

**AFFILIATED INSTITUTIONS**  
**ANNA UNIVERSITY**  
**R - 2008**  
**B.TECH. PHARMACEUTICAL TECHNOLOGY**  
**II TO VIII SEMESTERS CURRICULA & SYLLABI**

**SEMESTER II**

(Common to all B. E. / B. Tech. Degree Programmes except B. E. – Marine Engineering)

SL. No.	COURSE CODE	COURSE TITLE	L	T	P	C
<b>THEORY</b>						
1.	HS2161	<u>Technical English – II*</u>	3	1	0	4
2.	MA2161	<u>Mathematics – II*</u>	3	1	0	4
3.	PH2161	<u>Engineering Physics – II*</u>	3	0	0	3
4.	CY2161	<u>Engineering Chemistry – II*</u>	3	0	0	3
5. a	ME2151	<u>Engineering Mechanics</u> <b>(For non-circuit branches)</b>	3	1	0	4
5. b	EE2151	<u>Circuit Theory</u> <b>(For branches under Electrical Faculty)</b>	3	1	0	4
5. c	EC2151	<u>Electric Circuits and Electron Devices</u> <b>(For branches under I &amp; C Faculty)</b>				
6. a	GE2151	<u>Basic Electrical &amp; Electronics Engineering</u> <b>(For non-circuit branches)</b>	4	0	0	4
6. b	GE2152	<u>Basic Civil &amp; Mechanical Engineering</u> <b>(For circuit branches)</b>	4	0	0	4
<b>PRACTICALS</b>						
7.	GE2155	<u>Computer Practice Laboratory-II*</u>	0	1	2	2
8.	GS2165	<u>Physics &amp; Chemistry Laboratory - II*</u>	0	0	3	2
9. a	ME2155	<u>Computer Aided Drafting and Modeling Laboratory</u> <b>(For non-circuits branches)</b>	0	1	2	2
9. b	EE2155	<u>Electrical Circuits Laboratory</u> <b>(For branches under Electrical Faculty)</b>	0	0	3	2
9. c	EC2155	<u>Circuits and Devices Laboratory</u> <b>(For branches under I &amp; C Faculty)</b>	0	0	3	2
<b>TOTAL : 28 CREDITS</b>						
10.	-	<u>English Language Laboratory</u> <sup>+</sup>	0	0	2	-

## **A. CIRCUIT BRANCHES**

### **I Faculty of Electrical Engineering**

1. B.E. Electrical and Electronics Engineering
2. B.E. Electronics and Instrumentation Engineering
3. B.E. Instrumentation and Control Engineering

### **II Faculty of Information and Communication Engineering**

1. B.E. Computer Science and Engineering
2. B.E. Electronics and Communication Engineering
3. B.E. Bio Medical Engineering
4. B.Tech. Information Technology

## **B. NON – CIRCUIT BRANCHES**

### **I Faculty of Civil Engineering**

1. B.E. Civil Engineering

### **II Faculty of Mechanical Engineering**

1. B.E. Aeronautical Engineering
2. B.E. Automobile Engineering
3. B.E. Marine Engineering
4. B.E. Mechanical Engineering
5. B.E. Production Engineering

### **III Faculty of Technology**

1. B.Tech. Chemical Engineering
2. B.Tech. Biotechnology
3. B.Tech. Polymer Technology
4. B.Tech. Textile Technology
5. B.Tech. Textile Technology (Fashion Technology)
6. B.Tech. Petroleum Engineering
7. B.Tech. Plastics Technology

### SEMESTER III

S.No.	Subject Code	Subject	L	T	P	C
<b>Theory</b>						
1	MA3202	<u>Transforms and Partial Differential Equations</u>	3	1	0	4
2	PY3201	<u>Pharmaceutical Organic Chemistry</u>	4	0	0	4
3	GE3213	<u>Environmental Science and Engineering</u>	3	0	0	3
4	PY3202	<u>Physical Pharmaceutics</u>	4	0	0	4
5	CH3225	<u>Process Calculations</u>	4	0	0	4
6	CE3214	<u>Fluid Flow Operations</u>	4	0	0	4
<b>Practical</b>						
7	PY3205	<u>Pharmaceutical Organic Chemistry Laboratory</u>	0	0	3	2
8	PY3206	<u>Physical Pharmaceutics Laboratory</u>	0	0	3	2
9	CE3221	<u>Fluid Flow Operations Laboratory</u>	0	0	3	2
		<b>Total</b>	<b>22</b>	<b>0</b>	<b>9</b>	<b>29</b>

### SEMESTER IV

S.No.	Subject Code	Subject	L	T	P	C
<b>Theory</b>						
1	MA3021	<u>Numerical Methods</u>	3	1	0	4
2	PY3211	<u>Biochemistry</u>	3	0	0	3
3	PY3212	<u>Microbiology</u>	3	1	0	4
4	PY3213	<u>Regulatory Requirements in Pharmaceutical Industries</u>	3	0	0	3
5	CH3226	<u>Heat Transfer</u>	4	0	0	4
6	CH3227	<u>Chemical Engineering Operations</u>	4	0	0	4
<b>Practical</b>						
7	PY3216	<u>Microbiology Laboratory</u>	0	0	3	2
8	PY3217	<u>Biochemistry Laboratory</u>	0	0	3	2
9	CH3228	<u>Heat Transfer Laboratory</u>	0	0	3	2
		<b>TOTAL</b>	<b>20</b>	<b>2</b>	<b>9</b>	<b>28</b>

### SEMESTER V

S.No.	Subject Code	Subject	L	T	P	C
<b>Theory</b>						
1	PY3301	<u>Pharmaceutical Chemistry</u>	3	1	0	4
2	PY3302	<u>Pharmaceutical Dosage Forms</u>	4	0	0	4
3	PY3303	<u>Pharmacology</u>	3	0	0	3
4	PC3304	<u>Engineering Thermodynamics</u>	4	0	0	4
5	CH3325	<u>Chemical Reaction Engineering</u>	4	0	0	4
6	CH3306	<u>Process Instrumentation</u>	4	0	0	4
<b>Practical</b>						
7	PY3307	<u>Pharmaceutical Chemistry Laboratory</u>	0	0	3	2
8	PY3308	<u>Pharmaceutical Dosage Forms Laboratory</u>	0	0	3	2
9	CH3309	<u>Chemical Reaction Engineering Laboratory</u>	0	0	3	2
		<b>TOTAL</b>	<b>22</b>	<b>1</b>	<b>9</b>	<b>29</b>

### SEMESTER VI

S.No.	Subject Code	Subject	L	T	P	C
<b>Theory</b>						
1	PY3311	<u>Instrumental Methods of Pharmaceutical Analysis</u>	3	1	0	4
2	PY3312	<u>Separation Technology</u>	3	0	0	3
3	PY3313	<u>Process Equipment Design</u>	4	0	0	4
4	CH3314	<u>Mass Transfer Operations</u>	4	0	0	4
5	CS3315	<u>Object Oriented Programming</u>	3	0	0	3
6	E1****	Elective I	3	0	0	3
<b>Practical</b>						
7	PY3316	<u>Instrumental Methods of Pharmaceutical Analysis Laboratory</u>	0	0	3	2
8	CH3317	<u>Mass Transfer Laboratory</u>	0	0	3	2
9	GE3318	<u>Communication and Soft Skills Laboratory</u>	0	0	2	1
		<b>TOTAL</b>	<b>20</b>	<b>1</b>	<b>8</b>	<b>26</b>

### SEMESTER VII

S.No.	Subject Code	Subject	L	T	P	C
<b>Theory</b>						
1	<b>PY3401</b>	<u>Advanced Medicinal Chemistry</u>	3	1	0	4
2	<b>PY3402</b>	<u>Novel Drug Delivery System</u>	4	0	0	4
3	<b>PY3403</b>	<u>Pharmaceutical Biotechnology</u>	4	0	0	4
4	<b>CH3404</b>	<u>Process Dynamics and Control</u>	4	0	0	4
5	<b>CH3405</b>	<u>Technology of Fine Chemicals and Bulk Drugs</u>	4	0	0	4
6	<b>E2****</b>	Elective II	3	0	0	3
<b>Practical</b>						
7	<b>PY3406</b>	<u>Advanced Medicinal Chemistry Laboratory</u>	0	0	3	2
8	<b>PY3407</b>	<u>Novel Drug Delivery System Laboratory</u>	0	0	3	2
9	<b>CH3408</b>	<u>Process Dynamics and Control Laboratory</u>	0	0	3	2
<b>TOTAL</b>			<b>22</b>	<b>1</b>	<b>9</b>	<b>29</b>

### SEMESTER VIII

S.No.	Subject Code	SUBJECT	L	T	P	C
<b>Theory</b>						
1	<b>CH3411</b>	<u>Unit Processes in Organic Synthesis</u>	4	0	0	4
2	<b>GE3403</b>	<u>Total Quality Management</u>	3	0	0	3
3	<b>E3****</b>	Elective III	3	0	0	3
<b>PRACTICAL</b>						
4	<b>PY3412</b>	<u>Project Work</u>	0	0	12	12
<b>TOTAL</b>			<b>10</b>	<b>0</b>	<b>12</b>	<b>22</b>

**ELECTIVE I**

S.No.	Subject Code	Subject	L	T	P	C
<b>THEORY</b>						
1	<b>PY3001</b>	<u>Solid Dosage Form Technology</u>	3	0	0	3
2	<b>PY3002</b>	<u>Herbal Technology</u>	3	0	0	3
3	<b>PY3003</b>	<u>Pharmaceutical Production Management</u>	3	0	0	3
4	<b>PY3004</b>	<u>Industrial Management</u>	3	0	0	3

**ELECTIVE II**

S.No.	Subject Code	Subject	L	T	P	C
<b>THEORY</b>						
1	<b>PY3005</b>	<u>Water Treatment and Management</u>	3	0	0	3
2	<b>PY3006</b>	<u>Validation in Pharmaceutical Industries</u>	3	0	0	3
3	<b>PY3007</b>	<u>Natural Products Chemistry</u>	3	0	0	3
4	<b>PY3008</b>	<u>Materials Science and Technology</u>	3	0	0	3

**ELECTIVE III**

S.No.	Subject Code	Subject	L	T	P	C
<b>THEORY</b>						
1	<b>PY3009</b>	<u>Pharmaceutical Packaging Technology</u>	3	0	0	3
2	<b>PY3010</b>	<u>Pilot Plant and Scale up Methods</u>	3	0	0	3
3	<b>PY3011</b>	<u>Drugs Through Biotechnology</u>	3	0	0	3
4	<b>MG3012</b>	<u>Safety and Risk Management</u>	3	0	0	3

**AIM**

To encourage students to actively involve in participative learning of English and to help them acquire Communication Skills.

**OBJECTIVES**

- To help students develop listening skills for academic and professional purposes.
- To help students acquire the ability to speak effectively in English in real-life situations.
- To inculcate reading habit and to develop effective reading skills.
- To help students improve their active and passive vocabulary.
- To familiarize students with different rhetorical functions of scientific English.
- To enable students write letters and reports effectively in formal and business situations.

**UNIT I****12**

Technical Vocabulary - meanings in context, sequencing words, Articles- Prepositions, intensive reading& predicting content, Reading and interpretation, extended definitions, Process description

**Suggested activities:**

1. Exercises on word formation using the prefix 'self' - Gap filling with preposition.
2. Exercises - Using sequence words.
3. Reading comprehension exercise with questions based on inference – Reading headings
4. and predicting the content – Reading advertisements and interpretation.
5. Writing extended definitions – Writing descriptions of processes – Writing paragraphs based on discussions – Writing paragraphs describing the future.

**UNIT II****12**

Phrases / Structures indicating use / purpose – Adverbs-Skimming – Non-verbal communication - Listening – correlating verbal and non-verbal communication -Speaking in group discussions – Formal Letter writing – Writing analytical paragraphs.

**Suggested activities:**

1. Reading comprehension exercises with questions on overall content – Discussions analyzing stylistic features (creative and factual description) - Reading comprehension exercises with texts including graphic communication - Exercises in interpreting non-verbal communication.
2. Listening comprehension exercises to categorise data in tables.
3. Writing formal letters, quotations, clarification, complaint – Letter seeking permission for Industrial visits– Writing analytical paragraphs on different debatable issues.

**UNIT III****12**

Cause and effect expressions – Different grammatical forms of the same word - Speaking – stress and intonation, Group Discussions - Reading – Critical reading - Listening, - Writing – using connectives, report writing – types, structure, data collection, content, form, recommendations .

**Suggested activities:**

1. Exercises combining sentences using cause and effect expressions – Gap filling exercises using the appropriate tense forms – Making sentences using different grammatical forms of the same word. ( Eg: object –verb / object – noun )
2. Speaking exercises involving the use of stress and intonation – Group discussions– analysis of problems and offering solutions.
3. Reading comprehension exercises with critical questions, Multiple choice question.
4. Sequencing of jumbled sentences using connectives – Writing different types of reports like industrial accident report and survey report – Writing recommendations.

**UNIT IV****12**

Numerical adjectives – Oral instructions – Descriptive writing – Argumentative paragraphs – Letter of application - content, format (CV / Bio-data) - Instructions, imperative forms - Checklists, Yes/No question form – E-mail communication.

**Suggested Activities:**

1. Rewriting exercises using numerical adjectives.
2. Reading comprehension exercises with analytical questions on content – Evaluation of content.
3. Listening comprehension – entering information in tabular form, intensive listening exercise and completing the steps of a process.
4. Speaking - Role play – group discussions – Activities giving oral instructions.
5. Writing descriptions, expanding hints – Writing argumentative paragraphs – Writing formal letters – Writing letter of application with CV/Bio-data – Writing general and safety instructions – Preparing checklists – Writing e-mail messages.

**UNIT V****9**

Speaking - Discussion of Problems and solutions - Creative and critical thinking – Writing an essay, Writing a proposal.

**Suggested Activities:**

1. Case Studies on problems and solutions
2. Brain storming and discussion
3. Writing Critical essays
4. Writing short proposals of 2 pages for starting a project, solving problems, etc.
5. Writing advertisements.

**TOTAL: 60 PERIODS****TEXT BOOK**

1. Chapters 5 – 8. Department of Humanities & Social Sciences, Anna University, 'English for Engineers and Technologists' Combined Edition (Volumes 1 & 2), Chennai: Orient Longman Pvt. Ltd., 2006. Themes 5 – 8 (Technology, Communication, Environment, Industry)

**REFERENCES**

1. P. K. Dutt, G. Rajeevan and C.L.N Prakash, 'A Course in Communication Skills',



- Cambridge University Press, India 2007.
2. Krishna Mohan and Meera Banerjee, 'Developing Communication Skills', Macmillan India Ltd., (Reprinted 1994 – 2007).
  3. Edgar Thorpe, Showick Thorpe, 'Objective English', Second Edition, Pearson Education, 2007.

**Extensive Reading:**

1. Robin Sharma, 'The Monk Who Sold His Ferrari', Jaico Publishing House, 2007

**Note:**

The book listed under Extensive Reading is meant for inculcating the reading habit of the students. They need not be used for testing purposes.

**MA2161**

**MATHEMATICS – II**

**L T P C  
3 1 0 4**

**UNIT I                    ORDINARY DIFFERENTIAL EQUATIONS                    12**

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 II                    VECTOR CALCULUS                    12**

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 parallelepipeds.

**UNIT III                    ANALYTIC FUNCTIONS                    12**

Functions of a complex variable – Analytic functions – Necessary conditions, Cauchy – Riemann equation and Sufficient conditions (excluding proofs) – Harmonic and orthogonal properties of analytic function – Harmonic conjugate – Construction of analytic functions – Conformal mapping :  $w = z+c$ ,  $cz$ ,  $1/z$ , and bilinear transformation.

**UNIT IV                    COMPLEX INTEGRATION                    12**

Complex integration – Statement and applications of Cauchy's integral theorem and Cauchy's integral formula – Taylor and Laurent expansions – Singular points – Residues – Residue theorem – Application of residue theorem to evaluate real integrals – Unit circle and semi-circular contour(excluding poles on boundaries).

**UNIT V                    LAPLACE TRANSFORM                    12**

Laplace transform – Conditions for existence – Transform of elementary functions – Basic properties – Transform of derivatives and integrals – Transform of unit step function and impulse functions – Transform of periodic functions.

Definition of Inverse Laplace transform as contour integral – Convolution theorem (excluding proof) – Initial and Final value theorems – Solution of linear ODE of second order with constant coefficients using Laplace transformation techniques.

**TOTAL : 60 PERIODS**

**TEXT BOOKS**

1. Bali N. P and Manish Goyal, "Text book of Engineering Mathematics", 3<sup>rd</sup> Edition, Laxmi Publications (p) Ltd., (2008).
2. Grewal. B.S, "Higher Engineering Mathematics", 40<sup>th</sup> Edition, Khanna Publications, Delhi, (2007).

**REFERENCES**

1. Ramana B.V, "Higher Engineering Mathematics", Tata McGraw Hill Publishing Company, New Delhi, (2007).
2. Glyn James, "Advanced Engineering Mathematics", 3<sup>rd</sup> Edition, Pearson Education, (2007).
3. Erwin Kreyszig, "Advanced Engineering Mathematics", 7<sup>th</sup> Edition, Wiley India, (2007).
4. Jain R.K and Iyengar S.R.K, "Advanced Engineering Mathematics", 3<sup>rd</sup> Edition, Narosa Publishing House Pvt. Ltd., (2007).

**PH2161**

**ENGINEERING PHYSICS – II**

**L T P C**  
**3 0 0 3**

**UNIT I CONDUCTING MATERIALS 9**

Conductors – classical free electron theory of metals – Electrical and thermal conductivity – Wiedemann – Franz law – Lorentz number – Draw backs of classical theory – Quantum theory – Fermi distribution function – Effect of temperature on Fermi Function – Density of energy states – carrier concentration in metals.

**UNIT II SEMICONDUCTING MATERIALS 9**

Intrinsic semiconductor – carrier concentration derivation – Fermi level – Variation of Fermi level with temperature – electrical conductivity – band gap determination – extrinsic semiconductors – carrier concentration derivation in n-type and p-type semiconductor – variation of Fermi level with temperature and impurity concentration – compound semiconductors – Hall effect – Determination of Hall coefficient – Applications.

**UNIT III MAGNETIC AND SUPERCONDUCTING MATERIALS 9**

Origin of magnetic moment – Bohr magneton – Dia and para magnetism – Ferro magnetism – Domain theory – Hysteresis – soft and hard magnetic materials – anti – ferromagnetic materials – Ferrites – applications – magnetic recording and readout – storage of magnetic data – tapes, floppy and magnetic disc drives.

Superconductivity : properties - Types of super conductors – BCS theory of superconductivity(Qualitative) - High T<sub>c</sub> superconductors – Applications of superconductors – SQUID, cryotron, magnetic levitation.

**UNIT IV DIELECTRIC MATERIALS 9**

Electrical susceptibility – dielectric constant – electronic, ionic, orientational and space charge polarization – frequency and temperature dependence of polarisation – internal field – Clausius – Mosotti relation (derivation) – dielectric loss – dielectric breakdown – uses of dielectric materials (capacitor and transformer) – ferroelectricity and applications.

**UNIT V MODERN ENGINEERING MATERIALS 9**

Metallic glasses: preparation, properties and applications.

Shape memory alloys (SMA): Characteristics, properties of NiTi alloy, application, advantages and disadvantages of SMA

Nanomaterials: synthesis –plasma arcing – chemical vapour deposition – sol-gels – electrodeposition – ball milling - properties of nanoparticles and applications.

Carbon nanotubes: fabrication – arc method – pulsed laser deposition – chemical vapour deposition - structure – properties and applications.

**TOTAL : 45 PERIODS**

**TEXT BOOKS**

1. Charles Kittel ‘ Introduction to Solid State Physics’, John Wiley & sons, 7<sup>th</sup> edition, Singapore (2007)
2. Charles P. Poole and Frank J.Owren, ‘Introduction to Nanotechnology’, Wiley India(2007) (for Unit V)

**REFERENCES**

1. Rajendran, V, and Marikani A, ‘Materials science’Tata McGraw Hill publications, (2004) New delhi.
2. Jayakumar, S. ‘Materials science’, R.K. Publishers, Coimbatore, (2008).
3. Palanisamy P.K, ‘Materials science’, Scitech publications(India) Pvt. LTd., Chennai, second Edition(2007)
4. M. Arumugam, ‘Materials Science’ Anuradha publications, Kumbakonam, (2006).

**CY2161**

**ENGINEERING CHEMISTRY – II**

**L T P C  
3 0 0 3**

**AIM**

To impart a sound knowledge on the principles of chemistry involving the different application oriented topics required for all engineering branches.

**OBJECTIVES**

- The student should be conversant with the principles electrochemistry, electrochemical cells, emf and applications of emf measurements.
- Principles of corrosion control
- Chemistry of Fuels and combustion
- Industrial importance of Phase rule and alloys
- Analytical techniques and their importance.

**UNIT I ELECTROCHEMISTRY 9**

Electrochemical cells – reversible and irreversible cells – EMF – measurement of emf – Single electrode potential – Nernst equation (problem) – reference electrodes – Standard Hydrogen electrode – Calomel electrode – Ion selective electrode – glass electrode and measurement of pH – electrochemical series – significance – potentiometer titrations (redox -  $\text{Fe}^{2+}$  vs dichromate and precipitation –  $\text{Ag}^+$  vs  $\text{Cl}^-$  titrations) and conductometric titrations (acid-base – HCl vs, NaOH) titrations,

**UNIT II CORROSION AND CORROSION CONTROL 9**

Chemical corrosion – Pitting – Bedworth rule – electrochemical corrosion – different types – galvanic corrosion – differential aeration corrosion – factors influencing corrosion – corrosion control – sacrificial anode and impressed cathodic current methods – corrosion inhibitors – protective coatings – paints – constituents and functions – metallic coatings – electroplating (Au) and electroless (Ni) plating.

**UNIT III FUELS AND COMBUSTION 9**

Calorific value – classification – Coal – proximate and ultimate analysis metallurgical coke – manufacture by Otto-Hoffmann method – Petroleum processing and fractions – cracking – catalytic cracking and methods-knocking – octane number and cetane number – synthetic petrol – Fischer Tropsch and Bergius processes – Gaseous fuels-water gas, producer gas, CNG and LPG, Flue gas analysis – Orsat apparatus – theoretical air for combustion.

**UNIT IV PHASE RULE AND ALLOYS 9**

Statement and explanation of terms involved – one component system – water system – condensed phase rule – construction of phase diagram by thermal analysis – simple eutectic systems (lead-silver system only) – alloys – importance, ferrous alloys – nichrome and stainless steel – heat treatment of steel, non-ferrous alloys – brass and bronze.

**UNIT V ANALYTICAL TECHNIQUES 9**

Beer-Lambert's law (problem) – UV-visible spectroscopy and IR spectroscopy – principles – instrumentation (problem) (block diagram only) – estimation of iron by colorimetry – flame photometry – principle – instrumentation (block diagram only) – estimation of sodium by flame photometry – atomic absorption spectroscopy – principles – instrumentation (block diagram only) – estimation of nickel by atomic absorption spectroscopy.

**TOTAL: 45 PERIODS**

**TEXT BOOKS**

1. P.C.Jain and Monica Jain, "Engineering Chemistry" Dhanpat Rai Pub, Co., New Delhi (2002).
2. S.S.Dara "A text book of Engineering Chemistry" S.Chand & Co.Ltd., New Delhi (2006).

**REFERENCES**

1. B.Sivasankar "Engineering Chemistry" Tata McGraw-Hill Pub.Co.Ltd, New Delhi (2008).
2. B.K.Sharma "Engineering Chemistry" Krishna Prakasan Media (P) Ltd., Meerut (2001).



## TEXT BOOK

1. Beer, F.P and Johnson Jr. E.R. "Vector Mechanics for Engineers", Vol. 1 Statics and Vol. 2 Dynamics, McGraw-Hill International Edition, (1997).

## REFERENCES

1. Rajasekaran, S, Sankarasubramanian, G., "Fundamentals of Engineering Mechanics", Vikas Publishing House Pvt. Ltd., (2000).
2. Hibbeler, R.C., "Engineering Mechanics", Vol. 1 Statics, Vol. 2 Dynamics, Pearson Education Asia Pvt. Ltd., (2000).
3. Palanichamy, M.S., Nagam, S., "Engineering Mechanics – Statics & Dynamics", Tata McGraw-Hill, (2001).
4. Irving H. Shames, "Engineering Mechanics – Statics and Dynamics", IV Edition – Pearson Education Asia Pvt. Ltd., (2003).
5. Ashok Gupta, "Interactive Engineering Mechanics – Statics – A Virtual Tutor (CDROM)", Pearson Education Asia Pvt., Ltd., (2002).

**EE2151**

### **CIRCUIT THEORY**

**L T P C**

(Common to EEE, EIE and ICE Branches)

**3 1 0 4**

#### **UNIT I BASIC CIRCUITS ANALYSIS**

**12**

Ohm's Law – Kirchoffs laws – DC and AC Circuits – Resistors in series and parallel circuits – Mesh current and node voltage method of analysis for D.C and A.C. circuits.

#### **UNIT II NETWORK REDUCTION AND NETWORK THEOREMS FOR DC AND AC CIRCUITS**

**12**

Network reduction: voltage and current division, source transformation – star delta conversion.

Thevenins and Novton & Theorem – Superposition Theorem – Maximum power transfer theorem – Reciprocity Theorem.

#### **UNIT III RESONANCE AND COUPLED CIRCUITS**

**12**

Series and paralled resonance – their frequency response – Quality factor and Bandwidth - Self and mutual inductance – Coefficient of coupling – Tuned circuits – Single tuned circuits.

#### **UNIT IV TRANSIENT RESPONSE FOR DC CIRCUITS**

**12**

Transient response of RL, RC and RLC Circuits using Laplace transform for DC input and A.C. with sinusoidal input.

#### **UNIT V ANALYSING THREE PHASE CIRCUITS**

**12**

Three phase balanced / unbalanced voltage sources – analysis of three phase 3-wire and 4-wire circuits with star and delta connected loads, balanced & un balanced – phasor diagram of voltages and currents – power and power factor measurements in three phase circuits.

**TOTAL : 60 PERIODS**

## TEXT BOOKS

1. William H. Hayt Jr, Jack E. Kemmerly and Steven M. Durbin, "Engineering Circuits Analysis", Tata McGraw Hill publishers, 6<sup>th</sup> edition, New Delhi, (2002).
2. Sudhakar A and Shyam Mohan SP, "Circuits and Network Analysis and Synthesis", Tata McGraw Hill, (2007).

## REFERENCES

1. Paranjothi SR, "Electric Circuits Analysis," New Age International Ltd., New Delhi, (1996).
2. Joseph A. Edminister, Mahmood Nahri, "Electric circuits", Schaum's series, Tata McGraw-Hill, New Delhi (2001).
3. Chakrabati A, "Circuits Theory (Analysis and synthesis), Dhanpath Rai & Sons, New Delhi, (1999).
4. Charles K. Alexander, Mathew N.O. Sadik, "Fundamentals of Electric Circuits", Second Edition, McGraw Hill, (2003).

**EC2151**                      **ELECTRIC CIRCUITS AND ELECTRON DEVICES**                      **L T P C**  
(For ECE, CSE, IT and Biomedical Engg. Branches)                      **3 1 0 4**

**UNIT I**                      **CIRCUIT ANALYSIS TECHNIQUES**                      **12**  
Kirchoff's current and voltage laws – series and parallel connection of independent sources – R, L and C – Network Theorems – Thevenin, Superposition, Norton, Maximum power transfer and duality – Star-delta conversion.

**UNIT II**                      **TRANSIENT RESONANCE IN RLC CIRCUITS**                      **12**  
Basic RL, RC and RLC circuits and their responses to pulse and sinusoidal inputs – frequency response – Parallel and series resonances – Q factor – single tuned and double tuned circuits.

**UNIT III**                      **SEMICONDUCTOR DIODES**                      **12**  
Review of intrinsic & extrinsic semiconductors – Theory of PN junction diode – Energy band structure – current equation – space charge and diffusion capacitances – effect of temperature and breakdown mechanism – Zener diode and its characteristics.

**UNIT IV**                      **TRANSISTORS**                      **12**  
Principle of operation of PNP and NPN transistors – study of CE, CB and CC configurations and comparison of their characteristics – Breakdown in transistors – operation and comparison of N-Channel and P-Channel JFET – drain current equation – MOSFET – Enhancement and depletion types – structure and operation – comparison of BJT with MOSFET – thermal effect on MOSFET.

**UNIT V SPECIAL SEMICONDUCTOR DEVICES (Qualitative Treatment only) 12**  
Tunnel diodes – PIN diode, varactor diode – SCR characteristics and two transistor equivalent model – UJT – Diac and Triac – Laser, CCD, Photodiode, Phototransistor, Photoconductive and Photovoltaic cells – LED, LCD.

**TOTAL : 60 PERIODS**

**TEXT BOOKS**

1. Joseph A. Edminister, Mahmood, Nahri, "Electric Circuits" – Shaum series, Tata McGraw Hill, (2001)
2. S. Salivahanan, N. Suresh kumar and A. Vallavanraj, "Electronic Devices and Circuits", Tata McGraw Hill, 2<sup>nd</sup> Edition, (2008).
3. David A. Bell, "Electronic Devices and Circuits", Oxford University Press, 5<sup>th</sup> Edition, (2008).

**REFERENCES**

1. Robert T. Paynter, "Introducing Electronics Devices and Circuits", Pearson Education, 7<sup>th</sup> Edition, (2006).
2. William H. Hayt, J.V. Jack, E. Kemmebly and Steven M. Durbin, "Engineering Circuit Analysis", Tata McGraw Hill, 6<sup>th</sup> Edition, 2002.
3. J. Millman & Halkins, Satyabranta Jit, "Electronic Devices & Circuits", Tata McGraw Hill, 2<sup>nd</sup> Edition, 2008.

**GE2151 BASIC ELECTRICAL AND ELECTRONICS ENGINEERING L T P C**  
(Common to branches under Civil, Mechanical and Technology faculty) **4 0 0 4**

**UNIT I ELECTRICAL CIRCUITS & MEASUREMENTS 12**  
Ohm's Law – Kirchoff's Laws – Steady State Solution of DC Circuits – Introduction to AC Circuits – Waveforms and RMS Value – Power and Power factor – Single Phase and Three Phase Balanced Circuits.

Operating Principles of Moving Coil and Moving Iron Instruments (Ammeters and Voltmeters), Dynamometer type Watt meters and Energy meters.

**UNIT II ELECTRICAL MECHANICS 12**  
Construction, Principle of Operation, Basic Equations and Applications of DC Generators, DC Motors, Single Phase Transformer, single phase induction Motor.

**UNIT III SEMICONDUCTOR DEVICES AND APPLICATIONS 12**  
Characteristics of PN Junction Diode – Zener Effect – Zener Diode and its Characteristics – Half wave and Full wave Rectifiers – Voltage Regulation.

Bipolar Junction Transistor – CB, CE, CC Configurations and Characteristics – Elementary Treatment of Small Signal Amplifier.



**UNIT IV DIGITAL ELECTRONICS 12**  
Binary Number System – Logic Gates – Boolean Algebra – Half and Full Adders – Flip-Flops – Registers and Counters – A/D and D/A Conversion (single concepts)

**UNIT V FUNDAMENTALS OF COMMUNICATION ENGINEERING 12**  
Types of Signals: Analog and Digital Signals – Modulation and Demodulation: Principles of Amplitude and Frequency Modulations.

Communication Systems: Radio, TV, Fax, Microwave, Satellite and Optical Fibre (Block Diagram Approach only).

**TOTAL : 60 PERIODS**

**TEXT BOOKS**

1. V.N. Mittle “Basic Electrical Engineering”, Tata McGraw Hill Edition, New Delhi, 1990.
2. R.S. Sedha, “Applied Electronics” S. Chand & Co., 2006.

**REFERENCES**

1. Muthusubramanian R, Salivahanan S and Muraleedharan K A, “Basic Electrical, Electronics and Computer Engineering”, Tata McGraw Hill, Second Edition, (2006).
2. Nagsarkar T K and Sukhija M S, “Basics of Electrical Engineering”, Oxford press (2005).
3. Mehta V K, “Principles of Electronics”, S.Chand & Company Ltd, (1994).
4. Mahmood Nahvi and Joseph A. Edminister, “Electric Circuits”, Schaum’ Outline Series, McGraw Hill, (2002).
5. Premkumar N, “Basic Electrical Engineering”, Anuradha Publishers, (2003).

**GE2152 BASIC CIVIL & MECHANICAL ENGINEERING L T P C**  
(Common to branches under Electrical and I & C Faculty) **4 0 0 4**

**A – CIVIL ENGINEERING**

**UNIT I SURVEYING AND CIVIL ENGINEERING MATERIALS 15**  
**Surveying:** Objects – types – classification – principles – measurements of distances – angles – leveling – determination of areas – illustrative examples.

**Civil Engineering Materials:** Bricks – stones – sand – cement – concrete – steel sections.

**UNIT II BUILDING COMPONENTS AND STRUCTURES 15**  
**Foundations:** Types, Bearing capacity – Requirement of good foundations.

**Superstructure:** Brick masonry – stone masonry – beams – columns – lintels – roofing – flooring – plastering – Mechanics – Internal and external forces – stress – strain – elasticity – Types of Bridges and Dams – Basics of Interior Design and Landscaping.

**TOTAL: 30 PERIODS**

**B – MECHANICAL ENGINEERING**

**UNIT III POWER PLANT ENGINEERING 10**

Introduction, Classification of Power Plants – Working principle of steam, Gas, Diesel, Hydro-electric and Nuclear Power plants – Merits and Demerits – Pumps and turbines – working principle of Reciprocating pumps (single acting and double acting) – Centrifugal Pump.

**UNIT IV I C ENGINES 10**

Internal combustion engines as automobile power plant – Working principle of Petrol and Diesel Engines – Four stroke and two stroke cycles – Comparison of four stroke and two stroke engines – Boiler as a power plant.

**UNIT V REFRIGERATION AND AIR CONDITIONING SYSTEM 10**

Terminology of Refrigeration and Air Conditioning. Principle of vapour compression and absorption system – Layout of typical domestic refrigerator – Window and Split type room Air conditioner.

**TOTAL: 30 PERIODS**

**REFERENCES**

1. Shanmugam G and Palanichamy M S, “Basic Civil and Mechanical Engineering”, Tata McGraw Hill Publishing Co., New Delhi, (1996).
2. Ramamrutham. S, “Basic Civil Engineering”, Dhanpat Rai Publishing Co. (P) Ltd. (1999).
3. Seetharaman S. “Basic Civil Engineering”, Anuradha Agencies, (2005).
4. Venugopal K and Prahu Raja V, “Basic Mechanical Engineering”, Anuradha Publishers, Kumbakonam, (2000).
5. Shantha Kumar S R J., “Basic Mechanical Engineering”, Hi-tech Publications, Mayiladuthurai, (2000).

**GE2155 COMPUTER PRACTICE LABORATORY – II L T P C  
0 1 2 2**

**LIST OF EXPERIMENTS**

**1. UNIX COMMANDS 15**

Study of Unix OS - Basic Shell Commands - Unix Editor

**2. SHELL PROGRAMMING 15**

Simple Shell program - Conditional Statements - Testing and Loops

**3. C PROGRAMMING ON UNIX 15**

Dynamic Storage Allocation-Pointers-Functions-File Handling

**TOTAL : 45 PERIODS**

## HARDWARE / SOFTWARE REQUIREMENTS FOR A BATCH OF 30 STUDENTS

### Hardware

- . 1 UNIX Clone Server
- . 33 Nodes (thin client or PCs)
- . Printer – 3 Nos.

### Software

- . OS – UNIX Clone (33 user license or License free Linux)
- . Compiler - C

GS2165

PHYSICS LABORATORY – II

L T P C  
0 0 3 2

### LIST OF EXPERIMENTS

1. Determination of Young's modulus of the material – non uniform bending.
2. Determination of Band Gap of a semiconductor material.
3. Determination of specific resistance of a given coil of wire – Carey Foster Bridge.
4. Determination of viscosity of liquid – Poiseuille's method.
5. Spectrometer dispersive power of a prism.
6. Determination of Young's modulus of the material – uniform bending.
7. Torsional pendulum – Determination of rigidity modulus.

- A minimum of FIVE experiments shall be offered.
- Laboratory classes on alternate weeks for Physics and Chemistry.
- The lab examinations will be held only in the second semester.

GS2165

CHEMISTRY LABORATORY – II

L T P C  
0 0 3 2

### LIST OF EXPERIMENTS

1. Conduct metric titration (Simple acid base)
2. Conduct metric titration (Mixture of weak and strong acids)
3. Conduct metric titration using  $\text{BaCl}_2$  vs  $\text{Na}_2\text{SO}_4$
4. Potentiometric Titration ( $\text{Fe}^{2+}$  /  $\text{KMnO}_4$  or  $\text{K}_2\text{Cr}_2\text{O}_7$ )
5. PH titration (acid & base)
6. Determination of water of crystallization of a crystalline salt (Copper sulphate)
7. Estimation of Ferric iron by spectrophotometry.

- A minimum of FIVE experiments shall be offered.
- Laboratory classes on alternate weeks for Physics and Chemistry.
- The lab examinations will be held only in the second semester.

**ME2155 COMPUTER AIDED DRAFTING AND MODELING LABORATORY L T P C**  
**0 1 2 2**

**List of Exercises using software capable of Drafting and Modeling**

1. Study of capabilities of software for Drafting and Modeling – Coordinate systems (absolute, relative, polar, etc.) – Creation of simple figures like polygon and general multi-line figures.
2. Drawing of a Title Block with necessary text and projection symbol.
3. Drawing of curves like parabola, spiral, involute using Bspline or cubic spline.
4. Drawing of front view and top view of simple solids like prism, pyramid, cylinder, cone, etc, and dimensioning.
5. Drawing front view, top view and side view of objects from the given pictorial views (eg. V-block, Base of a mixie, Simple stool, Objects with hole and curves).
6. Drawing of a plan of residential building ( Two bed rooms, kitchen, hall, etc.)
7. Drawing of a simple steel truss.
8. Drawing sectional views of prism, pyramid, cylinder, cone, etc,
9. Drawing isometric projection of simple objects.
10. Creation of 3-D models of simple objects and obtaining 2-D multi-view drawings from 3-D model.

**TOTAL: 45 PERIODS**

**Note: Plotting of drawings must be made for each exercise and attached to the records written by students.**

**List of Equipments for a batch of 30 students:**

1. Pentium IV computer or better hardware, with suitable graphics facility -30 No.
2. Licensed software for Drafting and Modeling. – 30 Licenses
3. Laser Printer or Plotter to print / plot drawings – 2 No.

**EE2155 ELECTRICAL CIRCUIT LABORATORY L T P C**  
**(Common to EEE, EIE and ICE) 0 0 3 2**

**LIST OF EXPERIMENTS**

1. Verification of ohm's laws and kirchoff's laws.
2. Verification of Thevemin's and Norton's Theorem
3. Verification of superposition Theorem
4. Verification of maximum power transfer theorem.
5. Verification of reciprocity theorem
6. Measurement of self inductance of a coil
7. Verification of mesh and nodal analysis.
8. Transient response of RL and RC circuits for DC input.
9. Frequency response of series and parallel resonance circuits.
10. Frequency response of single tuned coupled circuits.

**TOTAL: 45 PERIODS**

**EC2155**

**CIRCUITS AND DEVICES LABORATORY**

**L T P C**  
**0 0 3 2**

1. Verification of KVL and KCL
2. Verification of Thevenin and Norton Theorems.
3. Verification of superposition Theorem.
4. Verification of Maximum power transfer and reciprocity theorems.
5. Frequency response of series and parallel resonance circuits.
6. Characteristics of PN and Zener diode
7. Characteristics of CE configuration
8. Characteristics of CB configuration
9. Characteristics of UJT and SCR
10. Characteristics of JFET and MOSFET
11. Characteristics of Diac and Triac.
12. Characteristics of Photodiode and Phototransistor.

**TOTAL: 45 PERIODS**

**ENGLISH LANGUAGE LABORATORY (Optional)**

**L T P C**  
**0 0 2 -**

**1. Listening:** **5**  
Listening & answering questions – gap filling – Listening and Note taking- Listening to telephone conversations

**2. Speaking:** **5**  
Pronouncing words & sentences correctly – word stress – Conversation practice.

**Classroom Session** **20**

1. Speaking: Introducing oneself, Introducing others, Role play, Debate- Presentations: Body language, gestures, postures. Group Discussions etc
2. Goal setting – interviews – stress time management – situational reasons

**Evaluation**

(1) Lab Session – 40 marks

- Listening – 10 marks
- Speaking – 10 marks
- Reading – 10 marks
- Writing – 10 marks

(2) Classroom Session – 60 marks

- Role play activities giving real life context – 30 marks
- Presentation – 30 marks

**Note on Evaluation**

1. Examples for role play situations:
  - a. Marketing engineer convincing a customer to buy his product.

- b. Telephone conversation – Fixing an official appointment / Enquiry on availability of flight or train tickets / placing an order. etc.
2. Presentations could be just a Minute (JAM activity) or an Extempore on simple topics or visuals could be provided and students could be asked to talk about it.

## REFERENCES

1. Hartley, Peter, Group Communication, London: Routledge, (2004).
2. Doff, Adrian and Christopher Jones, Language in Use – (Intermediate level), Cambridge University Press, (1994).
3. Gammidge, Mick, Speaking Extra – A resource book of multi-level skills activities , Cambridge University Press, (2004).
4. Craven, Miles, Listening Extra - A resource book of multi-level skills activities, Cambridge, Cambridge University Press, (2004).
5. Naterop, Jean & Rod Revell, Telephoning in English, Cambridge University Press, (1987).

## LAB REQUIREMENTS

1. Teacher – Console and systems for students
2. English Language Lab Software
3. Tape Recorders.

**MA3202**

**TRANSFORMATIONS AND PARTIAL  
DIFFERENTIAL EQUATIONS**

**LT P C  
3 1 0 4**

## OBJECTIVES

The course objective is to develop the skills of the students in the areas of Transforms and Partial Differential Equations. This will be necessary for their effective studies in a large number of engineering subjects like heat conduction, communication systems, electro-optics and electromagnetic theory. The course will also serve as a prerequisite for post graduate and specialized studies and research.

### UNIT I           FOURIER SERIES

**9 + 3**

Dirichlet's conditions – General Fourier series – Odd and even functions – Half range sine series – Half range cosine series – Complex form of Fourier Series – Parseval's identity – Harmonic Analysis.

### UNIT II           FOURIER TRANSFORMS

**9 + 3**

Fourier integral theorem (without proof) – Fourier transform pair – Sine and Cosine transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval's identity.

**UNIT III PARTIAL DIFFERENTIAL EQUATIONS 9 + 3**  
 Formation of partial differential equations – Lagrange’s linear equation – Solutions of standard types of first order partial differential equations - Linear partial differential equations of second and higher order with constant coefficients.

**UNIT IV APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS 9 + 3**  
 Solutions of one dimensional wave equation – One dimensional equation of heat conduction – Steady state solution of two-dimensional equation of heat conduction (Insulated edges excluded) – Fourier series solutions in cartesian coordinates.

**UNIT V Z -TRANSFORMS AND DIFFERENCE EQUATIONS 9 + 3**  
 Z-transforms - Elementary properties – Inverse Z-transform – Convolution theorem - Formation of difference equations – Solution of difference equations using Z-transform.

**LECTURES : 45 TUTORIALS : 15 TOTAL : 60 PERIODS**

**TEXTBOOKS**

1. Grewal B.S, “Higher Engineering Mathematics”, 39th Edition, Khanna Publishers, 2007.
2. Ramana B.V., “Higher Engineering Mathematics”, Tata McGraw-Hill Company Ltd., 2007.

**REFERENCES**

1. Bali.N.P. and Manish Goyal., “A Textbook of Engineering Mathematics”, 7th Edition, Laxmi Publications (P) Ltd.
2. Ramana.B.V., “Higher Engineering Mathematics” Tata McGraw Hill.
3. Glyn James, “Advanced Modern Engineering Mathematics”, 3rd Edition, Pearson Education, 2007.
4. Erwin Kreyszig, “Advanced Engineering Mathematics” 8th Edition, Wiley India, 2007.

**PY3201 PHARMACEUTICAL ORGANIC CHEMISTRY L T P C**  
**4 0 0 4**

**UNIT I CONCEPT OF AROMATICITY AND AROMATIC CHARACTER 12**

General mechanism of aromatic electrophilic substitution reactions – Principle involved in alkylation and acylation – Industrial applications – Hoesch reaction – Formylation reactions – Gattermann reaction – Gattermann-Koch reaction – Vilsmeier reaction – Reimar-Tiemann reaction – Aromatic nucleophilic substitution reaction mechanisms.

**UNIT II MOLECULAR REARRANGEMENTS 12**

Wolff rearrangement – Schmidt reaction – Curtius rearrangement – Mechanism and applications – Oxidation mechanism – Applications of the following oxidation reactions –  $\text{KMnO}_4$  –  $\text{MnO}_2$  – Stereochemistry and applications of the following reduction reactions – Catalytic dehydrogenation – Meerwein-Ponndorf-Verley –  $\text{NaBH}_4$  – Clemmenson.

<b>UNIT III</b>	<b>AROMATIC AMINES AND SULPHONIC ACIDS</b>	<b>12</b>
<p>Methods of introduction of the aromatic amino group into an aromatic nucleus – Diazotization reaction and reactions of aryl diazonium salts such as Sandmeyer – Ullmann – Azo coupling – Deamination – Benzidine rearrangement – Aromatic sulphonic acids – Sulphonation reaction – Chlorosulphonation.</p>		
<b>UNIT IV</b>	<b>POLYNUCLEAR AROMATIC HYDROCARBONS</b>	<b>12</b>
<p>Synthesis and reactions of naphthalene – Anthracene – Phenanthrene – Diphenyl and triphenyl compounds and its medically important derivatives.</p>		
<b>UNIT V</b>	<b>HETEROCYCLIC AROMATIC COMPOUNDS</b>	<b>12</b>
<p>Aromaticity of pyrrole – Thiophene – Furan – Pyridine – Dipole moment – Reactive sites and stability of these heterocycles – General principles of heterocyclic synthesis – Methods of preparation and reactions of pyridines – Pyrroles – Thiophenes – Furans – Quinolines – Isoquinolines.</p>		
<b>TOTAL: 60 PERIODS</b>		

#### **TEXT BOOKS**

1. Bahl, A. and Bahl, B.S., “Advanced Organic Chemistry”, 1st Edition, S. Chand and Company, 2004.
2. Morrison and Boyd, “Organic Chemistry”, 6th Edition, Prentice Hall Publications, 2004.

#### **REFERENCES**

1. Kalsi, P.S., “Organic Reaction and Their Mechanisms”, 2nd Edition, New Age International Pvt. Ltd. Publications, 2004.
2. Tewari, N., “Advanced Organic Reaction Mechanism”, Books and Allied Publishers, 2006.
3. Finar, I. L., “Organic Chemistry”, 6th Edition, Longmans Publications, 2002.



**AIM**

To create awareness in every engineering graduate about the importance of environment, the effect of technology on the environment and ecological balance and make them sensitive to the environment problems in every professional endeavour that they participate.

**OBJECTIVE**

- At the end of this course the student is expected to understand what constitutes the environment, what are precious resources in the environment, how to conserve these resources, what is the role of a human being in maintaining a clean environment and useful environment for the future generations and how to maintain ecological balance and preserve bio-diversity. The role of government and non-government organization in environment managements.

**UNIT I ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY 14**

Definition, scope and importance of environment – need for public awareness - concept of an ecosystem – structure and function of an ecosystem – producers, consumers and decomposers – energy flow in the ecosystem – ecological succession – food chains, food webs and ecological pyramids – 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 8**

Definition – causes, effects and control measures of: (a) Air pollution (b) Water pollution (c) Soil pollution (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards – soil waste management: causes, effects and control measures of municipal solid wastes – role of an individual in prevention of pollution – pollution case studies – disaster management: floods, earthquake, cyclone and landslides.

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 over-utilization of surface and ground water, floods, drought, conflicts over 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. 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.

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 – climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, case studies. – wasteland reclamation – consumerism and waste products – environment production act – Air (Prevention and Control of Pollution) act – Water (Prevention and control of Pollution) act – Wildlife protection act – Forest conservation act – enforcement machinery involved in environmental legislation- central and state pollution control boards- 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 – role of information technology in environment and human health – Case studies.

**TOTAL: 45 PERIODS**

#### **TEXT BOOKS**

1. Masters, G.M. “Introduction to Environmental Engineering and Science”, 2<sup>nd</sup> Edition, Pearson Education, 1998.
2. Benny Joseph, “Environmental Science and Engineering”, Tata McGraw-Hill, 2006.

#### **REFERENCES**

1. Trivedi, R.K. “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. Senger, Dharmendra S. “Environmental Law”, Prentice Hall of India, 2007.
4. Rajagopalan, R, “Environmental Studies-From Crisis to Cure”, Oxford University Press, 2005.

<b>PY3202</b>	<b>PHYSICAL PHARMACEUTICS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>4</b>	<b>0</b>	<b>0</b>	<b>4</b>

<b>UNIT I</b>	<b>MICROMERITICS</b>	<b>12</b>
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Particle size and size distribution – Methods of determining particle size – Particle shape and surface area – Methods of determining surface area pore size and derived properties of powders.

<b>UNIT II</b>	<b>RHEOLOGY</b>	<b>12</b>
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Newtonian systems – Non newtonian systems – Plastic flow – Pseudo plastic flow – Dilatant flow – Thixotropy – Viscometers – Types of viscometers.

<b>UNIT III</b>	<b>COLLOIDS</b>	<b>12</b>
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Electrical and optical properties of colloids – Sedimentation – Stokes law – Stability of colloidal dispersions – Protective colloids – Sensitization of colloidal system – Applications of colloids in pharmacy.

<b>UNIT IV</b>	<b>SUSPENSIONS AND EMULSIONS</b>	<b>12</b>
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Interfacial properties of suspended particles – Settling in suspensions – Formulation of suspensions – Theories of emulsification – Physical stability of emulsions – Preservation of emulsions – Rheologic properties of emulsions – Special emulsion system.

<b>UNIT V</b>	<b>DRUG STABILITY</b>	<b>12</b>
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Chemical degradation of pharmaceutical products – Hydrolysis, oxidation, isomerization, polymerization, decarboxylation – Physical factors influencing chemical degradations – Temperature, moisture, light, radiation – Factors influencing and methods of reducing chemical degradation – Physical degradation of pharmaceutical products – Accelerated stability testing.

**TOTAL: 60 PERIODS**

### **TEXT BOOKS**

- Martin, A., “Physical Pharmacy”, 4th Edition, Lippincott Williams and Wilkins, B.I. Publications, 2002.
- Derle, D.V., “Essentials of Physical Pharmacy”, 1st Edition, Pharma Book Syndicate, 2006.

### **REFERENCES**

- Copper and Gunns, “Tutorial Pharmacy”, 6th Edition, CBS Publishers, 2005.
- Bentley’s, “Text book of Pharmaceutics”, 1st Edition, AITBS Publishers, 2006.
- Shotton, E., “Physical Pharmaceutics”, 1st Edition, Pharma Book Syndicate, 2007.

CH3225

**PROCESS CALCULATIONS**

**L T P C**  
**4 0 0 4**

**UNIT I STOICHIOMETRY 12**

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

**UNIT II IDEAL GASES AND VAPOR PRESSURE 12**

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

**UNIT III HUMIDITY AND SOLUBILITY 12**

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

**UNIT IV MATERIAL BALANCE 12**

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 12**

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: 60 PERIODS**

**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. Chohey, N.P. and Hicks, T.G., "Handbook of Chemical Engineering Calculations", 2nd Edition, McGraw-Hill Inc, 1984.

**UNIT I            PROPERTIES OF FLUIDS AND CONCEPT OF PRESSURE            12**

Introduction – Nature of fluids – Physical properties of fluids – Types of fluids – Fluid statics – Pressure – Density – Height relationships – Pressure measurement – Units and dimensions – Dimensional analysis – Similarity – Forces arising out of physical similarity – Dimensionless numbers.

**UNIT II            MOMENTUM BALANCE AND ITS APPLICATIONS            12**

Kinematics of fluid flow – Stream line – Stream tube – Velocity potential – Newtonian and non-Newtonian fluids – Time dependent fluids – Reynolds number – Experiment and significance – Momentum balance – Forces acting on stream tubes – Potential flow – Bernoulli's equation – Correction for fluid friction – Correction for pump work.

**UNIT III           FLOW OF INCOMPRESSIBLE FLUIDS THROUGH DUCTS            12**

Flow of incompressible fluids in pipes – Laminar and turbulent flow through closed conduits – Velocity profile and friction factor for smooth and rough pipes – Head loss due to friction in pipes, fitting etc – Introduction to compressible flow – Isentropic flow through convergent and divergent nozzles and sonic velocity.

**UNIT IV           FLOW OF FLUIDS THROUGH SOLIDS            12**

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            12**

Measurement of fluid flow – Orifice meter, venturi meter, Pitot tube, rotameter, weirs and notches – Wet gas meter and dry gas meter – Hot wire anemometers – Transportation of fluids – Fluid moving machinery performance – Selection and specification – Air lift and diaphragm pumps – Positive displacement pumps – Rotary and reciprocating pumps – Centrifugal pumps – Performance and characteristics.

**TOTAL: 60 PERIODS**

**TEXT BOOKS**

1. Bansal, R.K., "Fluid Mechanics and Hydraulic machines", 9th Edition, Laxmi Publications (P) Ltd., 2005.
2. McCabe, W.L., Smith, J.C. and Harriott, P., "Unit Operations of Chemical Engineering", 7th Edition, McGraw Hill, 2004.

## REFERENCES

1. Coulson, J.M. and Richardson, J.F., "Chemical Engineering", Vol.I, 6th Edition, Butterworth – Heinemann Publishers, 2002.
2. Noel, D. and Nevers, "Fluid Mechanics for Chemical Engineers", 2nd Edition, McGraw Hill, International Edition, 1991.
3. Liggett de Nevers, "Fluid Mechanics for Chemical Engineers", McGraw Hill, 1994.

**PY3205**

**PHARMACEUTICAL ORGANIC CHEMISTRY  
LABORATORY**

L	T	P	C
0	0	3	2

1. Determination of Impurities
2. Synthesis of some organic compounds involving single step reactions like nitration, halogenation, acetylation and hydrolysis.
3. Synthesis of organic compounds involving Two steps
4. Assay of organic compounds involving acidimetry, alkalimetry, Iodometry etc.
5. Determination of rate of reaction in zero, first order reactions.
6. Determination of physical constants used as criteria of purity like melting point, boiling point, weight per ml, refractive index and viscosity.
7. Determination of pH, potentiometric and dead stop endpoint technique.
8. Preparation of buffers, sensitivity, specificity, precision and accuracy.
9. Tests for Purity for official compounds mentioned in IP/BP/USP.
10. Limit test for marketed formulations.
11. Functional group analysis
12. Molecular weight calculations

**TOTAL: 45 PERIODS**

<b>PY3206</b>	<b>PHYSICAL PHARMACEUTICS LABORATORY</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>0</b>	<b>0</b>	<b>3</b>	<b>2</b>

1. Determination of density of Liquid.
2. Determination of surface tension/ interfacial tension of liquid.
3. Determination of critical micellar concentration of surfactant.
4. Effect of concentration on adsorption.
5. Determination of half life, rate constant and order of chemical reaction.
6. Effect of temperature on specific rate constant.
7. Determination of specific surface area of powder by adsorption method.
8. Determination of derived properties of powders like density, porosity, compressibility, angle of repose etc.
9. Effect of electrolytes on the stability of colloids.
10. Preparation of various types of suspensions and determination of their sedimentation parameters.
11. Determination of particle size of powders and globules.
12. Preparation and stability of emulsion.

**TOTAL: 45 PERIODS**

<b>CE3221</b>	<b>FLUID FLOW OPERATIONS LABORATORY</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>0</b>	<b>0</b>	<b>3</b>	<b>2</b>

1. To verify Hagen- Poiseuille Equation.
2. To relate Reynolds Number and Friction factor.
3. To study the effect of coil diameter on Friction factor.
4. Experiment on Orificemeter.
5. Experiment on Venturimeter.
6. Calibration of Rotameter.
7. To evaluate the performance of Weirs and Notches.
8. To evaluate the performance of centrifugal pump.
9. Draining time of open tank.
10. To verify Ergun's equation.
11. To characterize the behavior of Fluidized bed.
12. Performance of packed bed (Gas- Liquid).

**TOTAL: 45 PERIODS**

**UNIT I SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS (10 +3)**

Solution of algebraic and transcendental equations - Fixed point iteration method – Newton-Raphson method- Solution of linear system of equations - Gauss Elimination method – Pivoting - Gauss-Jordan methods – Iterative methods of Gauss-Jacobi and Gauss-Seidel - Matrix Inversion by Gauss-Jordan method - Eigenvalues of a matrix by Power method and by Jacobi's method.

**UNIT II INTERPOLATION AND APPROXIMATION (8 + 3)**

Interpolation with unequal intervals - Lagrange interpolation – Newton's divided difference interpolation – Cubic Splines - Interpolation with equal intervals - Newton's forward and backward difference formulae.

**UNIT III NUMERICAL DIFFERENTIATION AND INTEGRATION (9 + 3)**

Approximation of derivatives using interpolation polynomials - Numerical integration using Trapezoidal, Simpson's 1/3 and Simpson's 3/8 rules – Romberg's method – Two point and three point Gaussian quadrature formulae – Evaluation of double integrals by Trapezoidal and Simpson's rules.

**UNIT IV INITIAL VALUE PROBLEMS FOR ORDINARY DIFFERENTIAL EQUATIONS (9 + 3)**

Single step-methods - Taylor's series method - Euler's method - Modified Euler's method - Fourth order Runge-Kutta method for solving first and second order equations – Multistep methods - Milne's and Adams-Bashforth predictor-corrector methods for solving first order equations.

**UNIT V BOUNDARY VALUE PROBLEMS IN ORDINARY AND PARTIAL DIFFERENTIAL EQUATIONS (9 + 3)**

Finite difference methods for solving two-point linear boundary value problems. Finite difference techniques for the solution of two dimensional Laplace's and Poisson's equations on rectangular domain – One dimensional heat-flow equation by explicit and implicit (Crank Nicholson) methods - One dimensional wave equation by explicit method.

**L: 45 T: 15 TOTAL : 60 PERIODS**

**TEXT BOOKS**

1. Grewal, B.S. and Grewal, J.S., "Numerical methods in Engineering and Science", 6<sup>th</sup> Edition, Khanna Publishers, New Delhi, 2004.
2. Sankara Rao, K. "Numerical methods for Scientists and Engineers", 3rd Edition Prentice Hall of India Private Ltd., New Delhi, 2007.

**REFERENCES**

1. Chapra, S. C and Canale, R. P. "Numerical Methods for Engineers", 5th Edition, Tata McGraw-Hill, New Delhi, 2007.
2. Gerald, C. F. and Wheatley, P. O., "Applied Numerical Analysis", 6th Edition, Pearson Education Asia, New Delhi, 2006.
3. Brian Bradie, "A friendly introduction to Numerical analysis", Pearson Education Asia, New Delhi, 2007.



<b>PY3211</b>		<b>BIOCHEMISTRY</b>		<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
				<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>
<b>UNIT I</b>	<b>BIOMOLECULES</b>						<b>9</b>
	Structure and properties of mono, di, oligo and polysaccharides – Fatty acids – Phospholipids – Glycolipids – Steroids – Purine and pyrimidines bases.						
<b>UNIT II</b>	<b>BIOSYNTHESIS</b>						<b>9</b>
	Biosynthesis of amino acids, neocleotides and lipids.						
<b>UNIT III</b>	<b>INTERMEDIARY METABOLISM</b>						<b>9</b>
	Glycogenesis – Glycogenolysis – Gluconeogenesis – Glycolysis – Pentose phosphate pathway – TCA cycle.						
<b>UNIT IV</b>	<b>BIOENERGETICS</b>						<b>9</b>
	Electron transport chain (Phosporylation) in mitochondria – Exergonic and endergonic reactions – Chemiosmotic hypothesis.						
<b>UNIT V</b>	<b>ENZYMES</b>						<b>9</b>
	Classification and nomenclature – Mechanism of enzyme action – Specificity of enzyme – Factors affecting enzyme activity.						

**TOTAL: 45 PERIODS**

#### TEXT BOOKS

1. Berg, J.M., Tymoczko, J.L. and Stryer, L., “Biochemistry”, 5th Edition, McMillan Publications, 1994.
2. Voet, D. and Voet, G., “Biochemistry”, 2nd Edition, John Wiley and Sons, 1994.

#### REFERENCES

1. David, N.L. and Michael, M.C., “Lehninger Principles of Biochemistry”, 3rd Edition, CBS Publications, 1993.
2. Satyanarayana, U. and Chakrapani, U., “Biochemistry”, 3rd Edition, Books and Allied Publishers, 2006.
3. Robert, K.M., Darryl, K.G., Peter, A.M. and Victor, W.R., “Harper’s Illustrated Biochemistry”, 26th Edition, McGraw Hill Publications, 2003.

PY3212

**MICROBIOLOGY**

**L T P C**  
**3 1 0 4**

**UNIT I INTRODUCTION TO MICROBIOLOGY 9**

Classification and identification of microorganisms – Phase contrast and electron microscopy – Chemistry and structural organization of bacteria, virus, fungi, actinomycetes – Multiplication of bacteriophage, bacteria and organisms such as yeast, fungi.

**UNIT II GROWTH OF MICROORGANISMS 9**

Microbial nutrition and environment – Factors controlling growth of microorganisms in different media – Growth curve – Methods of enumeration of multiplying microorganisms – Culture media – Preservation of microbes – Sterilization and disinfection.

**UNIT III MICROBIAL METABOLISM 9**

Microbial Metabolism – Metabolic pathways - Production of secondary metabolites and their complication in industry – Beneficial micro organisms and products – Formation of toxic materials by microorganisms – A general study of food, industrial and agricultural microbiology.

**UNIT IV CONTROL OF MICROORGANISMS 9**

Diseases caused by microorganisms and control – Chemotherapeutic agents – Beta-lactam antibiotics – Macrolide antibiotics – Cephalosopriins – Quinolones – Sulphonamides and disinfectants.

**UNIT V ENVIRONMENTAL APPLICATIONS OF MICROBIOLOGY 9**

Recycling of waste biomass – Production of biogas – Leaching of ores by microorganism –Application of biofertilizers and bio-pesticides – Bioremediation.

**L: 45 T: 15 TOTAL: 60 PERIODS**

**TEXT BOOKS**

1. Katheelen, P.T., "Foundations in Microbiology", 5th Edition, McGraw-Hill, 2004.
2. Pelczar, M.J., Chan, E.C.S. and Kreig, N.R., "Microbiology", Tata McGraw-Hill Edition, 1993.

**REFERENCES**

1. Purohit, S.S., "Microbiology (Fundamental and application)", 6th Edition, Agrobios, 2001.
2. James, M.J., "Modern Food Microbiology", Chapman and Hall Inc, 2005.
3. Madigan, M.T. and Martinko, J.M., "Brock Biology of Microorganisms", 11th Edition, Prentice Hall, 2005.

<b>PY3213</b>	<b>REGULATORY REQUIREMENTS IN PHARMACEUTICAL INDUSTRIES</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**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**

**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. Sharma, P.P., “How to Practice GMPs”, 3rd Edition, Vandana Publications, 2006.

CH3226

HEAT TRANSFER

L T P C  
4 0 0 4

**UNIT I           FUNDAMENTAL CONCEPTS AND CONDUCTIVE HEAT TRANSFER** **12**

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** **12**

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** **12**

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** **12**

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** **12**

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: 60 PERIODS**

**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.

<b>CH3227</b>	<b>CHEMICAL ENGINEERING OPERATIONS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>4</b>	<b>0</b>	<b>0</b>	<b>4</b>

<b>UNIT I</b>	<b>PARTICLE SEPARATION</b>	<b>12</b>
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Properties and characterization of particulate solids – Analysis and technical methods for size and surface area distribution of powder – Introduction – Preparation and techniques for the measurement of nanoparticles – Introduction to storage and conveying of solids – Principles of magnetic separation.

<b>UNIT II</b>	<b>SIZE REDUCTION</b>	<b>12</b>
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Size reduction equipment – Determination of energy and power requirement in milling operations – Screening equipment – Capacity and effectiveness.

<b>UNIT III</b>	<b>FILTRATION</b>	<b>12</b>
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Filtration equipment – Filtration media and filter aids – Principles of filtration and clarification – Estimation of filtration parameters for compressible and incompressible cakes and calculations – Centrifugal filtration equipment and principles of operation.

<b>UNIT IV</b>	<b>SETTLING AND SEDIMENTATION</b>	<b>12</b>
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Separation based on the motion of particles through fluids – Gravity settling processes – Sedimentation – Kynch theory of sedimentation – Equipment for sedimentation thickness – Rate of sedimentation and sedimentation zones in continuous thickeners – Design of thickeners and clarifiers – Principles of centrifugal sedimentation.

<b>UNIT V</b>	<b>AGITATION AND MIXING</b>	<b>12</b>
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Introduction to agitation and mixing of liquids- agitation equipment – Axial and radial flow impellers and flow patterns in agitated vessels- prevention of swirling – Power consumption in agitated vessels – Blending and mixing – Dispersion operations – Mixing of solids and pastes and types of mixers.

**TOTAL: 60 PERIODS**

**TEXT BOOKS**

1. McCabe, W.L., Smith, J.C. and Harriot, P., "Unit Operations in Chemical Engineering", 7th Edition, McGraw Hill, 2005.
2. Badger, W.L. and Banchemo, J.T., "Introduction to Chemical Engineering", Tata McGraw Hill, 2002.

**REFERENCES**

1. Raymond, A.K., "Materials Handling Handbook", 3rd Edition, Wiley - Interscience Publications, 1985.
2. Coulson, J.M. and Richardson, J.F., "Chemical Engineering", 3rd Edition, Butterworth Heineman Publications, 1977.

**PY3216****MICROBIOLOGY LABORATORY**

L	T	P	C
0	0	3	2

1. Sterilization techniques (lecture / demonstration)
2. Preparation of various culture media.
3. Culturing of micro-organisms
  - (a) Isolation of specific group of microbes symbiotic – asymbiotic, chemolithotrophs, organotrophs
  - (b) Pure culture techniques – Streak plate, pour plate, isolation and preservation of bacterial culture, single spore isolation.
4. Identification of microorganisms by staining techniques
5. Identification of microorganisms by biochemical testing.
6. Quantification of microorganisms by turbidimetry
7. Quantification of microorganisms by serial dilution, MPM.
8. Preservation of cells, slants stabs, use of mineral oil, liquid paraffin, whey, glycerol, sterile water, lyophilization.
9. Environmental sample analysis – Polluted soil and effluent.
10. Food microbiology – Milk – Fermented food – Yogurt, meat, ice cream
11. Clinical microbiology – Normal mouth flora, pus, urine.
12. Determination of MIC of antimicrobial agents

**TOTAL: 45 PERIODS****PY3217****BIOCHEMISTRY LABORATORY**

L	T	P	C
0	0	3	2

1. Study of units for volume, weight, measurements and concentration. sensitivity, specificity, precision and accuracy.
2. Preparation of buffers and pH measurements.
3. Qualitative tests for carbohydrates.
4. Qualitative tests for amino acids.
5. Estimation of Reducing sugars by the Benedict's method.
6. Estimation of amino acids by ninhydrin method.
7. Protein estimation by various methods.
8. Acid hydrolysis of proteins
9. Enzyme assays: Phosphatase from potato, Amylase from sweet potato, Trypsin digestion of proteins, Assay of proteases, NADH Dehydrogenase, Catalase and peroxidase.
10. Extraction of lipids.
11. Phospholipids: Ashing and estimation of phosphate.
12. Estimation of cholesterol.
13. Estimation of nucleic acids.

**TOTAL: 45 PERIODS**

**CH3228****HEAT TRANSFER LABORATORY**

L	T	P	C
0	0	3	2

- To determine the conductivity of metal rod.
- To determine the conduction parameters using composite wall.
- To determine individual heat transfer film coefficient in forced convection.
- To determine individual heat transfer film coefficient in free convection.
- To determine Stefan Boltzmann law constant.
- To determine condensing heat transfer coefficient in vertical condenser.
- To determine condensing heat transfer coefficient in horizontal condenser.
- To determine rate of evaporation in open pan evaporator.
- To determine overall heat transfer coefficient of double pipe heat exchanger by parallel flow.
- To determine overall heat transfer coefficient of double pipe heat exchanger by counter flow.
- To determine overall heat transfer coefficient of shell and tube heat exchanger.
- To determine overall heat transfer coefficient of plate type heat exchanger by parallel flow.
- Apparatus for determination of emissivity.
- To determine the thermal conductivity of insulating powder.

**TOTAL: 45 PERIODS****PY3301****PHARMACEUTICAL CHEMISTRY**

L	T	P	C
3	1	0	4

**UNIT I      PHYSICO-CHEMICAL PROPERTIES ON BIOLOGICAL ACTION OF DRUGS      9**

Physical properties – Optical isomers – Geometric isomers – Bioisosterism – Receptors – Occupational theory – Affinity theory.

**UNIT II      AUTONOMIC AND CENTRAL NERVOUS SYSTEM ACTING DRUGS      9**

Structure – Synthesis – Uses – Pilocarpine – Neostigmine – Propanthallene – Salbutamol – Amphetamine – Phenoxy benzamine – Tolazoline – Thiopentone – Diazepam – Chlorpromazine – Haloperidol.

**UNIT III      CARDIOVASCULAR AND RESPIRATORY SYSTEM ACTING DRUGS      9**

Synthesis – Uses – Digoxin – Digitoxin – Procainamide – Diltiazem – Isosorbide dinitrate – Captopril – Frusemide – Lovastatin – Clofibrate.





**UNIT III SEMISOLID DOSAGE FORMS 12**

Classification – Advantages – Disadvantages – Semisolid bases types – Mechanism of drug penetration – Factors influencing penetration – Selection – General formulation – Manufacturing procedure – Evaluation – Packaging – Labeling – Storage requirements of ointments – Paste – Gels.

**UNIT IV PARENTERAL DOSAGE FORMS 12**

Routes of administration – Official types of injections – Vehicles – Solutes – Containers – Devices – Formulation – Production – Sterilization – Packaging – Evaluations – Ophthalmic preparations – Formulation – Packaging – Storage – Official methods of evaluation.

**UNIT V AEROSOLS 12**

Advantage and disadvantage of aerosols – Components of aerosol package – Aerosol systems – Aerosol formulations – Selection of components – Aerosol filling – Quality control of pharmaceutical aerosol.

**TOTAL: 60 PERIODS**

**TEXT BOOKS**

1. Aulton, M.E., "Pharmaceutics – The Science of Dosage form Design", 2nd Edition, ELBS Publications, 2002.
2. Lachman, L. and Liberman, H.A., "Theory and Practice of Industrial Pharmacy", 3rd Edition, Varghese Publishing House, 1991.

**REFERENCES**

1. Gennaro, A.R., "Remington: The Science and Practice of Pharmacy", 21st Edition, Vol. I and II, Lippincott Williams and Willkins, 2005.
2. Carter, S.J., "Cooper and Gunn's Dispensing Pharmacy for Pharmaceutical Students", 12th Edition, CBS Publishers and Distributors, 1987.
3. Banker, G.S. and Rhodes, C.T., "Modern Pharmaceutics", 4th Edition, Informa Health Care, 2002.

**PY3303**

**PHARMACOLOGY**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**UNIT I GENERAL PHARMACOLOGY 9**

Routes of administration – Pharmacokinetics – Pharmacodynamics – Receptors – Theories of receptors – Occupational theory – Affinity theory – Mechanism of action of drugs – Agonist – Antagonist – Factors modifying drug action – Dosage calculations.

**UNIT II SYSTEMIC PHARMACOLOGY 9**

Mechanism of action – Pharmacology – Acetylcholine – Atropine – Adrenaline – Prazosin – Propranolol – Barbiturates – Benzodiazepine – Chlorpromazine – Imipramine

<b>UNIT III</b>	<b>CARDIOVASCULAR PHARMACOLOGY</b>	<b>9</b>
Classification – Mechanism of action – Pharmacology – Digoxin – Glyceryl trinitrate – Verapamil – Clonidine – Hydralazine – Quinidine – Statins		
<b>UNIT IV</b>	<b>ANTIMICROBIAL PHARMACOLOGY</b>	<b>9</b>
Mode of action – Pharmacology – Sulphonamides – Ciprofloxacin – Penicillin G – Erythromycin – Rifampicin – Amphotericin B – Acyclovir – Chloroquine – Alkylating agents – Paclitaxel		
<b>UNIT V</b>	<b>PERIPHERAL NERVOUS SYSTEM AND GASTROINTESTINAL PHARMACOLOGY</b>	<b>9</b>
Classification – Mechanism of action – d-Tubocurarine – Succinyl choline – Cimetidine – Metoclopramide – Amoxicillin – Ondansetron – Lactulose.		

**TOTAL: 45 PERIODS**

**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 Brothers Medical 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. Lawrence, D.R., Bennett, P.N. and Brown, M.J., "Clinical Pharmacology" 8th Edition, Churchill Livingstone, 1998.
3. Das, M.M., "Pharmacology for Second Professional Students" 5th Edition, Books and Allied (P) Ltd, 2004.

<b>PC3304</b>	<b>ENGINEERING THERMODYNAMICS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>4</b>	<b>0</b>	<b>0</b>	<b>4</b>

<b>UNIT I</b>	<b>FUNDAMENTAL CONCEPTS AND FIRST LAW OF THERMODYNAMICS</b>	<b>12</b>
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            12**

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

**UNIT III            REFRIGERATION, VAPOR and COMBINED POWER CYCLES            12**

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            12**

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 – gas mixtures.

Thermodynamic relations – Maxwell's relations – Estimation of thermodynamic properties– Thermodynamic properties of homogeneous mixtures – Partial molar properties, Fugacity and fugacity coefficients – Lewis and Randall rule – Property changes of mixing, activity – Excess properties, activity coefficients.

**UNIT V            PHASE EQUILIBRIA AND CHEMICAL REACTION EQUILIBRIA            12**

Phase equilibria – Pure component and mixtures – Van Laar, Margules equation – Group contribution method – Gibb's Duhem equation – Consistency tests – Partially miscible and immiscible systems – Azeotropes – Retrograde condensation – Thermodynamic diagrams.

Chemical equilibria – Heat effects – industrial reactions – Free energy calculations – Homogeneous and heterogeneous reactions – Equilibrium composition.

**TOTAL: 60 PERIODS**

**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.

<b>CH3325</b>	<b>CHEMICAL REACTION ENGINEERING</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>4</b>	<b>0</b>	<b>0</b>	<b>4</b>

**UNIT I REACTION KINETICS 12**

Chemical kinetics – Classification of chemical reactions – Concentration and temperature dependent term of rate equation – Arrhenius collision and transition state theory – Searching for a mechanism.

**UNIT II INTERPRETATION OF BATCH REACTOR DATA 12**

Integral and differential methods of analysis – Half-life method – Zero order reaction – Empirical rate equation of  $n^{\text{th}}$  order – Irreversible first and second order reactions for variable and constant volume systems.

**UNIT III REACTOR DESIGN 12**

Ideal reactors – Batch reactor – Plug flow reactor – Mixed flow reactor – Space time – Space velocity – Performance equations and their graphical representation.

**UNIT IV HEAT EFFECTS 12**

Temperature and pressure effects on single and multiple reactions – Adiabatic – Non-adiabatic – Isothermal and non-isothermal operations.

**UNIT V DESIGN OF REACTOR FOR SINGLE AND MULTIPLE REACTIONS 12**

Single reactions – Size comparison of single reactors – Recycle reactor – Auto catalytic reactions – Multiple reactions – Irreversible reactions in series and parallel.

**TOTAL: 60 PERIODS**

**TEXT BOOKS**

1. Levenspiel, O., "Chemical Reaction Engineering", 3rd Edition, John Wiley Publications, 1999.
2. Fogler, W., "Chemical Reaction Engineering", 3rd Edition, Prentice Hall of India, 1999.

**REFERENCES**

1. Smith, J.M., "Chemical Engineering Kinetics", 3rd Edition, McGraw Hill, 1981.
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.

**UNIT I          PHYSICAL PROPERTY MEASUREMENT          12**

Density and specific gravity – Viscosity and consistency – Refractive index analyzers – Boiling point – Flash point analyzers – Thermal conductivity.

**UNIT II          TEMPERATURE MEASUREMENT          12**

Differential expansion and fluid expansion types – Resistance thermometers – Thermoelectric pyrometers – Radiation pyrometers – Optical pyrometers – Pyrometric cones – Ultrasonic thin wire thermometer.

**UNIT III          PRESSURE MEASUREMENT          12**

Absolute pressure – Gauge pressure or vacuum – Liquid types and spring balanced types – Differential pressure – Manometer types – Simple U tube and inclined tube manometer and sealed bell types – Pressure transmitters.

**UNITIV          FLOW MEASUREMENT          12**

Volumetric meters – Variable head meters – Orifice meter – Venturi meter – Pitot tube – Closed channel and open channel types – Variable area meters – Velocity and current meters – Anemo meter – Ultrasonic flowmeter – Mass meters.

**UNIT V          LEVEL MEASUREMENT          12**

Measurement of head and level – Float methods – Hydrostatic pressure methods – Gauge Glass automatic detector – Ultrasonic probe – Electronic level gauge – Continuous capacitance gauge.

**TOTAL: 60 PERIODS****TEXT BOOKS**

1. Nakra B.C. and Chaudhry K.K., "Instrumentation, Measurement and Analysis" Second Edition, Tata McGraw- Hill, 2004.
2. Singh S.K., "Industrial Instrumentation and Control", Second Edition, Tata McGraw-Hill, 2007.

**REFERENCES**

1. Doebelin E.O., "Measurement system Application and Design", Fourth Edition, McGraw Hill, 1998.
2. Patranabis D., "Principles of Industrial Instrumentation", Second Edition, Tata McGraw-Hill, 2007.
3. Sawhney A.K., "A Course in Electrical, Electronics measurement and Instrumentation", Dhanpat Rai and sons, 1999.

<b>PY3307</b>	<b>PHARMACEUTICAL CHEMISTRY LABORATORY</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>0</b>	<b>0</b>	<b>3</b>	<b>2</b>

1. Determination of percentage purity given drug sample.
2. Estimation of amount of active ingredient present in the given sample.
3. Chromatographic identification of organic compounds.
4. Analysis and identification of functional groups of pharmaceutical substances.
5. Analysis of impurities in fine chemicals / pharmaceutical substances by conventional chemical methods.
6. Official limit tests for impurities in pharmaceutical raw materials.
7. Determination of physical constants – melting point, boiling point, weight per ml, refractive index and viscosity.
8. Purification techniques for bulk drugs.

**TOTAL: 45 PERIODS**

<b>PY3308</b>	<b>PHARMACEUTICAL DOSAGE FORMS LABORATORY</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>0</b>	<b>0</b>	<b>3</b>	<b>2</b>

1. Preparation of three official solutions.
2. Preparation of two official syrups.
3. Preparation of three official lotions.
4. Preparation of two official liniments.
5. Preparation of official ointments with different classes of bases.
6. Preparation of two creams.
7. Preparation of two pastes.
8. Preparation of two suspensions.
9. Preparation of two emulsions.
10. Preparation and evaluation of injection.
11. Preparation of granules and effervescent granules.
12. Determination of stability of emulsion.
13. Formulation of two powders.
14. Preparation of microcapsules by solvent evaporation method.

**TOTAL: 45 PERIODS**

<b>CH3309</b>	<b>CHEMICAL REACTION ENGINEERING</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
	<b>LABORATORY</b>	<b>0</b>	<b>0</b>	<b>3</b>	<b>2</b>

1. Determination of reaction rate constant for a saponification reaction in batch reactor.
2. Determination of reaction rate constant for a saponification reaction in plug flow reactor.
3. Determination of reaction rate constant for a saponification reaction in mixed flow reactor.
4. Determination of mean residence time by RTD studies in plug flow reactor.
5. Determination of mean residence time by RTD studies in mixed flow reactor.

**TOTAL: 45 PERIODS**

<b>PY3311</b>	<b>INSTRUMENTAL METHODS OF PHARMACEUTICAL ANALYSIS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>1</b>	<b>0</b>	<b>4</b>

**UNIT I UV – VISIBLE SPECTROSCOPY 9**

Properties of electromagnetic spectrum – Chromophore concept – Beer's and Lambert's law – Limitations – Theory of electronic spectroscopy – Choice of solvent and solvent effects – Modern instrumentation – Design and working principle – Applications of UV-Visible spectroscopy – Nephelometry and turbidimetry – Principle – Instrumentation – Applications.

**UNIT II INFRARED AND NMR SPECTROSCOPY 9**

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

**UNIT III MASS AND ATOMIC SPECTROSCOPY 9**

Principles – Instrumentation – Ionization techniques – Electron impact ionization – Chemical ionization – Applications – Atomic absorption spectroscopy – Principle – Instrumentation – Applications.

**UNIT IV CHROMATOGRAPHIC TECHNIQUES 9**

Chromatographic methods – Paper chromatography – Thin layer chromatography – Ion exchange chromatography – Column chromatography – High performance liquid chromatography – Applications.

**UNIT V ELCTROCHEMICAL METHODS OF ANALYSIS 9**

Potentiometry – Types of electrodes – Measurement of EMF and pH – Applications – Conductometry – Measurement of conductivity – Conductometric titrations.

**L: 45 T: 15 TOTAL: 60 PERIODS**

**TEXT BOOKS**

1. Beckett, A.K. and Stenlake, J.B., "Practical Pharmaceutical Chemistry", Part I and II, 4th Edition, CBS Publications, 1997.
2. Chatwal, G.R. and Anand, S.K., "Instrumental Methods of Chemical Analysis", Himalaya Publishing House, 2005.

**REFERENCES**

1. Willard, H.H., Merritt Jr, L.L., Dean, J.A. and Settle Jr, F.A., "Instrumental Methods of Analysis", 7th Edition, CBS Publications, 1986.
2. Skoog, D.A., Holler, F.J. and Nieman, T.A., "Principles of Instrumental Analysis", 5th Edition, Harcourt College Publishers, 2001.
3. Settle, F., "Hand Book of Instrumental Techniques for Analytical Chemistry", Pearson Education (P) Ltd, 2004.



**PY3312**

**SEPARATION TECHNOLOGY**

**L T P C**  
**3 0 0 3**

**UNIT I BIO-SEPARATION 9**

Characterization of biomolecules – Fermentation broths – Role of downstream processing in biotechnology – Broad strategies for design of bio-separation processes.

**UNIT II DOWNSTREAM PROCESSING 9**

Cell disruption – Mechanical and chemical methods – Cake filtration and microfiltration – Centrifugation and sedimentation – Membrane processes – Dialysis – Ultra filtration – Reverse osmosis and electro-dialysis.

**UNIT III LIQUID-LIQUID SEPARATIONS AND PROTEIN SEPARATIONS 9**

Solvent extraction of small molecules – Aqueous two-phase extraction of proteins – PEG/Dextran separation – Precipitation of proteins with salts and organic solvents – Salting out method – Electrostatic interaction – Protein solvation with polyelectrolytes – Polyvalent metal ions – Sorption.

**UNIT IV CHROMATOGRAPHIC SEPARATIONS 9**

Adsorption processes – Principles of chromatographic separation – Gel filtration – Reversed phase – Hydrophobic interaction – Ion-exchange – Immuno-bio-affinity chromatography – Design and selection of chromatographic matrices – Modes of operations – Design of large scale chromatographic separation processes – Electrophoresis.

**UNIT V PRODUCT PURIFICATION 9**

Crystallization – Crystal geometry – Equilibrium and yields – Nucleation – Crystal growth – Equipments for crystallization – Continuous crystallizer – Draft tube baffle crystallizer – Drying and lyophilization – Principles – Temperature patterns – Heat transfer in dryers – Bound – Unbound water – Freeze drying or lyophilization – Equipments for drying – Tray dryer – Fluidised bed dryer – Spray dryer.

**TOTAL: 45 PERIODS**

**TEXTBOOKS**

1. Geankoplis, C.J., "Transport Processes and Separation Process Principles", 4th Edition, Prentice-Hall, Inc, 2003.
2. Mukhopadhyay, S.N., "Process Biotechnology Fundamentals", 2nd Edition, Viva Books (P) Ltd., 2004.

## REFERENCES

1. Adamovies, J.A., "Chromatographic Analysis of Pharmaceuticals", 2nd Edition, Marcel Dekker, 1997.
2. McCabe, W.L., Smith, J.C and Harriot, P., "Unit Operations of Chemical Engineering", 6th Edition, McGraw Hill Publications, 2001.
3. Cruger, W. and Cruger,V., "A Text Book of Industrial Microbiology", 2nd Edition, Prentice-Hall, Inc, 1997.

<b>PY3313</b>	<b>PROCESS EQUIPMENT DESIGN</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
	(To Consider as Practical Subject for Examination Purpose)	<b>4</b>	<b>0</b>	<b>0</b>	<b>4</b>

<b>UNIT I</b>	<b>HEAT EXCHANGERS</b>				<b>12</b>
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Design of shell and tube heat exchangers- Double pipe heat exchangers

<b>UNIT II</b>	<b>EVAPORATORS</b>				<b>12</b>
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Design of single and multiple effect evaporators.

<b>UNIT III</b>	<b>DISTILLATION</b>				<b>12</b>
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Design of distillation columns – sieve and bubble cap towers.

<b>UNIT IV</b>	<b>ABSORPTION COLUMNS</b>				<b>12</b>
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Design of absorption columns – plate & packed columns

<b>UNIT V</b>	<b>DRYERS</b>				<b>12</b>
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Design of batch and continuous dryers.

**TOTAL: 60 PERIODS**

## TEXT BOOKS

1. Perry, R.H., "Chemical Engineers Handbook", 7th Edition, McGraw Hill Co, 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", 1st Edition, CBS Publishers and Distributors, 1985.
2. Dawande, S.D., "Process Design of Equipment", Central Techno Publications, 2005.
3. Donald, Q.K., "Process Heat Transfer", 1st Edition, Tata McGraw Hill Publishing Co, 1997.

**Note: Necessary Data Book is to be issued while conducting Practical Examination**

CH3314	MASS TRANSFER OPERATIONS	L	T	P	C
		4	0	0	4
<b>UNIT I</b>	<b>DIFFUSION</b>				<b>12</b>
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.					
<b>UNIT II</b>	<b>ABSORPTION</b>				<b>12</b>
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.					
<b>UNIT III</b>	<b>DISTILLATION</b>				<b>12</b>
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.					
<b>UNIT IV</b>	<b>LEACHING</b>				<b>12</b>
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 12**

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: 60 PERIODS**

**TEXT BOOKS**

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

**REFERENCES**

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

**CS3315 OBJECT ORIENTED PROGRAMMING L T P C  
3 0 0 3**

**UNIT I FUNDAMENTALS 9**

Object oriented programming concepts – Encapsulation – Programming elements – Program structure – Enumeration types – Functions and pointers – Function invocation – Overloading functions – Scope and storage class – Pointer types – Arrays and pointers – Call-by-reference – Assertions – Standard template library.

**UNIT II IMPLEMENTING ADTS AND ENCAPSULATION 9**

Aggregate type structure – Structure pointer operators – Unions – Bit fields – Data handling and member functions – Classes – Constructors and destructors – Static member – This pointer – Reference semantics – Implementation of simple ADTs.

**UNIT III POLYMORPHISM 9**

ADT conversions – Overloading – Overloading operators – Unary operator overloading – Binary operator overloading – Function selection – Pointer operators.

**UNIT IV INHERITANCE 9**

Derived class – Typing conversions and visibility – Code reuse – Virtual functions – Run-time type identifications – Exception – Handlers – Standard exceptions.

**UNIT V          TEMPLATES AND FILE HANDLING****9**

Template class – Function templates – Class templates – C++ streams – Console streams – Console stream classes – Formatted and unformatted console I/O operations – Manipulators – File streams – Classes file modes – File pointers and manipulations – File I/O – Exception handling.

**TOTAL: 45 PERIODS****TEXT BOOKS**

1. Ira Pohl, "Object-Oriented Programming Using C++", Pearson Education, 2nd Edition, 2003.
2. Venugopal, K.R., Buyya, R. and Ravishankar, T., "Mastering C++", Tata McGraw Hill, 2003.

**REFERENCES**

1. Ashok, B. and Kamthane, N., "Object-Oriented Programming with ANSI and Turbo C++", Pearson Education, 2006.
2. Stroustrup, "The C++ Programming Language", Addison Wesley, 2000.
3. Hubbard, J.R., "Programming with C++", Schaums Outline Series, Tata McGraw Hill, 2003.

**PY3316****INSTRUMENTAL METHODS OF  
PHARMACEUTICAL ANALYSIS LABORATORY**

L	T	P	C
0	0	3	2

1. Determination of impurities by limit test.
2. Determination of  $\lambda_{\max}$ .
3. Determination of isobestic point.
4. Determination of the percentage purity of a drug using colorimetry.
5. Determination of percentage purity of drug in marketed tablets and capsules using UV spectrophotometer by  $E_{1\%}^{1\text{cm}}$  method.
6. Determination of percentage purity of marketed or formulated tablets using UV spectrophotometer using calibration method.
7. Separation of mixtures of drugs by TLC.
8. Determination of  $R_f$  values of drugs using paper chromatography.
9. Determination of EMF using potentiometer.
10. Effect of pH on absorbance spectrum of phenolic compounds (Paracetamol).

**TOTAL: 45 PERIODS**

**CH3317**

**MASS TRANSFER LABORATORY**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>0</b>	<b>0</b>	<b>3</b>	<b>2</b>

1. Determination of the critical moisture content and drying rate.
2. Determination of the critical moisture content and drying rate under vacuum.
3. Verification of Rayleigh equation.
4. Determination of the efficiency of steam distillation.
5. Determination of diffusion coefficient.
6. Determination of HETP.
7. Optimization of the number of leaching stages.
8. Determination of the break point for adsorption.
9. Mass transfer coefficient and Reynolds number relation.
10. Verification of adsorption isotherms

**TOTAL: 45 PERIODS**

**GE3318**

**COMMUNICATION SKILLS AND SOFT SKILLS LAB**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>0</b>	<b>0</b>	<b>2</b>	<b>1</b>

**AIM:**

To enhance the overall capability of students and to equip them with the necessary Communication Skills and Soft Skills that would help them excel in their profession.

**OBJECTIVES:**

- To equip students of engineering and technology with effective speaking and listening skills in English.
- To help them develop their soft skills and interpersonal skills, which will make the transition from college to workplace smoother and help them excel in their job.
- To enhance the performance of students at Placement Interviews, Group Discussions and other recruitment exercises.

**I. PC based session**

**A. Career Lab (15 periods) Viewing and discussing audio-visual materials**

1. **Resume / Report Preparation / Letter Writing:** (3)

- Letter writing – Job application with Resume - Project report - Email etiquette.
2. **Presentation skills:** (3)  
Elements of effective presentation – Structure of presentation - Presentation tools – Body language.
  3. **Soft Skills:** (3)  
Time management – Stress management – Assertiveness – Negotiation strategies, Psychometrics - Analytical and logical reasoning.
  4. **Group Discussion:** (3)  
Group discussion as part of selection process, Structure of group discussion – Strategies in group discussion – Mock group discussions.
  5. **Interview Skills:** (3)  
Kinds of interviews – Interview techniques – Corporate culture – Mock interviews.

**TOTAL 30 PERIODS**

**II. Class Room Session**

1. **Resume / Report Preparation / Letter writing:** Students prepare their own resume and report. (9)
2. **Presentation Skills:** Students make presentations on given topics. (12)
3. **Group Discussion:** Students participate in group discussions. (12)
4. **Interview Skills:** Students participate in Mock Interviews (12)

**Note:** Classroom sessions are practice sessions.

**REFERENCES:**

1. Prakash P, Verbal and Non-Verbal Reasoning, Macmillan India Ltd., 2<sup>nd</sup> Edition, New Delhi, 2004.
2. John Seely, The Oxford Guide to Writing and Speaking, Oxford University Press, New Delhi 2004.
3. Paul V Anderson, Technical Communication, Thomson Wadsworth , 6<sup>th</sup> Edition, New Delhi, 2007.
4. Edgar Thorpe and Showick Thorpe, Objective English, Pearson Education, 2<sup>nd</sup> Edition, New Delhi 2007.
5. David Evans, Decision maker, CUP, 1997

**Lab Requirement:**

1. Teacher console and systems for students.
2. English Language Lab Software
3. Tape recorders

<b>PY3401</b>	<b>ADVANCED MEDICINAL CHEMISTRY</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>1</b>	<b>0</b>	<b>4</b>

**UNIT I QUANTITATIVE DESCRIPTION OF PHYSICOCHEMICAL PROPERTIES 9**

Quantitative description of physicochemical properties of drug molecules with reference to electronic effects in drugs – Hydrophobic properties of drugs – Methods of calculating partition coefficient – 3D structure of drugs – Other physicochemical parameters in relation to biological action.

**UNIT II QUANTITATIVE STRUCTURE ACTIVITY RELATIONSHIP 9**

History and development of QSAR – Classification of QSAR methodology – Hansch analysis – Free Wilson analysis – Applications advantages and pitfalls of QSAR.

**UNIT III DESIGN OF ENZYME INHIBITORS 9**

Forces involved information of enzyme substrate and enzyme inhibitor complexes – Design of rapid reversible inhibitors – Multisubstrate inhibitors – Mechanism based inhibitors – Application with recent examples from literature.

**UNIT IV DOCKING OF FLEXIBLE MOLECULES 9**

Docking of flexible molecules in protein/enzyme active sites – Docking by energy minimization superimposition – Molecular dynamic – Monte Carlo – Distance geometry and build-up methods – Applications with recent examples from literature.

**UNIT V COMPUTER-AIDED DEVELOPMENT OF THREE-DIMENSIONAL PHARMACOPHORE MODES 9**

Direct and indirect ligand design – The pharmacophore concept – Steps in 3-D-pharmacophore identification – Selection of pharmacophore elements – Representation of pharmacophore elements as ligand points or site points – Receptor exclude and receptor essential volumes.

**L: 45 T: 15 TOTAL: 60 PERIODS**

**TEXT BOOKS**

- Kadam, S.S., Mahadik, K.R. and Bothara, K.G., "Principles of Medicinal Chemistry", Vol. I and Vol. II, 7th Edition, Nirali Prakashan Publications, 1999.
- Remers, W.A. and Delgado, J.N., "Wilson and Gisvold's Textbook of Pharmaceutical Organic Chemistry", Lippincott William and Wilkins, 2004.

**REFERENCES**

- Wolff, M.E., "Burger's Medicinal Chemistry", 5th Edition, Vol. I – V, John Willey and Sons, 2003.
- Hansch, C., "Comprehensive Medicinal Chemistry", Vol.4, Pergamon Press, 1998.
- Leach A.R., "Molecular Modeling and Drug Design" 2nd Edition, Pearson Prentice-Hall, 2001.



<b>PY3402</b>	<b>NOVEL DRUG DELIVERY SYSTEM</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>4</b>	<b>0</b>	<b>0</b>	<b>4</b>

**UNIT I POLYMERS 12**

Polymers used in controlled drug delivery modules – Classification – Advantages and disadvantages of polymers – Polymerization mechanisms – Degradation mechanism – Polymer characterization.

**UNIT II SUSTAINED RELEASE DRUG DELIVERY SYSTEMS 12**

Physicochemical and biological properties of drugs – Oral dosage forms – Diffusion systems – Systems utilizing dissolution – Osmotic systems – Ion exchange resins.

**UNIT III TARGETED DRUG DELIVERY SYSTEM 12**

Nanoparticles – Liposomes – Resealed erythrocytes – Immunologically based system – Antibodies for drug delivery – Magnetic microspheres.

**UNIT IV MODULE FOR GASTRO INTESTINAL TRACTS 12**

Approaches to increase gastric retention – Factors affecting gastric retention – Formulation development of floating drug delivery system – Expanding systems – Systems for colon specific delivery – Targeting approaches to colon.

**UNIT V MUCOADHESIVE DRUG DELIVERY SYSTEMS 12**

Buccal drug delivery – Concepts – Advantages – Disadvantages – Permeability enhancers – In vitro and in-vivo evaluation – Nasal drug delivery system – Pulmonary drug delivery system – Applications.

**TOTAL: 60 PERIODS**

**TEXT BOOKS**

1. Robinson, J.R. and Lee, V.H.L., "Controlled Drug Delivery Systems", 2nd Edition, Marcel Dekker, 1992.
2. Vyas, S.P. and Khar, R.K., "Controlled Drug Delivery Concepts and Advantages", 1st Edition, 2002.

**REFERENCES**

1. Chein, Y.W., "Novel Drug Delivery Systems", 2nd Edition, Marcel Dekker Inc, 1992.
2. Gennaro, A R., "Remington: The Science and Practice of Pharmacy", Vol. I and II, 21st Edition, Lippincott Williams and Willkins, 2005.
3. Jain, N.K., "Advances in Controlled and Novel Drug Delivery", 1st Edition, CBS Publishers and Distributors, 2001.

**PY3403**

**PHARMACEUTICAL BIOTECHNOLOGY**

**L T P C**  
**4 0 0 4**

**UNIT I FERMENTATION TECHNOLOGY 12**

Industrial fermentation processes and products – Role of bioprocess engineer – Unit operations in an integrated bioprocess – Process flowsheet – Survey of organisms – Processes – Products – Market economics of modern industrial biotechnology.

**UNIT II RAW MATERIALS FOR FERMENTATION PROCESS 12**

Isolation of microorganisms – Preservation and improvement of industrial microorganisms for overproduction of primary and secondary metabolites – Medium requirements for fermentation process – Carbon, nitrogen, minerals, vitamins, and other nutrients – Simple and complex media.

**UNIT III PRIMARY METABOLITES 12**

Primary metabolite – Methods for the production of citric acid – Itaconic acid – Lactic acid-Acetic acid – Gluconic acid – Tartaric acid .

**UNIT IV SECONDARY METABOLITES 12**

Production of low molecular weight secondary metabolites – Penicillins – Cephalosporins -Streptomycin – Kanamycin – 1,2-benzoquinones – Ciprofloxacin – Gatifloxacin.

**UNIT V PRODUCTION AND CONTROL OF BIOTECH DERIVED PRODUCTS 12**

Recombinant DNA products – Insulin – Growth hormones – Erythropoietin – Cytokines – Diagnostic proteins – Protein A – Protein G – Antibodies.

**TOTAL: 60 PERIODS**

**TEXT BOOKS**

1. Stanbury, P.F., Whitaker, A. and Hall, S.J., "Principles of Fermentation Technology", 2nd Edition, Aditya Books (P) Ltd, 1995.
2. Shuler, M.L. and Kargi, F., "Bioprocess Engineering Basic Concepts", 2nd Edition, Prentice Hall of India, 2004.

**REFERENCES**

1. Purohit, S.S., Saluja, A.K. and Kulkarni, H.N., "Pharmaceutical Microbiology", 1st Edition, Agrobios (India), 2003.
2. Hugo, W.B. and Russel, A.D., "Pharmaceutical Microbiology", 6th Edition, Blackwell Science, 2003.
3. Casida Jr, L.E., "Industrial Microbiology", 2nd Edition, Wiley Eastern Ltd, 1968.

<b>CH3404</b>	<b>PROCESS DYNAMICS AND CONTROL</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>4</b>	<b>0</b>	<b>0</b>	<b>4</b>

**UNIT I FIRST ORDER SYSTEMS 12**

Linear open to loop systems – Laplace transformation – Transform of standard functions – First order and linearised first order systems – Response to various disturbances – Inversion – Theorems in laplace transformation – Applications.

**UNIT II HIGHER ORDER SYSTEMS 12**

First order in series – Linearization and its application in process control – Higher order systems – Second order and Transportation lag – Response to various disturbances.

**UNIT III CLOSED LOOP CONTROL SYSTEMS 12**

Closed loop control systems – Development of block diagram for feed – back control systems – Servo and regulator problems – Transfer function for controllers and final control element – Principles of pneumatic and electronic controllers – Transient response of closed-loop control systems and their stability.

**UNIT IV FREQUENCY RESPONSE 12**

Introduction to frequency response of closed-loop systems – Routh analysis – Control system design by frequency – Bode diagram – Stability criterion – Tuning of controller settings.

**UNIT V SPECIAL CONTROLS 12**

Cascade – Feed forward and ratio control – Dead time compensation – Internal model control – Control valves – Process identification.

**TOTAL: 60 PERIODS**

**TEXT BOOKS**

1. Coughnowr, D.P., "Process Systems Analysis and Control", 2nd Edition, McGraw Hill , 1991.
2. Smith, C.A. and Corripio, A.B., "Principles and Practice of Automatic Process Control", 2nd Edition, John Wiley, 1997.

**REFERENCES**

1. Harriot, P., "Process Control", Tata McGraw Hill, 1984.
2. George Stephanopolous., "Chemical Process Control", Prentice – Hall of India Pvt. Ltd., 1990.
3. Patranabis, D., "Principles of Process control", 2nd Edition, Tata McGraw – Hill Publishing Co. Ltd., 1981.

<b>CH3405</b>	<b>TECHNOLOGY OF FINE CHEMICALS AND BULK DRUGS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>4</b>	<b>0</b>	<b>0</b>	<b>4</b>

**UNIT I INTRODUCTION OF FINE CHEMICALS AND BULK DRUGS 12**

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

**UNIT II PRODUCTION, PLANNING AND CONTROL 12**

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

**UNIT III BASE CHEMICAL PRODUCTION 12**

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

**UNIT IV DRUG INTERMEDIATES AND FINE CHEMICAL PRODUCTION 12**

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

**UNIT V BULK DRUGS 12**

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

**TOTAL: 60 PERIODS**

**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. Moulijin, J.A., Makkee, M. and Diepan, A.V., "Chemical Process Technology", John Wiley and Sons, 2001.
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.

<b>PY3406</b>	<b>ADVANCED MEDICINAL CHEMISTRY</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
	<b>LABORATORY</b>	<b>0</b>	<b>0</b>	<b>3</b>	<b>2</b>

1. Design of structures using chemsketch
2. Finding C log P value for drug structures
3. Determination of pKa value of drugs and drugs intermediates
4. Determination of partition co-efficient and calculation of partition co-efficient values of various drugs
5. Determination of physicochemical properties of synthesized drugs
6. Determination of electronic properties of drug molecules using simulation softwares
7. Finding potential lead molecules using docking software
8. Studies on QSAR for the synthesized drugs

**TOTAL: 45 PERIODS**

<b>PY3407</b>	<b>NOVEL DRUG DELIVERY SYSTEM LABORATORY</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>0</b>	<b>0</b>	<b>3</b>	<b>2</b>

1. Preparation and evaluation of liposomes
2. Formulation and evaluation of egg albumin microspheres by single emulsion technique
3. Formulation and evaluation of microspheres by emulsion solvent evaporation method
4. Formulation and evaluation of microcapsules through coacervation phase separation by solvent evaporation method
5. Formulation and evaluation of solid dispersion by fusion method
6. Formulation and evaluation of solid dispersion by melting point solvent technique
7. Preparation and evaluation of magnetic microsphere
8. Formulation and evaluation of transdermal films
9. Formulation and evaluation of sustained release matrix tablets
10. Comparison of in vitro release studies of marketed sustained release tablets
11. In vitro release studies of marketed enteric coated tablets

**TOTAL: 45 PERIODS**



**UNIT IV HALOGENATION 12**

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 12**

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

**TOTAL: 60 PERIODS**

**TEXT BOOKS**

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

**REFERENCES**

1. Mukharjee, 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.

**GE3403 TOTAL QUALITY MANAGEMENT LT P C  
3 0 0 3**

**AIM:**

To provide comprehensive knowledge about the principles, practices, tools and techniques of Total quality management.

**OBJECTIVES:**

- To under the various principles, practices of TQM to achieve quality
- To learn the various statistical approaches for quality control.
- To understand the TQM tools for continuous process improvement.
- To learn the importance of ISO and Quality systems.

**UNIT I INTRODUCTION 9**

Introduction - Need for quality - Evolution of quality - Definition of quality - Dimensions of manufacturing and service quality - Basic concepts of TQM - Definition of TQM – TQM Framework - Contributions of Deming, Juran and Crosby – Barriers to TQM.

**UNIT II TQM PRINCIPLES 9**

Leadership – Strategic quality planning, Quality statements - Customer focus – Customer orientation, Customer satisfaction, Customer complaints, Customer retention - Employee involvement – Motivation, Empowerment, Team and Teamwork, Recognition and Reward, Performance appraisal - Continuous process improvement – PDSA cycle, 5s, Kaizen - Supplier partnership – Partnering, Supplier selection, Supplier Rating.

**UNIT III TQM TOOLS & 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 & TECHNIQUES II 9**

Quality circles – Quality Function Deployment (QFD) – Taguchi quality loss function – TPM – Concepts, improvement needs – Cost of Quality – Performance measures.

**UNIT V QUALITY SYSTEMS 9**

Need for ISO 9000- ISO 9000-2000 Quality System – Elements, Documentation, Quality auditing- QS 9000 – ISO 14000 – Concepts, Requirements and Benefits – Case studies of TQM implementation in manufacturing and service sectors including IT.

**TOTAL : 45 PERIODS**

**TEXT BOOK**

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”, 6<sup>th</sup> Edition, South-Western (Thomson Learning), 2005.
2. Oakland, J.S. “TQM – Text with Cases”, Butterworth – Heinemann Ltd., Oxford, 3<sup>rd</sup> Edition, 2003.
3. Suganthi,L and Anand Samuel, “Total Quality Management”, Prentice Hall (India) Pvt. Ltd.,2006.
4. Janakiraman,B and Gopal, R.K, “Total Quality Management – Text and Cases”, Prentice Hall (India) Pvt. Ltd., (2006).

**PY3412**

**PROJECT WORK**

L	T	P	C
0	0	12	12

The project may be considered as the ultimate exercise presented to the final semester student before graduation to measure accumulated technical knowledge and experience. At the same time, the project itself should provide the students with some new skills, innovation and information, and strengthen the acquired ones.







<b>PY3002</b>	<b>HERBAL TECHNOLOGY</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**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 plant 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 PHYTOPHARMACEUTICALS 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 – Conservation strategies of medicinal plants – Conservation types – Government policies for protecting the traditional knowledge.

**TOTAL: 45 PERIODS**

**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.

- Lanza, R.P. and Atala, A., "Methods of Tissue Engineering" Elsevier Publications, 2006.
- Daniel, M., "Herbal Technology: Concepts and Advances" Satish Serial Publishing House, 2008.

<b>PY3003</b>	<b>PHARMACEUTICAL PRODUCTION MANAGEMENT</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**UNIT I PILOT PLANT AND SCALE-UP TECHNIQUES 9**  
 Pharmaceutical Pilot plant – Pilot plant design – Case studies for tablets – Capsules – Aerosols – Liquid orals – Parenterals – Sustained release preparation – Semi-solid preparation – Basic requirements – Design of product – Facility – Equipment selection and personnel.

**UNIT II PRODUCTION, PLANNING, SCHEDULING AND FORECASTING 9**  
 Production systems – Production department – Production process routing and loading – Scheduling – Despatching of records – Production control.

**UNIT III FORMULATION PRODUCTION MANAGEMENT 9**  
 Plant site selection and layout – Material handling for various pharmaceutical products – Service facilities – Preventive maintenance in pharmaceutical companies – Group and individual replacement.

**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.

**UNIT V HUMAN RESOURCE DEVELOPMENT 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 – Labour welfare.

**TOTAL: 45 PERIODS**

**TEXT BOOKS**

- Vidyasagar, G., "Pharmaceutical Industrial Management", 3rd Edition, Varghese Publications, 2001.
- 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 Williams, 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.

**PY3004**

## **INDUSTRIAL MANAGEMENT**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

### **UNIT I PERSONNEL MANAGEMENT 9**

Principles and functions – Handling union – Negotiation process – Labour legislation in India – Managerial decision making process, tools and techniques – Role of employee through empowerment – Industrial management program – Public relation.

### **UNIT II TQM TOOLS AND TECHNIQUES 9**

Bench marking process – Concept, reason, application – Quality function deployment and its benefits – Study of manufacturing costs and techniques for financial control – Tools and techniques for six sigma philosophy – Tacuchi law functions – Statistical process control.

### **UNIT III QUALITY AND ENVIRONMENTAL MANAGEMENT SYSTEMS 9**

Philosophy of Total Quality Management – ISO registration procedure and benefits – Concepts of ISO 9000, 14000, 18000 standards – Internal quality audit – Quality improvement and customer satisfaction – Importance of documentation procedure – Plant safety and industrial hygiene.

### **UNIT IV ENGINEERING ECONOMICS 9**

Micro and Macro economics – Accounting procedures and preparation of financial statements – Principles of lean manufacturing philosophy – Study of global market – Methods to overcome competitiveness.

### **UNIT V PROCESS ECONOMICS 9**

Amortisation, Capital recovery, Depreciation - Economics of selecting alternatives – Rate of return and payout time – Budgeting – Operation Management – Strategic analysis – Problem solving techniques – Preparation of technical reports – Process Improvement.

**TOTAL: 45 PERIODS**



**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**

**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, 7<sup>th</sup> 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.

**PY3006 VALIDATION IN PHARMACEUTICAL INDUSTRIES L T P C**  
**3 0 0 3**

**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 (Q<sub>1</sub>A) – Photo stability testing of new substances and products (Q<sub>1</sub>B) – Validation on analytical procedures (Q<sub>2</sub>A).

**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**

**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.

**PY3007 NATURAL PRODUCTS CHEMISTRY L T P C**  
**3 0 0 3**

**UNIT I PROTEINS AND AMINO ACIDS 9**

Classification – Properties – Reaction and preparation of amino acids – Essential amino acids.

**UNIT II TERPENOIDS 9**

Classification – General methods of determining the structure – Chemistry and uses of citral – Menthol – Thymol – Camphor –  $\alpha$ -Terpineol –  $\alpha$ -pinene.









**UNIT- III      DESIGN** **9**  
Pilot plant design for flow ducts – Mixing equipments – Heat transfer equipments.

**UNIT- IV      METHODS** **9**  
Design methods for packed towers – Batch and continuous distillation columns.

**UNIT- V      EQUIPMENTS** **9**  
Pilot plants for reactors – Furnaces – Filters and mechanical operations equipments.

**TOTAL: 45 PERIODS**

**TEXT BOOKS**

1. Bisio, A. and Kabel, R.L., "Scale Up of Chemical Processes", John Wiley Publishers, 1990.
2. Johnstone, R.E. and Thring, M.W., "Pilot Plants Models and Scale Up Methods in Chemical Engineering", McGraw Hill Book Co., 1987.

**REFERENCES**

1. Ernest, J. and Staffin, K.H., "Stage-wise Process Design", John Wiley Publications, 1989.
2. Levin, M., "Pharmaceutical Process Scale-Up", Informa Healthcare, 2002.
3. Hynes, M.D., "Preparing for FDA Pre-approval Inspections", Informa Healthcare, 1998.

<b>PY3011</b>	<b>DRUGS THROUGH BIOTECHNOLOGY</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**UNIT I      GENETIC ENGINEERING** **9**  
Recombinant DNA Technology – Aims – Genetic engineering applications – Genetic engineering tools – General techniques of genetic engineering – Transformation and analysis of recombinants.

**UNIT II      VECTORS** **9**  
Design of Plasmid vectors – Bacteriophage vectors – Cosmids – Eukaryotic vectors – Genomic and DNA Libraries – Screening procedures.

**UNIT III      IMMUNOGLOBULINS** **9**  
Antigens – Adjuvants – Monoclonal antibodies – Hybridoma cells – Applications of monoclonal antibodies – Idiotypic antibodies – Enzymes linked immuno-sorbant assay – Radiimmuno assay.

**UNIT IV IMMUNOTHERAPY 9**

Vaccine technology – DNA based vaccines – Pathogenesis of infections microorganism – Antibody Engineering – Applications – Catalytic antibodies – Humanised monoclonal antibodies.

**UNIT V GENE THERAPY 9**

Strategies – Future scope – Potential – Recent developments in biopharmaceuticals – Production through biotechnology – Genome-based medicine – Molecular modeling – Drug designing.

**TOTAL: 45 PERIODS**

**TEXT BOOKS**

1. Taybor, J.M., "Genetic Engineering Technology in Industrial Pharmacy – Principles and Applications", Marcel Dekker, 1989.
2. De Roberts, E.D.P. and De Roberts, E.M.F., "Cell and Molecular Biology", 8th Edition, Lea and Febiger, 1987.

**REFERENCES**

1. Trevan, M.D., Boffey, S., Goulding, K.H. and Stan Burg, P., "Biotechnology: The Biological Principles", Tata McGraw Hill, 1987.
2. Rehin, H.J. and Reed, G., "Biotechnology – A Comprehensive Treatise", Verlag Chemic, 1983.
3. Manfred, E.W., "Burger's Medicinal Chemistry and Drug Discovery", Vol.I, John Wiley, 1995.

<b>MG3012</b>	<b>SAFETY AND RISK MANAGEMENT</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**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**

**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.ChE.
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.