of alkaloids by TLC
10. UV spectrometric determination of Ibuprofen

TOTAL : 60 PERIODS

OUTCOMES:

Student will be able to perform

- Preparation and standardization of various assay reagents with respect to chemical and drug analysis
- Separation and quantification of chemicals, drugs and metabolites by chromatographic and spectral techniques.

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

1. UV spectrophotometer
2. Hot air oven
3. Digital weighing balance
4. Digital pH meter

REFERENCES:

1. Atherden, L.M. “Bentley and Driver’s Textbook of Pharmaceutical Chemistry”. 8th Edition, Oxford University Press, 1977.
2. Siddiqui, Anees A. “Pharmaceutical Analysis”. Vol.I & II, CBS, 2006.
3. Higuchi, Tekeru and Brochmann, Einar “Pharmaceutical Analysis”. CBS Publishers, 1997.
4. Gennaro, Alfonso R. “Remington : The Science and Practice of Pharmacy” Vol. I & II,20th Edition, Lippincott Williams & Wilkins / B.I. Publication, 2000.
5. Kenneth A. Connors, “Text book of Pharmaceutical Analysis”, 3rd Edition, John wiley and sons, Newyork.1982.

GE6757 **TOTAL QUALITY MANAGEMENT** **L T P C**
3 0 0 3

OBJECTIVE:

- To facilitate the understanding of Quality Management principles and process.

UNIT I INTRODUCTION 9

Introduction - Need for quality - Evolution of quality - Definitions of quality - Dimensions of product and service quality - Basic concepts of TQM - TQM Framework - Contributions of Deming, Juran and Crosby - Barriers to TQM - Quality statements - Customer focus - Customer orientation, Customer satisfaction, Customer complaints, Customer retention - Costs of quality.

UNIT II TQM PRINCIPLES 9

Leadership - Strategic quality planning, Quality Councils - Employee involvement - Motivation, Empowerment, Team and Teamwork, Quality circles Recognition and Reward, Performance appraisal - Continuous process improvement - PDCA cycle, 5S, Kaizen - Supplier partnership - Partnering, Supplier selection, Supplier Rating.

UNIT III TQM TOOLS AND TECHNIQUES I 9

The seven traditional tools of quality - New management tools - Six sigma: Concepts, Methodology, applications to manufacturing, service sector including IT - Bench marking - Reason to bench mark, Bench marking process - FMEA - Stages, Types.

UNIT IV TQM TOOLS AND TECHNIQUES II 9

Control Charts - Process Capability - Concepts of Six Sigma - Quality Function Development (QFD) - Taguchi quality loss function - TPM - Concepts, improvement needs - Performance measures.

UNIT V QUALITY SYSTEMS 9

Need for ISO 9000 - ISO 9001-2008 Quality System - Elements, Documentation, Quality Auditing - QS 9000 - ISO 14000 - Concepts, Requirements and Benefits - TQM Implementation in manufacturing and service sectors..

TOTAL: 45 PERIODS

OUTCOME :

- The student would be able to apply the tools and techniques of quality management to manufacturing and services processes.

TEXTBOOK:

1. Dale H. Besterfiled, et at., "Total quality Management", Pearson Education Asia, Third Edition, Indian Reprint (2006).

REFERENCES:

1. James R. Evans and William M. Lindsay, "The Management and Control of Quality", 8th Edition, First Indian Edition, Cengage Learning, 2012.
2. Suganthi.L and Anand Samuel, "Total Quality Management", Prentice Hall (India) Pvt. Ltd., 2006.
3. Janakiraman. B and Gopal .R.K., "Total Quality Management - Text and Cases", Prentice Hall (India) Pvt. Ltd., 2006.

PY6601 PHARMACEUTICAL DOSAGE FORMS

L	T	P	C
3	1	0	4

OBJECTIVE:

To provide the concepts of various parameters involved in the formulation and development of various dosage forms.

UNIT I PREFORMULATION STUDIES AND MONOPHASIC LIQUID DOSAGE FORMS 9

Physical/physicochemical properties of drugs - physical form, particle size, shape, density, wetting, dielectric constant, solubility, polymorphism, dissolution, organoleptic properties and their effect on formulation, stability and bioavailabilty. Dissolution process – Solubility and Physical characters of liquid dosage forms – Liquid formulations for internal use – external use.

UNIT II BIPHASIC SYSTEMS AND SEMI SOLID DOSAGE FORMS 9

Emulsions – formulation of emulsions – stability – evaluation of emulsions – Suspensions – Formulations – problems in suspension – evaluation of suspensions – Suppositoreis – Suppository bases – formulation and packaging – formulation problems – processing of suppositories – drug availabilities from suppositories – evaluation of suppositories – Ointments – skin structure and drug absorption – ointment bases – additives – special type of ointments – processing and evaluation of ointments. Creams- formulation and evaluation

UNIT III SOLID DOSAGE FORMS 9

Types of tablets - Tabletting equipments – Granulation technology – Formulation of Tablets – Processing problem of tablets and evaluation of tablets. Tablets Coating – Principles – Tablet coating process – Sugar coating – Film Coating – Specialized coating – Evaluation of coated tablets. Hard gelatin Capsules – Raw materials – Manufacture – Formulations – Filling equipments – Evaluations – Soft gelatin capsule – Rationale – Manufacture – Formulation – Evaluation.

UNIT IV PARENTERAL PRODUCTS 9

Diversities of parenteral products – Formulation of parenteral products – Sustained action parenteral products – Processing and Packaging– Evaluation of parenteral products – specialized parentral products.

UNIT V PHARMACEUTICAL AEROSOLS 9

Components of aerosol package – Formulation, Stability testing, Manufacture, Quality control and Testing of pharmaceutical aerosols

TOTAL (L:45 + T:15) : 60 PERIODS

OUTCOMES:

The student will be able to

- Understand the factors influencing the development of various dosage forms.
- Understand the formulation concepts and evaluate different dosage forms to meet out the compendial requirements.

TEXT BOOKS:

1. Lachman, Leon et al. “The Theory and Practice of Industrial Pharmacy” 3rd Ed., Varghese Publishing House, 1987.
2. Aulton, Michael E. “Pharmaceutics: The Science of Dosage Form Design” 2nd Ed., Churchill Livingstone, 2002.
3. Allen, Loyd V. et al. “Ansel’s Pharmaceutical Dosage Forms and Drug Delivery Systems” 9th Ed., Wolters Kluver/Lippin Cott Williams & Wilkins, 2011.

REFERENCES:

1. Avis, K.E. et al. “Pharmaceutical Dosage Forms: Parenteral Medications” Vol.1-3, 2nd Ed., Marcel Dekker, 2005.
2. Libermann, H.A. et al. “ Pharmaceutical Dosage Forms : Tablets” Vol.1-3, 2nd Ed., Marcel Dekker, 2005.
3. Libermann, H.A. et al., “Pharmaceutical dosage forms: Disperse Systems” Vol. 1-3, 2nd Ed., Marcel dekker, 2005.

PY6602 PROCESS EQUIPMENT DESIGN

L	T	P	C
3	1	0	4

OBJECTIVE:

To provide the basic concepts and principles in designing of equipments used in heat transfer, evaporation, distillation and drying.

UNIT I HEAT EXCHANGERS **9**

Design of shell and tube heat exchangers - Double pipe heat exchangers.

UNIT II EVAPORATORS **9**

Design of single and multiple effect evaporators

UNIT III DISTILLATION **9**

Design of distillation columns- sieve and bubble cap towers

UNIT III ABSORPTION COLUMNS **9**

Design of absorption columns- plate and packed columns

UNIT III DRYERS **9**

Design of batch and continuous dryers

TOTAL (L:45 +T:15) : 60 PERIODS

OUTCOMES:

The student will be able to

- Understand the basic concepts and principles in designing of equipments.
- Understand the basic design of equipments used in heat transfer such as evaporation, distillation and drying.

TEXT BOOKS:

1. Perry, R.H., Chemical Engineers Handbook, McGraw Hill Co, 7th Edition, 1988.
2. Coulson, J.M. and Richardson,J.F, Chemical Engineering, Vol.6, Pergamon Press, 1977

REFERENCES:

1. Bhattacharya, B.C., Introduction to chemical equipment design mechanical aspects, CBS publishers and distributors, 1985.
2. Dawande, S.D., Process Design of Equipment, Central Techno Publications, 2005
3. Donald, Q.K, Process Heat Transfer, Tata McGraw Hill Co, 1st edition, 1997.

BT6703 CREATIVITY, INNOVATION AND NEW PRODUCT DEVELOPMENT

L	T	P	C
3	0	0	3

OBJECTIVE:

To impart the knowledge of various aspects of Creativity, Innovation and New Product Development

UNIT I INTRODUCTION **9**

The process of technological innovation - factors contributing to successful technological innovation - the need for creativity and innovation - creativity and problem solving - brain storming - different techniques

UNIT II PROJECT SELECTION AND EVALUATION **9**

Collection of ideas and purpose of project - Selection criteria - screening ideas for new products (evaluation techniques)

UNIT III NEW PRODUCT DEVELOPMENT 9

Research and new product development - Patents - Patent search - Patent laws - International code for patents - Intellectual property rights (IPR).

UNIT IV NEW PRODUCT PLANNING 9

Design of proto type - testing - quality standards - marketing research - introducing new products

UNIT V MODEL PREPARATION & EVALUATION 9

Creative design - Model Preparation - Testing - Cost evaluation - Patent application

TOTAL : 45 PERIODS

OUTCOME:

On completion of the course, students will have gained knowledge on various issues related to Patents, Quality, Creativity, Innovation, New Product Development, Planning and Evaluation.

TEXT BOOKS:

1. Twiss, Brian. “Managing Technological Innovation”, Pitman Publishing Ltd., 1992.
2. Watton, Harry B. “New Product Planning”, Prentice Hall Inc., 1992.

REFERENCES:

1. Nystrom, Harry “Creativity and Innovation”, John Wiley & Sons, 1979.
2. Khandwalla, N. – “Fourth Eye (Excellence through Creativity) - Wheeler Publishing”, 1992.
3. I.P.R. Bulletins, TIFAC, New Delhi, 1997.

PY6611 PHARMACEUTICAL DOSAGE FORMS LABORATORY

L	T	P	C
0	0	4	2

OBJECTIVE:

To study, the basic principles in formulating liquid, semisolid, solid and parentral dosage forms and their evaluations.

LIST OF EXPERIMENTS

1. Preparation of solutions
2. Preparation of suspensions
3. Evaluation of suspensions
4. Preparation of emulsions
5. Evaluation of emulsions
6. Preparation of creams
7. Evaluation of creams
8. Preparation of ointments
9. Evaluation of ointments
10. Preformulation studies on prepared granules
11. Manufacture and evaluation of granules - wet granulation and dry granulation methods
12. Preparation of tablets
    a. Tablets prepared from wet and dry granules
    b. Tablets prepared by direct compression
    c. Chewable tablet
13. Formulation and filling of hard gelatin tablets
14. Preparation and evaluation of parenterals
    a. Ascorbic acid injection
    b. Calcium gluconate injection

c. Sodium chloride injection
d. Dextrose and sodium chloride injection/infusion

TOTAL: 60 PERIODS

OUTCOMES:

- Acquire knowledge to prepare and evaluate various liquid, semi solid, solid dosage forms.
- Application of the knowledge to formulate new dosage forms.

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

1. Tablet punching machine – Mini press
2. Automatic capsule filling machine
3. pH meter
4. Reverse osmosis water treatment plant
5. Stability chamber

REFERENCES:

1. Pharmaceutical Dosage Forms: Parenteral Medications, Volume I, Kenneth E. Avis, Herbert A. Lieberman (Editor), Leon Lachman (Editor)
2. Pharmaceutical Dosage Forms: Disperse Systems, Volume 1 -Leon Lachman, Herbert A. Lieberman
3. The Theory and Practice of Industrial Pharmacy By Lachman and Lieberman (3rd Edition)
4. Hard capsules, development and technology. Edited by K. Ridgway. The Pharmaceutical Press: London, UK. 1987. 320 pp.ISBN 0-85369-159-2.

GE6562 EMPLOYABILITY SKILLS L T P C
0 0 2 1

OBJECTIVES:

- To enhance the employability skills of learners with a special focus on presentation skills, group discussion and interview skills.
- To enable them to improve their soft skills necessary for workplace contexts.
- To equip them with effective communicative competence for a global reach.

UNIT I SPEAKING SKILLS 6

Conversational skills (formal and informal contexts) - telephonic communication, attending job interviews (responding to FAQs) - taking part in GDs - making presentations.

UNIT II WRITING SKILLS 6

Job applications – cover letter – resume – applying online – writing proposals – emails – letters – reports – memos – minutes – blogging – tweeting – writing recommendations and instructions – writing for publications.

UNIT III READING SKILLS 6

Vocabulary building – speed reading (skimming – scanning) – reading different genres of texts from newspapers to philosophical treatises – critical reading – effective reading strategies such as reading 'beyond the lines', summarizing, graphic organizers and distinguishing facts from opinions.

UNIT IV LISTENING/VIEWING SKILLS 6

Speeches of different nationalities with focus on American and British accent (TED talks, podcasts) – listening to lyrics – lectures – instructions – dialogues – news casting – talk shows – interviews (Hard talk, Devil's Advocate)

UNIT V SOFT SKILLS 6

Motivation - persuasive skills – negotiations – time management – emotional intelligence – stress management – creative and critical thinking.

TOTAL: 30 PERIODS

TEACHING METHODS:

1. To be totally learner-centric with minimum teacher intervention as the course revolves around practice.
2. Suitable audio/video samples from Podcast/YouTube to be used for illustrative purposes.
3. Portfolio approach for writing to be followed. Learners are to be encouraged to blog, tweet, text and email employing appropriate language.
4. GD/Interview/Role Play/Debate could be conducted off the laboratory (in a regular classroom) but learners are to be exposed to telephonic interview and video conferencing.
5. Learners are to be assigned to read/write/listen/view materials outside the classroom as well for graining proficiency and better participation in the class.

Lab Infrastructure:

Sl. No	Description of Equipment (Minimum Configuration)	Qty Required
1	**Server**	1 No.
	PIV System	
	1 GB RAM / 40 GB HDD	
	OS: Win 2000 server	
	Audio card with headphones	
	JRE 1.3	
2	**Client Systems**	60 Nos.
	PIII System	
	256 or 512 MB RAM / 40 GB HDD	
	OS: Win 2000	
	Audio card with headphones	
	JRE 1.3	
3	Handicam	1 No.
4	Television 46”	1 No.
5	Collar mike	1 No.
6	Cordless mike	1 No.
7	Audio Mixer	1 No.
8	DVD recorder/player	1 No.
9	LCD Projector with MP3/CD/DVD provision for Audio/video facility	1 No.

Evaluation:

Internal: 20 marks

Record maintenance: Students should write a report on a regular basis on the activities conducted, focusing on the details such as the description of the activity, ideas emerged, learning outcomes and so on. At the end of the semester records can be evaluated out of 20 marks.

External: 80 marks

Online Test	- 35 marks
Interview	- 15 marks
Presentation	- 15 marks
Group Discussion	- 15 marks

NOTE FOR THE INTERNAL ASSESSMENT:

1. Interview – mock interview can be conducted on one-on-one basis.
2. Speaking **–** example for role play:

a. Marketing engineer convincing a customer to buy his product.

b. Telephonic conversation- fixing an official appointment/placing an order/enquiring and so on.

3. Presentation – should be extempore on simple topics
4. Discussion – topics of different kinds; general topics, case studies and abstract concept

OUTCOMES:

At the end of the course learners should be able to

- Participate in conversations both formal and informal, attend phone calls and interviews successfully.
- Read different types of texts.
- Listen to, and understand foreign accents**.**

REFERENCES:

1. Barker, A. **Improve Your Communication Skills.** New Delhi: Kogan Page India Pvt. Ltd., 2006.
2. Craven, Miles. **Listening Extra – A resource book of multi-level skills activities**. Cambridge University Press, 2004.
3. Gammidge, Mick. **Speaking Extra - A resource book of multi-level skills activities.** Cambridge University Press, 2004.
4. Hartley, Peter. **Group Communication**. London: Routledge, 2004.
5. John Seely. **The Oxford Guide to Writing and Speaking**. New Delhi: Oxford University Press, 2004.
6. Naterop Jean & Rod Revell. **Telephoning in English**. Cambridge University Press,1987.
7. Ramesh, Gopalswamy and Mahadevan Ramesh. **The ACE of Soft Skills**. New Delhi: Pearson, 2010.

Web Sources:

1. www.humanresources.about.com
2. www.careerride.com

BT6604 CHEMICAL REACTION ENGINEERING

L	T	P	C
3	0	0	3

OBJECTIVES:

- To provide the basic concepts of types of reactions, variable affecting the rate of reaction, predicting the rate equations for different types of reactions.
- To provide the information about different reactor systems, deriving the performance equations and predicting the rate equations in chemical reaction engineering system.

UNIT I SCOPE OF CHEMICAL KINETICS & CHEMICAL REACTION ENGINEERING 8

Broad outline of chemical reactors; rate equations; concentration and temperature dependence; development of rate equations for different homogeneous reactions. Industrial scale reactors.

UNIT II IDEAL REACTORS 10

Isothermal batch, flow, semi-batch reactors; performance equations for single reactors; multiple reactor systems; multiple reactions.

UNIT III IDEAL FLOW AND NON IDEAL FLOW 10

RTD in non-ideal flow; non-ideal flow models; reactor performance with non-ideal flow.

UNIT IV GAS-SOLID, GAS-LIQUID REACTIONS 9

Resistances and rate equations; heterogeneous catalysis; reactions steps; resistances and rate equations.

UNIT V FIXED BED AND FLUID BED REACTORS 8

G/L reactions on solid catalysis; trickle bed, slurry reactors; three phase-fluidized beds; reactors for fluid-fluid reactions; tank reactors.

TOTAL : 45 PERIODS

OUTCOMES:

The student will be able to

- Write the rate equation for any type of reaction.
- Design reactors for heterogeneous reactions and optimise operating conditions.
- Relate and calculate the conversions, concentrations and rates in a reaction.
- An ability to identify, formulate and solve chemical engineering problems.

TEXT BOOKS:

1. Levenspiel O. Chemical Reaction Engineering. 3rd Edition. John Wiley.1999.
2. Fogler H.S. Elements Of Chemical Reaction Engineering. Prentice Hall India.2002

REFERENCES:

1. Missen R.W., Mims C.A., Saville B.A. Introduction To Chemical Reaction EngineeringAnd Kinetics. John Wiley.1999
2. Dawande, S.D., “Principles of Reaction Engineering”, 1st Edition, Central Techno Publications, 2001.
3. Richardson, J.F. and Peacock, D.G., “Coulson Richardson - Chemical Engineering”, Vol. III, 3rd Edition, Butterworth- Heinemann- Elsevier, 2006.

PY6701 ADVANCED DRUG DELIVERY SYSTEM

L	T	P	C
3	1	0	4

OBJECTIVES:

To enable the students to

- Understand the properties of polymer and its significance in drug delivery systems.
- Interpret physicochemical properties of the drug with the drug delivery system modules.
- Apply the concepts of newer method of drug delivery systems involved in the pharmaceutical sciences and relevance of their drug delivery strategies.

UNIT I POLYMERS 9

Polymers used in controlled drug delivery modules – Classification – Advantages and disadvantages of polymers – Polymer Characterisation - Various classes of controlled release systems.

UNIT II SUSTAINED RELEASE FORMULATIONS 9

Introduction, concept, advantages and disadvantages. Physicochemical and biological properties of drugs relevant to sustained release formulations.

UNIT II TRANSDERMAL DRUG DELIVERY SYSTEMS 9

Permeation through skin – factors affecting permeation – basic components of TDDS – permeation enhancers – formulation approaches used in development of TDDS and their evaluation.

UNIT IV TARGETED DRUG DELIVERY SYSTEMS 9

Concepts – Advantages and disadvantages – Nanoparticles – Liposomes – Microspheres – Magnetic microspheres.

UNIT V DRUG DELIVERY LARGE MOLECULES 9

Delivery system for Peptides and Proteins – Delivery of nucleic acids – Antibodies and siRNA.

TOTAL (L:45 + T:15) : 60 PERIODS

OUTCOMES:

The student will be able to

- Understand the properties and importance of polymer in novel drug delivery systems.
- Understand the application of polymer in sustained release, topical and targeted drug delivery systems.

TEXT BOOKS:

1. Vyas S.P., Khar R.K, "Targeted & Controlled Drug Delivery: Novel Carrier Systems", CBSPD, 2006.
2. Junginger H.E "Drug Targeting and Delivery- concepts in dosage form design" EllisHarwood series in Pharmaceutical Technology

REFERENCES:

1. Vasant Ranade , mannfred A Hollinger "Drug delivery systems" II ed , CRC Press.
2. Grietje Molema and Dirk K F Meijer "Drug Targetting organ-specific strategies" WILEY-VCH , 2001
3. Anya M Hillery et al " Drug Delivery and Targeting", CRC Press, 2010.

PY6702 BIOPHARMACEUTICS AND PHARMACOKINETICS L T P C
3 0 0 3

OBJECTIVES:

- To teach important parameters involved in drug disposition and its principles in living systems.
- To make the students to understand how the drug disposition takes place in the *invitro* and *invivo* conditions.

UNIT I INTRODUCTION TO BIOPHARMACEUTICS 7

Definition and Role in Product Development, Explanation of the Terms: Bioavailability, and Bioequivalence, Equivalence Types: Chemical, Clinical, Therapeutic, Generic, and Pharmaceutical Alternatives. Bio-equivalency testing studies

UNIT II PRINCIPLES OF DRUGS DISSOLUTION 11

Dissolution of solids: Mechanisms and Models of Dissolution, Factors influencing Dissolution Rate (in vitro Release), Quantitative Study of Dissolution – Methods – Dissolution of Tablets & Capsules. *In vitro – In vivo* correlations.

UNIT III PRINCIPLES OF DRUG ABSORPTION AND BIO-AVAILABILITY 11

Physico – Chemical Factors: Lipid Solubility, Dissociation & pH, Complexation & Surface – active agents. Pharmaceutical Factors: Dosage Form Types and Formulation Variables Biological Factors: Passage of Drugs through Natural Membranes, Gastric Emptying & Intestinal Transition. Blood Flow, G.I. – Metabolism & Degradation, Interactions with Food & Co-administered Drugs, Disease State and Route of Administration.

UNIT IV PHARMACOKINETICS 11

Principles of Pharmacokinetics, Concepts of Compartmental Model, Characteristics of One Compartment Model – based Pharmacokinetic Derivations (involving the concepts of (a.) Experimentally Determined Rates, (b.) Methods of Residuals and (c.) Trapezoidal Rule for the following modes of Drug Administration: Intra-Venous Administration (Plasma Level & Urinary Excretion Data)-Single Dose, Absorption Based Administration (Single Dose) - Absorption Rate Constant (ka), Elimination Rate Constant (K) & Elimination Half life (t½), AUC, Cmax, and tmax. Apparent Volume of Distribution (Vd) & Renal Clearance (Q).

UNIT V MULTIPLE DOSAGE REGIMENS 5

Concept, Accumulation, Persistent and elimination factors. Calculation of dosage regimen following repetitive IV and oral administration

TOTAL : 45 PERIODS

OUTCOMES:

The student will be able to

- Narrate the various factors influencing the drug disposition, various pharmacokinetic parameters**.**
- Design and interpret the dissolution studies for various dosage forms.

TEXT BOOKS:

1. Brahmankar, D.H. and Sunil B.Jaiswal "Biopharmaceutics and Pharmacokinetics:aTreatise" Vallabh Prakashan, 1995.
2. Kulkarni, J.S. et al. "Biopharmaceutics and Pharmacokinetics", CBS Publishers, 2006.

REFERENCES:

1. Chatwal, G.R. "Biopharmaceutics and Pharmacokinetics" Himalaya Publishing House, 2003.
2. Jambhekar, Sunil S. and Philip J. Breen "Basic Pharmacokinetics" Pharmaceutical Press, 2009.
3. Milo Gibaldi "Biopharmaceutics & Clinical Pharmacokinetics" Pharma Book Syndicate, 4th Edition, 2011.

PY6711	ADVANCED DRUG DELIVERY SYSTEMS LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES:

To enable the students to

- Understand and analyse the factors influencing the formulation of novel drug delivery systems.
- Choose right choice of excipients for the right delivery systems.
- Characterize and interpret the results of marketed products**.**

LIST OF EXPERIMENTS

1. Preparation of Transdermal Films
2. Evaluation of Transdermal Films
3. Preparation of Microspheres
4. Characterization of Microspheres
5. Preparation of matrix tablets using various polymers
6. Evaluation of matrix tablets using various polymers
7. Preparation of solid dispersions
8. Evaluation of solid dispersions
9. Evaluation of quality control parameters of various sustained release formulations of marketed products.
10. Preparation of Liposomes
11. Characterization of Liposomes.
12. Preparation of polysaccharide particle based drug delivery

TOTAL : 60 PERIODS

OUTCOMES:

On successful completion students able to

- Comprehend various classes of excipients involved in formulation of novel drug delivery systems.

- Formulate and evaluate appropriate novel drug delivery formulations in a practical setting in response to defined criteria.
- Perform various quality control tests for the marketed products.

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

- Tablet Punching Machine
- Magnetic stirrer with hot plate
- Mechanical stirrer
- Dissolution apparatus
- Disintegration tester
- Rotary evaporator

PY6712	BIOPHARMACEUTICS AND PHARMACOKINETICS LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVE:
To impart the knowledge of the rate and extent of drug absorption and distribution,

LIST OF EXPERIMENTS

1. In-vitro disintegration study of the given tablet.
2. In-vitro dissolution study of the given uncoated tablet dosage form using various dissolution media.
3. In-vitro dissolution study of the given sustained released tablet dosage form using various dissolution media.
4. To study the effect of formulation on drug release (Tablet, Solution, suspension etc.).
5. To determine the % protein binding of the given drugs. and the effect of protein binding on drug bioavailability.
6. To calculate the various Pharmacokinetic parameters from the given blood data of I.V bolus injection (one compartment model).
7. To calculate various Pharmacokinetic parameters from the given urinary excretion data of I.V bolus injection using both methods (Rate of elimination & sigma minus method one compartment model).
8. To determine the various Pharmacokinetic parameters from the given blood data of oral dosage form.

TOTAL : 60 PERIODS

OUTCOMES:
On completion of the course the students able to

- Perform disintegration and dissolution studies for the conventional and modified dosage forms.
- Estimate various pharmacokinetic parameters using plasma and urine drug level data.
- Predict the effects of dosage form design and routes of drug administration on drug levels in body.

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

- pH Meter
- Disintegration test apparatus
- Dissolution test apparatus
- Cooling Centrifuge
- Ultra Violet Spectrophotometer

- HPLC

REFERENCES:

1. Brahmanker, D.M. and S.B. Jaiswal "Biopharmaceutics and Pharmacokinetics : A Treatise". Vallabh Prakashan, 1995.
2. Venkateswarlu, V. "Biopharmaceutics and Pharmacokinetics". Pharmabook Syndicate, 2004.
3. Gibaldi, Milo "Pharmacokinetics" 2nd Edition, Marcek Dekker, 1982.
4. Burton, M.E. "Applied Pharmacokinetics & Pharmocodynamics : Principles of Therapeutics" 4th Edition, Lippincott Williams Wilkins, 2006.

MG6091 INDUSTRIAL MANAGEMENT LT P C
3 0 0 3

OBJECTIVE :

- To provide an opportunity to learn basic management concepts essential for business..

UNIT I INTRODUCTION 9

Management - Definition – Functions – Evolution of Modern Management – Scientific Management Development of Management Thought. Approaches to the study of Management, Forms of Organization – Individual Ownership – Partnership – Joint Stock Companies – Co-operative Enterprises – Public Sector Undertakings, Corporate Frame Work – Share Holders – Board of Directors – Committees – Chief Executive –Trade Union.

UNIT II FUNCTIONS OF MANAGEMENT 9

Planning – Nature and Purpose – Objectives – Strategies – Policies and Planning Premises – Decision Making – Organizing – Nature and Process – Premises – Departmentalization – Line and staff – Decentralization – Organizational culture, Staffing - selection and training – Placement – Performance appraisal – Career Strategy – Organizational Development. Leading – Managing human factor – Leadership – Communication, Controlling - Process of Controlling – Controlling techniques,
productivity and operations management – Preventive control, Industrial Safety.

UNIT III ORGANIZATIONAL BEHAVIOUR 9

Definition – Organization – Managerial Role and functions – Organizational approaches, Individual behaviour – causes – Environmental Effect – Behavior and Performance, Perception – Organizational Implications. Personality – Contributing factors - Dimension – Need Theories – Process Theories – Job Satisfaction, Learning and Behavior – Learning Curves, Work Design and approaches.

UNIT IV GROUP DYNAMICS 9

Group Behavior – Groups – Contributing factors – Group Norms, Communication – Process – Barriers to communication – Effective communication, leadership – formal and informal characteristics – Managerial Grid – Leadership styles – Group Decision Making – Leadership Role in Group Decision, Group Conflicts – Types – Causes – Conflict Resolution – Inter group relations and conflict, Organization centralization and decentralization – Formal and informal – Organizational Structures – Organizational Change and Development – Change Process – Resistance to Change – Culture and
Ethics.

UNIT V MODERN CONCEPTS 9

Management by Objectives (MBO), Management by Exception (MBE), Strategic Management - Planning for Future direction – SWOT Analysis – Information technology in management – Decisions support system – Business Process Re-engineering (BPR) – Enterprises Resource Planning (ERP) – Supply Chain Management (SCM) – Activity Based Management (ABM).

TOTAL : 45 PERIODS

OUTCOME :

- Students gain knowledge on the basic management principles to become management(s) professional.

TEXTBOOKS:

1. Herald Knottz and Heinz Weihrich, 'Essentials of Management', Tata McGraw Hill Education Pvt. Ltd., 2010.
2. Stephen P. Robbins, 'Organization Behaviour', Pearson Education Inc., 13 edition, 2010.

REFERENCES:

1. Ties, AF, Stoner and R.Edward Freeman, 'Management' Prentice Hall of India Pvt. Ltd. New Delhi 110 011, 1992
2. Joseph J, Massie, 'Essentials of Management' Prentice Hall of India Pvt. Ltd. 1985.
3. P.C. Tripathi & P.N. Reddy, 'Principles of Management', TataMcGraw Hill, 2006.

PY6001 PHARMACEUTICAL PRODUCTION MANAGEMENT

L	T	P	C
3	0	0	3

OBJECTIVE:

To make understand the process involved in the pharmaceutical industries and its management.

UNIT I PILOT PLANT AND SCALE-UP TECHNIQUES 9

Pharmaceutical Pilot plant – Pilot plant Design – Theories of similarities – General considerations of pilot plant scaleup – Case studies for tablets – Capsules – Liquid orals – Parenterals – Sustained release preparation – Semi-solid preparation.

UNIT II FORMULATION PRODUCTION MANAGEMENT 9

Plant site selection and layout – Plant Material handling for various pharmaceutical products – Functions – Selection – Maintenance – Types – Different categories of Pharmaceutical Plant maintenance – Replacement analysis – Group and individual replacement.

UNIT III PRODUCTION, PLANNING, SCHEDULING AND FORECASTING 9

Production systems – Production department Personnel – Production process, routing, loading and Scheduling – Despatching of records – Production control.

UNIT IV MATERIAL MANAGEMENT 9

Materials – Quality and quantity – Value analysis – Purchasing – Centralized and decentralized – Vendor development – Buying techniques – Purchasing cycle and procedures – Stores management – Salvaging and disposal of scrap surplus – Selective inventory control – RQM and EOQ – Modern inventory management systems – Cost and savings in inventory – Evaluation of inventory performance.

UNIT V HUMAN RESOURCE MANAGEMENT 9

Human resource planning – Job analysis and design – Recruitment – Personnel selection – Orientation and placement – Training and development – Supervision – Performance appraisal – Remuneration and salaries – Compensation – Industrial relations – Motivation.

TOTAL : 45 PERIODS

OUTCOMES:

The student will be able to

- Identify the various factors influencing for choosing a suitable location for pharmaceutical plant and its construction.
- Handle and execute various process of pharmaceutical product manufacturing and manage the materials and human resources.

TEXT BOOKS:

1. Vidyasagar, G., "Pharmaceutical Industrial Management", 3rd Edition, Varghese Publications, 2001.
2. Subramaniam, C.V.S., "Textbook of Pharmaceutical Production Management", Vallabh Prakashan, 2000.

REFERENCES:

1. Lachman, L. and Liberman, H.A., "The Theory and Practice of Industrial Pharmacy", 3rd Edition, Varghese Publications, 1986.
2. Evans, J., Sweeny, A. and Wiliams, H "Applied Production and Operations Management", 3rd Edition, West Publishing Company Ltd., 1992.
3. Drucker, P.F., "Management (Task, Responsibility and Practices)", Allied Publication, 1993.

PY6002 UNIT PROCESSES IN ORGANIC SYNTHESIS

L	T	P	C
3	0	0	3

OBJECTIVE:

To provide the basic concepts and fundamental principles of various process in organic synthesis.

UNIT I SULFONATION AND SULFATION 9

Sulfating – Sulfonating agents – Applications – Chemical and physical factors in sulfonation and sulfation – Thermodynamics mechanism – Kinetic considerations –Industrial equipments and techniques – Sulfonation of benzene – Aniline.

UNIT II NITRATION 9

Nitrating agents – Aromatic nitration – Thermodynamics – Kinetics of nitration process – Nitration of benzene – Toluene – Phenol – Glycerine – Naphthalene – Industrial equipments for nitration – Preparation of m-dinitrobenzene – Chloro-nitro benzenes –Continuous nitration process.

UNIT III AMINATION BY REDUCTION 9

Methods of reduction – Bechamp method – Reduction mechanism – Preparation of aniline, p-phenylene diamine – Catalytic hydrogenation process – Catalyst involved in the reduction process – Reduction mechanism – Manufacture of aniline using catalytic reduction – Manufacture of p-aminophenol – Electrolytic reduction.

UNIT IV HALOGENATION 9

Halogenating agents – Thermodynamic and kinetic considerations – Chlorination of methane – Ethane – Propane – Photohalogenation – Manufacture of allyl chloride –Chloroacetic acid – Chloral hydrate – Ethylene chlorohydrin – Chloromethane – Vinyl chloride.

UNIT V OXIDATION 9

Oxidation reactions – Oxidizing agents – Liquid phase and vapour phase oxidation with air and oxygen – Catalysts used – Kinetics and thermodynamic considerations –Manufacture of phthalic anhydride – Acetaldehyde – Acetic acid – Benzaldehyde –Salicylic acid.

TOTAL : 45 PERIODS

OUTCOMES:

The student will be able to

- Understand the nature of different chemical agents involved in sulfonation, nitration, reductive amination, halogenation and oxidation reaction.
- Understand and apply the principles of thermodynamics and kinetics in various commercially important chemical reactions.

TEXT BOOKS:

1. Groggins, P.H., "Unit Processes in Organic Synthesis", 5th Edition, McGraw HillLtd., 1995.
2. Morison, R.T. and Boyd, R.N., "Organic Chemistry", 6th Edition, Prentice Hall of India (P) Ltd, 2006.

REFERENCES:

1. Mukherjee, S. and Singh, S.P., "Reaction Mechanism in Organic Chemistry", 3rd Edition, Mc Millan India Ltd., 2000.
2. Jerry, M., "Advanced Organic Chemistry – Reactions, Mechanism and Structure", 4th Edition, John-Wiley and Sons, 1992.
3. Bruckner, R., "Advanced Organic Chemistry- Reactions Mechanisms", Academic Press, 2002.

PY6003 VALIDATION IN PHARMACEUTICAL INDUSTRIES

L	T	P	C
3	0	0	3

OBJECTIVES:

- To provide the information on GMP/GLP regulations involved in the manufacturing of API and biological products.
- To provide the importance of impurity profile and stability testing of drugs.

UNIT I DRUGS AND COSMETICS ACT AND GMP FOR API 9

Drugs and cosmetics act -1948 – Organization and personnel – Buildings and facilities – Equipment – Documentation and records – Material management – Production and in process control – Packaging and labeling – Storage Distribution.

UNIT II IMPURITIES IN DRUG SUBSTANCES AND DRUG PRODUCTS 9

Quality USP description of impurities – Validation and impurity issue related to manufacturing – Processing of drug substances – Enantiomers as impurities – Polymorphs as unwanted components.

UNIT III CLEANING FOR API MANUFACTURING FACILITIES 9

Regulatory requirements – Multiple vs dedicated equipment – Unique nature of API – Multiple level approach to cleaning – Nature of contaminants – Selection of a worst case – Cleaning techniques – Sampling – Analytical methods – Limits and acceptance criteria, documentation.

UNIT IV STABILITY TESTING 9

Reasons for stability testing – Modes of degradation – Shelf lives and expiration dates – Possible strategies to improve shelf lives – Stability testing of new drug substances and products (Q1A) – Photo stability testing of new substances and products (Q1B) – Validation on analytical procedures (Q2A).

UNIT V GMP FOR BIOLOGICAL PRODUCTS 9

Organization and personnel – Buildings and facilities – Equipment – Documentation – Production and in-process control – Packaging and labeling – Storage – Distribution – Disposal of bio medical waste.

TOTAL: 45 PERIODS

OUTCOMES:

The student will be able to

- Determine the shelf-life, impurity profile and expiry date for the API and finished products through stability studies.
- Understand the role of cleanliness in manufacturing high purity products and reducing adverse products.
- Understand regulatory practices and administrative functions adopted in the pharmaceutical organizations.

TEXT BOOKS:

1. Ira, R.B. and Harpaz, D., "Validation of Active Pharmaceutical Ingredients", 2nd Edition, CRC Press, 2001.
2. Anjaneyulu, Y. and Maraya, R., "Quality Assurance and Quality Management in Pharmaceutical Industry", Pharma Book Syndicate, 2005.

REFERENCES:

1. Willig, S.H., "Good Manufacturing Practice for Pharmaceuticals", 5th Edition, Marcel Dekker, 2005.
2. Iyer, S., "Guidelines on cGMP and Quality of Pharmaceutical Products", 1st Edition, D.K.Publications, 2003.
3. Carstensen, J.T. and Rhodes, C.T., "Drug Stability Principles and Practice", 3rd Edition,Marcel Dekker, 1995

PY6004 GENETIC ENGINEERING AND PHARMACOGENOMICS

L	T	P	C
3	0	0	3

OBJECTIVES:

To enable the student to know about genetic engineering and pharmacogenomics principles and application in human genome associated diseases.

To provide the knowledge about the influence of genetic variation on drug response .

UNIT I BASICS OF RECOMBINANT DNA TECHNOLOGY 9

Manipulation of DNA and RNA – Restriction and Modification enzymes, Design of linkers and adaptors. Characteristics of cloning and expression vectors based on plasmid and bacteriophage, Vectors for insect, yeast and mammalian system, Prokaryotic and eukaryotic host systems, Introduction of recombinant DNA in to host cells and selection methods.

UNIT II DNA LIBRARIES 9

Construction of genomic and cDNA libraries, Artificial chromosomes – BACs and YACs, Chromosomal walking, Screening of DNA libraries using nucleic acid probes and antisera.

UNIT III SEQUENCING AND AMPLIFICATION OF DNA 9

Maxim Gilbert's and Sanger's methods of DNA sequencing. PCR: Inverse, Nested, AFLP-, Allele specific, Assembly, Asymmetric, Hot start, inverse, Colony, single cell, Real-time PCR/qPCR – SYBR green assay, Taqman assay, Molecular beacons. Site directed mutagenesis.

UNIT IV HUMAN GENOME AND ASSOCIATION STUDIES IN PHARMACOGENOMICS 9

Expressed sequence Tags (EST) and computational biology, Microbial genomics, computational analysis of whole genomes, computational genome analysis, Genomic differences that affect the outcome of host pathogen interactions: A template for the future of whole genome-based pharmacological science, Viability and ADR in drug response: contribution of genetic factor, Multiple inherited genetic factors influence the outcome of drug treatments, Plasma binding proteins, Drug targets.

UNIT V PHARMACOGENOMICS AND DRUG DESIGN WITH CASE STUDIES 9

Understanding biology and diseases,Target identification and validation, Drug candidate identification and optimization incorporation of pharmacogenomics principles, cases studies for CVS, CNS, immunomodulators, antioxidants etc.

TOTAL: 45 PERIODS

OUTCOMES:

The student will be able to

- Understand the influence of genetic variation on drug response in patients by correlating gene expression or single-nucleotide polymorphisms with a drug's efficacy or toxicity.
- Achieve an overview of advanced principles and techniques of human genetic engineering.

TEXT BOOKS:

1. Primrose, S. Twyman, R. "Principles of Gene Manipulation and Genomics" 7th Edition, Blackwell Publishing, 2006.
2. Chakraborty, Chiranjib and Atanu Bhatta Charya "Pharmacogenomics : An Approach to New Drug Development", Biotech Books, 2004.

REFERENCES:

1. Brown, T.A. "Gene Cloning & DNA Analysis : An Introduction", 5th Edition, Blackwell Publishing, 2006.
2. Glick, B.R. and J.J. Pasternak "Molecular Biotechnology : Principles and Applications of Recombinant DNA", 3rd Edition, ASM, 2003.
3. Licinio, Julio and Ma-Liwong "Pharmacogenomics : The Search for Individualized Therapies", Wiley – VCH, 2002.

PY6005	PHARMACOGNOSY	L	T	P	C
		3	0	0	3

OBJECTIVES:

To study about the general pharmacognosy and drug containing various active substances.
To study, classify, identify and understand the medicinal compounds derived from plant sources and relate to therapeutic applications

UNIT I GENERAL PHARMACOGNOSY 9

Definition, history, scope and development of pharmacognosy. Sources and Classification of drugs : sources of drugs. Classification. Cultivation, collection, processing and storage of crude drugs. Factors influencing cultivation of medicinal plants, types of soil and fertilizers of common use. Pest management and natural pest control agents. Plant hormones and their applications. Polyploidy, mutation and hybridization with reference to medicinal plants.

UNIT II QUALITY CONTROL OF CRUDE DRUGS 6

Quality control of crude drugs : Adulteration of crude drugs and their detection by organoleptic, microscopic, physical, chemical and biological methods of evaluation.

UNIT III DRUGS CONTAINING CARBOHYDRATES, LIPIDS, RESINS, TANNIN AND VOLATILE OIS 12

An Introduction to chemical constituents of drugs: their isolation, classification and properties & systematic pharmacognostic study. Carbohydrates and derived products : Agar, Gum Acacia, Gum tragacanth, Honey, Isapgol, pectin, Starch. Lipids : Bees wax, Castor oil, , Cod-liver oil, Hydnocarpus oil, Lard, Linseed oil, , shark liver oil and wool fat.Resins and resin combinations : Colophony, Podophyllum, , Cannabis, Capsicum, Myrrh, Asafoetida, Balsam of Peru, Balsam of Tolu, Benzoin, Turmeric. Tannins and tannins containing drugs : Gambier, black catechu, gall and myrobalan. Volatile oils: Mentha, Coriander, Cinnamon, Cassia, Caraway, Dill, Clove, Fennel, Nutmeg, Cardamom, Lemon grass oil, Eucalyptus, Sandalwood.

UNIT IV DRUGS CONTAINING SAPONIN, ANTHROQUINONE AND CARDIAC GLYCOSIDE 9

Study of the biological sources, cultivation, collection, commercial varieties, chemical constituents, substitutes, adulterants, uses, diagonistic macroscopic and microscopic features and specific chemical tests of following groups containing glycosides. Saponins: glycyrrhiza, ginseng, dioscorea, sarsaparilla and senega. Cardioactive sterols : digitalis, squill, strophanthus and thevitia. Anthraquinone cathartics: Aloe, Senna, rhubarb and cascara. Psoralea, , gentian, chirata, quassia.

UNIT V DRUGS CONTAINING ALKALOIDS AND DERIVED PRODUCTS 9

Study of the biological sources, cultivation, collection, commercial varieties, chemical constituents, substitutes, adulterants, uses, diagnostic macroscopic and microscopic features and specific chemical tests of following Alkaloids and its derived compounds: Cinchona,Ipecac,Opium,Ergot, Rauwolfia, Nuxvomica Belladona, Ephedra and Vinca.

TOTAL : 45 PERIODS

OUTCOMES:

The student will be able to understand

- Various sources of natural drugs.
- Classification and identification of drugs of natural origin and detection of its adulterant.
- Plant derived important constituents and its therapeutic uses.

TEXT BOOKS:

1. Evans, W.C. “Trease and Evans Pharmacognosy”, 15th Edition, Saunders / Elsevier, 2005.
2. Kokate, C.K. etal., “Pharmacognosy”, 39th Edition, Nirali Prakashan, 2007.
3. Wallis, T.E. “Textbook of Pharmacognosy”, 5th Edition, CBS Publishers, 1985.

REFERENCES:

1. Gennaro, A.R. “Remington : The Science and Practice of Pharmacy”, Vol. I & II. 20th Edition, B.I. Publications Pvt. Ltd. / Lippincott Willisams & Wilkins, 2004.
2. Mohammed Ali, “Textbook of Pharmacognosy”, 2nd Edition, CBS Publishers, 1994.
3. Kalia, A.N. “Textbook of Industrial Pharmacognosy”, CBS Publishers, 2005.

PY6006 CHEMISTRY OF NATURAL PRODUCTS

L	T	P	C
3	0	0	3

OBJECTIVE:

To provide the knowledge about the natural products, isolation and characterization of their active substances from their botanical source.

UNIT I STRUCTURAL BASIS OF NATURAL PRODUCTS 9

Chemical and spectral approaches to simple molecules of natural origin. Identification of natural products by chromatographic and spectroscopic methods and application of I.R., N.M.R. and Mass spectroscopy in the structural elucidation of organic compounds.

UNIT II GLYCOSIDES 8

Classification, biosynthetic studies and basic metabolic pathways, introduction to biogenesis of secondary metabolites, chemistry, general methods of extraction, isolation, chemical tests, medicinal properties of cardinolides and bufadienolides, digoxin and digitoxin.

UNIT III ALKALOIDS 12

Classification, chemistry, general methods of extraction, isolation, chemical tests, and structural elucidation of Pyridine alkaloids, Tropane alkaloids, Quinoline and Isoquinoline

alkaloids, Phenanthrine alkaloids, Indole alkaloids, Imidazole alkaloids, Alkaloid amines, Glycoalkaloid, Xanthine alkaloid

UNIT IV TERPENES AND FLAVONOIDS 8

Classification, biosynthetic studies and basic metabolic pathways, introduction to biogenesis of secondary metabolites, chemistry, general methods of extraction, isolation, chemical tests, medicinal properties and structural elucidation, flavonoids, quercetin; Terpenes– special isoprene rule, and structural elucidation of citral, carvone, menthol and camphor.

UNIT V STUDY OF TRADITIONAL DRUGS 8

Classification of indigenous drugs traditional drugs, common vernacular names, botanical source, chemical constituents, uses and marketed formulations with ingredients like – Amla, Satavari, Bhilwua, guggul, gymnema, neem ,tulsi, Shilajit and Spirulina

TOTAL : 45 PERIODS

OUTCOMES:

The student will be able

- To classify extract, isolate and characterize the natural products by chemical tests.
- To understand the classification, metabolic pathways, metabolites and their structural elucidation.

TEXT BOOKS:

1. O.P. Agarwal,Chemistry of Natural Products (Vol.-1 & 2),41st edition,Goel publishing house, 2013
2. Gurdeep Chatwal, Organic Chemistry of Natural Products (Vol.-1 & 2) . Himalaya Publishing House. 1986
3. I.L.Finar, “Organic chemistry” Volume 2, 5th edition, Pearson education pvt.Ltd.

REFERENCES:

1. Varro E. Tyler, Lynn R. Brady, James E. Robbers, Pharmacognosy Lea & Febiger, 1981.
2. Trease, G. E. and Evans, W.C. Pharmacognosy, Published by Elsevier, a Division of ... Wallis, T.E. Textbook of Pharmacognosy, 15th Edition, CBS Publishers .

PY6007 PHARMACEUTICAL PACKAGING TECHNOLOGY L T P C

3 0 0 3

OBJECTIVE:

To provide the importance of packaging technology and its requirements in pharmaceutical products.

UNIT I PHARMACEUTICAL PACKAGING 9

Status – Scope in pharmaceutical industry – Classification of packaging material – Primary and secondary packaging – Functions of packaging.

UNIT II PRIMARY PACKAGING MATERIAL 9

Glass containers – Metals containers – Fiber and paper board for bulk – Films and foils for lamination – Equipments used in strip and blister packaging.

UNIT III SECONDARY PACKAGING MATERIALS 9

Folding cartons and sets of boxes – Materials of construction – Design – Specifications – Packaging inserts – Specifications – Test methods – Quality control – Cushioning materials – Applications – Tapes and adhesives – Cap threads – Cap liners – Bands – Shrink bands – Stoppers and plugs.

UNIT IV QUALITY CONTROL OF PACKAGING MATERIALS 9

Specifications – Quality control tests – Methods and evaluation of packaging of materials – Labels and labeling – Sterilization of containers.

UNIT V STABILITY AND REGULATIONS 9

Stability of Packaging materials – Law and regulations governing packaging.

TOTAL : 45 PERIODS

OUTCOMES:

The student will be able to

- Understand the various categories of packaging materials used in pharmaceutical industry.
- Choose proper packaging materials for different pharmaceutical dosage forms.

TEXT BOOKS:

1. Deak, D.A., Evans, E.R. and Hall, I.H., "Pharmaceutical Packaging Technology", Taylor and Francis, 2000.
2. Harburn, K., "Quality Control of Packaging Materials in the Pharmaceutical Industry", Informa Healthcare, 1990.

REFERENCES:

1. Anonymous, "Quality Assurance of Pharmaceuticals: A Compendium Of Guidelines And Related Materials", 2nd Edition, World Health Organization, 2004.
2. Styres, L.K., "Modern Packaging Encyclopedia", Packaging Catalog Corporation Publications, 1969.
3. Selke, S.E.M., "Understanding: Plastics Packaging Technology", Hanser Verlag Publications, 1997.

PY6008 SAFETY AND RISK MANAGEMENT

L	T	P	C
3	0	0	3

OBJECTIVE:

To provide comprehensive knowledge about the safety management, safety procedures and handling techniques of the chemicals in Industry.

UNIT I INDUSTRIAL SAFETY 9

Concepts of safety – Hazard classification chemical, physical, mechanical, ergonomics, biological and noise hazards – Hazards from utilities like air, water, steam.

UNIT II HAZARD IDENTIFICATION AND CONTROL 9

HAZOP, job safety analysis – Fault tree analysis – Event tree analysis – Failure modes and effect analysis and relative ranking techniques – Safety audit – Plant inspection – Past accident analysis.

UNIT III RISK MANAGEMENT 9

Overall risk analysis – Chapains model, E and FI model– Methods for determining consequences effects: Effect of fire, Effect of explosion and toxic effect – Disaster management plan – Emergency planning – Onsite and offsite emergency planning – Risk management – Gas processing complex, refinery – First aids.

UNIT IV SAFETY PROCEDURES 9

Safety in plant design and layout – Safety provisions in the factory act 1948 – Indian explosive act 1884 – ESI act 1948 – Advantages of adopting safety laws.

UNIT V SAFETY IN HANDLING AND STORAGE OF CHEMICALS 9

Safety measures in handling and storage of chemicals – Fire chemistry and its control – Personnel protection – Safety color codes of chemicals

TOTAL : 45 PERIODS

OUTCOMES:

The student will be able to

- Understand the various aspects of industrial safety, hazard identification and control.
- Understand the various risk management systems in chemical industry.
- Understand the safety procedure and handling of chemicals used in the various process.

TEXT BOOKS:

1. Blake, R.P., "Industrial Safety", Prentice Hall, 1953.
2. Lees, F.P., "Loss Prevention in Process Industries", 2nd Edition, Butterworth Heinemann, 1996.

REFERENCES:

1. Geoff Wells, "Hazard Identification and Risk Assessment", I.Ch E.
2. John Ridley and John Channing, "Safety at Work", 6th Edition. Butterworth-Heinemann, 2003.
3. Raghavan, K.V. and Khan, A.A., "Methodologies in Hazard Identification and Risk Assessment", Manual by CLRI, 1990

PY6009	COMPUTER AIDED DRUG DESIGN	L	T	P	C
		3	0	0	3

OBJECTIVES:

The course aims to provide students with an understanding of the process of drug discovery and development through in-silico methods right from the identification of novel drug targets to the introduction of new drugs into clinical practice.

The objective of this course is to present the appropriate tools for such a modeling ranging from molecular mechanics, molecular dynamics over computer graphics, data visualization, De Novo Design and chemometrics to computer assisted synthesis design based on artificial intelligence.

UNIT I MOLECULAR MECHANICS 9

Introduction to CADD, Techniques and Concepts Used In CADD. Molecular Recognition, Molecular Docking and Role of Solvents. Concept of Force Field in MM, molecular dynamics, molecular simulation, montecarlo, quantum mechanics semi empirical and empirical methods, applicability and limitations of a MM approach.

UNIT II MOLECULAR MODELLING 9

Historical overview, Graphical representation of molecules, technologies and models, simplified representation, molecular surfaces, Corey-Puling-Koltun (CPK) / Vander Waals surface, Solvent accessible and excluded surface, Conolly surface, Electron Density Surface, Molecular volume, Molecular superimposition, molecular similarity, molecular skin, molecular shape descriptors and mapping of information on molecular surfaces.

UNIT III CHEMOMETRICS 9

Origin and current status, multivariate data, definition and classification of data, preprocessing, distance between objects, latent variables, linear methods, projection of multivariate data, Principal Component Analysis, Multiple Linear Regression, Principle Component Regression, Partial Least Squares, nonlinear methods, Modelling methods, Classification methods, Linear discriminant analysis, validation tools, cross validation, bootstrapping, statistical indices

UNIT IV 2-D QSAR 9

Physicochemical descriptors in QSAR (Lipophilicity; clogP, polorizabilty; MR, Es, verloopsterimol parameter, electronic constants, ionization constant, HOMO, LUMO, and topological descriptors). Free-Wilson Model, Fugita-Ban Model, Hansch analysis. Comparison between Free-Wilson model and Hansch analysis. Molecular Connectivity Index (MCI)

UNIT V 3-D-QSAR: COMFA & CoMSIA 9

Introduction to 3-D QSAR, Comparative Molecular Field Analysis (CoMFA) methodology, steps in CoMFA analysis, derivation of CoMFA model, CoMFA coefficient maps, validation of results with relevant examples from recent literatures, CoMFA applications in drug design. Comparative Molecular Similarity Analysis (CoMSIA) : Introduction and Case studies

TOTAL : 45 PERIODS

OUTCOMES:

The student able to

- Have an in-depth overview over the state-of-the art methods and techniques nowadays applied in CADD.
- Choose the appropriate for a given problem like, lead optimization, structure based design, investigation of ligand receptor interaction.
- Perform, understand, and interpret the results of the calculations and bring them in a publication ready form.

TEXT BOOKS:

1. Computer Aided Drug Design Edited by Thomas J Perun, Marcel Dekker: New York, NY.
2. Structure based Drug Design Pandi Veerapandian, Taylor and Francis
3. Smith and Williams Introduction to Principles of Drug Design and Action Edited by H. John Smith, Taylor and Francis
4. Textbook of Drug Design and Discovery Edited by PovlKrogsgard-Larson, Taylor and Francis
5. Molecular Modeling: Principles and Applications, Andrew R. Leach

REFERENCES:

1. Burger's Medicinal Chemistry and Drug Discovery
2. Comprehensive Medicinal Chemistry. Vol IV.
3. G. Patrick. (2013) An Introduction to Medicinal Chemistry. Oxford University Press, UK.
4. D. C. Young. (2009) Computational Drug Design – A Guide for Computational and Medicinal Chemist. John Wiley & Sons, Inc., Hoboken, New Jersey.
5. A. Hinchliffe. (2008) Molecular Modelling for Beginners. John Wiley & Sons Ltd, England.

PY6010 EXPERIMENTAL DESIGN AND BIOSTATISTICS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To introduce the fundamentals of statistics, logical application, and interpretation of statistical models. Emphasis will be placed on gaining a conceptual understanding of the statistical tests and their application to pharmaceutical research.
- To provide foundations on design of experiments and statistical analysis of experimental data obtained from laboratory and/or industrial processes.

UNIT I 9

Introduction: Definition of Bio-Statistics, Application of Bio-statistics, classification and sampling of data, objects of classification, frequency of distribution, methods of sampling, Tabulation of data, difference between Classification and Tabulation.

UNIT II **9**

Measures of Central Tendency and Dispersion: Mean, median, mode, percentiles, range, variance, standard deviation, coefficient of variation measures skewness and kurtosis.
Methods of sampling: Simple Random sampling with and without replacement. Sampling distribution and standard deviation of sample mean.
Standard distributions: Binomial, Poisson, normal, exponential.

UNIT III **9**

Correlation and regression: scatter plot, correlation coefficient, properties, rank correlation.
Linear regression: Fitting of line and plane of regression.
Analysis of Variance: ANOVA principle, assumptions of ANOVA, ANOVA of one way classified data, Analysis of 2 way classified data, non parametric tests, ANOVA and multiple regressions for biological data.
Testing of Hypothesis: chi square test, test of fit, uses of chi square test.

UNIT IV **9**

Design of experiments: Statistical principles in experimental design - blocking, complete randomization; Factorial design, optimization of pharmaceutical formulations
Factor Effect Analysis: Analysis of individual factor and interaction effects; Response surface methodologies
Advanced topics: Variable selection; Fractional factorial design; Robustness

UNIT V **9**

Experimental design in clinical trials: Introduction, Principles of experimental design and analysis, parallel design, cross over design, split plot design, interim analysis. Monte carlo simulation and bootstrapping.

TOTAL : 45 PERIODS

OUTCOME:

The student will be able to understand the art of statistical data analysis combined with systematic approaches to experimental design.

TEXT BOOKS:

1. R.L. Mason, R.F. Gunst and J.L. Hess (2005). Statistical Design and Analysis of Experiments – with applications to engineering and science, 2nd edition, John Wiley & Sons Inc.
2. Z. R. Lazic (2006). Design of Experiments in Chemical Engineering: A Practical Guide. John Wiley & Sons Inc.
3. Pharmaceutical Statistics: Practical and clinical applications, Sanford Balton & Charles Bon, 4th edition, 2004, Marcel Dekker Inc, New York.

REFERENCES:

1. Pharmaceutical Experimental Design. Gareth A. Lewis, Didier Mathieu, Roger Phan-Tan-Luu. Marce l, Marcel Dekker, Inc. New York • Basel
2. D.C. Montgomery and G.C. Runger (2007). Applied Statistics and Probability for Engineers, 4th edition, John Wiley & Sons Inc.
3. Bernard Rosner, Fundamentals of Biostatistics, 5th Edition, Thomson Brooks/Cole, 2000.

PY6011 INTRODUCTION TO BIOMATERIALS AND TISSUE ENGINEERING

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the basics and properties of biomaterials.
- To study the clinical applications of biomaterials in tissue engineering.

UNIT I INTRODUCTION 9

Introduction to tissue engineering: Basic definition; current scope of development; use in therapeutics, cells as therapeutic agents, cell numbers and growth rates, measurement of cell characteristics morphology, number viability, motility and functions. Measurement of tissue characteristics, appearance, cellular component, ECM component, mechanical measurements and physical properties.

UNIT II TISSUE ARCHITECTURE 9

Tissue types and Tissue components, Tissue repair, Engineering wound healing and sequence of events. Basic wound healing Applications of growth factors: VEGF/angiogenesis, Basic properties, Cell-Matrix & Cell-Cell Interactions, telomeres and Self-renewal, Control of cell migration in tissue engineering.

UNIT III BIOMATERIALS 9

Biomaterials: Properties of biomaterials, Surface, bulk, mechanical and biological properties. Scaffolds & tissue engineering, Types of biomaterials, biological and synthetic materials, Biopolymers, Applications of biomaterials, Modifications of Biomaterials, Role of Nanotechnology.

UNIT IV BASIC BIOLOGY OF STEM CELLS 9

Stem Cells : Introduction, hematopoietic differentiation pathway Potency and plasticity of stem cells, sources, embryonic stem cells, hematopoietic and mesenchymal stem cells, Stem Cell markers, FACS analysis, Differentiation, Stem cell systems- Liver, neuronal stem cells, Types & sources of stem cell with characteristics: embryonic, adult, haematopoetic, fetal, cord blood, placenta, bone marrow, primordial germ cells, cancer stem cells induced pleuripotent stem cells.

UNIT V CLINICAL APPLICATIONS 9

Stem cell therapy, Molecular therapy, In vitro organogenesis, Neurodegenrative diseases, spinal cord injury, heart disease, diabetes, burns and skin ulcers, muscular dystrophy, orthopedic applications, Stem cells and Gene therapy Physiological models, tissue engineered therapies, product characterization, components, safety, efficacy. Preservation–freezing and drying. Patent protection and regulation of tissue-engineered products, ethical issues.

TOTAL : 45 PERIODS

OUTCOMES:

The student will be able to

- Understand the basics characters and current developments in biomaterials.
- Understand the tissue types, tissue components, tissue repairing techniques and wound healing sequence for the tissue architecture.
- Understand the various types, sources of stem cells with characteristics and the potency, plasticity of stem cells.
- Understand the major clinical applications (spinal cord injury, heart disease, orthopedic applications etc.) of stem cell therapy.

TEXT BOOKS:

1. Bernhard O.Palsson,Sangeeta N.Bhatia,"Tissue Engineering" Pearson Publishers 2009.
2. Meyer, U.; Meyer, Th.; Handschel, J.; Wiesmann, H.P. Fundamentals of Tissue Engineering and Regenerative Medicine.2009.

REFERENCES:

1. Bernard N. Kennedy (editor). New York : Nova Science Publishers, 2008.Stem cell

transplantation, tissue engineering, and cancer applications
2. Raphael Gorodetsky, Richard Schäfer. Cambridge : RSC Publishing, c2011. Stem cell based tissue repair.
3. R. Lanza, J. Gearhart etal (Eds), Essential of Stem Cell Biology, 2006, Elsevier Academic press.

PY6012	DOWNSTREAM PROCESSING	L	T	P	C
		3	0	0	3

OBJECTIVE:
To introduce the student to the downstream processing and purification of biological products of relevance to the pharmaceutical, technical and food industries.

UNIT I BIO PRODUCTS AND BIOSEPARATION-OVERVIEW 9
Broad classification of bioproducts - Small biomolecules - macromolecules, Stages of downstream processing. Cell disruption for product release – mechanical, enzymatic and chemical methods. Pretreatment and stabilisation of bioproducts.

UNIT II PHYSICAL METHODS OF SEPARATION 9
Unit operations for solid-liquid separation – filtration - Conventional and cross flow filtration, Filter media and equipment. Sedimentation – Principle, methods, production centrifuges, ultracentrifugation, flocculation, membrane separation –ultrafiltration and reverse osmosis, dialysis,

UNIT III ISOLATION OF PRODUCTS 9
Extraction- liquid-liquid extraction, solvent extraction principles, extraction process, aqueous two-phase extraction and its applications. Adsorption- Equilibrium and isotherms-adsorption column dynamics-fixed bed adsorption and agitated –bed adsorption.

UNIT IV PRODUCT PURIFICATION 9
Classification of Chromatographic techniques – chromatographic terms and parameters principles, instruments and practice, adsorption, reverse phase, ion-exchange, size exclusion, hydrophobic interaction, bioaffinity and pseudo affinity chromatographic techniques.

UNIT V FINAL PRODUCT FORMULATION AND FINISHING OPERATIONS 9
Precipitation of proteins, methods selective denaturation of unwanted proteins, Crystallization principles, batch crystallizers, crystallization of proteins, drying and lyophilization in final product formulation.

TOTAL : 45 PERIODS

OUTCOMES:
The students will be able to
- Acquire theoretical knowlegde of unit operations: Filtration, Centrifugation, Protein precipitaition, Crystallisation, Drying, distillation, absorption, liquid-liquid extraction taking into account economic, and technical concerns.
- Calculate dimensions and choosing the internal structure of separation equipment for simple separation applications.
- gain knowledge of the structure and function of biological macromolecules and its separation

TEXT BOOKS:

1. Belter, P.A., Cussler, E.L. and Wei-Houhu., Bioseparations, Downstream Processing For Biotechnology, Wiley Interscience Publication, Singapore, 1st Edition, 1988
2. Asenjo, Juan A. “Separation Processes in Biotechnology”. Taylor & Francis CRC, 5th Edition,1990.

REFERENCES:

1. Ghosh, Raja "Principles of Bioseparations Engineering". World Scientific, 2nd Edition 2006.
2. Jenkins, R.O., Product Recovery in Bioprocess Technology, Biotechnology by Open Learning Series, Butterworth- Heinemann, London, 2nd Edition, 1992
3. Harrison R.G., Todd P.W., Rudge S.R and Petrides D., Bioseparations science and engineering, Oxford University press, 2003

GE6081 FUNDAMENTALS OF NANOSCIENCE L T P C
3 0 0 3

OBJECTIVE:

To learn about basis of nanomaterial science, preparation method, types and application

UNIT I INTRODUCTION 8

Nanoscale Science and Technology- Implications for Physics, Chemistry, Biology and Engineering-Classifications of nanostructured materials- nano particles- quantum dots, nanowires-ultra-thinfilms-multilayered materials. Length Scales involved and effect on properties: Mechanical, Electronic, Optical, Magnetic and Thermal properties. Introduction to properties and motivation for study (qualitative only).

UNIT II GENERAL METHODS OF PREPARATION 9

Bottom-up Synthesis-Top-down Approach: Co-Precipitation, Ultrasonication, Mechanical Milling, Colloidal routes, Self-assembly, Vapour phase deposition, MOCVD, Sputtering, Evaporation, Molecular Beam Epitaxy, Atomic Layer Epitaxy, MOMBE.

UNIT III NANOMATERIALS 12

Nanoforms of Carbon - Buckminster fullerene- graphene and carbon nanotube, Single wall carbon Nanotubes (SWCNT) and Multi wall carbon nanotubes (MWCNT)- methods of synthesis(arc-growth, laser ablation, CVD routes, Plasma CVD), structure-property Relationships applications- Nanometal oxides-ZnO, TiO2,MgO, ZrO2, NiO, nanoalumina, CaO, AgTiO2, Ferrites, Nanoclays-functionalization and applications-Quantum wires, Quantum dots-preparation, properties and applications

UNIT IV CHARACTERIZATION TECHNIQUES 9

X-ray diffraction technique, Scanning Electron Microscopy - environmental techniques, Transmission Electron Microscopy including high-resolution imaging, Surface Analysis techniques- AFM, SPM, STM, SNOM, ESCA, SIMS-Nanoindentation

UNIT V APPLICATIONS 7

NanoInfoTech: Information storage- nanocomputer, molecular switch, super chip, nanocrystal, Nanobiotechlogy: nanoprobes in medical diagnostics and biotechnology, Nano medicines, Targetted drug delivery, Bioimaging - Micro Electro Mechanical Systems (MEMS), Nano Electro Mechanical Systems (NEMS)- Nanosensors, nano crystalline silver for bacterial inhibition, Nanoparticles for sunbarrier products - In Photostat, printing, solar cell, battery

TOTAL : 45 PERIODS

OUTCOMES:

Upon completing this course, the students

- Will familiarize about the science of nanomaterials
- Will demonstrate the preparation of nanomaterials
- Will develop knowledge in characteristic nanomaterial

TEXT BOOKS:

1. A.S. Edelstein and R.C. Cammearata, eds., "Nanomaterials: Synthesis, Properties and Applications", Institute of Physics Publishing, Bristol and Philadelphia, 1996.

2. N John Dinardo, “Nanoscale charecterisation of surfaces & Interfaces”, 2nd edition, Weinheim Cambridge, Wiley-VCH, 2000

REFERENCES:

1. G Timp (Editor), “Nanotechnology”, AIP press/Springer, 1999.
2. Akhlesh Lakhtakia (Editor),“The Hand Book of Nano Technology,Nanometer Structure, Theory, Modeling and Simulations”. Prentice-Hall of India (P) Ltd, New Delhi, 2007.

BT6013 BIOCONJUGATE TECHNOLOGY AND APPLICATIONS

L	T	P	C
3	0	0	3

OBJECTIVES:

To enable the students

- To understand the concepts of bioconjugate technology and its applications.
- To understand the chemical properties of bioconjugates
- To study the importance/role of biological products in body functions.

UNIT I FUNCTIONAL TARGETS 9

Modification of Amino Acids, Peptides and Proteins– Modification of sugars, polysaccharides and glycoconjugates – modification of nucleic acids and oligonucleotides.

UNIT II CHEMISTRY OF ACTIVE GROUPS 9

Amine reactive chemical reactions – Thiol reactive chemical reactions – carboxylate reactive chemical reactions – hydroxyl reactive chemical reactions – aldehyde and ketone reactive chemical reactions – Photoreactive chemical reactions.

UNIT III BIOCONJUGATE REAGENTS 9

Zero length cross linkers – Homobifunctional cross linkers – Heterobifunctional cross linkers – Trifunctional cross linkers – Cleavable reagent systems – tags and probes.

UNIT IV ENZYME AND NUCLEIC ACID MODIFICATION AND CONJUGATION 9

Properties of common enzymes – Activated enzymes for conjugation – biotinylated enzymes – chemical modification of nucleic acids – biotin labeling of DNA- enzyme conjugation to DNA – Fluorescent of DNA.

UNIT V BIOCONJUGATE APLICATIONS 9

Preparation of Hapten-carrier Immunogen conjugates - antibody modification and conjugation – immunotoxin conjugation techniques – liposome conjugated and derivatives- Colloidal – gold-labeled proteins – modification with synthetic polymers.

TOTAL : 45 PERIODS

OUTCOMES:

The student will be able to

- Understand the characters and functions of bioconjugate materials.
- Understand the various chemical reactions involved in the modifications of bioconjugates.
- Understand the major applications of bioconjugates.

TEXT BOOK:

1. Bioconjugate Techniques, G.T. Hermanson, Academic Press, 1999.

PY6013 TECHNOLOGY OF FINE CHEMICALS AND BULK DRUG

L	T	P	C
3	0	0	3

OBJECTIVE:

To enable the students about the plant design, Production technique and process Chemistry involved in the Fine chemicals and Bulk drug industry.

UNIT I INTRODUCTION OF FINE CHEMICALS AND BULK DRUGS 9

Concept of fine and Bulk drugs and their salient features – Evolution o f process – Process chemistry – Research and development strategies in pharmaceutical industries.

UNIT II PRODUCTION, PLANNING AND CONTROL 9

Flow sheets – Types of flow sheets – Flow symbols – Line symbols – Concept of all purpose and multipurpose plants – Plant design – Layout –– Process economics – Materials of construction – Effluent treatment – Solvent recovery for fine chemicals – Bulk drugs.

UNIT III BASE CHEMICAL PRODUCTION 9

Industrial Production of following base chemicals – Mineral acids (sulpuric acid, nitric acid, phosphoric acid) – Naphthalene – Ammonia – Caustic soda – Industrial alcohol – Butyl alcohol – Benzene – Phenol.

UNIT IV DRUG INTERMEDIATES AND FINE CHEMICAL PRODUCTION 9

Manufacture of following chemicals and their applications – Urea – Acrylonitrile – Ethylacetate – Butadiene – Quinoline – Aniline – Tetrahydrofuran – Titaniumdioxide – Vanillin.

UNIT V BULK DRUGS 9

Raw Materials – Production Techniques – Reaction Flow Sheet – Equipments – Utilities for the production of drugs below – Paracetamol – Aspirin – Ibuprofen – Diazepam – Darvon – Niacinamide – Chloramphenicol, Erythromycin.

TOTAL : 45 PERIODS

OUTCOMES:

The student will be able to

- Understand the principle of plant design in bulk drug industry.
- Understand the knowledge of base chemicals, drug intermediates and bulk drugs
- Understand kinetics, thermodynamics and plant construction material for the production of bulk drugs and fine chemicals.

TEXT BOOKS:

1. Gopal Rao, M. and Sittig, M., “Dryden’s Outlines of Chemical Technology”, 3rd Edition, Affiliated East West Press Pvt. Ltd., 2001.
2. Austin, G.T., “Shreve’s Chemical Process Industries”, 5th Edition, McGraw Hill Book Company, 1984.

REFERENCES:

1. Coulson and Richadson, “Chemical Engineering”Vol 6,3rd edition,Butterworth Heinemann, 2000.
2. Shah, K.M., “Hand Book of Industrial Chemistry”, Vol. I and II, Multi-Tech Publishing Co, 1999.
3. Pandey, G.N., “A Text Book of Chemical Technology”, Vol. II, Vikas Publishing House (P) Ltd., 2000.

PY6014 **HERBAL TECHNOLOGY** **L T P C**
3 0 0 3

OBJECTIVES:

- To enable to students to know about the various technologies used in herbal preparations.
- To teach the fundamental of various systems of herbal medicines, screening and its standardization.

UNIT I INDIAN SYSTEMS OF MEDICINE 9

Ayurveda – Unani – Homeopathy – Siddha – Yoga and naturopathy – Classification of herbs – Taxonomy – Harvesting – Post harvesting – Conditions of storage.

UNIT II IN-VITRO CULTURE OF MEDICINAL PLANTS 9

Requirements – Setting up a tissue culture lab – Basic laboratory procedure – Processing of plat tissue culture – Growth profile – Growth measurement – Plant tissue culture methods – Callus culture – Types of tissue culture – Tissue culture of medicinal plants – Applications of plant tissue culture.

UNIT III EXTRACTION, ISOLATION AND ANALYSIS OF PHYTO PHARMACEUTICALS 9

Infusion – Decoction – Digestion – Maceration – Percolation – Successive solvent extraction – Super critical fluid extraction – Steam distillation – Head space techniques – Sepbox – Selection of a suitable extraction process – Carbohydrates – Proteins – Alkaloids – Glycosides.

UNIT IV SCREENING METHODS FOR HERBAL DRUGS 9

Screening methods for anti-fertility agents – Antidiabetic drugs – Anti anginal drugs – Cardiac glycosides – Analgesic activity – Antipyretic activity – Anti cancer activity – Evaluation of hepatoprotective agents – Anti ulcer drugs.

UNIT V STANDARDIZATION AND CONSERVATION OF HERBAL DRUGS 9

Importance of standardization – Problems involved in the standardization of herbs – Standardization of single drugs and compound formulations – WHO guidelines for quality standardized herbal formulations – Estimation of parameter limits used for standardization – Conversation strategies of medicinal plants – Conservation types – Government policies for protecting the traditional knowledge.

TOTAL : 45 PERIODS

OUTCOMES:

The student will be able to

- Understand the various Indian systems of medicine
- Understand the screening and characterization of herbal products.

TEXT BOOKS:

1. Agarwal, S.S. and Paridhavi, M., “Herbal Drug Technology” Universities Press (India) Private Limited, 2007.
2. Wallis, T.E., “Textbook of Pharmacognosy” 5th Edition, CBS Publishers and Distributors, 1985.

REFERENCES:

1. Evans, W.C., “Trease and Evans Pharmacognosy” 15th Edition, Elsevier Health Sciences, 2001.
2. Lanza, R.P. and Atala, A., “Methods of Tissue Engineering” Elsevier Publications, 2006.
3. Daniel, M., “Herbal Technology: Concepts and Advances” Satish Serial Publishing House, 2008.

PM6603 WATER TREATMENT AND MANAGEMENT

L	T	P	C
3	0	0	3

OBJECTIVE:

To focus on the wastewater transport system and the theory and design technique for the wastewater treatment process

UNIT I INTERNAL TREATMENT PROCESS 9

Character and properties – Water problem and solution – Water Sedimentation - Coagulation – Filtration – Disinfection – Theory, necessity, process, equipment, application, location, limitation.

UNIT II EXTERNAL TREATMENT PROCESS 9

Softening by Ion – exchange process, Demineralization – Cation exchange materials – Removal of ion, Manganese, odour, colour taste – Deaeration – Oxidation – Fluoridation – Dealkalisation – Desalination by Reverse osmosis.

UNIT III BOILER WATER AND COOLING WATER 9

Concept – Importance – Location – Commonly used desalination process – Distillation – Electrodialysis – Reverse osmosis – Freezing – Solar distillation- Purpose – Problem associated with water quality and equipment – Steam system fundamentals – Hot water closed system – Measurement and control of pH, corrosion, fouling – Microbial analysis – Ozone control – Study of microorganism – Energy efficient operations and maintenance.

UNIT IV WASTE WATER TREATMENT 9

Waste water in Industry- Home and Agriculture – Various waste water treatment processes – Optimization – Benefits and costs – Microbial and sanitation water treatment – Biofilm formation and removal – Microbial trend analysis – Pretreatment system and equipment.

UNIT V WATER MANAGEMENT IN INDIA 9

Water resources and planning – Water policy – Indian scene – Main aspects of water management – Hydrological cycle – Hydrosphere – Water transport – Water exchange – Causes and problems in irrigation, rural water, urban water – Water conservation resource management – Rain Harvesting.

TOTAL : 45 PERIODS

OUTCOMES:

The student will be able to

- Understand the relationship between the natural water cycle and human water use, principles of water resources planning and total water management;
- Understand the physical, chemical, and biological processes necessary for designing and managing drinking water treatment processes and water conveyance and distribution systems.
- Understand the physical, chemical, and biological processes necessary for designing and managing primary, secondary, tertiary and advanced wastewater treatment processes and solids handling systems.

TEXT BOOKS:

1. P.C.Bansil “Water Management in India”, Concept Publishing company, New Delhi, First Edition, 2004.
2. G.S.Bridie and J.S.Bridie “Water Supply and Sanitary Engineering”, Dhanpat Raj Publishing company (P) Ltd., New Delhi, 7th Edition, 2003.

REFERENCES:

1. Austin G.T., “Shreve’s Chemical Process Industries”, Fifth Edition, McGraw Hill, 1998.
2. S.C. Rangwala, “Water supply and Sanitary Engineering”, Eighteenth Edition, Charotar Publishing House, 2003.
3. Pandey G.N., “Text Book of Chemical Technology”, Vikas Publishing House Pvt. Ltd., New Delhi, 1992.

PY6016 BIOINFORMATICS AND COMPUTATIONAL BIOLOGY

L	T	P	C
3	0	0	3

OBJECTIVE:

To provide an advanced learning of the core principles and basics of Bioinformatics and enable students to acquire a specialized knowledge and perceptive of the selected aspects.

UNIT I **9**

Introduction to Operating systems, Linux commands, File transfer protocols ftp and telnet, Introduction to Bioinformatics and Computational Biology, Biological sequences, Biological databases, Genome specific databases, Data file formats, Data life cycle, Database management system models, Basics of Structured Query Language (SQL).

UNIT II **9**

Sequence Analysis, Pairwise alignment, Dynamic programming algorithms for computing edit distance, string similarity, shotgun DNA sequencing, end space free alignment. Multiple sequence alignment, Algorithms for Multiple sequence alignment, Generating motifs and profiles, Local and Global alignment, Needleman and Wunsch algorithm, Smith Waterman algorithm, BLAST, PSIBLAST and PHIBLAST algorithms.

UNIT III **8**

Introduction to phylogenetics, Distance based trees UPGMA trees, Molecular clock theory, Ultrametric trees, Parsimonious trees, Neighbour joining trees, trees based on morphological traits, Bootstrapping. Protein Secondary structure and tertiary structure prediction methods, Homology modeling, *abinitio* approaches, Threading, Critical Assessment of Structure Prediction, Structural genomics.

UNIT IV **11**

Machine learning techniques: Artificial Neural Networks in protein secondary structure prediction, Hidden Markov Models for gene finding, Decision trees, Support Vector Machines. Introduction to Systems Biology and Synthetic Biology, Microarray analysis, DNA computing, Bioinformatics approaches for drug discovery, Applications of informatics techniques in genomics and proteomics: Assembling the genome, STS content mapping for clone contigs, Functional annotation, Peptide mass fingerprinting.

UNIT V **8**

Basics of PERL programming for Bioinformatics: Datatypes: scalars and collections, operators, Program control flow constructs, Library Functions: String specific functions, User defined functions, File handling.

OUTCOME:

The student will be able to understand the principles and limitations of bioinformatics and Computational Biology.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Introduction to Bioinformatics by Arthur K. Lesk, Oxford University Press.
2. Algorithms on Strings, Trees and Sequences by Dan Gusfield, Cambridge University Press.
3. Biological Sequence Analysis Probabilistic Models of proteins and nucleic acids by R.Durbin, S.Eddy, A.Krogh, G.Mitchison.

REFERENCES:

1. Bioinformatics The Machine Learning Approach by Pierre Baldi and Soren Brunak, MIT Press.
2. Bioinformatics Sequence and Genome Analysis by David W.Mount, Cold Spring Harbor Laboratory Press.
3. Beginning Perl for Bioinformatics: An introduction to Perl for Biologists by James Tindall, O'Reilley Media

PC6601 PROCESS INSTRUMENTATION DYNAMICS AND CONTROL

L	T	P	C
3	0	0	3

OBJECTIVES:

- To enable the students to understand the design principles of control system
- To introduce dynamic response of open and closed loop systems, control loop components and stability of control systems along with instrumentation.

UNIT I INSTRUMENTATION 9

Principles of measurements and classification of process instruments, measurement of temperature, pressure, fluid flow, liquid weight and weight flow rate, viscosity, pH, concentration, electrical and thermal conductivity, humidity of gases.

UNIT II OPEN LOOP SYSTEMS 9

Laplace transformation, application to solve ODEs. Open-loop systems, first order systems and their transient response for standard input functions, first order systems in series, linearization and its application in process control, second order systems and their dynamics; transportation lag.

UNIT III CLOSED LOOP SYSTEMS 9

Closed loop control systems, development of block diagram for feed-back control systems, servo and regulatory problems, transfer function for controllers and final control element, principles of pneumatic and electronic controllers, transient response of closed-loop control systems and their stability

UNIT IV FREQUENCY RESPONSE 9

Introduction to frequency response of closed-loop systems, control system design by frequency response techniques, Bode diagram, stability criterion, tuning of controller settings

UNIT V ADVANCED CONTROL SYSTEMS 9

Introduction to advanced control systems, cascade control, feed forward control, Smith predictor controller, control of distillation towers and heat exchangers, introduction to computer control of chemical processes

TOTAL : 45 PERIODS

OUTCOMES:

Upon completion of this course, the students would be able

- To demonstrate the mathematical knowledge in designing a control system
- To Identify the control configuration for a given process
- To apply the control mechanism for process control problems
- To explain and apply their knowledge of process control in instruments, process and various operations.

TEXT BOOKS:

1. Stephanopoulos, G., “Chemical Process Control“, Prentice Hall of India, 2003
2. Coughnowr, D., “ Process Systems Analysis and Control “, 2nd Edn., McGraw Hill,New York, 1991.

REFERENCES:

1. Marlin, T. E., “Process Control “, 2nd Edn, McGraw Hill, New York, 2000.
2. Smith, C. A. and Corripio, A. B., “Principles and Practice of Automatic Process Control”, 2nd Edn., John Wiley, New York, 1997.
3. Singh S.K., “Industrial Instrumentation and Control” Tata McGraw Hill, 2nd Edition, 2007

PY6017	PROCESS CALCULATIONS	L T P C 3 0 0 3

OBJECTIVE:

To introduce the basic calculation techniques, both computerized and by hand, for analyzing and designing chemical processing equipment with the help of Data sources containing relevant physical and chemical properties.

UNIT I STOICHIOMETRY 9

Introduction – Units and dimensions – Stoichiometric principles – Composition relations – Density and specific gravity.

UNIT II IDEAL GASES AND VAPOR PRESSURE 9

Behavior of ideal gases – Application of ideal gas law – Gaseous mixtures – Volume changes with change in composition – Vapor pressure – Effect of temperature on vapour pressure – Vapor pressure plots – Vapor pressure of immiscible liquids – Solutions.

UNIT III HUMIDITY AND SOLUBILITY 9

Humidity – Saturation – Vaporization – Condensation – Wet and dry bulb thermometry – Solubility and crystallization – Dissolution – Solubility of gases.

UNIT IV MATERIAL BALANCE 9

Material balance – Processes involving chemical reaction – Combustion of coal, fuel gases and sulphur – Recycling operations – Bypassing streams – Degree of conversion – Excess reactant – Limiting reactant.

UNIT V ENERGY BALANCE 9

Thermo chemistry – Calculation of heat of reaction at other temperatures – Hess's law of summation – Heat of formation, reaction, mixing, combustion – Mean specific heat – Theoretical flame temperature.

TOTAL : 45 PERIODS

OUTCOMES:

The student will be able to

- Carry out design calculations for processes involving separation operations.
- Carry out material and energy balance calculations for reaction and separation processes by hand or using a computer package as appropriate.
- Analyze the behavior of recycle processes, performing approximate material balances by hand, and setting up calculations for rigorous solution by computer.

TEXT BOOKS:

1. Bhatt, B.I. and Vora, S.M., "Stoichiometry", 4th Edition, Tata McGraw Hill Publishers Ltd, 2005.
2. Hougen, O.A., Watson, K.M. and Ragatz, R.A., "Chemical Process Principles", Vol.I, CBS Publishers and Distributors, 1995.

REFERENCES:

1. Venkataramani, V. and Anantharaman, N., "Process Calculations", Prentice Hall of India (P) Ltd, 2003.
2. Himmelblau, D., "Basic Principles and Calculations in Chemical Engineering", 6th Edition, Prentice Hall of India Ltd, 2000.
3. Chopey, N.P. and Hicks, T.G., "Handbook of Chemical Engineering Calculations", 2nd Edition, McGraw-Hill Inc, 1984.