

PHARMACEUTICAL SCIENCES AND TECHNOLOGY

Adopted Academic Year 2015-2016

The Bachelor of Technology is now a four year program, after 12th.

The structure consists of subjects common to all branches, and includes basic sciences, engineering and some humanities and management components.

In this document, the structure of the syllabus, divided into 8 semesters, is followed by the detailed syllabus for special subjects, within the Pharmaceutical Technology domain.

Syllabus Structure B. Tech. First Year

Semester I									
Subject Code	Subjects	Credits	Hrs/Week			Marks for various Exams			
			L	T	P	C. A.	M.S.	E. S.	Total
CHT1341	Physical Chemistry-I	3	2	1	0	10	15	25	50
CHT1401	Analytical Chemistry	3	2	1	0	10	15	25	50
MAT1101	Applied Mathematics-I	4	3	1	0	20	30	50	100
PYT1101	Applied Physics-I	4	3	1	0	20	30	50	100
CHP1343	Physical and Analytical Chemistry Laboratory	2	0	0	4	25	-	25	50
GEP1101	Engineering Graphics	4	2	0	6	50	-	50	100
HUP1101	Communication Skills	2	0	0	4	50	-	-	50
	TOTAL:	22	12	4	14	-	-	-	500

Semester II									
Subject Code	Subjects	Credits	Hrs/week			Marks for various Exams			
			L	T	P	C. A.	M.S.	E. S.	Total
CHT1342	Physical Chemistry-II	3	2	1	0	10	15	25	50
CHT1132	Organic Chemistry	4	3	1	0	20	30	50	100
CET1507	Process Calculations	4	3	1	0	20	30	50	100
MAT1102	Applied Mathematics-II	4	3	1	0	20	30	50	100
PYT1103	Applied Physics-II	3	2	1	0	10	15	25	50
PYP1101	Physics Laboratory	2	0	0	4	25	-	25	50
CHP1132	Organic Chemistry Laboratory	2	0	0	4	25	-	25	50
	Total	22	13	5	8	-	-	-	500

Syllabus Structure B. Tech. Second Year

Semester III									
Subject Code	Subjects	Credits	Hrs /week			Marks for various Exams			
			L	T	P	C. A.	M.S.	E.S.	Total
PHT1081	Spl 1: Pharmaceutics Formulation Technology I	4	3	1	0	20	30	50	100
PHT1023	Spl 2: Physiology and Pharmacology	4	3	1	0	20	30	50	100
BST1101	Microbiology	3	2	1	0	10	15	25	50
BST1102	Biochemistry	4	3	1	0	20	30	50	100
PHT1051	Chemistry of Natural Products	4	3	1	0	20	30	50	100
PHP1081	Pr 1: Pharmaceutical Formulation Technology-Laboratory I	2	0	0	4	25	-	25	50
PHP1022	Pr 2: Physiology-Pharmacology Laboratory	2	0	0	4	25	-	25	50
	Total	23	14	5	8	-	-	-	550

Semester IV									
Subject Code	Subjects	Credits	Hrs/week			Marks for various Exams			
			L	T	P	C. A.	M.S.	E. S.	Total
GET1116	Engg. Mechanics & Strength of Materials	4	3	1	0	20	30	50	100
PHT 1059	Pharmaceutical Organic Chemistry and Co-ordination	3	2	1	0	10	15	25	50
CET1105	Transport Phenomena	4	3	1	0	20	30	50	100
GET1105	Electrical Engg and Electronics	3	2	1	0	10	15	25	50
PHT1032	Spl 3: Pharmaceutical Analysis	4	3	1	0	20	30	50	100
GEP1106	Electrical Engg and Electronics Laboratory	2	0	0	4	25	-	25	50
MAP1201	Computer Applications Laboratory	2	0	0	4	25	-	25	50
	Total	22	13	5	8	-	-	-	500

Syllabus Structure B. Tech. Third Year

Semester V									
Subject Code	Subjects	Credits	Hrs /week			Marks for various Exams			
			L	T	P	C. A.	M.S.	E. S.	Total
CET1401	Chemical Engineering Operations	3	2	1	0	10	15	25	50
CET1201	Chemical Reaction Engineering	3	2	1	0	10	15	25	50
PHT1082	Spl 4: Pharmaceutical Formulation Technology- II	4	3	1	0	20	30	50	100
PHT1054	Spl 5: Medicinal Chemistry I	4	3	1	0	20	30	50	100
PHT1048	Spl 6: Medicinal Natural Products	4	3	1	0	20	30	50	100
PHP1043	Pr 3 : A. Medicinal Natural Products B. Pharmaceutical and Biochemistry Analysis	4	0	0	8	50	-	50	100
PHP1082	Pr 4 : Pharmaceutical Formulation Technology Laboratory- II	2	0	0	4	25	-	25	50
	Total	24	13	5	12	-	-	-	550

Semester VI									
Subject Code	Subjects	Credits	Hrs/week			Marks for various Exams			
			L	T	P	C. A.	M.S.	E. S.	Total
PHT1055	Spl 7 : Pharmaceutical Chemistry and Catalytic Process	4	3	1	0	20	30	50	100
PHT1083	Spl 8: Pharmaceutical Formulation Technology III	3	2	1	0	10	15	25	50
HUT1103	Industrial Psychology and Human Resource Management	3	2	1	0	10	15	25	50
HUT1104	Industrial Management – I	3	2	1	0	10	15	25	50
	Spl 9: Elective-I	3	2	1	0	10	15	25	50
HUT1106	Environmental Science and Technology	3	2	1	0	10	15	25	50
PHP1083	Pr 5: Pharmaceutical Formulation Technology Laboratory-III	4	0	0	8	50	-	50	100
PHP1053	Pr 6: Pharmaceutical Chemistry Laboratory	2	0	0	4	25	-	25	50
PHP1054	Pr 7: Medicinal Chemistry	2	0	0	4	25	-	25	50

	Laboratory								
	Total	27	13	6	16	-	-	-	550

Internship

- After the end of the sixth semester examination and before the start of the seventh semester, every student will have to undergo an internship. The Internship would be of 6 credits.
- The internship (preferably Industrial Internship) would be assigned to the student by the Departmental Internship Coordinator, with the approval of Head of the Department.
- The total duration of the internship would be for a period equivalent to 12 Calendar weeks. This period typically start from 1st May and end before 30th July every year. This means the end semester examination of T. Y. Tech (Semester VI) should be completed by 25th April every year. The Semester VII (4th Year B.Tech.) should commence w.e.f. 1st Aug every year. The internship may be completed in one or more organizations as described below.
- The internship could be of the following forms:
 - (i) Industrial internship in a company (within India or Abroad) involved in R&D / design / manufacturing (QA/QC/Plant Engineering/Stores and Purchase) / marketing / finance / consultancy / Technical services / Engineering / Projects, etc.
 - (ii) Research internship in reputed Institutes (within India or Abroad) like, ICT, IITs, NITs, IISC, NCL, IICT etc.
- At the end of the internship, each student will submit a written report based on the work carried out during the Internship. The report will be countersigned by the Supervisor from Industry / Institute as the case may be.
- Performance of the student will be assessed based on the written report and a presentation to a committee consisting of two faculty members from the Department.
- Students will be assigned a grade based on the written report and a presentation; evaluated by a committee of faculty members.

Syllabus Structure B. Tech. Final Year

Semester VII (will be of 10 weeks duration)									
Subject Code	Subjects	Credits	Hrs/week			Marks for various Exams			
			L	T	P	C. A.	M.S.	E.S.	Total
CET1703	Chemical Process Control	3	2	1	0	10	15	25	50
PHT1056	Spl 10: Medicinal Chemistry II	4	3	1	0	20	30	50	100
PHT1084	Spl 11: Validation and Regulatory Requirements	3	2	1	0	10	15	25	50
	Spl 12: Elective – II	3	2	1	0	10	15	25	50
HUT1105	Industrial Management – II	3	2	1	0	10	15	25	50
MAT1106	Design and Analysis of Experiment	3	2	1	0	10	15	25	50
CEP1714	Chem. Eng. Laboratory	2	0	0	4	25	-	25	50
PHP 1073	Seminar	2	0	0	4	-	-	50	50
PHP 1076	Project I	4	0	0	8	-	-	100	100
	Total	27	13	6	16	-	-	-	550

Semester VIII									
Subject Code	Subjects	Credits	Hrs /week			Marks for various Exams			
			L	T	P	C. A.	M.S.	E. S.	Total
CET1504	Chemical Project Engineering and Economics	3	2	1	0	10	15	25	50
PHT1063	Spl 13: Pharmaceutical Biotechnology	3	2	1	0	10	15	25	50
PHT1057	Spl 14: Medicinal Chemistry III	3	2	1	0	10	15	25	50
PHT1058	Spl 15: Process Technology of Drugs and Intermediates	4	3	1	0	20	30	50	100
	Spl 16: Elective III	3	2	1	0	10	15	25	50
HUT1107	Value Education	3	2	1	0	10	15	25	50
PHP1075	Project II	4	0	0	8	-	-	100	100
PHP1055	Pr 8: Process Technology (Chemistry and Biotechnology) Laboratory	4	0	0	8	50	-	50	100

Total	27	14	6	16	-	-	-	550
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Semester I

	Course Code: CHT1341	Course Title: Physical Chemistry I	Credits = 3		
	Semester: I		Total contact hours: 45	L	T
			2	1	0
List of Prerequisite Courses					
	HSC chemistry				
List of Courses where this course will be prerequisite					
Description of relevance of this course in the B. Tech programme					
The course will enable the students to understand chemical and phase equilibria, direction of spontaneity and calculation of equilibrium compositions, effect of experimental parameters on phase and chemical equilibria					
Sr. No.	Course Contents (Topics and subtopics)				Reqd. hours
1	Introduction- Thermodynamic systems, work, heat and energy, state and path functions				2
2	First law of thermodynamics – Enthalpy and heat capacities, application of first law to gases, standard states				2
3	Second and third laws of thermodynamics -. Statements and applications, entropy and calculation of entropy changes, absolute entropies, verification of third law, molecular basis of thermodynamics				3
4	Spontaneous process and equilibrium: Criteria for spontaneous processes, equilibrium states, Maxwell relations, Gibbs and Helmholtz free energy and their temperature relations, free energy and equilibrium constant, calculation of free energy changes, free energy and entropy of mixing, thermochemistry- Hess's law, Ellingham diagrams				3
5	Multicomponent systems -. Partial molar quantities and chemical potential, Gibbs Duhem equation, thermodynamics of solutions, ideal and non ideal solutions Fugacity, activity and activity coefficients, thermodynamic properties of electrolytes in solutions				2
6	Phase equilibria -. Gibbs Phase rule, equilibrium between phases Gibbs energy and phase transitions, classification of phase transitions, one component systems – phase diagrams, Clausius- Clapeyron equation, Henry's law and Raoult's law, solubility and extraction				5
7	Two and three component systems – liquid- liquid and liquid vapour systems- pressure -composition and temperature- composition phase diagrams, solid- liquid phase diagrams, three component phase diagrams, colligative properties				5
8	Electrochemistry – thermodynamics of electrochemical systems- electrochemical cells, determination of electrode potentials, types of electrochemical cells, activity and activity coefficients, theory of dissociation				8

	of electrolytes, ionic equilibria	
List of Text Books/ Reference Books		
1	Physical chemistry – Robert G Mortimer – Elsevier publications	
2	Basic chemical thermodynamics- E. Brian smith – Oxford University press	
3	Introduction to Chemical Engineering Thermodynamics- J.M.smith , Van Ness	
4	Chemical nad Engineering thermodynamics – Milo Koretsky, Wiley publications	
5	Phase rule and its applications-Alexander Findlay, Dover publications	
Course Outcomes (students will be able to....)		
1	Appreciate the significance of thermodynamics in chemical, electrochemical and physical processes	
2	Problem solving skills	
3	significance of equilibrium and spontaneity , phases in equilibrium	

	Course Code: CHT1401	Course Title: Analytical Chemistry	Credits = 3			
	Semester: I		Total contact hours:45	L	T	P
				2	1	0
List of Prerequisite Courses						
	HSC Chemistry					
List of Courses where this course will be prerequisite						
	Other Chemistry Courses, Physical and Analytical Chemistry Laboratory					
Description of relevance of this course in the B. Tech programme						
To introduce the principles and applications of analytical chemistry						
Sr. No.	Course Contents (Topics and subtopics)				Reqd. hours	
1	Introduction – Analytical procedures- hazards and handling, treatment of waste, good laboratory practices				4	
2	Aspects of analysis- errors – systematic and random errors, statistical treatment of experimental results, least square method, correlation coefficients Sampling – basics and procedures, preparation of laboratory samples				5	
3	Applied analysis – analytical procedures in environmental monitoring, water, soil and air quality, BOD and COD determinations,				5	
4	Instrumental methods – Criteria for selecting instrumental methods - precision, sensitivity, selectivity, and detection limit, transducers, sensors and detectors, signals and noise				4	
5	Molecular spectral methods – Uv-visible, molecular fluorescence, IR and FT-IR Mass spectroscopy				8	
6	Atomic spectral methods – atomic emission and absorption methods				3	
7	Thermal methods – TGA, DTA and DSC				4	
8	Chromatographic and other separation methods – GC, HPLC , ion exchange and size exclusion chromatography , super critical fluid extraction				12	

List of Text Books/ Reference Books		
1	D.A. Skoog, D.M. West, F.J. Holler, S.R. Crouch, Fundamentals of Analytical Chemistry	
2	J.G. Dick, Analytical Chemistry, R.E. Krieger Pub	
3	Environmental Chemistry, A. K. De, Wiley	
4	Chromatography	
5	Thermal Methods	
Course Outcomes (students will be able to.....)		
1	List different analytical techniques	
2	Describe the basic principles of different analytical techniques	
3	Compute the mean from a set of measurements	
4	Suggest possible analytical techniques for identification and quantification of chemicals	

	Course Code: MAT1101	Course Title: Applied Mathematics I	Credits = 4		
			L	T	P
	Semester: I	Total contact hours: 60	3	1	0
List of Prerequisite Courses					
	HSC Standard Mathematics				
List of Courses where this course will be prerequisite					
	This is a basic Mathematics course. This knowledge will be required in almost all subjects later on				
Description of relevance of this course in the B. Tech programme					
This is a basic Mathematics course. This knowledge will be required in almost all subjects later on. This knowledge is also required for solving various mathematical equations that need to be solved in several chemical engineering courses such as MEBC, momentum transfer, reaction engineering, separation processes, thermodynamics, etc.					
Sr. No.	Course Contents (Topics and subtopics)				Reqd. Hours
1	Solutions of system of linear equations (Gauss-elimination, LU-decomposition etc.) Numerical methods for solving non-linear algebraic / transcendental etc. Newton's method, Secant, Regula Falsi, Jacobi Numerical solution set of linear algebraic equations: Jacobi, Gauss Siedel, and under / over relaxation methods				10
2	Interpolation and extrapolation for equal and non-equal spaced data (Newtons Forward, Newtons backward and Lagrange) Numerical integration (trapezoidal rule, Simpson's Rule)				10
3	Probability of Statistics: Functions of random variables, probability distribution functions, expectation, moments Statistical hypothesis tests, t-tests for one and two samples, F-test, χ^2 -test Statistical Methods for Data Fitting: Linear, multi-linear, non-linear regression				10
4	Differential Calculus: Higher order differentiation and Leibnitz Rule for the derivative, Taylor's and Maclaurin's theorems, Maxima/Minima, convexity of functions, Radius of curvature;				10
5	Functions of two or more variables, Limit and continuity, Partial differentiation, Total derivatives, Taylor's theorem for multivariable functions and its application to error calculations, Maxima/Minima, Jacobian.				10
6	Integral Calculus: Beta and Gamma functions, Differentiation under the integral sign, surface integrals, volume integrals				10
List of Text Books/ Reference Books					
1	Advanced Engineering Mathematics, Erwin Kreyszig, John-Wiely.				
2	Advanced Engineering Mathematics S. R. K. Iyengar, R. K. Jain, Narosa				
3	Introductory Methods Of Numerical Analysis, S. S. Sastry, PHI.				
4	A First Course in Probability, Sheldon Ross, Pearson Prentice Hall				
5	Probability and Statistics in Engineering , W.W. Hines, D. C. Montgomery, D.M. Goldsman, John-Wiely				
Course Outcomes (students will be able to.....)					
1	Students should be able to solve system of linear algebraic equations				
2	Students should be able to do numerical integrations of functions.				

3	Students should be able to fit relationship between two data sets using linear, non-linear regression.	
4	Students should be able to calculate maxima/minima and functions.	

	Course Code: PYT1101	Course Title: Applied Physics I	Credits = 4		
	Semester: I	Total contact hours: 60	L	T	P
			3	1	0
List of Prerequisite Courses					
	XIIth Standard Physics				
List of Courses where this course will be prerequisite					
	Applied Physics – II, Physics Laboratory, Chemical Engineering Thermodynamics, Momentum and Mass Transfer, Heat Transfer, Material Science and Engineering, Structural Mechanics, etc.				
Description of relevance of this course in the B. Tech. Program					
This is a basic physics course. This knowledge will be required in almost all subjects later on. This knowledge is also required for understanding various chemical engineering concepts that will be introduced in courses such as momentum transfer, reaction engineering, separation processes, thermodynamics, heat transfer, etc.					
Sr. No.	Course Contents (Topics and subtopics)				Reqd. Hours
1	Solid State Physics Crystal structure of solids: unit cell, space lattices and Bravais lattice, Miller indices, directions and crystallographic planes, Cubic crystals: SSC, BCC, FCC, Hexagonal crystals: HCP, atomic radius, packing fraction, Bragg's law of x-ray diffraction, determination of crystal structure using Bragg spectrometer Semiconductor Physics: Formation of energy bands in solids, concept of Fermi level, classification of solids: conductor, semiconductor and insulator, intrinsic and extrinsic semiconductors, effect of doping, mobility of charge carriers, conductivity, Hall effect.				15
2	Fluid Mechanics Basic concepts of density and pressure in a fluid, ideal and real fluids, Pascal's law, absolute pressure and pressure gauges, basic concepts of surface tension and buoyancy, fluid flow, equation of continuity, Bernoulli's equation, streamlined and turbulent flow, concept of viscosity, Newton's law of viscosity, brief introduction to non-Newtonian behaviour.				15
3	Optics and Fibre Optics Diffraction: Introduction to interference and example; concept of diffraction, Fraunhofer and Fresnel diffraction, Fraunhofer diffraction at single slit, double slit, and multiple slits; diffraction grating, characteristics of diffraction grating and its applications. Polarisation: Introduction, polarisation by reflection, polarisation by double refraction, scattering of light, circular and elliptical polarisation, optical activity. Fibre Optics: Introduction, optical fibre as a dielectric wave guide: total internal reflection, numerical aperture and various fibre parameters, losses associated with optical fibres, step and graded index fibres, application of optical fibres.				10
4	Lasers Introduction to interaction of radiation with matter, principles and working of				10

	laser: population inversion, pumping, various modes, threshold population inversion, types of laser: solid state, semiconductor, gas; application of lasers.	
5	Ultrasound Generation of ultrasound: mechanical, electromechanical transducers; propagation of ultrasound, attenuation, velocity of ultrasound and parameters affecting it, measurement of velocity, cavitation, applications of ultrasound.	10
List of Text Books/ Reference Books		
	Physics: Vols. I and II – D. Halliday and R. Resnick, Wiley Eastern.	
	Lectures on Physics: Vols. I, II and III – R. P. Feynman, R. B. Leighton and M. Sands, Narosa.	
	Concepts of Modern Physics – A. Beiser, McGraw-Hill.	
	Introduction to Modern Optics – G. R. Fowles, Dover Publications.	
	A Course of Experiments with LASERS – R. S. Sirohi, Wiley Eastern.	
	Optical Fibre Communication – G. Keiser, McGraw-Hill.	
	Optoelectronics – J. Wilson and J. F. B. Hawkes, 2nd ed, Prentice-Hall India.	
	Ultrasonics: Methods and Applications – J. Blitz, Butterworth.	
	Applied Sonochemistry – T. J. Mason and J. P. Lorimer, Wiley VCH.	
Course Outcomes (students will be able to.....)		
1	Students will be able to state Bragg's Law	
2	Student will be able to apply Bernoulli equation in simple pipe flows	
3	Students will be introduced to the principles of lasers, types of lasers and applications.	
4	Students should be able to calculate resolving power of instruments.	
5	Students should be able to describe principles of optical fibre communication.	
6	Application of acoustic cavitation of Chemical Engineering Processes.	

	Course Code: CHP1343	Course Title: Physical and Analytical Chemistry Laboratory	Credits = 2		
	Semester: I		Total contact hours: 60	L	T
			0	0	4
List of Prerequisite Courses					
	H.S.C. Chemistry laboratory courses				
List of Courses where this course will be prerequisite					
Description of relevance of this course in the B. Tech Programme					
Students will become familiar with laboratory experimental skills, plan and interpretation of experimental tasks, understand the relevance of principles of physical chemistry in chemical processes					
Sr. No.	Course Contents (Topics and subtopics)				Reqd. hours
1	Experiments based on chemical reaction kinetics, phase equilibria and electrolyte systems, surface and interfacial phenomena such as surface tension and CMC Measurements.				4h per session
List of Text Books/ Reference Books					
1	Practical physical Chemistry – B. Viswanthan and P.S. Raghavan				

2	Practical physical Chemistry- Alexander Findlay	
Course Outcomes (students will be able to.....)		
1	Identify and determine physicochemical parameters using simple tools	
2	Interpretation of data and drawing scientific conclusions	

	Course Code: GEP1101	Course Title: Engineering Graphics	Credits = 4		
	Semester: I		Total contact hours: 90	L	T
			2	0	6
List of Prerequisite Courses					
	Basic Geometry				
List of Courses where this course will be prerequisite					
	Engineering Graphics – II, Equipment Design and Drawing-I, Equipment Design and Drawing-II, Home Paper – II, Structural Mechanics,				
Description of relevance of this course in the B..Tech. Program					
<p>A student of Chemical Engineering is required to know the various processes and also the equipment used to carry out the processes. Some of the elementary processes like filtration, size reduction, evaporation, condensation, crystallization etc., are very common to all the branches of technology. These and many other processes require machines and equipments. One should be familiar with the design, manufacturing, working, maintenance of such machines and equipments. The subject of "drawing" is a medium through which, one can learn all such matter, because the "drawings" are used to represent objects and processes on the paper. Through the drawings, a lot of accurate information is conveyed which will not be practicable through a spoken word or a written text. Drawing is a language used by engineers and technologists. This course is required in many subjects as well as later on in the professional career.</p>					
Sr. No.	Course Contents (Topics and subtopics)				Reqd. hours
1	Orthographic projections				12
2	Sectional views				12
3	Isometric projections				10
4	Missing views (or interpretation of views.)				10
5	Projection of solids				12
6	Sections of solids				12
7	Development of surface				12
8	Interpenetration of solids				10
List of Text Books/ Reference Books					
	1.Engineering Drawing by N.D.Bhat				
	2. Engineering Drawing by N.H.Dubey				
Course Outcomes (students will be able to.....)					
1	Read Drawing				
2	Can understand different views.				

	Course Code: HUP1101	Course Title: Communication Skills	Credits = 2		
	Semester: I	Total contact hours: 60	L	T	P
			0	0	4
List of Prerequisite Courses					
	XIIth Standard English				
List of Courses where this course will be prerequisite					
	All				
Description of relevance of this course in the B.Tech. Program					
This is an important course for the effective functioning of an Engineer. Communication skills are required in all courses					
Sr. No.	Course Contents (Topics and subtopics)				Reqd. hours
1	Development of communication skills in oral as well as writing.				10
2	The writing skills should emphasize technical report writing, scientific paper writing, letter drafting, etc.				14
3	The oral communication skills should emphasize presentation skills.				10
4	Use of audio-visual facilities like powerpoint, LCD. for making effective oral presentation.				14
5	Group Discussions				12
List of Text Books/ Reference Books					
	Elements of style – Strunk and white				
Course Outcomes (students will be able to.....)					
1	Students should be able to write grammar error free technical reports in MS Words or equivalent software.				
2	Students should be able to make power point slides in MS PowerPoint or equivalent software.				

Semester II

	Course Code: CHT1342	Course Title: Physical chemistry II	Credits = 3		
	Semester: II		Total contact hours: 45	L	T
			2	1	0
List of Prerequisite Courses					
	Physical Chemistry –I, HSC Chemistry				
List of Courses where this course will be prerequisite					
Description of relevance of this course in the B. Tech programme					
Relevance of reaction rates and parameters affecting the same , concept of interfaces and surfaces and the importance of disperse systems					
Sr. No.	Course Contents (Topics and subtopics)				Reqd. hours
1	Chemical kinetics – Introduction, concept of reaction rates and order, experimental methods in kinetic studies, differential and integral methods to formulate rate equations of zero, first and second order reactions				2
2	Experimental methods of kinetic studies				1
2	Complex reactions- parallel, consecutive and reversible				2
3	Kinetics and reaction mechanism- steady state and rate determining step Mechanism of thermal photochemical chain reactions, polymerization reactions				2
4	Surface reactions – Adsorption, kinetics of surface reactions- Hishelwood and Rideal models of surface reactions				2
	Theories of reaction rates and temperature effects- collision theory and TST Theory of unimolecular reactions				3
5	Kinetics of reactions in solutions- solvent effects				2
6	Fast reactions – experimental techniques				1
7	Surface and interfacial Chemistry – introduction, surface tension and surface free energy, methods of determining surface and interfacial tensions				2
8	Thermodynamics of surfaces – surface excess, Gibbs adsorption equation, curved surfaces- bubbles, droplets and foams, Kelvin, Young Laplace and Thomson equations, homogeneous nucleation				3
9	Liquid- liquid and solid liquid interfaces – contact angle, wetting and spreading, adhesion and cohesion, contact angle measurements and hysteresis				3
10	Surfactants: Types, adsorption at surfaces and interfaces, surfactant aggregates, factors affecting aggregation phenomena, applications of surfactants and mixed surfactant systems				3
11	Disperse systems - Emulsions microemulsions and foams-. Thermodynamics and stability, HLB values , colloids - preparation, stability, characterization, surface charges and electrical double layer				4

List of Text Books/ Reference Books		
1	Chemical Kinetics – K.J.Laidler	
2	Principles of Chemical Kinetics – James E House	
2	Surfaces interfaces and colloids- Drew Myers- Wiley VCH	
3	Colloids and interfaces with polymers and surfactants - Jim Goodwin, wiley	
4	Surfactants and interfacial phenomena- Milton J Rosen – Wiley Interscience	
5	Industrial utilization of surfactants principles and applications – M.J. Rosen and M Dahanayake, AOCS Press	
6	Principles of colloids and surface Chemistry – Paul C Hemenz and Raj Rajagopalan- Marcel Dekker	
7	Foundations of Colloid science – Robert J Hunter – Oxford university Press	
Course Outcomes (students will be able to.....)		
1	Understand the importance of chemical kinetics in process design	
2	Importance and application of surface active agents	
3	Understand the stability and importance of disperse systems	

	Course Code: CHT1132	Course Title: Organic Chemistry	Credits = 4		
	Semester: II		Total contact hours: 60	L	T
			3	1	0
List of Prerequisite Courses					
	Organic Chemistry –I, HSC Chemistry				
Sr. No.	Course Contents				Reqd. Hrs.
1	Mechanisms of organic reactions: Types of Organic Reaction, Reactive intermediates; their generation, structure, stability and general reactions. Acidity and basicity. Mechanisms of simple organic transformations.				12
2	Stereochemistry: Stereodescriptors, Elements of symmetry, stereochemistry of compounds containing one and two carbon atoms. Racemates and their resolution, conformation of cyclic and acyclic systems, Idea of asymmetric synthesis.				5
3	Aromaticity: Huckel's theory of Aromaticity. Aromaticity of simple benzenoid and non benzenoid species.				4
4	Aromatic compounds: Sources. BTX, Aromatic hydrocarbons. General mechanisms of aromatic electrophilic and nucleophilic substitution reactions. Orientation of electrophile in arenes.				6
5	Friedel-Crafts and related reactions: Friedel-Crafts alkylation and acylation reactions. Aromatic formylation reactions. Aromatic carboxylation.				5
6	Chemistry of enolates: Mechanism of aldol and related reactions				5
7	Chemistry of ethers, epoxides, sulphonic acids.				4
8	Amines: Methods of preparation, chemistry of aromatic diazonium				4

	salts	
	Reference Books	
1	Organic Chemistry, J. McMurry, Brooks/Cole	
2	Organic Chemistry, T.W.G. Solomons, C.B. Fryhle, John Wiley and Sons Inc.,	
3	Organic Chemistry, L.G. Wade Jr, Pearson Education	
4	StereoChemistry of Carbon compounds, E.L. Eliel, Mcgraw-Hill	
5	Organic Chemistry, Paula Y. Bruice, Pearson Education	

	Course Code: CET 1507	Course Title: Process Calculations	Credits = 4		
	Semester: II		Total contact hours: 60	L	T
			2	2	0
List of Prerequisite Courses					
	XIIth Standard Mathematics, Chemistry, Physics				
List of Courses where this course will be prerequisite					
	This is a basic Course. This knowledge will be required in ALL subjects later on.				
Description of relevance of this course in the B. Tech. Program					
This is a basic course. This knowledge will be required in almost all subjects later on. This subject introduces the various concepts used in Chemical Engineering to the students. The knowledge of this subject is required for in ALL B. Tech. courses, etc. It can be applied in various situations such as process selection, economics, sustainability, environmental impacts					
Sr. No.	Course Contents (Topics and subtopics)				Reqd. Hours
1	Introduction to Chemical process calculations, overview of single stage and multistage operations, concept of process flow sheets				2
2	Revision of Units and Dimensions, Dimensional analysis of equations, Mathematical techniques				4
3	Mole concept, composition relationship, types of flow rates				2
4	Material balance in non-reacting systems: application to single and multistage processes				8
5	Stoichiometry				2
6	Material balance in reacting systems: application to single and multistage processes				6
7	Behaviour of gases and vapors				4
8	Introduction to psychrometry, humidity and air-conditioning calculations.				6
9	Calculation of X-Y diagrams based on Raoult's law.				2
10	Applications of material balances to Multiphase systems				6
11	Basic concepts of types of Energy and calculations				2
12	Application of Energy balance to non-reacting systems				6
13	Application of Energy balance to reacting systems				6
14	Fuels and combustion.				4
List of Text Books/ Reference Books					
	Elementary Principles of Chemical Processes, Felder, R.M. and Rousseau,				

	R.W.	
	Chemical Process Principles, Hougen O.A., Watson K. M.	
	Basic Principles and Calculations in Chemical Engineering, Himmelblau,	
	Stoichiometry, Bhatt B.I. and Vora S.M.	
Course Outcomes (students will be able to.....)		
1	Students will be able to convert units of simple quantities from one set of units to another set of units	
2	Students will be able to calculate quantities and /or compositions, energy usages, etc. in various processes and process equipment such as reactors, filters, dryers, etc.	

	Course Code: MAT1102	Course Title: Applied Mathematics II	Credits = 4		
	Semester: II		Total contact hours: 60	L	T
			3	1	0
List of Prerequisite Courses					
	XIIth Standard Mathematics, Applied Mathematics - I				
List of Courses where this course will be prerequisite					
	This is a basic Mathematics course. This knowledge will be required in almost all subjects later on				
Description of relevance of this course in the B. Tech. Program					
This is a basic Mathematics course. This knowledge will be required in almost all subjects later on. This knowledge is also required for solving various mathematical equations that need to be solved in several chemical engineering courses such as MEBC, momentum transfer, reaction engineering, separation processes, thermodynamics, etc.					
Sr. No.	Course Contents (Topics and subtopics)				Reqd. Hours
1	Differential Equations: Solution of Higher order ODE with constant and variable coefficients and its applications to boundary and initial value problems, Series solution of differential equations, Bessel functions, Legendre Polynomials, Error function. Fourier series, Laplace Transforms and their application in differential equation (both ODEs PDEs). Partial Differential Equations, Classification of higher order PDEs, Solution of parabolic equation using separation of variables				20
2	Numerical methods for solution of initial values problems using RK method, Euler's method and Taylor series method.				20
3	Finite difference methods: Forward difference, backward difference, central differences, application of finite difference methods to ODE Boundary value problem.				20
List of Text Books/ Reference Books					
1	Advanced Engineering Mathematics, Erwin Kreyszig, John-Wiely				
2	Advanced Engineering Mathematics S. R. K. Iyengar, R. K. Jain, Narosa.				
3	Elements of <i>Applied Mathematics</i> . Volume 1, P.N.Wartikar and J.N.Wartikar, Pune VidyarthiGraha				
4	Introductory Methods Of Numerical Analysis, S. S. Sastry, PHI.				
5	Numerical Solution of differential Equations, M. K. Jain, Wiley Eastern.				

Course Outcomes (students will be able to.....)		
1	Students should be able to solve simple first and second order ODE by Analytical methods	
2	Students will be able to solve simple first and second order differential equations numerically	
3	Students will be able to solve simple parabolic partial differential equations numerically	

Course Code: PYT 1103	Course Title: Applied Physics II	Credits = 3		
Semester: II	Total contact hours: 45	L	T	P
		2	1	0

List of Prerequisite Courses		
	XIIth Standard Physics, Applied Physics – I, Physics Laboratory,	

List of Courses where this course will be prerequisite		
	This is a basic physics course. This knowledge will be required in almost all subjects later on	

Description of relevance of this course in the B. Chem. Engg. Program		
This is a basic physics course. This knowledge will be required in almost all subjects later on. This knowledge is also required for understanding various chemical engineering concepts that will be introduced in courses such as momentum transfer, reaction engineering, separation processes, thermodynamics, heat transfer, etc.		

Sr. No.	Course Contents (Topics and subtopics)	Reqd. Hours
1	Quantum Mechanics Introduction to quantum physics, black body radiation, explanation using the photon concept, photoelectric effect, Compton effect, de Broglie hypothesis, wave-particle duality, Born's interpretation of the wave function, verification of matter waves, uncertainty principle, Schrodinger wave equation, particle in box, quantum harmonic oscillator, hydrogen atom (no detailed derivation)	25
2	Dielectric and Magnetic Properties of Materials Introduction to the 'del' operator and vector calculus, revision of the laws of electrostatics, electric current and the continuity equation, revision of the laws of magnetism. Polarisation, permeability and dielectric constant, polar and non-polar dielectrics, internal fields in a solid, Clausius-Mossotti equation, applications of dielectrics. Magnetisation, permeability and susceptibility, classification of magnetic materials, ferromagnetism, magnetic domains and hysteresis, applications.	20

List of Text Books/ Reference Books		
	Physics: Vols. I and II – D. Halliday and R. Resnick, Wiley Eastern.	
	Lectures on Physics: Vols. I, II and III – R. P. Feynman, R. B. Leighton and M. Sands, Narosa.	
	Concepts of Modern Physics – A. Beiser, McGraw-Hill.	
	Solid State Physics – A. J. Dekker, 1957, MacMillan India.	
	Perspectives of Modern Physics – A. Beiser, 1969, McGraw-Hill.	

Course Outcomes (students will be able to.....)		
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1	Students will be able to do simple quantum mechanics calculations	
2	Students will be able to define various terms related to properties of materials such as, permeability, polarization, etc.	
3	Students will be able to state some of the basic laws related to quantum mechanics as well as magnetic and dielectric properties of materials	

	Course Code: PYP1101	Course Title: Physics Laboratory	Credits = 2		
	Semester: II		Total contact hours: 60	L	T
			0	0	4

List of Prerequisite Courses

	Applied Physics - I	
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List of Courses where this course will be prerequisite

	This is a basic physics Laboratory course. This knowledge will be required in almost all subjects later on.	

Description of relevance of this course in the B.Tech. Program

This is a basic physics course. Students will be able to learn various concepts by doing experiments on different topics. This knowledge will be required in almost all subjects later on. This knowledge is also required for understanding various chemical engineering concepts that will be introduced in courses such as momentum transfer, reaction engineering, separation processes, thermodynamics, heat transfer, etc.

Sr. No.	Course Contents (Topics and subtopics)	Reqd. Hours
1	Viscosity	5
2	Thermistor	6
3	Thermal conductivity	5
4	Ultrasonic interferometer	6
5	Photoelectric effect	5
6	Hall effect	6
7	Newton's rings	5
8	Dispersive power of prism	8
9	Laser diffraction	8
10	Resolving power of grating	6

List of Text Books/ Reference Books

1	Physics: Vols. I and II – D. Halliday and R. Resnick, Wiley Eastern.	
2	Lectures on Physics: Vols. I, II and III – R. P. Feynman, R. B. Leighton and M. Sands, Narosa.	
3	Concepts of Modern Physics – A. Beiser, McGraw-Hill.	
4	Introduction to Modern Optics – G. R. Fowles, Dover Publications.	
5	A Course of Experiments with LASERS – R. S. Sirohi, Wiley Eastern.	
6	Optical Fibre Communication – G. Keiser, McGraw-Hill.	
7	Optoelectronics – J. Wilson and J. F. B. Hawkes, 2nd ed, Prentice-Hall India.	
8	Ultrasonics: Methods and Applications – J. Blitz, Butterworth.	
9	Applied Sonochemistry – T. J. Mason and J. P. Lorimer, Wiley VCH.	

Course Outcomes (students will be able to.....)

1	Students will be able to state various laws which they have studied through experiments	
2	Student will be able to measure transport properties like viscosity,	

	conductivity, etc.	
3	Students will be able to state application of acoustic cavitation	

CHP1132 Organic Chemistry Laboratory

Synthesis of simple organic compounds to demonstrate various unit processes. Separation and purification of binary mixtures by physical and chemical methods. Purification of organic compounds.

Semester III

	Course Code: PHT1081	Course Title: SPL1Pharmaceutical Formulation Technology-I	Credits = 4		
			L	T	P
	Semester: III	Total contact hours: 60	3	1	0
List of Prerequisite Courses					
	HSC (Science)				
List of Courses where this course will be prerequisite					
	Pharmaceutical Formulation Technology-II				
Description of relevance of this course in the B. Tech (Pharmacy)					
To train the students with respect to basics of monophasics, biphasics, topical formulation, aerosols, stability testing and stabilization					
Sr. No.	Course Contents (Topics and subtopics)				Reqd. hours
1	Over view of Pharmaceutical Industry with introduction and classification of pharmaceutical dosage forms and routes of drug administration				5
2	Origin & development of the pharmacopoeia – IP/BP/USP, Introduction to monograph, parts of monograph. Introduction to biopharmaceutics				4
3	Solubilization techniques				3
4	Monophasics (Oral and Topicals)(solution, syrups, elixirs, linctus, glycerites, nasal drops, ear drops, etc.) <ul style="list-style-type: none"> • Preformulation • Formulation • Quality Control 				5
5	Large scale manufacturing of monophasics <ul style="list-style-type: none"> • Large scale manufacture and packaging with focus onequipment • Layout design and unit operations 				3
6	Biphasic - Suspensions <ul style="list-style-type: none"> • Preformulation • Principles and Stabilization techniques • Formulation Development • Evaluation • Large scale manufacture and packaging with focus onequipment • Layout design and unit operations 				5
7	Biphasic - Emulsions <ul style="list-style-type: none"> • Preformulation • Theories of emulsions • Formulation • Evaluation including stress testing • Large scale manufacture and packaging with focus onequipment • Layout design and unit operations 				5

8	Ointments <ul style="list-style-type: none"> • Preformulation • Formulation • Evaluation • Large scale manufacture and packaging with focus on equipment • Layout design and Unit operations 	4
9	Creams <ul style="list-style-type: none"> • Preformulation • Formulation • Evaluation • Large scale manufacture and packaging with focus on equipment • Layout design and Unit operations 	4
10	Gels <ul style="list-style-type: none"> • Preformulation • Formulation • Evaluation • Large scale manufacture and packaging with focus on equipment • Layout design and Unit operations 	4
11	Suppositories <ul style="list-style-type: none"> • Preformulation • Formulation • Evaluation • Large scale manufacturing with focus on equipment • Layout design and Unit operations 	5
12	Aerosols <ul style="list-style-type: none"> • Containers and Propellants • Formulation of aerosols • Evaluation of aerosols 	5
13	Large scale manufacturing of aerosols <ul style="list-style-type: none"> • Filling equipments • Large scale manufacturing • Layout design 	3
14	Stability studies <ul style="list-style-type: none"> • Introduction to International Conference on Harmonization • Climatic zones as per ICH • ICH guidelines for Stability Testing of New Drug Substances and Products [Q1A (R2)] • ICH guidelines for Stability Testing: Photostability Testing of New Drug Substances and Products [Q1B] • ICH guidelines for Stability Testing for New Dosage Forms [Q1C] • Stabilization of dosage forms 	5
List of Text Books/ Reference Books		
1	Pharmaceutical Dosage Form And Drug Delivery Systems, Howard C. Ansel, Nicholas G. Popovich, Lord V. Alien, 6 th edition, 1995,	
2	Remington-The Science And Practice Of Pharmacy (Vol.1& 2), David B.Troy, 21st edition,2006, Lippincott Williams &Wilkins	
3	Tutorial Pharmacy J.W. Cooper, Colin Gunn, 4th edition,1950, Sir Isaac	
4	Pitman & Sons Ltd.,London Pharmaceutics: The Science Of Dosage Form Design, Michael E. Aulton, 1998, Churchill-Livingstone Dermatological Formulations, B. W. Barry, 198, New York, Marcel Dekker	

5	Pharmaceutical Production Facilities: Design & Applications, Graham C.Cole, 1st Edition, 1990, Ellis Horwood	
6	Theory & Practice Of Industrial Pharmacy, Leon Lachman, Herbert A.Lieberman & Joseph Kanig, 3 rd edition, 1987, Lea &Febiger, Philadelphia	
7	ICH Guidelines	
8	Introduction Of Pharmaceutical DosageForms, Howard Ansel 3rd edition, 1981, Lea &Febiger Pharmacopoeias: Indian Pharmacopoeia, British Pharmacopoeia, United States Pharmacopoeia, all editions	
Course Outcomes (students will be able to.....)		
1	Explain principles of preformulations and basic formulation considerations for monophasic liquid orals and emulsions	
2	Conceptualize and develop monophasic liquid oral and topical	
3	Conceptualize and develop biphasic oral products and semi solid	
4	Describe unit operations, large scale manufacturing and layout for monophasic, biphasics, semisolids, suppositories and aerosols	
5	Explain stability evaluation and stabilization of products	

	Course Code: PHT1023	Course Title: Physiology and Pharmacology	Credits = 4		
	Semester: III		Total contact hours: 60	L	T
			3	1	0
List of Prerequisite Courses					
	Biology				
List of Courses where this course will be prerequisite					
	Medicinal chemistry, Pharmaceutical Technology, drug regulatory affairs				
Description of relevance of this course in the B. Tech Pharm. Program					
Student will understand human anatomy and Physiology, the common disorders and their pathophysiology, the drug categories, principles of pharmacology and its applications to medicinal chemistry and pharmaceutical technology					
Sr. No.	Course Contents (Topics and subtopics)	Reqd. hours			
1	Introduction to human body, Organization of human body, Different system of human body	1			
2	Composition and functions of blood, lymph, immunity	3			
3	General pharmacology (ADME, routes of administration, MOA)	4			
4	Hematinics, thrombolytics, coagulants / anticogulants	2			
5	Digestive system antacids, purgatives	3			
6	Structure and function of kidney, diuretics	3			
7	Respiratory system- Anatomy and Physiology	1			
8	CNS- Anatomy and physiology of CNS, Neurotransmission	6			
9	Drugs acting on CNS- Sedatives, hypnotics, psychopharmacological agents, antiepileptics, anaesthetics, nootropics, CNS stimulants.	5			
10	ANS- Anatomy and Physiology, Adrenergic and Cholinergic systems.	3			

11	Drugs acting on ANS- Cholinergic agents, Anticholinergic agents, Adrenergics, Adrenergic blockers, Neuromuscular blockers.	5
12	Antidiabetics	2
13	Drugs used in hypertension, vasodilator	2
	Analgesics (Narcotics/non narcotics)	2
14	Local anesthetics, histaminic, anti-histaminic,	3
15	Chemotherapy-I- Sulphonamides, Diaminopyridines, Quinolones, β -lactam antibiotics, Tetracyclines, Nitrobenzene derivatives, Aminoglycosides, Macrolide, Lincosamide, Glycopeptides, Polypeptide antibiotics, Nitrofurantoin derivatives, Nitroimidazoles, Polyene, Azole derivatives, Nicotinic acid derivatives, Oxazolidinone.	7
16	Chemotherapy-II- Anti-malarial, Anti-fungal, Anti-tubercular, Anti-leprotic, Anthelmintic and anti-cancer agents.	8
List of Text Books/ Reference Books		
1	Elements of Pharmacology R. K. Goyal, Ahmedabad, India.	
2	Pharmacology H. P. Rang, M. M. Dale, J. M. Ritter 5	
3	Ross and Wilson's Anatomy and Physiology in Health and Illness Anne Waugh and Allison Grant 10th edition, 2006 Churchill Livingstone, London	
Course Outcomes (students will be able to.....)		
1	Understand the organization, placement, structures and functioning of human body as whole.	
2	Understand the body fluids; namely, blood and lymph; their formation, presence and functions as well as disorders	
3	Understand the anatomy and physiology of systems namely respiratory, urinary, digestive, with the disorders affecting the systems.	
4	Know the different drug categories with special emphasis on antacids, diuretics, haematinic, coagulants and anti-coagulants, diuretics, anti-histaminics and local anaesthetics and concept of bioassay with example of histamine and anti-histaminics.	
5	Understand general principles of Pharmacology including pharmacokinetics and Pharmacodynamics.	
6	Understand the Anatomy and Physiology of the Nervous system namely, CNS and ANS.	
7	Know the drugs that act on the various disorders of CNS and ANS.	
8	Know about the Pharmacology of chemotherapeutic agents and immunomodulators used for infectious diseases and cancer.	
9	Know about drugs and their pharmacology used in Diabetes mellitus and cardiovascular disorders.	

	Course Code: BST 1101	Course Title: Microbiology	Credits = 3		
			L	T	P
	Semester: III	Total contact hours: 45	2	1	0
List of Prerequisite Courses					

	Science (Any combination of Physics, Chemistry, Maths and Biology) in Std 12	
List of Courses where this course will be prerequisite		
	None	
Description of relevance of this course in the B. Tech./B.Pharm. Program		
To familiarize students with diverse microorganisms in different industries like food industry, dairy industry, bio-based fermentation industry, oil industry, pharmaceutical industry and bio-energy; with diversity of microorganisms, microbial cell structure and function, microbial growth and metabolism, environmental factors affecting their growth and cultivate/control growth of microbes using physical and chemical technologies; with basics of microbial replication, transcription, translation and mutagenesis and involvement of microorganisms in diseases and role of immune system in defending invading pathogens		
Sr. No.	Course contents (Topics and subtopics)	Reqd. hours
1	Introduction to microbiology and its significance (beneficial and harmful) in Foods (Dairy including pre and probiotics, cheese, vitamins, beverages etc), Pharmaceuticals (Antibiotics, vaccine production, pathogenic organisms etc), Oils (bioremediation, bio-diesel from microorganism etc) , and environment (waste water, nitrification, methanation, green chemicals and biofuels etc)	5
2	Prokaryotes and Eukaryotes- morphology, structure and function of microbial cells and their components	5
3	Major groups of microorganisms - Bacteria, Virus, Yeasts and Molds, Rickettsia, Chlamydia and Algae	5
4	Gram character and staining techniques, Isolation, preservation and maintenance of pure cultures	5
5	nutrient requirements of microorganism, Composition, preparation and sterilization of microbiological media; Classification of media, Methods of sterilization, disinfection, sanitation, asepsis	5
6	Growth studies (lag phase, log phase, stationary phase, death phase); concept of generation time; Physical and chemical factors affecting growth of microbes	5
7	Extremophiles and their applications-Acidophiles, Basophiles, Thermophiles, Hyperthermophiles, Psychrophiles, Osmophiles	5
8	Microscopy (dark, Fluorescence, atomic force, scanning tunnel, confocal etc); Enumeration of microorganisms (TPC, Yeast and molds count, MPN, turbidometry, rapid methods like flow cytometry etc)	5
9	Principles of immunology	5
List of Text Books/ Reference Books		
1	Microbiology by Prescott, Harley & Klein's 7th Edition, 2008, Mcgraw-Hill	
2	Microbiology by Pelczar, 5 th edition, 1993, Mcgraw-Hill	
Course Outcomes (students will be able to)		
1	Know the application of diverse microorganisms in different industries like food, dairy, oil, pharmaceutical, bio-based fermentation and bio-energy	
2	Know the cultivation/control methods for diversity of microorganisms, their physiology and metabolism	
3	Understand the flow of genetic information from DNA to protein and the mechanisms involved therein	

4	Understand the significance of microorganisms in diseases and basic immune system against invading pathogens	
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Course Code: BST1102	Course Title: Biochemistry	Credits = 4		
		L	T	P
Semester: III	Total contact hours: 60	3	1	0
List of Prerequisite Courses				
10th std. Biology; 12th std Chemistry				
List of Courses where this course will be prerequisite				
Pharmaceutical and Biochemical Analysis Laboratory, Pharmaceutical Biotechnology, Process Technology and Biotechnology Laboratory				
Description of relevance of this course in the B. Tech./B.Pharm. Program				
To train the students with respect to the core chemistry principles involved in functioning of biological systems, structural and chemical biology of macromolecules, including proteins, carbohydrates, lipids, nucleic acid and vitamins, structure, function and kinetic properties of enzymes and their role in metabolism of living cells, major catabolic as well as anabolic pathways involved in cell metabolism and quantitative aspects of biochemical analysis of macromolecules				
Sr. No.	Course contents (Topics and subtopics)	Reqd. hours		
1	Carbohydrates: Fundamentals of chemistry of carbohydrates, concept of ring structures and straight chain structure of common carbohydrates glucose, fructose, galactose, lactose, maltose, sucrose, polysaccharides, starch, glycogen, cellulose	5		
	Qualitative tests / colour reaction: phenyl hydrazine, alkali – oxidation reduction with practical significance	2		
	Metabolic pathways and energy yield for breakdown of carbohydrates: glycolysis, gluconeogenesis, citric acid cycle; pentose phosphate pathway, electron transport chain and coupled oxidative phosphorylation	5		
2	Lipids: Fatty acids, waxes, phospholipids, sphingolipids, terpenoids. With representative structure and significance	4		
	Functions & comparative distribution of lipids, lipoproteins	4		
	β oxidation of fatty acids, functions of cholesterol & significance. Rancidity, saponification value, iodine value & hydrogenating	4		
3	Proteins & Amino acids: Amino acids: Structures, pK – isoelectric point, essential & non-essential amino acids Colour reaction of amino acids.	5		
	Structure of protein: globular, fibrous Structural organization of protein: primary, secondary, tertiary, quaternary	4		
	Elementary idea about chromatography & electrophoresis.	5		
	Metabolism of proteins (digestion and absorption), catabolic reactions of amino acids, urea cycle	2		
4	Nucleic acids and their components: DNA & RNA bases, nucleosides, nucleotides, chemistry of nucleic acids, Structure and functions of RNA & DNA	5		
	Types of RNA: mRNA, tRNA & rRNA Salient features of protein biosynthesis & idea of genetic code.	5		

5	Enzymes- definition, function, nomenclature, classification, mechanism of enzyme action, specificity of enzymes, enzyme kinetics, enzyme inhibition and regulation.	5
6	Vitamins & Co-enzymes: Structures & function of Nicotinamide, nicotinic acid, riboflavin, lipoic acid, biotin, thiamine, B6, folic acid, B12, pantothenic acid, ascorbic acid, vitamins A, D, K, and E.	5
List of Text Books/ Reference Books		
1	Principles of Biochemistry, Lehninger AL, Nelson DL and Cox MM, 5 th Edition, 2008, MacMillan.	
2	Biochemistry, Stryer L, Berg JM and Tymoczko JL, 5 th Edition, 2002, Freeman & Co.	
3	Fundamentals of Biochemistry – Voet DJ and Voet JG, Upgrade edition, 2002, John Wiley & Sons.	
Course Outcomes (students will be able to)		
1	Apply of fundamental knowledge of chemistry to biological systems	
2	Understand and elucidate structural as well as metabolic role of different macromolecules in the cell	
3	Apply analytical tests involved in detection of macromolecules in/derived from biological samples	
4	Understand role of enzymes in cellular environment and their use in industrial applications for their practical applications	
5	Evaluate and elucidate impact of different catalytic reactions involved in metabolic pathway	
6	Evaluate and explain influence and interactions of different metabolic pathway on each other	

Course Code: PHT1051	Course Title: Chemistry of Natural Products	Credits = 4		
		L	T	P
Semester: III	Total contact hours: 60	3	1	0
List of Prerequisite Courses				
Basic organic chemistry; A course in medicinal natural products; General understanding of metabolic pathways				
List of Courses where this course will be prerequisite				
Description of relevance of this course in the B. Tech. Program				
Study the source of bioactive compounds using the natural products as well as their biosynthesis routes				
Sr. No.	Course Contents (Topics and subtopics)	Reqd. hours		
1	General classification of natural products Vitamins: Classification, Structural chemistry and stability of fat soluble vitamins Organic chemistry of biochemical role	10		
2	Structural chemistry and stability of water soluble vitamins and Organic chemistry of biochemical role. ω -3 fatty acids	10		
3	Hormones (other than steroids and those not covered in detail under medicinal chemistry) Classification, structural chemistry, organic chemistry of biological role, Organic chemistry of biosynthesis. Synthesis	5		

	of peptides: protecting groups,	
4	Coupling agents, solid phase synthesis, Synthesis of some synthetic peptide hormones. Structures of poisonous peptides	4
5	Terpines: classification; organic chemistry of biosynthesis, Wagner-Meerwein and other rearrangements, Terpines as pharmaceutical raw materials	4
6	Terpenoids of biological importance: form neem, texanes, artemisine, terpinoid, iridoids, alkaloids, structure and biological activity	1
7	Pyrethroids and retinones: occurrence, structure and reactions, biological activity and unique features	3
8	Plant pigments: occurrence, classifications, nomenclature, structure and characteristic features, Pharmaceutically important flavanoids, polyphenols, organic chemistry of biosynthesis, organic chemistry of biological anti oxidant activity. Carotenoids,	5
9	Porphyrins: Structure, general chemistry, and properties, Some examples to be discussed Haemoglobin, chlorophyll, and cytochromes	3
10	Eicosanoids: Classification, nomenclature, and chemical properties	8
11	Alkaloids(details will be covered elsewhere): only organic chemistry of biosynthesis of any three classes to be covered	2
12	Marine natural products: classification, unique structural features and biological, organic chemistry of biosynthetic path way of any one	2
13	Antibiotics not covered elsewhere, structure and organic chemistry of their biological activity, importance as new lead molecules.	2
14	Carbohydrate derived natural products, nojirimycins, glycosides, biological activity.	1
List of Text Books/ Reference Books		
1	Chemistry of Natural Products, R.H. Thopson, Springer International Edition, 2008	
2	Insecticides of Plant Origin, J. T. Arnason et al, Americal Chemical Society, 1989	
3	Biochemistry, D.E. Metzler, Academic Press, 2001.	
4	Organic Chemistry, G.M. Loudon, Oxford University Press, 2002.	
5	Introduction to Flavanoids, B.A. Bohm, harwood academic publisher, 1998	
6	Studies in natural Product Chemistry: Structure and Chemistry - Series Atta-ur Rahman ; Elsevier	
7	Recent Review articles on specific topics	
Course Outcomes (students will be able to.....)		
1	Appreciation of organic chemical reaction types that play a role in enzymatic transformations, biosynthesis and synthesis.	
2	Knowing of through a variety of biomolecules mechanistic explanations, of their synthesis with enzymes involved.	
3	To get know characteristic features and typical biological activity with respect to structure and synthesis.	
4	Biosynthetic pathways present different natural sources and speculate potential other natural products.	
5	Correlate biological activity and potential natural products in herbal medicines.	

	Course Code: PHP1081	Course Title: Pr 1: Pharmaceutical Formulation Technology Laboratory-I	Credits = 2		
			L	T	P
	Semester: III	Total contact hours: 60	0	0	4
List of Prerequisite Courses					
	HSC (Science)				
List of Courses where this course will be prerequisite					
	Pharmaceutical Formulation Technology Laboratory II				
Description of relevance of this course in the B. Tech (Pharma)					
To train the students with respect to practical aspects of monophasic, biphasic and topical semisolid pharmaceutical formulation development and quality control thereof					
Sr. No.	Course Contents (Topics and subtopics)				Reqd. hours
1	Representative examples of monophasic liquids (Preparation, packaging and evaluation)				16
2	Representative examples of emulsions (Preparation, packaging and evaluation)				8
3	Representative examples of suspensions (Preparation, packaging and evaluation)				8
4	Large scale manufacture of one monophasic and one biphasic liquids(Preparation, packaging and evaluation)				8
5	Representative examples of semisolid dosage forms e.g. ointments, creams , gels etc. (Preparation, packaging and evaluation)				12
6	Representative examples of suppositories and aerosols (Preparation, packaging and evaluation)				8
List of Text Books/ Reference Books					
1	Pharmacopoeias				
2	Pharmaceutical Prduction Facilities: Design and Applications G.C.Cole				
3	New York Ellis Horwood 1990				
4	Husa's Pharmaceutical Dispensing Martin E. W. Easton Mack Pub. Co. 1971				
5	Transdermal Delivery of Drug A. Kydonieus Florida, CRC Press, 1987				
6	Transdermal Controlled System Medications Y. W. Chien, New York, Marcel Dekker 1987				
7	The Theory and Practice of Industrial Pharmacy, Lachman Bombay, K. M. Warghese Co. 1976				
8	The Theory and Practice of Industrial Pharmacy, Lachman Bombay, K. M. Warghese Co. 1976				
9	Pharmaceutical Dosage Forms Vol. I & II, Liebermann, New York, Marcel Dekker, 1996.				
10	Drug Delivery Devices: Fundamentals and Applications, Tyle New York, Marcel Dekker 1988				
Course Outcomes (students will be able to.....)					
1	Prepare, evaluate and label pharmacopoeial and non pharmacopoeial monophasic liquid oral formulation				
2	Prepare, evaluate and label pharmacopoeial and non pharmacopoeial biphasic formulations				
3	Prepare, evaluate and label pharmacopoeial and non pharmacopoeial				

	semisolid and suppository formulations	
4	Propose unit operations in large scale manufacturing and type of container specific to product application	

	Course Code:	Course Title: Pr2: Physiopharmacology Laboratory	Credits = 2		
	PHP1022		L	T	P
	Semester: III		0	0	4

List of Prerequisite Courses

	H.S.C (Biology)	

List of Courses where this course will be prerequisite

Description of relevance of this course in the B. Tech Pharm. Program

To train the students with respect to basics of bioassays, effect of drugs, routes of drug administration and haematological parameters

Sr. No.	Course Contents (Topics and subtopics)	Reqd. hours
1	RBC Count	2*4
2	WBC Count	2*4
3	Differential leukocyte count	2*4
4	Hemoglobin estimation	4
5	Blood grouping	4
6	Study of effects of various drugs on isolated frogs heart e.g. Ach, adrenaline (through audiovisual demonstration)	4
7	Demonstration of DRC of ACh	4
8	Effect of adrenergic and cholinergic blockers (through audiovisual demonstration)	4
9	Effect of ions on the isolated frog heart (through audiovisual demonstration)	4
10	Demonstration of different routes of administration of drugs.	4
11	Clotting time	4
12	Blotting time	4

List of Text Books/ Reference Books

1	Praful B. Godkar, Textbook Of Medical Laboratory Technology 3rd edition, Bhalani Publishing House, Mumbai, 2014	
2	V.G. Ranade, P.N. Joshi And Shalini Pradhan, A Textbook of Practical Physiology 4th edition, P.V.G. Prakashan, Pune-30, 1996	
3	G K Pal, Pravati Pal, Textbook of practical physiology, 3rd edition, 2011.	
4	C L Ghai, A Textbook of practical physiology, 8th edition 2013.	

Course Outcomes (students will be able to.....)

1	Evaluate and measure his/her own blood parameters. (HB/RBC/WBC/DLC/ESR/Clotting time/blood group/bleeding time)	
2	Understand the procedure of evaluation of bioassays	
3	Understand the effects of adrenergic and cholinergic blockers	
4	Learn the different routes of pre-clinical drug administration	

Semester IV

	Course Code: GET 1116	Course Title: Engineering Mechanics and Strength of Materials	Credits = 4		
			L	T	P
	Semester: IV	Total contact hours: 60	3	1	0
List of Prerequisite Courses					
	XIIth Standard Physics and Mathematics, Applied Mathematics-I and II, Applied Physics-I				
Description of relevance of this course in the B. Tech. (All Branches)					
This subject will help students to understand use of basics of Applied Mechanics and Strength of Materials. As a practicing engineer and technologist, what are different types of forces to be considered and how to quantify them during design of equipments? To know the conditions of equilibrium and how to apply them to analyse the problems. Importance of centre of gravity and moment of Inertia in Engineering Design. Study of different types of stresses and strains occurring in various components of the structure. Advantages and disadvantages of various geometric sections available for engineering design. What are different advanced fibre polymer composite materials used in Industry for various applications. Different performance enhancing construction chemicals. This is the foundation course for a good Design Engineer and Technologist.					
	Course Contents (Topics and subtopics)				Reqd. hours
1	Concepts of forces, their types, Resolution of forces, Composition of forces, Steps in Engineering Design, Different types supports and free body diagram.				4
2	Equilibrium of rigid bodies - Conditions of equilibrium. Determinant and indeterminate structures. Equilibrium of beams, trusses and frames problems on analysis of beams and truss.				5
3	Concept of moment of Inertia (Second moment of area) its use. Parallel axis theorem. Problems of finding centroid and moment of Inertia of single figures, composite figures. Perpendicular axis theorem, Polar M.I., Radius of gyration.				5
4	Shear Force and Bending Moment - Basic concept, S.F. and B.M. diagram for cantilever, simply supported beams (with or without overhang). Problems with concentrated and U.D. loads.				5
5	Stresses and Strains - Tensile and compressive stresses, strains, modulus of elasticity, modulus of rigidity, bulk modulus. Thermal stresses and strains. Problems based on stresses and strains. Basics of Engineering Design - Steps in the engineering design, Importance of analysis, 1-D, 2-D and 3-D analysis and interpretation of results. Design philosophies.				5
6	Theory of Bending - Assumptions in derivation of basic equation, Basic equation, section modulus, bending stress distribution.				4
7	Problems on shear stress - Concept, Derivation of basic formula. Shear stress distribution for standard shapes. Problems of Shear stress distribution				4
8	Slope and Deflection of beams - Basic concept, Slope and Deflection of cantilever and simply supported beams under standard loading. Macaulay's method.				4
9	Short and Long Columns (Struts) – Basic Concept, Crippling load, End conditions, Euler's and Rankine's Approach (Without Derivations)				4
10	Torsion of a circular shaft – Concept, basic derivation, shear stress distribution, power transmitted by shafts, Simple problems				4
11	Thin and Thick Cylinders – Concept of circumferential, longitudinal stresses, Behaviour of thin cylinders, problems on thin cylindrical and				4

	spherical shells, Behaviour of thick cylinders (Theory only)	
12	Natural Materials, Manmade materials, Materials used for coatings, anticorrosive coatings, special purpose floorings, water proofing compounds, Various polymers and epoxies used for industrial applications. Composite Materials – various types of fibres, fabrics used in polymer composites, Glass and Carbon fibre polymer composites, methods of manufacturing, Uses in various industrial applications.	6
13	Concrete – Basics, Ingredients of concrete, properties of concrete, testing of fresh and hardened concrete, uses of concrete. Different types of performance enhancing and special purpose construction chemicals. Plasticizers and super-plasticizers, air entraining agents, accelerators and retarders, viscosity modifying agents, corrosion inhibitors, Cement, Basic process of hardening, types of cements, blended cements, Recycling of waste – value addition.	6
List of Text Books/ Reference Books		
	Engineering Mechanics Vol I Statics by B. N. Thadani, Publisher Wenall Book Corporation	
	Introduction to Mechanics of Solids by Egor Popov, Prentice Hall of India Pvt. Ltd	
	Mechanics of Materials by Ferdinand Beer and E. Russel Johnston, Tata McGraw Hill	
	Fundamentals of applied Mechanics by Dadhe, Jamdar and Walavalkar, SaritaPrakashan Pune	
	Engineering Mechanics by S. Timoshenko and D. H. Young, McGraw Hill Publications	
	Strength of Materials by Ferdinand Singer and Andrew Pytel, Harper Colins Publishers	
	Mechanics of composite Materials by Autar K. Kaw, Publisher CRC Press	
	Fundamental of Fibre reinforced composite materials by A. R. Busell and J. Renard, Taylor & Francis	
	Concrete Technology by A. M. Neville, Pearson Education ltd	
	Concrete Technology – Theory and Practice by M. S. Shetty, S. Chand & Co.	
	Corrosion and Corrosion Protection Handbook by Philip A. Schweitzer, CRC press	
	<p>Course Objectives</p> <ol style="list-style-type: none"> 1) To know the various types of forces acting on the various structures in engineering. To know the conditions of equilibrium and how to apply them to analyse the structures. 2) To understand the concept and importance of centroid and moment of Inertia for different sections used in engineering and plane areas. 3) To analyse the different types of structures to know axial force, shear force and bending moment in the different parts of the 	

	<p>body/structure.</p> <p>4) To know the basics of different stresses and strains, types of materials and their properties.</p> <p>5) To able to determine the axial stress, bending stress and shear stress in the structure and draw its variation across the section.</p> <p>6) To understand the deformations in axial, lateral and rotational direction. Calculation of slope and deflections in different beams under simple and complex loading.</p> <p>7) To understand torsional loads, Use in power transmission. Behaviour of short and long columns with various end conditions.</p> <p>8) To know the Thin and Thick cylinders, stresses and strains in thin cylinders.</p> <p>9) To know various polymers, epoxies, fibre polymer composite materials used for various applications in engineering.</p> <p>10) To make awareness about the cement and its composites, performance enhancing construction chemicals used to alter properties.</p>	
	Course Outcome: At the end of the course the student will be able to	
1	Quantify the actions and able to find reactions by applying conditions of equilibrium	
2	Find out the Centroid and Moment of Inertia for various cross sections used in engineering structures and for plane areas.	
3	Able to draw the Shear Force and Bending Moment diagram for different types of beams under simple and complex loading.	
4	Calculate the forces, reactions, stresses, strains in components of the bodies of a complex engineering structure.	
5	To find out the Bending Stresses at different positions and Shear Stress distribution across the cross section at various points.	
6	To calculate the Slope and Deflection at different points under simple and complex loading.	
7	To know effect of Torsion in shafts, power transmission, Euler's and Rankine's approach for columns.	
8	To know Thin and Thick cylinders, stresses and strains in thin cylinders.	
9	To know various polymers and epoxies, fibre polymer composites used in various applications in engineering. Corrosion of steel and its mitigation.	
10	To know most widely used cement composite – Concrete, Chemicals used to alter the properties of concrete.	

	Course Code: PHT1059	Course Title: Pharmaceutical Organic Chemistry and Co-ordination Chemistry	Credits = 3		
	Semester: IV	Total contact hours: 45	L	T	P
			2	1	0
List of Prerequisite Courses					
	HSC chemistry				
List of Courses where this course will be prerequisite					
Description of relevance of this course in the B. Tech programme					
The course will enable the students to understand chemical and phase equilibria, direction of spontaneity and calculation of equilibrium compositions, effect of experimental parameters on phase and chemical equilibria					
Sr. No.	Course Contents (Topics and subtopics)				Reqd. hours
1	Heterocyclic Chemistry Characteristic properties and reactivity of 5 and 6 membered monocyclic heteroaromatic compounds with one or more heteroatoms				10
2	Bicyclic heteroaromatics				3
3	An overview of the synthetic routes to the best selling drugs containing 6-membered heterocycles				2
4	Molecular Orbital Theory				5
5	Pericyclic Reactions				5
6	Free Radical Reactions – Basic concepts applications in pharmaceutical chemistry				5
7	CO-ordination chemistry definitions				3
8	Nature of C-M bond: Metal-carbon bond with main group and transition elements. Factors controlling metal-carbon bond formation. Methods of M-C bond formation. Nomenclature and hapticity. Electron counting and 16 and 18 electron rules - applications and exceptions. Stability. Stereochemical nonrigidity in organometallic compounds.				6
9	Structure and bonding of metal alkyls and aryls. Complexes with CO and related ligands, olefins, acetylenes and related unsaturated molecules. Organic transition metal complexes as protective and stabilizing groups for double bond, triple bond, propyl cation and short lives species. Complexes with cyclopentadiene and arenes and other C _n H _n sandwich and half-sandwich complexes. Hydride, dinitrogen and dihydrogen complexes				6
List of Text Books/ Reference Books					
1	J. McMurry, Brooks/Cole, Organic Chemistry				
2	T.W.G. Solomons, C.B. Fryhle, Organic Chemistry, John Wiley and Sons Inc.,				
3	L.G. Wade Jr, Organic Chemistry, Pearson Education				
4	E.L. Eliel, StereoChemistry of Carbon compounds, Mcgraw-Hill				
5	Paula Y. Bruice, Organic Chemistry, Pearson Education				
6	Joseph E. Rice, Organic Chemistry concepts and applications for medicinal				

	chemistry, Elsevier, 2014	
7	Organometallic Chemistry of the transition metals, R.H. Crabtree, John Wiley & Sons, 2009	
8	Concise inorganic Chemistry, J.D. Lee, Wiley India	
Course Outcomes (students will be able to....)		
1	Understand the concepts of stereochemistry in detail with application to pharmaceutical and medicinal chemistry	
2	Comprehend properties and reactivity of heterocyclics	
3	Apply retrosynthesis to synthesis of simple organic molecules	
4	Grasp concepts of molecular orbital theory and free radical reactions, with relevance to pharmaceutical chemistry	
5	Knowledge of co-ordination chemistry.	
6	Ability to visualize and write structure of metal complexes with stereochemistry	
7	To develop capacity to analyze and write mechanism of homogeneous catalysis.	
8	Ability to write mechanism of organometallic transformations.	

	Course Code: CET 1105	Course Title: Transport Phenomena	Credits = 4		
			L	T	P
	Semester: IV	Total contact hours: 60	3	1	0
List of Prerequisite Courses					
	XIIth Standard Physics and Mathematics				
List of Courses where this course will be prerequisite					
	This is a basic course required in special subjects that deal with flow of fluids, heat and mass transfer, etc.				
Description of relevance of this course in the B. Tech. Program					
This basic course introduces concepts of momentum, heat and mass transfer to students. Various concepts such as pressure, momentum, energy are introduced. Laws related to conservation of momentum, energy, mass are taught. Applications of these laws to various engineering and technological situations and process equipment is explained with the help of several problems					
Sr. No.	Course Contents (Topics and subtopics)				Reqd. Hours
1	Fluid Statics and applications to engineering importance.				4
2	Equations of Continuity and Motion in laminar flows and its applications for simple applications like flow in pipes.				6
3	Applications of Bernoulli's Equation, Pressure drop in pipes and Fittings, meters, and fluid moving machinery such as pumps.				10
4	Particle Dynamics, Flow through Fixed and Fluidised Beds				4
5	Heat conduction. Convective heat transfer and concepts of heat transfer coefficient.				6
6	Design aspects of exchangers like: Double pipe heat exchangers: Concurrent, counter-current and cross flows, mean temperature difference.				8

	Shell and tube heat exchangers: Basic construction and features. Design methods for shell and tube heat exchangers.	
7	Introduction to heat transfer in condensers, reboilers and evaporators.	6
8	Introduction to Heat transfer in agitated vessels: heating and cooling times	6
9	Fundamentals of mass transfer: Molecular diffusion in fluids, concept of mass transfer coefficients, and interface mass transfer, applications.	10
List of Text Books/ Reference Books		
	Transport Phenomena, Bird R.B., Stewart W.E., Lightfoot E.N.	
	Fluid Mechanics, Kundu Pijush K.	
	Fluid Mechanics, F. W. White	
	Unit Operations of Chemical Engineering, McCabe, Smith	
Course Outcomes (students will be able to.....)		
1	Students should be able to calculate friction factor, pressure drop, power requirements for single phase flow in pipes	
2	Students will be able to calculate flow and power required for pumps	
3	Students should be able to calculate heat transfer coefficients and do basic sizing of double pipe and shell and tube heat exchangers	
4	Students should be able to calculate mass transfer coefficients and estimate mass transfer rates in simple situations	

Course Code: GET1105	Course Title: Basic Electrical Engineering and Electronics	Credit=3		
		L	T	P
Semester: IV	Total contact hours: 45	2	1	0
List of Prerequisite Courses				
XIIth Standard Physics and Mathematics courses,				
List of Courses where this course will be prerequisite				
None				
Course objectives				
<ol style="list-style-type: none"> 1. Students will get an insight to the importance of Electrical Energy in Chemical Plants. 2. The students will understand the basics of electricity, 3. They will get basic knowledge about Transformer and selection of different types of drives for a given application process. 4. They will get basic knowledge as regards to electronic devices and their application in Power supplies, amplifiers and other circuits. 				
Sr. No.	Topic	Reqd Hrs.		
1	Basic Laws: Kirchoff's current and voltage law, Simple series and parallel connections, star and delta transformation. Mesh and nodal analysis, Basic elements R, L and C. Concept of self and mutual inductance.	6		
2	Network theorems: super position, Thevenin's theorems	3		
3	A.C. Fundamentals: Equations of alternating voltages and currents, cycle, frequency. Time period, amplitude, peak value average value, R.M.S. value, A.C. through resistance, inductance and capacitance, simple RL, RC and RLC circuits. Resonance in series RLC circuits, Power, power factor, series and parallel circuits.	5		
4	Three Phase systems: Star and delta connections, relationship between line and phase voltages and currents, Power in three phase circuits	5		

5	Transformer: Introduction, principle of operation, e.m.f. equation, phasor diagrams. Ideal transformer, transformer on no load, Transformer under load, Transformer losses, efficiency, regulation.	5
6	Introduction to dc and ac drives	5
7	Diodes and rectifiers: P-N junction diode characteristics, Zener diode, Half wave and full wave rectifiers, their waveforms, brief introduction to filters.	4
7	Bi-polar junction transistor: Current components. Modes of operation, Input and output characteristics, Regions of operation, Transistor as an amplifier, classification of amplifiers	6
8	Introduction to Uni junction transistor, Characteristics, UJT relaxation oscillator,	3
9	Silicon controlled rectifier, controlled rectification, characteristics, methods of turning-on. Applications.	3

List of Text Books/ Reference Books

1	Electrical Engineering Fundamentals by Vincent Deltoro	
2	Electronic devices and circuits by Boylestad, Nashelsky	
3	Electrical Machines by Nagrath, Kothari	
4	Electrical Machines by P.S. Bhimbra	
5	Electrical Technology by B.L.Theraja, A.K.Therajavol I,II,IV	
6	Thyristors and their applications by M.Ramamurthy	
7	Power Electronics by P.S. Bhimbra	

Course Outcomes (students will be able to.....)

1	Understand the basic concepts of D.C circuits. Solve basic electrical circuit problems	
2	Understand the basic concepts of single phase and three phase AC supply and circuits.	
3	Understand the basic concepts of transformers and motors used as various industrial drives.	
4	Understand the basic concepts of electronic devices and their applications	

	Course Code: PHT1032	Course Title: Spl 3: Pharmaceutical Analysis	Credits = 4		
			L	T	P
	Semester:IV	Total contact hours: 60	3	1	0
List of Prerequisite Courses					
	Analytical chemistry				
List of Courses where this course will be prerequisite					
	Pharmaceutics, Pharmacology, and Pharmaceutical chemistry, Biotechnology				
Description of relevance of this course in the B. Tech.Pharm. Program					
To train the students with respect to understand pharmacopoeialmonograph, analytical method validation, solvent extraction technique, analytical techniques, spectroscopic techniques, chromatographic separation techniques, characterization techniques, modern hyphenated techniques and thermal analysis					
Sr. No.	Course Contents (Topics and subtopics)				Reqd. hours
1	Introduction: Pharmacopoeialmonograph, literaturecollection, data handling andexpression of analytical results – documentation and record keeping				4
2	Analyticalmethodvalidation (asperUSP andICH guidelines): Accuracy,Precision,Limitof detection,Limitof quantification,Linearity, Range, Robustness, Ruggedness				4
3	Solvent extraction-basic principles, classification, mechanism of				4

	extraction, equilibria, techniques and applications	
4	Refractometry; theory, instrumentation and application	1
5	Polarimetry: theory, instrumentation and application	1
6	UV Visible Spectroscopy: Introduction to interaction between electromagnetic radiation and matter, absorption of radiation by molecules, Molecular structure and electronic spectra-theory of electronic transitions and electronic spectra, spectra of isolated chromophores definitions - auxochromes, bathochromic shift, hypsochromic shift; Hyperchromism and hypochromism, Effect of solvent on absorption spectra, Quantitative uses of absorption, Spectroscopy-Beer and Lambert's law and its derivation, limitation of Beer's law, application of Beer's law to single component analysis and multi-component systems (Simultaneous equation method, Absorbance ratio method, Difference spectroscopy and derivative spectroscopy). Instrumentation of UV visible spectrophotometer, single beam UV visible spectrophotometer and double beam spectrophotometer, Woodward feiser Rule	4
7	Infrared spectroscopy: Molecular structure and infra red spectra, vibrational transition frequency-structure correlations. various regions of infra red bands- hydrogen stretching, C-C stretching, C=C stretching and bending, effect of hydrogen bonding; Measurement of absorption spectra, Instrumentation- discussions of light sources, frequency selector, Intensity control detectors, samples, preparation, ray diagrams of typical I.R. spectrophotometers; Near IR spectroscopy – Different applications in pharmaceutical industry, sampling techniques; Difference between FTIR and Dispersive IR	4
8	Fluorescence spectroscopy: Theory of fluorescence phenomenon-origin of fluorescence and phosphorescence multiplicities, singlet and triplet states; Excitation and fluorescence spectra, Molecular structure and fluorescence; Quantitative fluorescence analysis; Practical fluorescence analysis: Application of fluorescence analysis to drug; Instrumentation	4
9	Atomic absorption spectroscopy: Principle instrumentation and pharmaceutical application	1
10	Atomic emission spectroscopy (Flame photometry) : Principle instrumentation and pharmaceutical applications	1
11	Chromatography: Terminologies- mobile phase, stationary phase, normal phase, reverse phase, isocratic elution, gradient elution, retention time, theoretical plate, HETP, resolution; Van Deemter's equation	4
12	Types of chromatography- Adsorption chromatography, partition chromatography, ion-exchange chromatography, ion-pair chromatography, affinity chromatography, size exclusion chromatography, paper chromatography; TLC-Rf value, factors affecting resolution in TLC, visualization techniques in TLC	4
13	HPLC (Principle and instrumentation - pumps, injectors, columns, detectors, autosamplers); Gas chromatography (Principle and instrumentation-types of columns, detectors)	4
14	Nuclear magnetic resonance Spectroscopy ^1H NMR spectroscopy: Principle, precessional frequency, chemical shift, spin-spin coupling constant, brief instrumentation; FT NMR	4
15	Mass spectroscopy: Principle, methods of ionization-chemical ionization, FAB MS, thermospray, electrospray; Fragmentation patterns- α fission, β fission, Mc	4

	Laffarty rearrangement, Retro Diel's Alder; Quadrupole mass spectrometer	
16	Hyphenated techniques: GC-MS, LC-MS, LC-MS-MS, interfaces, advantages and limitations	4
17	Structural elucidation of simple organic compounds: using ¹ H NMR spectroscopy, mass spectroscopy, UV spectroscopy and IR spectroscopy	4
18	Thermal analysis: Thermogravimetric analysis (TGA); Differential Scanning Calorimetry (DSC): Principle and pharmaceutical applications, polymorphism.	4
List of Text Books/ Reference Books		
1	Practical pharmaceutical chemistry, 4 th Edn. (Part II) - Beckett, A.H & Stenlake, J.B.	
2	Pharmaceutical analysis - Lee, David & Webb, Michael,	
3	Analytical chemistry, 6th edn. - Christian, Gary	
4	Vogel's textbook of quantitative chemical analysis, 6th edn - Mendham, J	
5	Vogel's qualitative inorganic analysis - Svehla, G	
6	Introduction to Spectroscopy - Pavia	
7	Pharmaceutical Analysis by Skoog and West	
8	Organic Spectroscopy by William Kemp	
9	Indian Pharmacopoeia	
10	United States pharmacopoeia	
11	British pharmacopoeia	
12	Instrumental Analysis by Skoog	
Course Outcomes (students will be able to.....)		
1	Describe validation criteria of analytical methods as per ICH and industry guidelines	
2	Do Structure elucidation of organic molecules	
3	Describe Identification & quantitative analysis of APIs, related substances	
4	Suggest application of method of analysis in various phases of drug development	
5	Describe Isolation, purification & characterization of molecules of synthetic & natural origin	

Course Code: GEP1106	Course Title: Electrical Engineering and Electronics laboratory	Credits=2		
		L	T	P
Semester: IV	Total contact hours: 60	0	0	4
List of Prerequisite Courses				
XII Standard Physics and Mathematics courses,				
List of Courses where this course will be prerequisite				
Course objectives				
<ol style="list-style-type: none"> Students will get an insight to the importance of Electrical Energy in Chemical Plants. The students will understand the basics of electricity. They will understand the working and utility of transformers and electrical drives. They will get basic knowledge as regards to electronic devices and their application in Power supplies, amplifiers and other circuits. 				
Sr. No.	Course Contents (Topics and subtopics)			Req. hours
	Suitable no of experiments out of the following will be conducted.			
1	Superposition Theorem			

2	Thevenin's Theorem	4
3	Series RL circuit	
4	Reconance in Series RLC circuit	
5	H.W. and F.W. Rectifiers	4
6	Cathode Ray Oscilloscope	4
7	Input and output characteristic of npn transistor in CE mode.	4
8	Load Test on Transformer	4
9	Three phase star connection	4
10	Three phase delta connection	5
11	Study of UJT relaxatation oscillator	4
12	Design of UJT relaxation oscillator	4
12	Load Test on 3 phase induction motor	4
13	Study of Thermo couple	4
Course Outcomes (students will be able to.....)		
1.	Understand concepts of basic working of D.C circuits.	
2.	Understand the basic applications of single phase and three phase AC supply and circuits.	
3.	Understand the working and utility of transformers and motors used as various industrial drives.	
4.	Understand the basic working and applications of electronic devices and circuits	

Course Code:	Course Title: Computer Applications Laboratory	Credits = 2		
MAP 1201		L	T	P
Semester IV	Total contact hour: 60 h	0	0	4

Part I: Spreadsheet Programme (Microsoft Excel or Libre Office Calc) (3 Lab Sessions)

1. Basic Introduction to Spreadsheet Programmes, Plotting Graphs of Functions and Data Plotting.
2. Exploring Basic Statistics, Hypothesis Testing with Spreadsheet.
3. Numerical Solution of Linear and Non-Linear Equations.

Part II: Statistics with R-Programming (4 Lab Sessions)

1. Basic Introduction to R and Rstudio.
2. Data Management in R.
3. Exploring Distribution Function in R.
4. Hypothesis Testing in R.
5. Basic Regression Analysis in R

Part III: C-Programming

Unit I: (2 Lab Sessions)

What is C-programming? Data Types, Variables, Constants, Arithmetic Operations, Input-Output Statements, Expressions and Expression Evaluations, Type Conversions.

Unit II:

(2 Lab Sessions)

Making Decisions-if and switch statement, Repetition Statements-For Loop, While and Do-While Loops, Nested Loops, Use of Break, Continue and Goto in Loops, File Input-Output statements and its use.

Unit III:

(3 Lab Sessions)

Functions- User Defined functions, Calling Function and passing arguments, Arrays- Definition, Accessing and Storing elements, Concept of Multi-dimensional Arrays, Array and Functions.

Unit IV:

(2 Lab Sessions)

String Manipulation. Basic of Structures and unions. Dynamic Memory allocation.

References:

1. Programming In Ansi C, E Balagurusamy, Tata McGraw-Hill Publishing Company Limited, 2002
2. Let Us C, Yashavant P. Kanetkar, 2008, Infinity Science Press
3. Introductory Statistics with R, Peter Dalgaard, Springer, 2008
4. Basic Statistics: An Introduction with R, TenkoRaykov, George A. Marcoulides, 2013
5. Excel for Chemists: A Comprehensive guide, E. Joseph Billo, WILEY, 2011
6. Mathematical Modeling with Excel, Brian Albright, Jones & Bartlett India Private Limited, 2010
7. Statistics and Probability for Engineering Applications With Microsoft® Excel by W.J. DeCoursey, 2003

Semester V

Course Code: CET 1401	Course Title: Chemical Engineering Operations	Credits=		
		L	T	P
Semester: IV	Total contact hours: 45	2	1	0
List of				
	Material & Energy Balance Calculations, Physical Chemistry, Organic Chemistry, Transport Phenomena			
List of Courses where this course will be prerequisite				
	This is a basic Chem Engg. course. It is required in almost all the courses, such as, Chemical Engineering Laboratory, Chemical Technology Projects etc.			
Description of relevance of this course in the B.Tech. Program				
This is a basic Chem Engg. course. The principles learnt in this course are required in almost all the courses and throughout the professional career of Chemical Engineer				
Sr	Course Contents (Topics and subtopics)	Reqd. hours		
1	Introduction to Unit Operations and Chemical Engineering Processes	1		
2	Single Equilibrium Stage, Flash Calculations and Cascade systems: Binary vapor-liquid systems, bubble-point, and dew-point calculations, Cascade configurations, co-	2		
3	Absorption and Stripping of dilute mixtures: Fundamentals of absorption, equilibrium curves, Operating lines from material balances, Number of equilibrium stages, Kremser Equation, Stage efficiency and column performance, Trayed and packed columns, Rate based methods for packed columns (HTU, NTU), Design	6		
4	Distillation of binary mixtures: Differential distillation, Flash equilibrium distillation, Fractionating column and multistage column, design and analysis factors, degrees of freedom, specifications, reflux, reflux ratio, need for reflux, McCabe-Thiele, Lewis-Sorel method of estimation of number of plates, Operating and feed lines, minimum and optimum reflux ratio, Tray and column efficiency, Packed column distillation: rate based methods: HETP, HTU, Ponchon-Savarit method, Batch	6		
5	Methods for multicomponent separations: Fenske-Underwood-Gilliland Method, selection of two key components, minimum number of stages, minimum reflux and distribution of nonkey components, Kremser group method	1		
6	Particulate solids: Particle characterization Shape, size, particle size measurement, Particle size analysis	2		
7	Particle Size Reduction: Necessity for size reduction of solids, Mechanism for size reduction, Energy Requirements for size reduction and scale-up considerations, Operational considerations, Crushing and grinding equipment: impact and roller mills, fluid energy mills, wet/dry media mills, Selection of equipment	3		
8	Liquid Filtration: Filtration theory: constant pressure, constant rate, and variable pressure-variable rate filtration, Incompressible and compressible cake filtration, Continuous filtration, filter aids, Filtration equipment, Selection, Sizing and Scale-up	4		
9	Sedimentation, Classification and Centrifugal Separations: Design and scale up equations, Performance evaluation, Sedimentation equipment, classifiers, centrifugalequipment, Sieving operations, types of sieving (dry, wet, vibro), magnetic separators, and froth flotation. Selection, sizing and scale up	2		

10	Drying of solids: Mechanism of drying, drying rate curves, Estimation of drying time , Drying Equipment,operation,Processdesignofdryers,materialandenergybalancesindirect dryers,Drying of bioproducts	3
List of Text		
1	Richardson,J.F.,Coulson,J.M.,Harker,J.H.,Backhurst,J.R.,2002.Chemicalengineering:Particle technology and separation processes. Butterworth-	
2	Seader, J.D., Henley,E.J.,2005. SeparationProcess Principles,2 ed.Wiley,	
3	Svarovsky,L., 2000. Solid-LiquidSeparation.Butterworth-Heinemann, Woburn,	
4	McCabe, W.,Smith,J.,Harriott,P.,2004.UnitOperationsofChemicalEngineering,7 ed.McGraw-	
5	Green,D.,Perry,R.,2007.Perry'sChemicalEngineers'Handbook,EighthEdition,8 ed.McGraw-Hill	
6	Dutta,B.K.,2007.PrinciplesofMassTransferandSeparationProcess.Prentice-HallofIndiaPvt.Ltd, New Delhi.	
CourseOutcomes(studentswill be able to.....)		
1	Knowthesignificanceandusageofdifferentparticulatecharacterizationparameters, andequipmentto	
2	DescribeSizedreductionenergyrequirements,estimateperformanceofequipment,selectionandsizing of equipment	
3	Analyzefiltrationdataandselectsystemsbasedonrequirements,estimatefiltrationareaforgiven	
4	Draw T-y-x diagrams, and y-x diagrams, operating lines, feed line, bubble point, dew point	

CourseCode:CET 1201	Course Title: Chemical Reaction Engineering	Credits= 3		
Semester: V	Total contact hours: 45	L	T	P
		2	1	0
List of				
Physical Chemistry, Material &Energy Balance Calculations,AppliedMathematics.				
List ofCourses where this coursewill be prerequisite				
Biochemical Engineering, Environmental Engineering and Process Safety, Proc. Dev andEngg.,				
Descriptionof relevanceof this course in the B.Tech.Program				
Chemical Reaction Engineering is concerned with the utilization of chemical reactions on a commercial scale. This course is very relevant but not limited to the following industries:Inorganicchemicals,organicchemicals,petroleum&petrochemicals, Pulp & paper, Pigments & paints ,rubber, plastics, synthetic fibres, Foods, Dyes and intermediates, Oils, oleo chemicals ,and surfactants ,Minerals, clean sing agents, Polymersandtextiles,Biochemicalsandbiotechnology,pharmaceuticalsand drugs, Microelectronics, energy from conventional and non-conventional resources, Metals				
CourseContents(Topics and subtopics)				Reqd.
1	Batchreactor(BR),continuousstirredtankreactor(CSTR),plugflowreactor(PFR),packed-bed			1
2	DesignequationsforBR,CSTR,PFR,PBR,andapplicationsofdesignequationsto variousseries- and parallel- combinationsof flowreactors			3
3	Rate laws and stoichiometry			2
4	Isothermal reactor design applied to BR, CSTR, PFR, PBR			3
5	Analysisof rate data: differentialmethod,integral method			2
6	Multiple reactions			2
7	Reactionmechanisms, pathways, bioreactions			3

8	Catalysis and catalytic reactors, catalyst deactivation, external diffusion effects on heterogeneous	4
9	Introduction to non-isothermal reactor design	3
1	Residence time distribution in reactors; models for non-ideal reactors	4
1	Mass transfer with chemical reaction in fluid-fluid and fluid-fluid-solid systems; Model contactors, pilot plants, and collection of scale-up data	3
List of Text Books		
1	Elements of Chemical Reaction Engineering – H.Scott FOGLER	
2	Chemical Reaction Engineering – Octave LEVENSPIEL	
3	The Engineering of Chemical Reactions – Lanny D.SCHMIDT	
4	An introduction to Chemical Engineering Kinetics and Reactor Design –	
5	Heterogeneous Reactions, Vol. I and II – L.K. Doraiswamy, M.M. Sharma	
Course Outcomes (students will be able to ...)		
1	design chemical reactors optimally, using minimum amount of data	
2	design experiments in a judicious way to get the required data, if not available	
3	fix some problems related to operability and productivity	
4	maintain and operate a process in a safe manner	
5	increase capacity and/or selectivity and/or safety by improving/changing the reactor type/sequence	

Course Code: PHT1082	Course Title: SPL4 : Pharmaceutical Formulation Technology II	Credits =		
		L	T	P
Semester: V	Total contact hours: 60	3	1	0
List of Prerequisite Courses				
Pharmaceutical Formulation Technology I				
List of Courses where this course will be prerequisite				
Validation and regulatory requirements				
Description of relevance of this course in the B. Tech (Pharma)				
To train the students with respect to basics and application of Technology of Solid dosage forms and introduce novel drug delivery systems				
	Course Contents (Topics and subtopics)	Reqd. hours		
1	Tablets Introduction <ul style="list-style-type: none"> • Introduction to tablet dosage form, rationale, advantages and limitations • Preformulation considerations for tablet dosage form <i>Granulation techniques, Direct compression</i>	5		
2	Excipients in tablets	3		
3	Tablets Formulation <ul style="list-style-type: none"> • Unit operations, tablet punching: physics of tablet punching, single punch and rotary tablet press, tablet tooling • Quality control of tablets 	5		
4	Types of tablets	5		
5	Problems in tableting	2		

6	Large scale manufacturing, packaging and layout design for	5
7	Tablet coating: <ul style="list-style-type: none"> • Introduction to tablet coating: rationale, advantages etc. • Preformulation considerations for tablet coating • Types of coating • Quality control of coated tablets • Large scale manufacture and packaging with focus on equipment • Layout design and Unit operations 	5
8	Capsules: <ul style="list-style-type: none"> • Introduction to capsule dosage form: rationale, advantages etc. • Preformulation considerations for capsule dosage form • Hard gelatin capsules: formulation considerations, capsule manufacture equipments, quality control tests, packaging, Large scale manufacture, layout design • Soft gelatin capsules: formulation considerations, capsule filling equipments, quality control tests, packaging, Large scale manufacture, layout design • Large scale manufacture and packaging with focus on equipment • Layout design and Unit operations 	5
9	Microencapsulation <ul style="list-style-type: none"> • Fabrication techniques • Evaluation • Large scale manufacture and packaging with focus on equipment 	5
10	Oral sustained release and controlled release formulations <ul style="list-style-type: none"> • Principles and dose calculations • Preformulation • Formulation of matrix and reservoir type systems • Liquid oral sustained release formulations 	5
11	Quality control, large scale manufacture and layout design of oral sustained release formulations	5
12	Novel Drug Delivery Systems <ul style="list-style-type: none"> • Introduction to Transdermal and Transmucosal (buccal, sublingual, nasal, vaginal, rectal) drug delivery systems 	5
13	Overview of cosmetic products <ul style="list-style-type: none"> • Definition of cosmetics; historical background, classification of cosmetics and primary functions • Brief overview of types of cosmetics [Skin care, hair care, nail care, eye care, dental products] <ul style="list-style-type: none"> o Formulation o Large scale manufacture and packaging with focus on 	5
List of Text Books/ Reference Books		
1	Remington-The Science And Practice Of Pharmacy (Vol.1 & 2), David B. Troy, 21 st edition, 2006, Lippincott Williams & Wilkins	
2	Tutorial Pharmacy J.W. Cooper, Colin Gunn, 4 th edition, 1950, Sir Isaac Pitman & Sons Ltd., London	
3	Pharmaceutics: The Science Of Dosage Form Design, Michael E. Aulton, 1998, Churchill-Livingstone Dermatological Formulations, B. W. Barry, 198, New York, Marcel Dekker	
4	Pharmaceutical Production Facilities: Design & Applications, Graham C. Cole, 1st Edition, 1990, Ellis Horwood	

5	Theory & Practice Of Industrial Pharmacy, Leon Lachman ,Herbert A.Lieberman& Joseph Kanig, 3 rd edition, 1987, Lea &Febiger, Philadelphia	
6	ICH Guidelines	
7	Coated Pharmaceutical Dosage Forms, K. H. Bauer, CRC Press, Boca Raton. Med Pharm	
8	Pharmaceutical Coating Technology, G. C. Cole, New York, Ellis, Horwood, 1990	
9	Pulsed and Self-Regulated Drug Delivery, J. Kost, Florida, CRC Press, 1987	
10	Extended Release Dosage Forms, - KlowCzynski, Florida, CRC Press, 1987	
11	Treatise on Controlled Drug Delivery, A. Kydonieus CRC Press 1987	
12	The Theory and Practice of Industrial Pharmacy, Lachman, Bombay, K. M. Warehese Co. 1976	
13	Pharmaceutical Dosage Forms Vol. I & II, Liebermann, New York, Marcel Dekker. 1996	
14	Hard Capsules: Development and Technology, K. Ridgway, London Pharmaceutical Press 1987	
15	Pharmaceutical Dosage Forms And Drug Delivery, Systems, Ansel, Philadelphia Lea and Febiger 1985	
16	Introduction to Pharmaceutical Dosage Forms Ansel, Henry Kimpton Publishers London	
17	Pharmaceutical Production Facilities: Design and Applciations G. C. Co	
18	New York Ellis Horwood 1990	
19	Husa'sPahraceutical Dispensing Martin E. W. Easton Mack Pub. Co. 1971	
20	Transdermal Delivery of Drug A. Kydonieus Florida, CRC Press, 1971	
21	Transdermal Controlled System Medications Y. W. Chien, New York, Marcel Dekker 1987	
22	Modern Pharmaceutics. Gilbert S.Banker, C.T. Rhodes, Marcel Dekker Inc 1990	
23	Pharmaceutics: The Science of Dosage Form Design. Michael E.Aulton, Churchill-Livingstone 1998	
Course Outcomes (students will be able to.....)		
1	Describe preformulation, formulation, unit operation, large scale manufacturing, layout design of tablets	
2	Explain the coating polymers, technology and equipments used for coating of tablets and describe microencapsulation techniques	
3	Describe formulations for hard and soft gelatin capsules, machinery used for filling hard gelatin capsules, process for soft gelatin capsules	
4	Describe Preformulation, formulation , evaluation and large scale manufacturing, packaging of oral controlled release and sustained release	
5	Explain basics of novel drug delivery systems and cosmetic products	

	Course Code: PHT1054	Course Title: Medicinal Chemistry-I	Credits =		
			4	L	T

	Semester: V	Total contact hours: 60	3	1	0
List of Prerequisite Courses					
	Organic Chemistry, Physical Chemistry				
List of Courses where this course will be prerequisite					
	Medicinal Chemistry -II, Medicinal Chemistry-III				
Description of relevance of this course in the B. Tech.Pharm. Program					
To acquaint students with nomenclature, classification, molecular mechanism of action, synthesis and SAR of anti-histaminic and anti-inflammatory agents and drugs acting on the cardiovascular system and hormonal system.					
Sr. No.	Course Contents (Topics and subtopics)				Reqd. hours
1	A General introduction to Medicinal Chemistry: Definitions and explanation of terms used in Medicinal Chemistry (hits, lead, lead development, molecular libraries, toxicity studies, high throughput screening ,ADME etc.), nomenclature of drugs				1
	Historical perspective, significance of medicinal chemistry - last 150 years serendipity, natural products in drug discovery,				1
	Introduction to modern drug discovery- rational design, molecular modeling, genetics and DNA technology				2
	Classification of Drugs: Classification of drugs based on: Therapeutic classes, Drug targets, Mechanism of action, Chemistry, etc.				2
2	Molecular targets (examples from current targets to be used)				
	General aspects : drug targets, concepts of drug binding, affinity, selectivity				3
	Enzymes as drug targets: a) definitions and concepts-enzyme, apoenzyme,holoenzyme, coenzyme b) targeting human enzymes in physiological conditions c) targeting human enzymes selective to pathogens				3
	Receptors as drug targets: a) Types and properties of receptors: GPCRs, Ligand gated ion channels,nuclear receptors, voltage gated ion channels, receptors with intrinsic, enzyme activity, receptors coupled to cytosolic proteins b) Types of bonds in ligand receptor interactions, role of functional groups c) Types of inhibition of drug-receptor interaction: competitive,oncompetitive,allosteric interactions d) Cellular responses to ligand-receptor interactions				5
	Target identification methods: Brief overview of target identification, biopharmaceutical therapy,identification of druggable targets by proteome investigation, cellularscreening, intracellular receptors and enzymes, transgenic animals, briefoverview of drug metabolism and toxicity				4
3	Small molecules as drugs (examples from current drugs to be used)				
	Small molecules as drugs				1
	Strategies for hit identification: Strategies for identification of hits: designofanalogs , systematic and random screening, High throughput				5

	screening, investigation of reaction intermediates, development of new leads from old drugs, rational approaches to drug discovery and design (high throughput virtual screening, molecular modeling, ligand based and receptor based drug design strategies)	
	Hit to lead development: examples of drugs derived from lead screening	2
4	Strategies in hit/lead discovery a) natural product based b) biology oriented synthesis c) in silico screening d) fragment based drug design	4
5	Lead optimization: lead likeness and drug likeness, determination of compound, drug biological, biochemical properties, metabolic information using internet, homologs, concepts of bioisosterism, isosteric replacements, ring transformations, conformational restrictions, homo/heterodimer ligands and chemical hybridization	4
6	SAR, QSAR: concept of SAR, effects of substituents and functional groups, methodology of QSAR, practical applications like compound library design, profiling, acquisition, screening.	4
7	Drug design: Ligand based (pharmacophore modeling) and receptor based drug design (protein crystallography, molecular docking)	4
8	Physicochemical properties and drug metabolism:	
	Passage of molecule through biological barriers: membrane transport (paracellular, transcellular)	2
	Drug absorption: drug dosage form, gastric emptying, gastric permeability to drug, first pass effect	1
	Drug distribution: drug-plasma binding, blood brain barrier, drug accumulation in tissues	1
	Drug elimination: a) drug excretion b) drug biotransformation c) Biotransformation reactions: functionalization, conjugation reactions, reactions leading to toxic metabolites	3
	Prodrugs: concept of prodrugs, examples and applications, carrier prodrugs, bioprecursor prodrugs	2
	Preparation of water soluble salts: drug ionization, pKa, acids and bases used for salt formation, physicochemical properties, pH	1
	Strategies for enhancing oral bioavailability and brain penetration: physicochemical properties, metabolic stability, structural rigidity	1
9	Legal aspects and patents: introduction and brief history of patents, patents as source of information	2
10	Concept of chemical space: introduction to concept of chemical space	2
List of Text Books/ Reference Books		
1	Foye's Principles Of Medicinal Chemistry W. O. Foye, Lippincott Williams & Wilkins, 6th edition, 2008.	

2	Textbook Of Medicinal And Pharmaceutical Chemistry Wilson And Gisvold, Lippincott Williams & Wilkins, Philadelphia, 11	
3	Burger's Medicinal Chemistry & Drug Discovery (Vol. 1- 6) A. Burger And M.E. Wolff; John Wiley & Sons-New Jersey, 6th edition, 2003	
4	Pharmaceutical Substances: Synthesis, Patents, Applications (N-Z) Kleemann Georg Thieme Verlag-Stuttgart. Thieme, 4th edition, 2001	
5	The Organic Chemistry of Drug Synthesis (Vol. 1-6) Daniel Lednicer John Wiley & Sons INC 1999	
6	The Organic Chemistry of Drug Design And Drug Action. R. B. Silverman Elsevier Publication 2	
7	Organic Synthesis-The Disconnection Approach, S Warren, John Wiley & Sons-Chichester, 2	
Course Outcomes (students will be able to.....)		
1	Classify drugs based on different methods	
2	Explain SAR and MOA of drugs at the molecular level of understanding	
3	Apply principles of drug discovery from hit to lead to preclinical molecules	
4	Theoretically predict absorption distribution, metabolism and excretion of drugs and related concept of prodrugs	
5	Have a brief overview of legal aspects of drug discovery and development	

	Course Code :PHT1048	Course Title: SPL6: Medicinal Natural Products	Credits = 4		
	Semester: V	Total contact hours:60	L	T	P
			3	1	0
List of Prerequisite Courses					
	HSC with Biology and Chemistry				
List of Courses where this course will be prerequisite					
	All Phytochemistry and Chemistry of Natural Product courses.				
Description of relevance of this course in B-Tech. Program					
To train the students with the basics of Medicinal Natural Products and Phytochemistry					
Sr. No.	Course contents (Topics and subtopics)				Reqd. hours
1	Scope of the subject, Source of the drug of natural origin, Classification of drug.				6

2	Organized and unorganized drugs; study of various plant parts and tissues; Adulterants and substitutes.	10
3	Preparation of drug for commerce and quality control, application of spectroscopy and chromatography techniques for isolation, identification and analysis of phytoconstituents.	10
4	Phytochemistry : Chemical constituents in the production of plants (carbohydrates, protein enzymes, lipids, alkaloids, glycosides, steroids, tannins, terpenoids, flavonoids, plant pigments, etc)	10
5	Biosynthesis approach : Building blocks and metabolic pathways for the formation of secondary metabolites.	6
6	Extraction and isolation of plant drugs: conventional and modern techniques used in extraction and separation of phytoconstituents.	6
7	Detailed study of one representative from each of the above mentioned chemical class (10drugs)	10
8	Recent advances in phytopharmaceuticals (topic of current interest)	2
List of Text Books/ Reference Books		
1	Dewick P.M., Medicinal Natural Products- A Biosynthetic Approach,2 edition/2002, John Wiley & Sons Ltd	
2	Bruneton J. Pharmacognosy &Phytochemistry Medicinal Plants,2 1999, Lavoisier Publishing Inc.	
3	Harborne J.B. Phytochemical Methods- A Guide to modern techniques of Plant analysis, 3	
4	Ikan R., Natural Products- A Laboratory Guide, 2	
5	Tyler V.E., Pharmacognosy, 8	
6	Trease& Evans, Textbook of Pharmacognosy, 15	
7	Wallis, Textbook of Pharmacognosy, 5	
8	Wagner H., Plant Drug Analysis- A Thin Layer Chromatography Atlas 1984,Springer-Verlag	
9	Wealth of India (11 volumes), Publications and Information Directorate,	
10	Jackson B.P., DW.Snowdon, Atlas of Microscopy of Medicinal Plants, Culinary Herbs and Spices, 1990,CBS Publishers	
11	The Merck Index, Merck Research Laboratories, 13	
12	Indian Pharmacopoeias, 2010, Governmen of India, Controlle of t r	
13	Ayurvedic Pharmacopoeia of India, AYUSH, CCRAS	
14	Quality Standards of Indian Medicinal Plants, all volumes, ICMR	
15	Indian Medicinal Plants, Kiritikar and Basu	
Course Outcome (students will be able to...)		
1	Understand and Undertake systematic identification of different plant / herbal material.	
2	Understand and undertake steps involved in the preparation of herbal drugs for commerce.	

3	Understand and undertake Extraction of plant materials and thereafter separation of phytoconstituents. Undertake separation of constituents by column chromatography	
4	Undertake evaluation of herbal raw material as well as formulations made from them	
5	Describe comprehensive requirement for setting up of extraction plant	

Course Code: PHP1043	Course Title: Pr 3: A. Medicinal Natural Products B. Pharmaceutical Analysis and Biochemistry Laboratory	Credits = 4		
		L	T	P
Semester: V	Total contact hours: 120	0	0	8
List of Prerequisite Courses				
Pharmaceutical analysis , Analytical chemistry				
List of Courses where this course will be prerequisite				
Pharmaceutics, Pharmacology, and Pharmacognosy. Pharmaceutical Chemistry				
Description of relevance of this course in the B. Tech. Pharm. Program				
To train the students with respect to Spectroscopic method, Bioanalytical methods and other physical methods of analysis				
	Course Contents (Topics and subtopics)			Reqd. hours
	A. MEDICINAL NATURAL PRODUCTS			
	Standardization of plant drugs using following methods			
1	Morphology, microscopic quantitative microscopy, details microscopic study of drugs			15
2	Physical constants like: specific gravity, swelling factor, ash values, extractive values, refractive index, optical rotation, etc			15
3	Chemical methods identification tests for various classes of phytoconstituents, Extraction and isolation of active principles such as alkalis, glycosides, tannins, carbohydrates resin, essential oils, fats etc. from natural drugs (4-5drugs) and evaluation of isolated material by chromatography and spectroscopy.			30
	B. PHARMACEUTICAL AND BIOCHEMISTRY ANALYSIS			
1	Qualitative and Quantitative tests for Carbohydrates Methods: DNS, Folin- Wu Method (Blood Sugar)			8
2	Qualitative and Quantitative tests for Amino acids, Proteins and Precipitation of proteins Methods: Folin Lowery Method, Biuret Method			8
3	Estimation of Cholesterol			4
4	Atomic absorption spectroscopy (Alkali earth metal determinations), DSC,TGA Demonstration			4
5	NMR, Mass Spectroscopy, GCMS Demonstration			4
6	NMR, Mass Spectroscopy problem solving from recorded spectra			4

7	Absorption spectroscopy (UV, Visible);	4
8	Fluorescence spectroscopy (Quinine salt), Quenching phenomenon.	4
9	Chromatography (PC, CC, TLC) application to reaction monitoring, purity assessment of drugs, separation of the mixtures.	4
10	Medicaments in formulations**: Liquid oral, tablet, injectable, aerosol, capsule, ointment, eye drops, suppositories, lozenges, etc. (one each);	4
11	Multi component analysis for drugs in combination**, eg: Using simultaneous equation method, using isoabsorption point method, Using solvent extraction method, Using colorimetric and UV methods.	8
12	Refractometry** Calibration of Abbe's Refractometer, Estimation of refractive index of natural oils and laboratory solvents, determination of the percentage of glycerin in the unknown by calibration curve. Polarimetry** Instrument information, Optical rotation of dextrose solution, determination of specific optical rotation of ethambutol,	4
List of Text Books/ Reference Books		
1	Indian Pharmacopoeia	
2	United States pharmacopoeia	
3	British pharmacopoeia	
Course Outcomes (students will be able to.....)		
1	Prepare sample for analysis from bulk	
2	Decide proper mobile phase and separate / resolve the mixture of compounds	
3	Analyse the drugs in single and multicomponent formulations using various techniques such as UV, IR, NMR, Mass	
4	Apply the techniques like Refractometry and Polarimetry to known and unknown pharmaceutical samples	
5	Apply all above the concept to an unknown sample	

	Course Code: PHP1082	Course Title: Pharmaceutical Formulation Technology Laboratory- II	Credits = 2		
			L	T	P
	Semester: V	Total contact hours: 60	0	0	4
List of Prerequisite Courses					
	Pharmaceutical Formulation Technology Laboratory I				
List of Courses where this course will be prerequisite					
	NIL				
Description of relevance of this course in the B. Tech (Pharma)					
To train the students with respect to practical aspects of pharmaceutical solid unit dosage form development and quality control thereof.					

Sr. No.	Course Contents (Topics and subtopics)	Reqd. hours
1	Representative examples of granules ready for compression (Preparation, packaging and evaluation)	8
2	Representative examples of tablets (Preparation, packaging and evaluation)	28
3	Representative examples and demonstration of tablet coating (Preparation, packaging and evaluation)	8
4	Representative examples of capsules (Preparation, packaging and evaluation)	8
6	Dissolution testing: <ul style="list-style-type: none"> Conventional marketed formulations representing- soluble drug, poorly soluble drug (selection of medium) 	8
List of Text Books/ Reference Books		
1	Pharmacopoeias	
2	Pharmaceutical Production Facilities: Design and Applications G.C.Cole	
3	New York Ellis Horwood 1990	
4	Husa's Pharmaceutical Dispensing Martin E. W. Easton Mack Pub. Co. 1971	
5	Transdermal Delivery of Drug A. Kydonieus Florida, CRC Press, 1987	
6	Transdermal Controlled System Medications Y. W. Chien, New York, Marcel Dekker 1987	
7	The Theory and Practice of Industrial Pharmacy, Lachman Bombay, K. M. Warghese Co. 1976	
8	The Theory and Practice of Industrial Pharmacy, Lachman Bombay, K. M. Warghese Co. 1976	
9	Pharmaceutical Dosage Forms Vol. I & II, Liebermann, New York, Marcel Dekker, 1996.	
10	Drug Delivery Devices: Fundamentals and Applications, Tyle New York, Marcel Dekker 1988	
Course Outcomes (students will be able to.....)		
1	Prepare and evaluate granules ready for compression	
2	Prepare, evaluate and label pharmacopoeial and non pharmacopoeial solid oral dosage forms	
3	Perform dissolution testing for oral dosage forms	

Semester VI

	Course Code: PHT1055	Course Title: SPL7: Pharmaceutical Chemistry and Catalytic Process	Credits = 4		
			L	T	P
	Semester: VI	Total contact hours: 60	3	1	0
List of Prerequisite Courses					
	Basic understanding of metal complexes and co-ordination chemistry; Physical chemistry of surfaces and isotherms; Elementary chemical reaction engineering; Basic knowledge of organic chemistry ; Basic knowledge of enzymes and protein structure				
List of Courses where this course will be prerequisite					
	To train the students in retro synthesis and application of catalyst in the				
Description of relevance of this course in the B. Tech. Program					
To train the students in the basis of different catalyst and use of catalyst in the process					
Sr. No.	Course Contents (Topics and subtopics)				Reqd. hours
	A. Pharmaceutical Chemistry				
1	Importance of Organic synthesis, linear vs telescopic synthetic strategies, Concept of retrosynthetic analysis; construction of simple carbon-hetro bonds				2
2	Understanding of molecular complexity, identification of building blocks and strategies of building molecules by joining the blocks, chemo selectivity issues				2
3	Building block based carbon-hetero bond disconnection based retrosynthetic analysis of larger drug and natural product molecules and synthetic strategies				4
4	Hetero cyclic ring construction analysis with illustrative				4
5	Retrosynthetic analysis of different drug molecules with combined approaches studies as above.				4
6	C-C bond disconnections and selection of synthons and corresponding reagents, analysis of synthesis of simple drug molecules.				4
7	Organo metallic chemistry based strategies in retrosynthesis and construction of molecules.				4
8	Wittig, aldol, Michael, Organo palladium, metathesis based retrosynthetic				4
9	Asymmetric transformations and retrosynthesis				2
	B. Catalytic Process				
10	Over view of Pharmaceutical Technology and current trends in process research. Importance of catalytic process in organic synthesis and Processes				2
11	Catalysis basic principles of catalysis, Classifications of catalytic processes, energy profile diagrams and kinetics. Specific acid and specific base catalysis				4
12	General acid and base catalysis, homogeneous catalysts and				4
13	Heterogeneous catalysts and catalysis, types of catalysts, characterization of catalysts -out line, kinetics, catalyst poisoning, Supported catalysts and catalysis				4

14	Biocatalysis, biocatalytic systems, Enzyme catalyzed reactions, principles, details studies on Lipases and catalyzed reactions	4
15	Immobilized biocatalytic systems and different approaches of immobilization chemistry, merits and demerits	4
16	Manufacture of chiral drugs through catalytic processes	3
17	Phase transfer catalysis	2
18	Basics of mixing and understanding, implication on catalytic processes, suspension of solids particles	3
List of Text Books/ Reference Books		
1	Modern Physical Organic Chemistry; E.V. Anslyn, D.A. Dougherty; University Book Press, 2006	
2	Biotechnology, Vol 4, H.J. Rahm, G. Reed; WeinheimVerlagChemie 1985.	
3	Principles of Process Research and Chemical Development in the Pharmaceutical Industry; O. Reiser, Wiley & Sons Inc. 1999	
4	Recent review articles on specific topics	
Course Outcomes (students will be able to.....)		
1	Comprehension of fundamental knowledge of catalysis and its	
2	Insight into Biocatalytic process and issues concerned with API	
3	Construction heterocycles by logical disconnection route	
4	Would able to map organic molecules with respect to functional group clusters, building block identification	
5	Logical disconnection of molecules at strategic bonds and identification of synthons with known chemistry and Logical design of synthesis of drug and biological molecules	

	Course Code: PHT1083	Course Title: Pharmaceutical Formulation Technology III	Credits = 3		
			L	T	P
	Semester: VI	Total contact hours: 45 Hrs	2	1	0
List of Prerequisite Courses					
	Pharmaceutical Formulation Technology II				
List of Courses where this course will be prerequisite					
	Validation and regulatory requirements				
Description of relevance of this course in the B. Tech (Pharma)					
To train the students with respect to basics and application of Technology of sterile pharmaceuticals, ophthalmic products, blood products and substitutes and sutures and ligatures					
Sr. No.	Course Contents (Topics and subtopics)				Reqd. hours
1	Sterile Pharmaceuticals <ul style="list-style-type: none"> • Introduction to sterile dosage forms, routes of parenteral administration • Preformulation considerations for sterile dosage forms : small volume 				4

	parenterals, large volume parenterals	
2	Facility design for parenteral manufacture with focus on air systems HEPA filters, environmental classes for manufacture of parenterals	5
3	Methods of sterilization	2
4	Water for Injection: Monograph IP, methods of preparation, quality control tests, storage	3
5	Containers and Closures for Parenteral Formulations: <ul style="list-style-type: none"> • Glass and plastic as a container material; ampoules, vials, bottles, rubber closures manufacturing, sterilization, quality control. 	5
6	Small volume parenterals <ul style="list-style-type: none"> • Formulation (discuss various dosage forms like solutions, suspensions, emulsions, dry powders) • Quality control • Large scale manufacture and packaging with focus on equipment • Layout design and Unit operations 	5
7	Freeze drying: Introduction, principle and equipment	2
8	Large volume parenterals <ul style="list-style-type: none"> • Formulation (discuss various dosage forms like solutions, suspensions, emulsions, dry powders) • Quality control • Large scale manufacture and packaging with focus on equipment • Layout design and Unit operations 	4
9	Ophthalmics <ul style="list-style-type: none"> • Introduction to Ophthalmic dosage form • Anatomy of eye, factors affecting ophthalmic drug absorption • Preformulation considerations for ophthalmic dosage forms • Dosage forms: discuss various dosage forms like solutions suspensions, ointments, gels, films, inserts, lenses etc. w.r.t advantages and limitations, excipients, methods, equipments, advances, problems and solutions thereof • Quality control of ophthalmics • Large scale manufacture and packaging with focus on equipment • Layout design and Unit operations 	5
10	Blood products and glandular products Blood products <ul style="list-style-type: none"> • Introduction, advantages and limitations • Collections and storage techniques for whole blood • Methods of blood and plasma fractionation into individual components • Quality control Plasma substitutes <ul style="list-style-type: none"> • Introduction, advantages and limitations • Methods of preparation • Quality control Insulin and insulin products	5
11	Sutures and ligatures <ul style="list-style-type: none"> • Introduction, advantages and limitations 	5

	<ul style="list-style-type: none"> • Difference between sutures and ligatures • Types of material used for sutures and ligatures e.g. absorbable and non-absorbable • Methods of preparation • Quality control • Large scale manufacture and packaging with focus on equipment 	
List of Text Books/ Reference Books		
1	Therapeutic Systems: Pattern-Specific Drug Delivery, Heilmann, Struttgart, G. Thiense Pub. 1978	
2	Encyclopedia of Pharmaceutical Technology, J. Swarbrick, New York, Marcel Dekker, 1993	
3	Remington's Pharmaceutical Sciences, A. R. Gennaro Mac Pub. Co. Easton, Pennsylvania 1990	
4	Indian Pharmacopoeia, British Pharmacopoeia, United States Pharmacopoeia.	
5	Theory & Practice of Industrial Pharmacy. L. Lachman, Herbert A.Lieberman & J. Kanig, Lea &Febiger, Philadelphia, 1987	
6	Pharmaceutical Dosage Form: Dispersed Systems (Vol.1 &2) HerberA. Lieberman, Martin A.Rieger,G.S.Ban, Marcel Dekker Inc., 1993	
7	Modern Pharmaceutics. Gilbert S.Banker, C.T. Rhodes, Marcel Dekker Inc.1990	
8	Pharmaceutics: The Science of Dosage Form Design. Michael E.Aulton, Churchill-Livingstone, 1998	
9	Pharmaceutical Dosage forms: Parenteral Medications in Three volumes, Kenneth E. Avis, Herbert A. Lieberman, Leon Lachman, Marcel Dekker Inc.1993	
Course Outcomes (students will be able to.....)		
1	Describe preformulation, formulation, evaluation, packaging, large scale manufacturing and facility design of parenteral products	
2	Describe anatomy, physiology of eye and explain formulation considerations, evaluation and packaging of different types of ophthalmic products	
3	List different blood products, methods to obtain the same, their quality control and discuss plasma substitutes, glandular products, sutures, ligatures and its quality control thereof	

CourseCode: HUT 1103	Course Title: Industrial Psychology and Human Resource Management	Credits=3		
		L	T	P
Semester: VI	Total contact hours: 45	2	1	0
List of Prerequisite Courses				

List of Courses where this course will be prerequisite				

Description of relevance of this course in the B. Tech. Program				
This course equips students with human resource management skills to be able to function effectively in their professional career				
Course Contents (Topics and subtopics)				Reqd.

1	Introduction & Overview of the course,	3
2	Changes/Challenges in HRM,	3
3	Management Theories	6
4	Research Methodology & Statistical Tools	3
5	Management of Change	6
6	Organizational Culture & Climate	3
7	Knowledge Productivity	3
8	New Leadership Motivation Theories	3
9	Talent Management	3
10	Training & Development	3
11	Performance Management	3
12	Selection & Recruitment	3
13	Compensation, Unions, Entrepreneurship	3
List of Text		
1	Personality and Organization., Argyris C.	
2	The Essence of Leadership, Locke, Edwin A.	
3	Organisational Behaviour, Robbins S	
4	Managing Human Resources, Bach, S. 2005	
5	Human Resource Management:	
Course Outcomes (students will be able to.....)		
1	Students should be able to explain the fundamental concepts of IPHRM.	
2	Students should be able to analyze practical situations	
3	Students will be able to provide applicable solutions.	

Course Code: HUT1104	Course Title: Industrial Management- I	Credits = 3		
		L	T	P
Semester: VI	Total contact hours: 45	2	1	0
List of Prerequisite Courses				
List of Courses where this course will be prerequisite				
Description of relevance of this course in the B.Tech. Program				
This course is essential for effective functioning of students in their professional career				
Sr. No	Course Contents (Topics and subtopics)	Reqd. hours		
1	Introduction: Principles, thoughts and contributions of FW Taylor, Henry Fayol and Elton Mayo. Responsibilities of management: society and development. Functions of	10		
2	Organisational Process and Behaviour: Introduction and Meaning of Organization, Organization as a process, Span of Control, Authority, Responsibility and Accountability, Delegation of authority, Decentralization of authority. Enhancing Managerial Effectiveness through self and others, Individual Personality & Behaviour, Perception, Attitudes, Values and Aptitude, Frustration,	10		
3	Technology Management: Strategies & their applications in industry, Business specifications versus	10		
4	Marketing Management: Marketing vs sales, advertising, marketing research, supply chain management,	10		
5	Laws: Company Laws, Factory Laws, Labor Laws and Intellectual Property	10		
6	Communication Skills: Communication process, media channels, written and verbal/presentation skills,	5		

List of Text		
1	Essentials of Management, Koontz	
2	Innovation and Entrepreneurship, Peter Drucker	
3	Industrial Management–I, Jhamb L. C. and Jhamb S.	
4	Essentials of Organizational Behavior, S. Robbins	
5	Organizational Behaviour, Luthans F	
6	Principles of Marketing, Kotler	
7	Research and Development Management, Bamfield P	
8	Industrial Management, Spriegel U.S.	
Course Outcomes (students will be able to.....)		
1	Students should be able to explain the fundamental concepts of Industrial	
2	Students should be able to analyze practical situations and be able to provide	

CourseCode:HUT1106	Course Title: Environmental Science and Technology	Credits= 3		
		L	T	P
Semester: VI	Total contact hours: 45	2	1	0
List of Prerequisite Courses				
List of Courses where this course will be prerequisite				
Sr. No.	Course Contents(Topics and subtopics)	Reqd. hours		
1	Multi disciplinary Nature of Environmental Studies: <ul style="list-style-type: none"> • Scope and Importance • Need for Public Awareness • Depleting Nature of Environmental resources such as Soil, Water, Minerals, and Forests. • Global Environmental Crisis related to Population, Water, Sanitation and Land. • Ecosystem: Concept, Classification, Structure of Ecosystem, overview of Foodchain, Foodweb and Ecological Pyramid 	4		
2	Sustainable Development <ul style="list-style-type: none"> • Concept of sustainable development • Social, Economical and Environmental aspect of sustainable development. • Control Measures:3R (Reuse, Recovery, Recycle),Appropriate Technology Environmental education Resource utilization as per 	4		

3	<p>Environmental Pollution:</p> <ul style="list-style-type: none"> Air Pollution: Sources, Effects of air pollution with respect to Global Warming, Ozone layer Depletion, Acid Rain, <p>Photo chemical smog, Two Control Measures-Bag house Filter, Venturiscrubber.</p> <p>Case Study</p> <ul style="list-style-type: none"> Water Pollution: Sources and Treatment, Concept of was tewaters-Domestic &Industrial and treatment. <p>Case Study</p> <ul style="list-style-type: none"> Land Pollution: Solid waste, Solid waste Management by Land filling, Composting. Noise Pollution: Sources and Effects 	7
4	<p>Environmental Legislation:</p> <ul style="list-style-type: none"> Overview Ministry of Environment and Forests (MoE&F).Organizational structure of MoE &F. Functions and powers of Central Control Pollution Board. Functions and powers of State Control Pollution Board. Environmental Clearance, Consent and Authorization Mechanism. Environmental Protection Act 	5
5	<p>Renewable sources of Energy:</p> <ul style="list-style-type: none"> Limitations of conventional sources of Energy. Various renewable energy sources. Solar Energy: Principle, Working of Flatplate collector &Photovoltaic cell. 	5
6	<p>Environment and Technology</p> <ul style="list-style-type: none"> Role of Technology in Environment and health Concept of Green Buildings, Indoor air pollution Carbon Credit: Introduction, General concept. Disaster Management: Two Events: Tsunami, Earthquakes, Techniques of Disaster Management Case Study 	5
List of Text		
1	Textbook of Environmental studies by Erach Bharucha, University Press.	
2	Environmental Studies by R. Rajagopalan, Oxford University Press.	
3	Essentials of Environmental Studies by Kurian Joseph &Nagendran, Pearson	
4	Renewable Energy by Godfrey Boyle, Oxford Publications.	
5	Perspective Of Environmental Studies, by Kaushik and Kaushik, New Age	
6	Environmental Studies by. Anandita Basak, Pearson Education	
7	Textbook of Environmental Studies by Dave and Katewa, Cengage Learning	
8	Environmental Studies by Benny Joseph, Tata McGraw Hill	

	Course Code: PHP1083	Course Title: Pharmaceutical Formulation Technology Laboratory - III	Credits = 4		
			L	T	P
	Semester: VI	Total contact hours: 120 Hrs.	0	0	8
List of Prerequisite Courses					
	Pharmaceutical Formulation Technology Laboratory II				
List of Courses where this course will be prerequisite					
	NIL				
Description of relevance of this course in the B. Tech (Pharma)					
To train the students with respect to practical aspects of sterile pharmaceutical formulation development, sustained release products including microencapsulation and quality control thereof. To demonstrate large scale manufacturing of pharmaceutical products					
Sr. No.	Course Contents (Topics and subtopics)				Reqd. hours
1	Representative examples of small volume parenterals (Preparation, packaging and evaluation)				20
2	Representative examples of large volume parenterals (Preparation, packaging and evaluation)				8
3	Representative examples of ophthalmic formulations (Preparation, packaging and evaluation)				12
4	Evaluation of containers and closures for parenterals				8
5	Monographic testing of water for injection IP, containers and closures used for parenterals				12
6	Accelerated stability studies				8
7	Representative examples of microencapsulation (Preparation, packaging and evaluation)				8
8	Prototype formulations of sustained release granules tablets and quality control thereof.				16
9	Dissolution testing of Sustained release formulations				8
10	Prototype formulation/Demonstration of Novel DDS				12
11	Scale up of some formulation/s				8
List of Text Books/ Reference Books					
1	Pharmacopoeias				
2	Pharmaceutical Production Facilities: Design and Applications G.C.Cole				
3	The Theory and Practice of Industrial Pharmacy, Lachman Bombay, K. M. Warghese Co. 1976				
4	The Theory and Practice of Industrial Pharmacy, Lachman Bombay, K. M. Warghese Co. 1976				
5	Pharmaceutical Dosage Forms Vol. I & II, Liebermann, New York, Marcel Dekker, 1996.				
6	Drug Delivery Devices: Fundamentals and Applications, Tyle New York, Marcel Dekker 1988				
Course Outcomes (students will be able to.....)					

1	Formulate and evaluate parenteral and ophthalmic products	
2	Understand importance of aseptic area	
3	Evaluate primary package for sterile products	
4	Perform accelerated stability studies and calculate shelf life	
5	Prepare and evaluate granules ready for compression	
6	Prepare, evaluate and label pharmacopoeial and non pharmacopoeial solid oral dosage forms including sustained release dosage forms	
7	Demonstrate use of specific unit operations for processing of solid dosage forms	

	Course Code: PHP1053	Course Title: Pr 6: Pharmaceutical Chemistry Laboratory	Credits = 4		
	Semester: VI	Total contact hours: 120	L	T	P
			0	0	4
List of Prerequisite Courses					
	General exposure chemistry laboratory and experience handling chemicals; Back ground of safety in chemical laboratory; Identification and separation of organic compound				
List of Courses where this course will be prerequisite					
	Process Technology Laboratory				
Description of relevance of this course in the B. Tech. Pharm. Program					
Sr. No.	Course Contents (Topics and subtopics)				Reqd. hours
1	Preparation of organic compounds in common use in pharmaceutical industry involving simple transformations				40
2	Few examples of synthesis using green approaches'				10
3	Application of synthetic methods reported in recent literature				10
List of Text Books/ Reference Books					
1	Vogel's Text book of Practical Organic Chemistry, 5 th Edition.				
2	Green methods of Preparation published by Department of Science and Technology				
Course Outcomes (students will be able to.....)					
1	Planning of laboratory synthesis				
2	Separation process, purification methods				
3	Characterization				
4	Labeling and safety aspects of identifying a chemical operation				
5	Laboratory skill development, appreciation of impact of green methods of synthesis				

	Course Code: PHP1054	Course Title: Pr 6: Medicinal Chemistry Laboratory	Credits = 2		
	Semester: VI	Total contact hours: 60	L	T	P
			0	0	4
List of Prerequisite Courses					

	Pharmaceutical Analysis, Organic chemistry	
List of Courses where this course will be prerequisite		
	Process Technology	
Description of relevance of this course in the B. Tech. Pharm. Program		
To train the students in basic medicinal chemistry laboratory practices and structure activity relationships including the use of molecular modelling software		
Sr. No.	Course Contents (Topics and subtopics)	Reqd. hours
1	Multistep synthesis of APIs (3 examples)	5*4
2	Synthesis of analogs eg. carboxylic acid derivatives	2*4
3	Experimental determination of pKa and comparison with software generated data	2*4
4	Experimental determination of log P values and comparison with software generated data	2*4
5	Experimental determination of simple in-vitro activity of series of structurally related compounds	4
6	Structure property relationship from experimental data	4
7	Demonstration of pharmacophore development and QSAR	4
8	Demonstration of structure based drug design	4
List of Text Books/ Reference Books		
1	Furniss, Brian S. Vogel's textbook of practical organic chemistry, Pearson Education India,	
2	J. Leonard, Trevor P. Toubé, B. Lygo, G Advanced Practical Organic Chemistry. Proctor, 2nd edition, Stanley Thorne. 1990	
3	Keese, R, Martin P. B, and Trevor P. Toubé. Practical organic synthesis: a student's guide. John Wiley & Sons, 2006.	
Course Outcomes (students will be able to.....)		
1	Work safely in the organic chemistry laboratory and synthesize drugs using multiple steps	
2	Compare physicochemical properties using experiments and software	
3	Predict SARs	
4	Understand basic drug design software and its applications	

Semester VII

	Course Code: CET 1703	Course Title: Chemical Process Control	Credits=3		
			L	T	P
	Semester: VII	Total contact hours: 45	2	1	0
List of Prerequisite Courses					
	Material and Energy Balance Calculations, Applied Mathematics, Chemical Engineering Operation, Chemical Reaction Engineering.				
List of Courses where this course will be prerequisite					
	Chemical Engineering Laboratory, Projects.				
Description of relevance of this course in the B.Tech. Program					
Process control plays a very critical role in the context of actual operation of a chemical plant. Most of the chemical engineering courses focus on the steady state operation. In the real life environment, process is continuously subjected to various disturbances which deviates the operation from the designed steady state. This course specifically prepares students to assess the impact of such disturbances and equip them with the tools available with the chemical engineer to handle these situations.					
	Course Contents(Topics and subtopics)				Reqd.
1	Introduction to process control: Motivation, importance, components of control system, control relevant				2
2	Dynamics of first, second and higher order systems: Examples systems, characterizing parameters,				5
3	Feedback control: Motivation, elements of feedback control, servoproblem, regulatory problem, effect of proportional, integral and derivative action, responses of P,				3
4	Controller selection and design: Controller selection guidelines, controller design criteria, common				3
5	Controller tuning: Open loop tuning, closed loop tuning, direct synthesis, commercial controller tuning packages				3
6	Stability analysis: Laplace domain analysis, frequency domain analysis				3
7	Multivariable and advanced control: Cascade control, dynamic matrix control, internal model control, basics of ratio control, split range control, override control, adaptive control, inferenti				5
8	Digital control: Discrete time systems, basics of z-transforms, stability analysis				2
9	Electronics for control systems: Distributed control system, Programmable Logic Controllers, SCADA, HMI				2
10	Instrumentation: Basic measurement devices and working principles for level, flow, pressure and				2
List of Text Books/ Reference Books					
1	Stephanopoulos, G. Chemical Process Control: An Introduction to Theory and				
2	Bequette, B. W. Process Control: Modeling, Design, and Simulation.				
3	Seborg, D.E. and Mellichamp, D.A. and Edgar, T.F. and Doyle, F. J. Process				
4	Johnson, C. D. Process Control Instrumentation Technology.				

	Course Code: PHT1056	Course Title: SPL10: Medicinal Chemistry II	Credits = 4		
			L	T	P
	Semester: VII	Total contact hours: 60	3	1	0
List of Prerequisite Courses					
	Organic Chemistry, Pharmacology and Pathophysiology				
List of Courses where this course will be prerequisite					

Description of relevance of this course in the B. Tech. Pharm Program					
To acquaint students with nomenclature, classification, molecular mechanism of action, synthesis and SAR of anti-infective agents and drugs acting on the CNS.					
Sr. No.	Course Contents (Topics and subtopics)			Reqd. hours	
1	Antibacterial agents: Antibiotics: beta-lactam antibiotics including-penicillin, cephalosporins, carbapenems, monobactams.			4	
	Tetracyclines and glycylicyclins, Marcolides and ketolides, Aminoglycosides, Miscellaneous including chloramphenicol, vancomycin, bacitracin etc.			3	
	Sulfonamides and DHFR inhibitors, Quinolones, Oxazolidinones and other miscellaneous agents.			4	
2	Antiparasitic agents: Antiamoebics, Antimalarials, Anthelmintics, Miscellaneous including drugs versus Trypanosomiasis, leishmaniasis, scabies, filaria etc			4	
3	Antifungal agents: Azoles, Polyene antibiotics and Miscellaneous including Allyl amines, Tolnaftate, griseofulvin etc.			3	
4	Antimycobacterial agents: Antitubercular agents, Antileprotic agents, Drugs versus MAC			2	
5	Anticancer agents: DNA alkylating agent, Nitrosoureas: Procarbazines, Triazines and miscellaneous. Organoplatinum agents, Antibiotics, Antimetabolites including DNA polymerase inhibitors, Pyrimidine and purine antagonists and miscellaneous agents, Mitosis inhibitors and other miscellaneous anticancer agents.			4	

6	Antiviral agents: General aspects, Agents interfering with nucleic acid replication including those with modification with bases sugars and phosphate, Amantidine and its analogs, interferon and its inductors, Nuraminidase inhibitors, Antiretroviral drugs including NRTI, NNRTI and protease inhibitors.	6
7	Drugs Affecting the Central Nervous System General introduction to biogenic amines and other biomolecules involved in neurotransmission, General anaesthetics: Inhaled general anesthetics and Intravenous general anesthetics, Sedatives and hypnotics: Benzpdiazepines, Non-benzodiazepine, Barbiturates, Miscellaneous.	3
	Antiseizure drugs or anticonvulsant agents -Clinical drugs and newer agents; Antidepressants - Selective norepinephrine reuptakeinhibitors (SNRIs), Selective 5-HT reuptake inhiitors (SSRIs), Nonselective reuptake inhibitors (NSRIs), Dopamine and norepinephrine reuptake inhibitors (DNRI), Serotonin antagonist/reuptake inhibitors (SARIs), nonadrenergic specific serotonergic antidepressants (NaSSAs), monoamine oxidase inhibitors (MAOIs), Moodstabilizers.	5
	Antipsychotics: phenothiazes, thioxanthenes, benzamide, benzapines, benzisoxazole and benzisothiazoles, miscellaneousagents, Anxiolytics: Benzodiazapines, Misc agents.	4
	Hallucinogens, Stimulants and related drugs of abuse or analeptics, xanthenes, psychedelics; Non classical Hallucinogens- cannabinoids, classical hallucinogens- Indolealkylamines, henylalkylamines, Central stimulants-amphetamine related agents, cocaine related agents	2
	Drugs used to treat neuromuscular disorder- Antiparkinsonian and spasmolytic agents; Drugs affecting serotonergic neurotransmission- drugs for migraine, Irritable Bowel Syndrome, Anitemeticagents.	2
8	Cholinergic Drugs or Drugs affecting cholinergic nerutransmission: <ul style="list-style-type: none"> General aspects of cholinergic receptor and acetylcholine,Acetyl choline mimetics- muscarinic agonist or cholinergic agonists, Anticholineesterases 	2
	<ul style="list-style-type: none"> Drugs for the treatment of Alzheimer's, Acetylcholineantagonistsmuscrinic antagonists, Neuromuscularblockingagents. 	2
9	Adrenergic Drugs or drugs affecting adrenergic neurotransmission: <ul style="list-style-type: none"> General aspects of adrenergic receptors and Non-selective adrenergic agonists- nor- epinephrine and epinephrine,Selective agonists and 	3
	<ul style="list-style-type: none"> Mixed-acting sympathomimetics, Non-selective and Selective α-adrenergic antagonists, β-adrenergic antagonists, Mixed α/β-adrenergic antagonists :Ergotalkaloids. 	2
10	Analgesics (Centrally Acting): <ul style="list-style-type: none"> Opoid or narcotic analgesics: μ-agonists, other analgesics, mixed agonist/antagonist analgesics, μ-antagonists; Antidiarrhealagents; Cough suppresants, anti-tuss 	3

List of Text Books/ Reference Books		
1	Foye's Principles Of Medicinal Chemistry W. O. Foye, Lippincott Williams & Wilkins, 6th edition, 2008.	
2	Burger's Medicinal Chemistry & Drug Discovery(Vol. 1- 6) A. Burger And M.E. Wolff; John Wiley & Sons-New Jersey, 6th edition,2003	
3	Textbook Of Medicinal And Pharmaceutical Chemistry Wilson And Gisvold, Lippincott Williams & Wilkins, Philadelphia, 11	
4	The Practice of Medicinal Chemistry, C.G. Wermuth, Academic Press, 3 edition, 2008	
Course Outcomes (students will be able to.....)		
1	Draw and understand the structures and write IUPAC names of structures (including 3D structure)	
2	Explain mechanism of action of drugs at a molecular level	
3	Understand and apply the concept of SAR	
4	Predict synthetic route for simple drugs	
	Note: The above course outcomes are with respect to anti-infective agents and drugs acting on the CNS	

Course Code: PHT1084	Course Title: SPL11:Validation and Regulatory Requirements	Credits = 3		
		L	T	P
Semester: VII	Total contact hours: 45 Hrs	2	1	0
List of Prerequisite				
	Pharmaceutical Formulation Technology III			
List of Courses where this course will be prerequisite				
	NIL			
Description of relevance of this course in the B. Tech (Pharma)				
To train the students with respect to basics of good manufacturing practices, scientific and risk based product development approached, validations and regulatory requirements of pharmaceuticals and biopharmaceuticals.				
Sr. No	Course Contents (Topics and subtopics)	Reqd. hours		
1	Good manufacturing practices and facility design <ul style="list-style-type: none"> • Good manufacturing practices: personnel, facility environmental and manufacturing factors • Quality assurance, • Quality audits 	3		
2	Schedule governing pharmaceutical product development (e.g. Schedule M , Schedule Y)	2		

3	Pilot Plat scale up <ul style="list-style-type: none"> • Introduction • Pilot plant scale up technique – group responsibilities, facilities, general considerations • Case studies (solid, liquid, semisolid dosage forms) 	5
4	Quality by Design <ul style="list-style-type: none"> • QbD elements • Design of experiments • Example of scaling up of liquid, solid oral formulations, semisolids, parenteral preparation using QbD approach 	5
5	Validation: <ul style="list-style-type: none"> • Introduction to validation, process validation and scope • Priority order for pharmaceutical validation • Types of validation (prospective, retrospective. concurrent and revalidation) • Steps in validation • Case studies (solid, liquid, semisolid dosage forms) 	5
6	Case studies on validation of processes, equipments and products	5
7	Documentation for pharmaceuticals	5
8	Introduction to regulatory aspects of pharmaceuticals <ul style="list-style-type: none"> • Introduction to Regulatory aspects of pharmaceuticals, need, advantages and limitation • Introduction to major regulatory bodies worldwide • Rationale for regulatory harmonization and introduction of ICH • Introduction to CTD Modules • Comparison of Indian and European guidelines w.r.t. USFDA guidelines 	5
9	Regulatory procedure for pharmaceutical product market approval as per USFDA guidelines: IND, NDA [505(b) (1) and (b) (2)], ANDA 505 (j) filing, review and approval process	5
10	Legal acts <ul style="list-style-type: none"> • DPCO • Drugs and cosmetics act • Rules including licensing intermediates industry 	5

List of Text Books/ Reference Books

1	Beotra's Law of Drugs Medicins and Cosmetics K. K. Singh, L. R. Bugga for the Law Book Co.Pvt. Ltd. Allahabad	
2	Modern Pharmaceutics, G. S. Banker, New York, Marcel Dekker1990	
3	Fundamentals of Pharmacy, Blome H. E., Philadelphia, Fea and Febiger,1985	
4	Pharmaceutical Production Facilities: Design and Applications, G. C. Cole, New York EllisHorwood 1990	
5	Drug Delivery Devices: Fundamentals and Applications Tyle, New York, Marcel Dekker1988	
6	Microbial Quality Assurance in Pharmaceuticals Cosmetics and Toiletries, S. F. Bloomfield,Chichester, Ellis, Horwood, 1998.	
7	Encyclopedia of Pharmaceutical Technology, J. Swarbrick, New York, Marcel Dekker,1993	
8	Remington's Pharmaceutical Sciences, A. R. Gennaro Mac Pub. Co. Easton, Pennsylvania1990	
9	Pharmaceutical Product Development: Insights into Pharmaceutical Processes, Management and Regulatory Affairs, PatravaleV,	
10	Indian Pahrnacopoiea, British Pahrncopoiea, United States Pharmcopoiea.	

11	Oral Mucosal Drug Delivery, Rathbone, New York, Marcel Dekker,1996	
12	Good Laboratory Practice Regulations A. F. Hirsch, New York, Marcel Dekker,1989	
13	Good Laboratory Practice Regulations Weinberg New York, Marcel Dekker,1995.	
Course Outcomes (students will be able to.....)		
1	Explain Schedule M, CGMP, quality assurance	
2	Describe product and process validation and documentation required for the	
3	Explain the regulatory pathways for new drug application and generic	
4	Explain Drugs and Cosmetics act, Drug price control order and regulations	

5	CourseCode:HUT110	Course Title: Industrial Management– II	Credits= 3		
			L	T	P
	Semester: VII	Total contact hours: 45	2	1	0
List of					
List of Courses where this course will be prerequisite					
Description of relevance of this course in the B.Chem. Engg.					
This course is essential for effective functioning of students in their professional career					
	Course Contents(Topics and subtopics)				Reqd. hours
1	Production Operations Management: Production Management – Modern Approach, Manufacturing systems, Interface management. Manufacturing/ Operations Strategy – Principles & concept, Operations as competitive weapon --Investment strategy, Capacity strategy, Quality strategy, Technology strategy, Customer focus strategy, Facility location strategy, Product flexibility strategy, Short delivery process strategy, Quick time delivery strategy, Concepts of Productivity, Measurement & Improvement, Lean Manufacturing, Value Engineering, Business Process Re-engineering. World Class Manufacturing (WCM) – Principles & concepts, Systems, Processes&toolsinWCM,Kanban,JIT,Wasteidentification&elimination,Poka Yokesystem,EHSSmanagementinWCM,HRDimensions in WCM, WC Min reference to Indian industry and Indian scenario, Maintenance practices				9
2	FinancialManagement:Investmentdecisions,LinkinginvestmenttoProductLifeCycle,Investmentrisk analysisandriskcontrol/mitigation,Accountingsystem,Stepcostingdiagram,Balancesheet evaluation, Fund Flow analysis, Financial ratios & their valuation/significance, Cost control by variableanalysis, Comparable Company evaluation. Budgetingand budgetary control.				9
3	QualityManagement:Quality–concept/meaning,ModernapproachtoQualityManagement,QAversus QC,Acceptancesamplingandstatisticalqualitycontrol,Deming’s14pointsofQM, TQMPrinciples& implementation,ISO 9000–2000, ISO 14000 (Environment) &ISO 50000 (Energy)quality standards.				9
4	MaintenanceManagement:Causes,costs,lifeprofiles,Classifications,Organization,Equipment&plant reliability and availability, Management of shutdowns& turnarounds.				9

5	Materials Management: Definition, objectives, organization, stages, factors responsible, value analysis, Management of project materials and maintenance materials, Purchasing and vendor development, Spares strategy, Ware-housing, store-keeping and inventory control.	9
List of Text Books/ Reference Books		
1	Production & Operations Management – An Applied Modern	
2	Industrial Management – I, Jhamb L.C. and Jhamb S.	
3	Industrial Management, Spriegel U.S.	
4	Operations Management for Competitive Advantage, Richard B. Chase, F. Robert Jacobs, Nicholas	
5	World Class Manufacturing- A strategic Perspective, B.S. Sahay, K.B.C. Saxena, A	
6	Management Finance, Varanasy Murthy	
7	Financial Management, R.M. Srivastava	
8	Quality, John M. Nicholas	
9	Quality Planning and Analysis, Juran and Gryna	
Course Outcomes (students will be able to.....)		
1	Students should be able to explain the fundamental concepts of Industrial	
2	Students should be able to analyze practical situations and be able to	

Course Code: MAT 1106	Course Title: Design and Analysis of Experiments	Credits=3		
		L	T	P
Semester: VII	Total contact hours: 45	2	1	0
List of Prerequisite Courses				
Applied Mathematics I				
List of Courses where this course will be prerequisite				
This course is required for graduating engineers to function effectively in Industry, Academia and other professional spheres.				
Description of relevance of this course in the B. Tech. Program				
<p>Modernday manufacturing activities and R&D activities need decision taken with scientific rigour and should be well-supported by 'statistics'. Chemical engineering graduates who will serve industry as well as postgraduate research students who will serve industry, R&D organisations, or academic research should have a reasonably good background of statistical decision making. This also involves extraction of meaningful data from well-designed minimal number of experiments at the lowest possible material costs. This course will also help the students in all domains of their life by imparting them a vision for critical</p>				
	Course Contents (Topics and subtopics)	Reqd. hours		
1	Overview of statistical analysis of data, statistical sampling, statistical inference, tests of significance, regression analysis.	8		
2	Analysis of variance.	8		
3	Statistical design of experiments, Factorial design, Response Surface	14		
4	Box-Behnken and Plackett-Burman methods, Central Composite Design (CCD)	15		
List of Text Books				
1	Design of Experiments in Chemical Engineering: Zivorad R. Lazić			
2	Design and Analysis of Experiments: D.C. Montgomery			
3	Introduction to Statistical Quality Control: D. C. Montgomery			
4	Response Surface Methodology: Process and Product Optimization using Designed Experiments: R. H.			
Course Outcomes (students will be able to.....)				
1	Realize importance of statistical analysis of data			
2	Statistically correlate one set of data with another set, and identify whether the correlation is significant or not			

3	List out set of experiments needed for a particular situation/process considering the interaction between	
4	Apply the methods of experimental design to optimisation, and to identifying those parameters that are of highest importance	

Course Code: CEP 1714	Course Title: Chemical Engineering Laboratory	Credits = 2		
Semester: VII	Total contact hours: 60	L	T	P
		0	0	4
List of Prerequisite Courses				
Process Calculations, Transport Phenomena, Chemical Engineering Operations, Chemical Reaction Engineering				
List of Courses where this course will be prerequisite				
Other B. Tech. courses				
Description of relevance of this course in the B. Tech. Program				
Chemical Engineering lab provides students the first hand experience of verifying various theoretical concepts learnt in theory courses. It also exposes them to practical versions of typical chemical engineering equipments and servers as a bridge between theory and practice. This particular lab focuses on fluid dynamics, distillation, filtration, drying and sedimentation.				
	Course Contents (Topics and subtopics)	Reqd. hours		
1	5 - 7 Experiments on fluid dynamics and heat transfer	24		
2	3 - 5 Experiments on Chemical Engineering Operations	16		
3	2 - 4 Experiments on Reaction Engineering	12		
4	1 - 3 Experiments on process dynamics and control	8		
List of Text Books/ Reference Books				
1	McCabe W.L., Smith J.C., and Harriott P. Unit Operations in Chemical Engineering, 2014			
2	Bird R.B., Stewart W.E., and Lightfoot, E.N. Transport Phenomena, 2007			
3	Coulson J.M., Richardson J.F., and Sinnott, R.K. Coulson & Richardson's Chemical Engineering: Chemical engineering design, 1996.			
4	Green D. and Perry R. Perry's Chemical Engineers' Handbook, Eighth Edition, 2007.			
Course Outcomes (students will be able to.....)				
1	Learn how to experimentally verify various theoretical principles			
2	Visualize practical implementation of chemical engineering equipments			
3	Develop experimental skills			

Semester VIII

CourseCode: CET 1504	Course Title: Chemical Project Engg. and Economics	Credits=		
		L	T	P
Semester: VIII	Total contact hours: 45	2	1	0
List of Prerequisite Courses				
Material and Energy Balance Calculations, Equip Des and Dwg I, Energy Engineering, Ind Eng Chem.				
List of Courses where this course will be prerequisite				
Home Paper I and II				
Description of relevance of this course in the B Tech. Program				
This course is required for the future professional career				
	Course Contents (Topics and subtopics)	Reqd.		
1	Introduction to greenfield projects and global nature of projects; Impact of currency fluctuation on Project justification and cash flows and Concepts of "Quality by Design" including typical design deliverables and understanding constructability, operability and maintainability during all stages of project execution. Meaning of Project Engineering, various stages of project implementation	6		
2	Relationship between price of a product and project cost and cost of production, EVA analysis. Elements of cost of production, monitoring of the same in a plant, Meaning of Administrative expenses, sales expenses etc. Introduction to various components of project cost and their estimation. Introduction to concept of Inflation, location index and their use in estimating plant and machinery cost. Various cost indices, Relationship between cost and capacity	8		
4	Project financing: debt: Equity ratio, Promoters' contribution, Shareholders' contribution, source of finance, time value of money. Concept of interest, time value of money, selection of various alternative equipment or system based on this concept. Indian norms, EMI calculations. Depreciation concept, Indian norms and their utility in estimate of working results of project. Working capital concept and its relevance to project.	7		
5	Estimate of working results of proposed project. Capacity utilization, Gross profit, operating profit, profit before tax, Corporate tax, dividend, Net cash accruals. Project evaluation: Cumulative cash flow analysis Break-Even analysis, incremental analysis, various ratios analysis, Discounted cash flow analysis	7		
6	Process Selection, Site Selection, Feasibility Report	4		
7	Project: Conception to Commissioning: milestones, Project execution as conglomeration of technical and nontechnical activities, contractual details. Contract: Meaning, contents, Types of contract. Lump-sum Turnkey (LSTK), Eng, Procurement and Construction (EPC), Eng, Procurement and Construction Management (EPCM). Mergers and Acquisitions	6		
8	Reading of Balance Sheets and evaluation of Techno-commercial Project Reports.	3		
9	PERT, CPM, bar charts and network diagrams	4		
List of Text Books/ Reference Books				
1	Chemical Project Economics, Mahajani V.V. and Mokashi SM.			
2	Plant Design and Economics for Chemical Engineers, Peters M.S., Timmerhaus K.D.			
3	Process Plant and Equipment Cost Estimation, Kharbanda O.P.			
Course Outcomes (students will be able to.....)				
1	Calculate working capital requirement for a given project			
2	Calculate cost of equipment used in a plant total project cost			

3	Calculate cashflow from a given project	
4	Select a site for the project from given alternatives	
5	List out various milestones related to project concept to commissioning	

	Course Code: PHT1063	Course Title: SPL13: Pharmaceutical Biotechnology	Credits = 3		
	Semester: VIII	Total contact hours: 45	L	T	P
List of Prerequisite Courses					
	10th std. Biology; 12th std Chemistry				
List of Courses where this course will be prerequisite					
	Process Technology and Biotechnology Laboratory				
Description of relevance of this course in the B. Tech Pharm. Program					
To familiarize students with areas of biotechnology and their application in healthcare, with techniques in biotechnology involving natural, enriched and engineered microorganisms, or their components or plant/mammalian cells for production of pharmaceutically relevant compounds of industrial importance and about the structural features and functions of immune system components and their involvement in development of immune response, the use of immunological techniques as analytical tools and the principles governing vaccination					
Sr. No.	Course Contents (Topics and subtopics)				Reqd. hours
1	Introduction to Pharmaceutical Biotechnology and its role in healthcare and diagnostics				5
2	Fermentation technology				
	Introduction to fermentation				4
	Types of fermentation, microorganisms in fermentation, strain improvement,				5
	Fermentors and types; Stages of fermentation; typical fermentation types – batch, continuous, fed-batch; factors affecting fermentation,				5
	Typical fermenter designs and explanation of design characteristics. Examples of industrial products				2
3	Enzyme fermentation and immobilization				4
4	Basics of immunology				
	Immune system, humoral and cell-mediated immunity				4
	Antibodies, antigen-antibody reactions,				4
	Active and passive immunity				3
5	Plant and animal tissue culture				4
	Techniques and applications				3
6	Pharmacogenomics				2

List of Text Books/ Reference Books		
1	Elements of biotechnology by PK Gupta, 2 Publications	
2	Kuby Immunology by Goldsby, Kindt and Osborne, 4 Freeman & Company	
3	Plant cell, Tissue and Organ culture, Gamborg O.L. and Phillips G. C. 1995, Springer Lab Manual	
4	Pharmaceutical Biotechnology, Concepts and Applications by Gary Walsh, 2007, Wiley	
5	Principles of fermentation technology, Stanbury P. F. and Whitaker A. 2 Elsevier	
Course Outcomes (students will be able to.....)		
1	Explain and utilize various concepts of biotechnology in academe and research in diagnostic, therapeutic and allied industrially relevant fields of molecular biology and biotechnology	
2	Explicate and employ various concepts of fermentation and different fermentative strategies, based on natural, enriched and engineered microorganisms, or their components as well as design a simple containment system (Bioreactor / fermentor) for producing compounds of industrial importance	
3	Explicate and exploit various components of immune system and mechanisms involved in immune system development and responsiveness as well as various immunological techniques to develop vaccines and vaccine formulations	
4	Elucidate and apply common cell culture techniques, e.g. callus culture, micropropagation, embryogenesis in plants and in mammalian cells to produce compounds of industrial, specifically therapeutic importance	
	Explain how individual genetic variations affect responses to drug and formulations to be able to develop 'personalized' medicines	

Course Code: PHT1057	Course Title: SPL14:Medicinal Chemistry III	Credits = 3		
Semester: VIII	Total contact hours: 45	L	T	P
		2	1	0
List of Prerequisite Courses				
	Organic chemistry, Pharmacology and Pathophysiology			
List of Courses where this course will be prerequisite				
	Medicinal Chemistry II			
Description of relevance of this course in the B. Tech. Pharm Program				
To acquaint students with nomenclature, classification, molecular mechanism of action, synthesis and SAR of anti-histaminic and anti-inflammatory agents and drugs acting on the cardiovascular system and hormonal system.				
Sr. No.	Course Contents (Topics and subtopics)	Reqd. hours		

1	a) Non-Steroidal Anti-inflammatory Agents: Antipyreticanalgesics, Salicylates, Aryl alkanolic acids, N-aryl anthranillic acids, Oxicams, Selective COX-2 inhibitors	5
	b) Antihistaminic agents: H ₁ antagonists- Classical antagonists & Non-sedative H ₁ antagonists	4
	c) Antiulcer agents: H ₂ antagonists, Proton Pump inhibitors, Others	3
2	Cardiovascular Drugs:	
	a) Cardiac agents:	
	• Cardiac glycosides and non-glycosides, Antianginal agents, Nitrates and nitrites, nitric oxide donors	3
	• Calcium channel blockers, Antiarrhythmic drugs: Class I to IV.	3
	b) Diuretics:	3
	Osmotic diuretics, Carbonic anhydrase inhibitors, Thiazide and thiazide like diuretics, Loop diuretics, Aldosterone antagonists, Potassium sparing diuretics	
	c) Antihypertensive agents:	3
	ACE inhibitors, Ca channels blockers, Adrenergic blockers, Vasodilators, Miscellaneous	
	d) Antihyperlipidemic agents and cholesterol reducing agents.	2
	e) Drugs affecting blood clotting -Anticoagulants: Heparin and oral, Direct thrombin inhibitors, Thrombolytics, antiplatelet drugs and Antifibrinolytic agents.	2
3	Drugs acting on hormonal systems:	
	(a) Anti- diabetic agents	3
	(b) Steroid hormones-adrenocorticoids, antiinflammatory steroids	3
	(c) Sex steroids and antagonists, oral contraceptive, anabolic steroids	4
	(d) Thyroid and anti-thyroid agents	2
4	Miscellaneous Classes of drugs:	
	(a) Drugs acting on calcium homeostatic, iron preparations	1
	(b) Introduction to biotechnology drugs	2
	(c) Newer drug targets and drugs (eg. PDE receptor based drugs)	3
List of Text Books/ Reference Books		
1	Foye's Principles Of Medicinal Chemistry W. O. Foye, Lippincott Williams & Wilkins, 6th edition, 2008.	
2	Textbook Of Medicinal And Pharmaceutical Chemistry Wilson And Gisvold, Lippincott Williams & Wilkins, Philadelphia, 11	
3	Burger's Medicinal Chemistry & Drug Discovery (Vol. 1- 6) A. Burger And M.E. Wolff; John Wiley & Sons-New Jersey, 6th edition, 2003	
4	Pharmaceutical Substances: Synthesis, Patents, Applications (N-Z) Kleemann Georg Thieme Verlag-Stuttgart. Thieme, 4th edition, 2001	
5	The Organic Chemistry of Drug Synthesis (Vol. 1-6) Daniel Lednicer John	

	Wiley & Sons INC 1999	
6	The Organic Chemistry of Drug Design And Drug Action. R. B. Silverman Elsevier Publication 2	
7	Organic Synthesis-The Disconnection Approach, S Warren, John Wiley & Sons-Chichester, 2	
Course Outcomes (students will be able to.....)		
1	Draw and understand the structures and write IUPAC names of structures (including 3D structure)	
2	Explain mechanism of action of drugs at a molecular level	
3	Understand and apply the concept of SAR	
4	Predict synthetic route for simple drugs	
	Note: The above course outcomes are with respect to anti-histaminic and anti- inflammatory agents and drugs acting on the cardiovascular system and hormonal system	

	Course Code: PHT1058	Course Title: Spl 15: Process Technology of Drugs and Intermediates	Credits = 4		
	Semester: VIII		Total contact hours: 60	L	T
			3	1	0
List of Prerequisite Courses					
	Concept of organic and physical chemistry should be clear; Concept of mass transfer and heat transfer should be clear; Elementary chemical reaction engineering and In-plant training should be completed; Concept of elementary drawing should be clear.				
List of Courses where this course will be prerequisite					
Description of relevance of this course in the B. Tech. Program					
To train the students with respect to process development, basic requirements for safe plane design and unit operations. Scale up of process.					
Sr. No.	Course Contents (Topics and subtopics)				Reqd. hours
1	Concept of fine and Bulk drugs and their salient features, Research and development strategies in pharmaceutical industries, Flow sheets – Types of flow sheets – Flow symbols Line symbols				5
2	Concept of all purpose and multipurpose plants – Plant design –Effluent treatment – Solvent recovery for fine chemicals – Bulk drugs.				5
3	Introduction, the chemical process life-cycle, Legislative requirements for safe process development and scale up				5
4	Development techniques for safe process design, Unit operations posing particular hazards during development				5

5	Strategies for chemical hazards assessment, Hazards of gas and vapor generation, Identification of highly-energetic materials, Small scale screening tests, case studies	5
6	Introduction-the purpose of chemical development, Discovering the best synthetic route; Selecting the best route for scale-up, Choice of raw materials, reagents etc case studies	5
7	The investigative approach to chemical development, Effect of process variables on yield and quality of products; Quality control in process analysis as an aid to optimization	5
8	Designing a robust process and preventing scale-up problems, Solvent effects, Work up and product isolation, Selecting the parameters to vary, Planning for scale up	5
9	Design of environmentally friendly processes, Effluent minimization and control, Statistical methods of optimizations	5

List of Text Books/ Reference Books

1	Mahmound M. "Pollution Prevention Through Process Integration (Systematic Design Tools)" Academic Press, 1997	
2	Neal G. Andreson, " Practical Process Research and Development"	
3	A. Cybulski, " Fine Chemicals Manufacture- Technology and Engineering Elsevier Publication, 2000	
4	Chemical Process Quantitative Risk Analysis" AIChE	
5	Gopal Rao, M. and Sittig, M., "Dryden's Outlines of Chemical Technology", 3 Affiliated East West Press Pvt. Ltd., 2001	
6	Austin, G.T., "Shreve's Chemical Process Industries", 5th Edition, McGraw Hill Book Company, 1984	

Course Outcomes (students will be able to.....)

1	Understand the principal of process design; presentation and selection of	
2	Exposure to impact of regulatory statutes on process	
3	Knowledge of process variables and implication in scale up	
4	Knowledge of Green chemistry, hazards, effluents and statistical methods	

CourseCode:HUT1107	Course Title: Value Education	Credits=3		
		L	T	P
Semester: VIII	Total contacthours:45	2	1	0
List of				
List of Courses where this course will be prerequisite				
Description of relevance of this course in the B.Tech. Program				
Course Contents (Topics and subtopics)				Reqd. hours
Unit –I Education and Human values				10+5
<ol style="list-style-type: none"> 1. Education: Etymology, definitions (western, Indian) 2. Relationship between education and Axiology (Ethics, Logic, aesthetics/Satyam, shivam , Sundaram) 3. Evaluation of education: Ancient Indian education :Purusharthas 				

<p>4. Concept and types of values</p> <p>5. Functions of holistic education for the development of Personal/individual growth *Social, National Global citizenship.</p>	
<p>Unit –II National and International Values for Global Development</p> <ul style="list-style-type: none"> • Importance for national integration and international understanding. • National values (constitutional Values)- Democracy, socialism ,Secularism ,Equality, Justice, Liberty, freedom and Fraternity • Constitutional provisions for values in Indian constitution –Article 14,15,16,17 & 19 • Social values- Empathy Social responsibility, self- control, Humanity university brotherhood. • Professional values- Religious Tolerance, Wisdom, character formation (Character building) • Aesthetic values- Love and appreciation of literature and fine arts and respect for the same 	10+5
<p>Unit –III Human Rights</p> <ol style="list-style-type: none"> 1. Right to information 2. Right when arrested 3. Right to compensation in accidents 4. Rights of consumers 5. Constitutional Rights of women 6. Rights of Wife and Children 7. Offenses relating to marriage 8. Women’s rights to protect from domestic violence 9. Rights against Dowry 10. Free Legal services to the poor 11. Workman’s right to compensation for accidents and Occupational Diseases 12. Working women’s right for Maternity benefits 13. Right of women against Sexual Harassment in workplaces 14. The law on rape 	10+5

Course Code: PHP1055	Course Title: Process Technology (Chemical andBiotechnology) Laboratory	Credits = 4		
		L	T	P
Semester: VIII	Total contact hours: 120	0	0	8
List of Prerequisite Courses				
General exposure to chemistry laboratory and experience handling chemicals; Background of analysis and organic reactions; Background of process modification; Microbiology and Biotechnology				
List of Courses where this course will be prerequisite				

Description of relevance of this course in the B. Tech. Program		
To train the students with respect to scale up, process development as well as to study the safe and green process		
Sr. No.	Course Contents (Topics and subtopics)	Reqd. hours
1	Synthesis of drugs involving two or more steps a) with analysis of raw materials and product synthesis b) in process control and reaction monitoring	70
2	Any innovative modifications in the process of drug synthesized (2 examples) and no repetition of the same from previous years	20
3	Scale up and Green chemistry route for synthesis (2 examples)	20
4	Bioconversions.	10
List of Text Books/ Reference Books		
1	Vogel's Text book of Practical Organic Chemistry, 5 th Edition	
2	Green methods of Preparation published by DST	
Course Outcomes (students will be able to.....)		
1	Exposure to process development	
2	Knowledge of process variables and implication in scale up	
3	Knowledge of Green chemistry, hazards, effluents and statistical methods of optimizations	

ELECTIVES

	Course Code: PHT1091	Course Title: Nanoscience and Technology	Credits = 3		
	Elective	Total contact hours: 45 hrs	L	T	P
			2	1	0
List of Prerequisite Courses					
	Pharmaceutical Formulation Technology III				
List of Courses where this course will be prerequisite					
	NIL				
Description of relevance of this course in the B. Tech (Pharma)					
To train the students with respect to basics of nanoscience and application of					
Sr. No.	Course Contents (Topics and subtopics)				Reqd. hours
1	Introduction to nanotechnology <ul style="list-style-type: none"> • Definition • Classification of nanostructures and systems • Pharmaceutical applications 				3
2	Nanoscale properties as a function of size structural properties, chemical properties, mechanical properties, thermal properties, optical properties, magnetic properties, electronic properties				5
3	Fabrication methods(general approaches) Top-down, bottom-up and templating approaches				5
4	Characterization methods Imaging(microscopy) methods, analysis(spectroscopy) methods, size measurements, zeta potential measurementsetc				5
5	Self-assembling nanostructures Principle of self assembly(non-covalent inter actions and intermolecular				2
6	Polymeric vesicular and micellar nanocarriers Preparation, properties characterization and pharmaceutical/healthcare				4
7	Nanofilms Preparation, properties characterization and pharmaceutical/healthcare				4
8	Dendrimers Preparation, properties characterization and pharmaceutical/healthcare				4
9	Colloidal lipid nanocarriers Preparation, properties characterization and pharmaceutical/healthcare				5
10	Gold and silver Nanoparticles Preparation, properties characterization and pharmaceutical/healthcare				4
11	Nanotechnology in catalysis nanostructure and catalysis - fundamental principles, examples of nanocatalyst based synthetic methodologies and applications thereof				4

List of Text Books/ Reference Books		
1	Nanoscale Science and Technology; R. Kesavallu, I. Hamley, M. Geoghegan;	
2	Nanobiotechnology (Concepts, applications and perspectives); C.M. Niemeyer and C.A. Mirkin;	
3	Nanotechnology in catalysis Vol 1 & 2, B. Zhou, S. Hermans and G.A. Somorjai;	
4	Nanoparticulate drug delivery: A Perspective on the transition from laboratory to market, Patravale V., P. Dandekar P., Jain R., 2012 , Woodhead Publishing	
5	Targeted Drug Delivery: Concepts and Design; P. Devarajan; S. Jain; 2015, Springer Publications	
6	Teacher shall prescribe some latest review articles.	
Course Outcomes (students will be able to.....)		
1	Understand basic concepts of nanotechnology	
2	Explain fabrication methodologies for polymeric, inorganic, lipidic	
3	Explain nanoscale properties and characterization thereof	
4	Justify use of nanotechnology for various applications	

Course Code: PHT1092	Course Title: Pharmaceutical Packaging Technology	Credits = 3		
		L	T	P
Elective	Total contact hours: 45 hrs	2	1	0
List of Prerequisite Courses				
Pharmaceutical Formulation Technology III				
List of Courses where this course will be prerequisite				
NIL				
Description of relevance of this course in the B. Tech (Pharma)				
To train the students with respect to basics of packaging technology				
Sr. No.	Course Contents (Topics and subtopics)	Reqd. hours		
1	Introduction to Packaging, Classification of Packaging, Essential Requirements, Functions of Packaging, Importance / significance of Pharma Packaging, Properties of Ideal Package, Packaging formats in Pharma Industry, Packaging recycling symbols, FDA Definitions, Introduction to Packaging materials, Classification of Packaging materials, Approach to package design, New Trends in the pharmaceutical packaging, Packaging Regulations And Legal Requirements	5		
2	Introduction to plastics and polymers, Raw Materials of Plastics, Types of Plastics, Resin identification code, Plastics and Packaging, testing of plastic containers	4		
3	Introduction to glass, Selection of glass as packaging materials for the pharmaceutical products , Advantages and disadvantages of glass containers , Properties of glass, Production of glass, Types of glass, Manufacturing of Glass containers, Testing of glass containers	4		

4	Introduction to metals, Aluminium and Aluminium foil , Collapsible Tubes, Tin, Stainless steel	4
5	Introduction to blister package, Blister design parameters, Materials, Formation, Types of Blisters, Advantages and disadvantages of Blister Packaging, Types of Problems/ Defects, Blister Packing Machine, Other packages, Strip Packs- High Barrier Laminates, Strip Packaging Process, Properties of Materials, Child-resistant strip package, Strip Sealing Machine, Strip Packing Machinery, Multi-Dose Strip Packaging	4
6	Introduction to Ancillary Materials used in Packaging, Adhesives , Paper , Paperboard, Wood, fibreboard , Packaging inserts , leaflets	4
7	Introduction to natural and synthetic rubber, Types of closures, Classification of contemporary closures by their utility, Special-purpose Closure, Closure Functions, Closure Materials, Types of Plastic Closures, Sealing Systems, Liners, Closure Liner Functions, Classification of Liners, Selection of Lining Material, Options for Closure Liners, Innerseals, Linerless Closures, Types of tapes, Strapping Materials, Evaluating Closure Liners, Standard Liners, Topical Solutions, Liner Description	4
8	Introduction, Components of Corrugated fibre board, Types of Corrugated Board, Advantages & Disadvantages, Manufacturing, Box Structure, Box Dimensions, Types of Box, Applications of C.F.B., New developments in CFB	4
9	Sterilization of packaging materials Introduction, Pharmaceutical Importance of Sterilization, Physical and Chemical Factors that affect sterilization, Terms commonly used, Classification of Sterilization Methods, Sterilization of Packaging Materials, Tests for Sterility , Incubation and examination of sterility tests, Interpretation of the test results, Evaluation of Sterilization Method, Process of Microbial Destruction, Evaluation and In Process Monitoring of Sterilization Procedures	4
10	Packaging of Parenterals, Ophthalmics, And Aerosols Introduction, Packaging of Sterile Pharmaceuticals, Packaging Components, Inspection of Filled Injectable Products, Storage and Labelling, Packaging of Ophthalmics, Selection of Packaging Materials, Packaging of Aerosols	4
11	Testing of packaging material <ul style="list-style-type: none"> • Defects In Packages: Introduction, Defects in Packaging Material • Package Testing And Testing of Containers & Closures: Introduction, Testing of containers and closures • Stability of Packages: Introduction, Legislation, Regulation, Pharmaceutical Stability Testing in Climatic Cabinets, Pharmaceutical Stability Testing Conditions, Photo-Stability Testing, Review of Pharmaceutical Product Stability, Packaging and the ICH Guidelines 	4
List of Text Books/ Reference Books		
1	D. A. Dean, Roy Evans, Ian Hall. Pharmaceutical packaging technology. Tylor and Francis.	
2	Edward J. Bauer, Pharmaceutical Packaging Handbook. Bausch and Lomb, Rochester, New York, USA.	
3	Wilmer A. Jenkins, Kenton R. Osborn. Packaging drugs and pharmaceuticals.	
4	Salvatore J. Turco, Sterile dosage forms: their preparation and clinical application	
5	Remington: The Science and Practice of Pharmacy.	
6	Michael E. Aulton, Kevin Tylor (Ed.). Aulton's Pharmaceutics: The design and Manufacture of Medicine.	
7	Gilbert Banker and Christopher Rhodes. Modern Pharmaceutics.	
8	Leon Lachman; Lieberman Herbert A.; Kanig, Joseph L. The theory and Practice of Industrial Pharmacy.	

Course Outcomes (students will be able to.....)		
1	Classify packaging materials and describe FDA regulations, properties of	
2	Explain primary packaging materials, containers and closures and their	
3	Explain secondary packaging materials and their testing	
4	Describe ancillary materials, unit dose and multi dose packing, Packaging of Parenterals, Ophthalmics, and Aerosols	

	Course Code: PHT1093	Course Title: Structural Analysis by Spectroscopy	Credits =		
			L	T	P
	Semester: VI	Total contact hours: 45	2	1	0
List of Prerequisite Courses					
	Basic knowledge of absorption spectroscopy; Mass spectroscopy; Under gone courses in instrumental methods of analysis				
List of Courses where this course will be prerequisite					
Description of relevance of this course in the B. Tech. Program					
To train the students in the analytical methods like NMR, IR, UV					
Sr. No.	Course Contents (Topics and subtopics)				Reqd. hours
1	UV-VIS spectroscopy and identification of chromophore				5
2	IR spectroscopy - correlation of absorption frequencies and functional groups. General analysis of IR spectrum				5
3	Proton NMR spectroscopy correlation of chemical shift of a proton with respect to structure. H-H Coupling and J values, On the basis of chemical shift, coupling constants, IR and UV information elucidation of structure of simple molecules				5
4	Mass spectroscopy, fragmentation, isotope mass				5
5	Problem solving using the above spectroscopy				5
6	¹³ C-NMR, Chemical Shift correlation, C-H coupling, NOE, DEPT, other techniques to identify p,s,t, and quaternary carbon				5
7	Problem solving using all the spectroscopies studied above				5
8	Multidimensional NMR COSEY, NOSEY, and other and structure information generation. With illustrative examples; P, N, and F NMR introduction				5
9	Problem solving				5
List of Text Books/ Reference Books					
1	Application of absorption spectroscopy of organic Compounds, John R. Dyer, Prentice Hall, India 1987.				
2	Application of absorption spectroscopy of organic Compounds, John R. Dyer, Prentice Hall, India 1987.				
3	Organic Spectroscopy, W. Kemp, 3				
4	Spectroscopic Identification of Organic Compounds by R.M. Silverstein, G.C. Bassler, Morill T.C.; John Wiley and Sons 1991.				

5	There are many Websites where structural problem are discussed. Teacher to identify time to time and guide the students	
Course Outcomes (students will be able to.....)		
1	Refreshing basic principles of absorption spectroscopy to equip you for	
2	Capability to interpret UV and IR spectra for identification of functional	
3	Identification of proton location at various chemical environments, origin of coupling and coupling constants. Application in structural elucidation, exposure to concept of multidimensional NMR and its value in structure analysis	
4	Underlying principle of mass spectroscopy, fragmentation pattern and combining fragments to arrive at the structure	
5	Structural elucidation skills by combining information from different	

	Course Code: PHT1094	Course Title: Regulatory Requirements for Pharmaceuticals	Credits = 3		
	Semester:	Total contact hours: 45 Hrs	L	T	P
			2	1	0
List of Prerequisite Courses					
	Pharmaceutical Formulation Technology III				
List of Courses where this course will be prerequisite					
	NIL				
Description of relevance of this course in the B. Tech (Pharma)					
To train the students with respect to basics of regulatory requirements of pharmaceuticals					
Sr. No.	Course Contents (Topics and subtopics)				Reqd. hours
1	Schedule governing pharmaceutical product development (e.g. Schedule M , Schedule Y)				3
2	ICH guidelines Q8(R2), Q9, Q10, Q11 and Q12				5
3	Documentation for pharmaceuticals				3
4	Introduction to regulatory aspects of pharmaceuticals <ul style="list-style-type: none"> • Introduction to Regulatory aspects of pharmaceuticals, need, advantages and limitation • Introduction to major regulatory bodies worldwide • Rationale for regulatory harmonization and introduction of ICH • Introduction to CTD Modules 				5
5	Drug Master file (DMF)				2
6	Regulatory procedure for pharmaceutical product market approval as per USFDA guidelines: Investigational New Drug Application (IND)- filing, review, approval process and representative case studies				3
7	Regulatory procedure for pharmaceutical product market approval as per USFDA guidelines: New Drug Application (NDA) [505(b) (1) and (b) (2)]- filing, review, approval process and representative case studies				4

8	Regulatory procedure for pharmaceutical product market approval as per USFDA guidelines: Abbreviated New Drug Application (ANDA) 505 (j)- filing, review, approval process and representative case studies	5
9	Regulatory procedure for pharmaceutical product market approval as per USFDA guidelines: New Animal Drug Application (NADA)- filing, review, approval process and representative case studies	2
10	Regulatory procedure for pharmaceutical product market approval as per USFDA guidelines: Abbreviated New Animal Drug Application (ANADA)- filing, review, approval process and representative case studies	2
11	Regulatory procedure for pharmaceutical product market approval as per USFDA guidelines: Biological License Application (BLA)- filing, review, approval process and representative case studies	2
12	Comparison of Indian, European and rest of the world Regulatory procedure for pharmaceutical product market approval in comparison to USFDA guidelines	4
13	Legal acts <ul style="list-style-type: none"> • DPCO • Drugs and cosmetics act • Rules including licensing intermediates industry 	5
List of Text Books/ Reference Books		
1	Beotra's Law of Drugs Medicines and Cosmetics K. K. Singh, L. R. Bugga for the Law Book Co. Pvt. Ltd. Allahabad	
2	Modern Pharmaceutics, G. S. Banker, New York, Marcel Dekker 1990	
3	Fundamentals of Pharmacy, Blome H. E., Philadelphia, Fea and Febiger, 1985	
4	Pharmaceutical Production Facilities: Design and Applications, G. C. Cole, New York Ellis Horwood 1990	
5	Drug Delivery Devices: Fundamentals and Applications Tyle, New York, Marcel Dekker 1988	
6	Microbial Quality Assurance in Pharmaceuticals Cosmetics and Toiletries, S. F. Bloomfield, Chichester, Ellis, Horwood, 1998.	
7	Encyclopedia of Pharmaceutical Technology, J. Swarbrick, New York, Marcel Dekker, 1993	
8	Remington's Pharmaceutical Sciences, A. R. Gennaro Mac Pub. Co. Easton, Pennsylvania 1990	
9	Pharmaceutical Product Development: Insights into Pharmaceutical Processes, Management and Regulatory Affairs, Patravale V, Rustomjee M, Dsouza J. 2016, CRC press	
10	Indian Pharmacopoeia, British Pharmacopoeia, United States Pharmacopoeia.	
11	Oral Mucosal Drug Delivery, Rathbone, New York, Marcel Dekker, 1996	
12	Good Laboratory Practice Regulations A. F. Hirsch, New York, Marcel Dekker, 1989	
13	Good Laboratory Practice Regulations Weinberg New York, Marcel	

	Dekker, 1995	
Course Outcomes (students will be able to.....)		
1	Explain the regulatory pathways for new drug application and generic product development	
2	Explain Drugs and Cosmetics act, Drug price control order and regulations therein	

	Course Code: PHT1095	Course Title: Intellectual Property Rights	Credits = 3		
	Semester:	Total contact hours: 45 Hrs	L	T	P
			2	1	0
List of Prerequisite Courses					
	NIL				
List of Courses where this course will be prerequisite					
	NIL				
Description of relevance of this course in the B. Tech (Pharma)					
To train the students with respect to basics of Intellectual Property Rights					
Sr. No.	Course Contents (Topics and subtopics)				Reqd. hours
1	Introduction to Intellectual Property: overview describing definition, need and evolution				2
2	IPR related laws: Biodiversity				2
3	Introduction to WIPO and Treaties under WIPO				6
4	Type of Intellectual Property: Copyright Introduction, Process of filing, rights achieved				4
5	Type of Intellectual Property: Trademarks Introduction, Process of filing, rights achieved				4
6	Type of Intellectual Property: Geographical Indication Introduction, Process of filing, rights achieved				3
7	Type of Intellectual Property: Industrial design Introduction, Process of filing, rights achieved				3
8	Type of Intellectual Property: Trade secret Introduction, Process of filing, rights achieved				3
9	Type of Intellectual Property: patent Introduction Patent and traditional knowledge Indian patent Act Process of filing Rights achieved				6
10	Patentability w.r.t. regional requirements				2
11	Patent filing under Paris Convention Treaty (PCT)				5
12	Role of IPR in Pharmaceuticals				5
List of Text Books/ Reference Books					
1	All documentation from World Intellectual Property Organization (www.wipo.int)				

2	Indian Patent Act (www. ipindia.nic.in)	
3	Pharmaceutical Product Development: Insights into Pharmaceutical Processes, Management and Regulatory Affairs, Patravale V, Rustomjee M, Dsouza J. 2016, CRC press	
Course Outcomes (students will be able to.....)		
1	Explain various types of Intellectual Property Rights	
2	Explain importance of Intellectual Property Rights in relevance to Pharmaceuticals	

	Course Code: PHT1096	Course Title: Cosmetic Delivery Systems	Credits = 3		
			L	T	P
	Semester:	Total contact hours: 45 Hrs	2	1	0
List of Prerequisite Courses					
	NIL				
List of Courses where this course will be prerequisite					
	NIL				
Description of relevance of this course in the B. Tech (Pharma)					
To train the students with respect to basics and advances of cosmetic delivery systems					
Sr. No.	Course Contents (Topics and subtopics)				Reqd. hours
1	Introduction to cosmetic delivery systems and cosmeceuticals and basic consideration: <ul style="list-style-type: none"> • Definition of cosmeceuticals • Advantages • Market overview • Current trends in cosmeceuticals w.r.t. nanotechnology and delivery platforms 				5
2	Vesicular Delivery systems (Introduction, Formulation, applications and advances): <ul style="list-style-type: none"> • Liposomes • Transferosomes • Niosomes • Phytosomes • Miscellaneous vesicular systems 				8
3	Particulate Systems (Introduction, Formulation, applications and advances): <ul style="list-style-type: none"> • Porous polymeric systems • Polymeric micro/ nanoparticulate systems 				8
4	Emulsion Delivery Systems (Introduction, Formulation, applications and advances): <ul style="list-style-type: none"> • Colloidal delivery systems • Micro/nano and multiple emulsions • Liquid crystals 				8

5	Other Delivery systems (Introduction, Formulation, applications and advances): <ul style="list-style-type: none"> • Cyclodextrin complexes • Carbosomes • Dendrimers • Nano Crystals 	8
6	Delivery Devices (Introduction, Formulation, applications and advances): <ul style="list-style-type: none"> • Iontophoresis • Microneedles • Cosmetic patches 	8
List of Text Books/ Reference Books		
1	Recent research and review articles from literature	
2	Advances in dermatological Sciences, 2013, R. P. Chilcott, Keith R. Brain, Royal Society of Chemistry	
3	Harry's Cosmeticology, Rieger 8 th edition, 2000, Leonard Hill Book &Intertext Publisher, London	
Course Outcomes (students will be able to.....)		
1	Explain concept of cosmetic delivery systems and cosmeceuticals	
2	Explain recent advances in cosmeceuticals	