II Year I Semester

S.No.	Category	Title	L	T	P	Credits
1	BS	Mathematics – III (Biostatistics)	3	0	0	3
2	HSMC	Universal human values – understanding harmony and Ethical human conduct	2	1	0	3
3	Engineering Science	Engineering Mechanics	3	0	0	3
4	Professional Core	Pharmaceutical Engineering– I	3	0	0	3
5	Professional Core	Thermodynamics for pharmaceutical engineers	3	0	0	3
6	Professional Core	Engineering Mechanics Lab	0	0	3	1.5
7	Professional Core	Pharmaceutical Engineering – I lab	0	0	3	1.5
8	Skill Enhancement Course	Soft skills	0	1	2	2
9	Audit Course	Environmental Science	2	0	0	-
Total			**15**	**2**	**10**	**20**

II Year II Semester

S.No.	Category	Title	L	T	P	Credits
1	Management Course- I	Managerial Economics and Financial Analysis	2	0	0	2
2	Engineering Science/ Basic Science	Reaction Engineering for Pharmaceutical Engineers	3	0	0	3
3	Professional Core	Heat Transfer for Pharmaceutical Engineers	3	0	0	3
4	Professional Core	Physical Pharmaceutics	3	0	0	3
5	Professional Core	Principles of Microbiology and Biochemistry	3	0	0	3
6	Professional Core	Physical Pharmaceutics Lab	0	0	3	1.5
7	Professional Core	Microbiology and Biochemistry lab	0	0	3	1.5
8	Skill Enhancement course	Organisational Behaviour	0	1	2	2
9	Engineering Science	Design Thinking & Innovation	1	0	2	2
Total			**15**	**1**	**10**	**21**
Mandatory Community Service Project Internship of 08weeks duration during summer Vacation						

II Year – I Semester

MATHEMATICS – III (BIOSTATISTICS)

L	T	P	C
3	0	0	3

PRE-REQUISITE: Biostatistics

COURSE OBJECTIVES: Upon completion of the course the student shall be able to
- Know the operation of M.S.Excel, R,DoE (Design of Experiment)
- Know the various statistical techniques to solve statistical problems
- Appreciate statistical techniques in solving the problems**.**

COUSRE OUTCOMES:
- Understand basic statistical concepts and their applications in biology and related fields.
- Apply descriptive statistics techniques to summarize and visualize data sets.
- Interpret and critically evaluate statistical analyses in research literature and experimental studies.
- Perform hypothesis testing and assess statistical significance in biological research.
- Use appropriate statistical software to analyze biological data and generate reports.
- Communicate statistical findings effectively to both technical and non-technical audiences.

COURSE CONTENT:

UNIT-I   **10 Hrs**

Introduction: Statistics, Biostatistics, Frequency distribution

Measures of central tendency: Mean, Median, Mode- Pharmaceutical examples **Measures of dispersion**: Dispersion, Range, standard deviation, Pharmaceutical problems

Correlation: Definition, Karl Pearson's coefficient of correlation, Multiple correlation - Pharmaceuticals examples

UNIT-II   **12 Hrs**

Regression: Curve fitting by the method of least squares, fitting the lines $y = a + bx$ and $x = a + by$, Multiple regression, standard error of regression– Pharmaceutical Examples

Probability: Definition of probability, Binomial distribution, Normal distribution, Poisson's distribution, properties - problems

Sample, Population, large sample, small sample, Null hypothesis, alternative hypothesis, sampling, essence of sampling, types of sampling, type-I, type - II errors, Standard error of mean (SEM) - Pharmaceutical examples

Parametric test: t-test (Sample, Pooled or Unpaired and Paired), ANOVA, (One way and Two way), Least Significance difference

UNIT-III   **8 Hrs**

Non Parametric tests: Wilcoxon Rank Sum Test, Mann-Whitney U test, Kruskal-Wallis test, Friedman Test

Graphs: Histogram, Pie Chart, Cubic Graph, response surface plot, Counter Plotgraph.

UNIT-IV   **10 Hrs**

Blocking and confounding system for Two-level factorials

Regression modeling: Hypothesis testing in Simple and Multiple regression models

Introduction to Practical components of Industrial and Clinical Trials Problems: Statistical Analysis Using Excel, SPSS, MINITAB®, DESIGN OF EXPERIMENTS, R - Online Statistical Software's to Industrial and Clinical trial approach.

UNIT-V   **6 Hrs**

Design and Analysis of experiments:

Factorial Design: Definition, 2^2, 2^3 design. Advantage of factorial design **Response Surface methodology**: Central composite design, Historical design, Design Optimization Techniques

Textbooks:

1. Introduction to Biostatistics and Research Methods, 5th edition by P.S.S. Sundhar Rao and J. Richard, PHI publishers.
2. Fundamentals of Biostatistics, Khan and Khanum, Ukaaz publications, Hyderabad.

Recommended Books :

1. Pharmaceutical statistics- Practical and clinical applications, 5th edition, Sanford Bolton, Publisher Marcel Dekker Inc.New York.
2. Fundamental of Statistics – Himalaya Publishing House, 7th edition, S.C.Guptha.
3. Design and Analysis of Experiments –PHI Learning Private, Eastern economy edition, Limited, R. Pannerselvam.
4. Design and Analysis of Experiments– Wiley, 10th edition, Douglas C.Montgomery.

II Year – I Semester

L	T	P	C
2	1	0	3

UNIVERSAL HUMAN VALUES – UNDERSTANDING HARMONY AND ETHICAL HUMAN CONDUCT

Course Objectives:
- To help the students appreciate the essential complementary between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity which are the core aspirations of all human beings.
- To facilitate the development of a Holistic perspective among students towards life and profession as well as towards happiness and prosperity based on a correct understanding of the Human reality and the rest of existence. Such holistic perspective forms the basis of Universal Human Values and movement towards value-based living in a natural way.
- To highlight plausible implications of such a Holistic understanding in terms of ethical human conduct, trustful and mutually fulfilling human behaviour and mutually enriching interaction with Nature.

Course Outcomes:
- Define the terms like Natural Acceptance, Happiness and Prosperity (L1, L2)
- Identify one's self, and one's surroundings (family, society nature) (L1, L2)
- Apply what they have learnt to their own self in different day-to-day settings in real life (L3)
- Relate human values with human relationship and human society. (L4)
- Justify the need for universal human values and harmonious existence (L5)
- Develop as socially and ecologically responsible engineers (L3, L6)

Course Topics

The course has 28 lectures and 14 tutorials in 5 modules. The lectures and tutorials are of 1-hour duration. Tutorial sessions are to be used to explore and practice what has been proposed during the lecture sessions.

The Teacher's Manual provides the outline for lectures as well as practice sessions. The teacher is expected to present the issues to be discussed as propositions and encourage the students to have a dialogue.

UNIT I   Introduction to Value Education (6 lectures and 3 tutorials for practice session)
Lecture 1: Right Understanding, Relationship and Physical Facility (Holistic Development and the Role of Education)
Lecture 2: Understanding Value Education
Tutorial 1: Practice Session PS1 Sharing about Oneself
Lecture 3: self-exploration as the Process for Value Education
Lecture4: Continuous Happiness and Prosperity – the Basic Human Aspirations
Tutorial 2: Practice Session PS2 Exploring Human Consciousness
Lecture 5: Happiness and Prosperity – Current Scenario
Lecture 6: Method to Fulfill the Basic Human Aspirations
Tutorial 3: Practice Session PS3 Exploring Natural Acceptance

UNIT II   Harmony in the Human Being (6 lectures and 3 tutorials for practice session)
Lecture 7: Understanding Human being as the Co-existence of the self and the body.
Lecture 8: Distinguishing between the Needs of the self and the body
Tutorial 4: Practice Session PS4 Exploring the difference of Needs of self and body.
Lecture 9: The body as an Instrument of the self
Lecture 10: Understanding Harmony in the self
Tutorial 5: Practice Session PS5 Exploring Sources of Imagination in the self
Lecture 11: Harmony of the self with the body
Lecture 12: Programme to ensure self-regulation and Health
Tutorial 6: Practice Session PS6 Exploring Harmony of self with the body

UNIT III   Harmony in the Family and Society (6 lectures and 3 tutorials for practice session)
Lecture 13: Harmony in the Family – the Basic Unit of Human Interaction
Lecture 14: 'Trust' – the Foundational Value in Relationship
Tutorial 7: Practice Session PS7 Exploring the Feeling of Trust
Lecture 15: 'Respect' – as the Right Evaluation
Tutorial 8: Practice Session PS8 Exploring the Feeling of Respect
Lecture 16: Other Feelings, Justice in Human-to-Human Relationship
Lecture 17: Understanding Harmony in the Society
Lecture 18: Vision for the Universal Human Order
Tutorial 9: Practice Session PS9 Exploring Systems to fulfil Human Goal

UNIT IV   Harmony in the Nature/Existence (4 lectures and 2 tutorials for practice session)
Lecture 19: Understanding Harmony in the Nature
Lecture 20: Interconnectedness, self-regulation and Mutual Fulfilment among the Four Orders of Nature
Tutorial 10: Practice Session PS10 Exploring the Four Orders of Nature
Lecture 21: Realizing Existence as Co-existence at All Levels
Lecture 22: The Holistic Perception of Harmony in Existence
Tutorial 11: Practice Session PS11 Exploring Co-existence in Existence.

UNIT V   Implications of the Holistic Understanding – a Look at Professional Ethics (6 lectures and 3 tutorials for practice session)
Lecture 23: Natural Acceptance of Human Values
Lecture 24: Definitiveness of (Ethical) Human Conduct
Tutorial 12: Practice Session PS12 Exploring Ethical Human Conduct
Lecture 25: A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order
Lecture 26: Competence in Professional Ethics
Tutorial 13: Practice Session PS13 Exploring Humanistic Models in Education
Lecture 27: Holistic Technologies, Production Systems and Management Models-Typical Case Studies
Lecture 28: Strategies for Transition towards Value-based Life and Profession

Tutorial 14: Practice Session PS14 Exploring Steps of Transition towards Universal Human Order

Practice Sessions for UNIT I – Introduction to Value Education
PS1 Sharing about Oneself
PS2 Exploring Human Consciousness
PS3 Exploring Natural Acceptance

Practice Sessions for UNIT II – Harmony in the Human Being
PS4 Exploring the difference of Needs of self and body
PS5 Exploring Sources of Imagination in the self
PS6 Exploring Harmony of self with the body

Practice Sessions for UNIT III – Harmony in the Family and Society
PS7 Exploring the Feeling of Trust
PS8 Exploring the Feeling of Respect
PS9 Exploring Systems to fulfil Human Goal

Practice Sessions for UNIT IV – Harmony in the Nature (Existence)
PS10 Exploring the Four Orders of Nature
PS11 Exploring Co-existence in Existence

Practice Sessions for UNIT V – Implications of the Holistic Understanding – a Look at Professional Ethics
PS12 Exploring Ethical Human Conduct
PS13 Exploring Humanistic Models in Education
PS14 Exploring Steps of Transition towards Universal Human Order

READINGS:
Textbook and Teachers Manual
a. The Textbook
R R Gaur, R Asthana, G P Bagaria, *A Foundation Course in Human Values and Professional Ethics*, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-47-1
b. The Teacher's Manual
R R Gaur, R Asthana, G P Bagaria,*Teachers' Manual for A Foundation Course in Human Values and Professional Ethics,* 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-53-2

Reference Books
1. *JeevanVidya: EkParichaya,* A Nagaraj, JeevanVidyaPrakashan, Amarkantak, 1999.
2. *Human Values*, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3. *The Story of Stuff* (Book).
4. *The Story of My Experiments with Truth* - by Mohandas Karamchand Gandhi
5. *Small is Beautiful* - E. F Schumacher.
6. *Slow is Beautifu*l - Cecile Andrews
7. *Economy of Permanence* - J C Kumarappa
8. *Bharat Mein Angreji Raj* – PanditSunderlal

9. *Rediscovering India* - by Dharampal
10. *Hind Swaraj or Indian Home Rule* - by Mohandas K. Gandhi
11. *India Wins Freedom* - Maulana Abdul Kalam Azad
12. *Vivekananda* - Romain Rolland (English)
13. *Gandhi* - Romain Rolland (English)

Mode of Conduct:

Lecture hours are to be used for interactive discussion, placing the proposals about the topics at hand and motivating students to reflect, explore and verify them.

Tutorial hours are to be used for practice sessions.

While analyzing and discussing the topic, the faculty mentor's role is in pointing to essential elements to help in sorting them out from the surface elements. In other words, help the students explore the important or critical elements.

In the discussions, particularly during practice sessions (tutorials), the mentor encourages the student to connect with one's own self and do self-observation, self-reflection and self-exploration.

Scenarios may be used to initiate discussion. The student is encouraged to take up "ordinary" situations rather than" extra-ordinary" situations. Such observations and their analyses are shared and discussed with other students and faculty mentor, in a group sitting.

Tutorials (experiments or practical) are important for the course. The difference is that the laboratory is everyday life, and practical are how you behave and work in real life. Depending on the nature of topics, worksheets, home assignment and/or activity are included. The practice sessions (tutorials) would also provide support to a student in performing actions commensurate to his/her beliefs. It is intended that this would lead to development of commitment, namely behaving and working based on basic human values.

It is recommended that this content be placed before the student as it is, in the form of a basic foundation course, without including anything else or excluding any part of this content. Additional content may be offered in separate, higher courses. This course is to be taught by faculty from every teaching department, not exclusively by any one department.

Teacher preparation with a minimum exposure to at least one 8-day Faculty Development Program on Universal Human Values is deemed essential.

Online Resources:

1. https://fdp-si.aicte-india.org/UHV-II%20Class%20Notes%20&%20Handouts/UHV%20Handout%201-Introduction%20to%20Value%20Education.pdf
2. https://fdp-si.aicte-india.org/UHV-II%20Class%20Notes%20&%20Handouts/UHV%20Handout%202-Harmony%20in%20the%20Human%20Being.pdf
3. https://fdp-si.aicte-india.org/UHV-II%20Class%20Notes%20&%20Handouts/UHV%20Handout%203-Harmony%20in%20the%20Family.pdf
4. https://fdp-si.aicte-india.org/UHV%201%20Teaching%20Material/D3-S2%20Respect%20July%202023.pdf

5. https://fdp-si.aicte-india.org/UHV-II%20Class%20Notes%20&%20Handouts/UHV%20Handout%205-Harmony%20in%20the%20Nature%20and%20Existence.pdf

6. https://fdp-si.aicte-india.org/download/FDPTeachingMaterial/3-days%20FDP-SI%20UHV%20Teaching%20Material/Day%203%20Handouts/UHV%203D%20D3-S2A%20Und%20Nature-Existence.pdf

7. https://fdp-si.aicte-india.org/UHV%20II%20Teaching%20Material/UHV%20II%20Lecture%2023-25%20Ethics%20v1.pdf

8. https://www.studocu.com/in/document/kiet-group-of-institutions/universal-human-values/chapter-5-holistic-understanding-of-harmony-on-professional-ethics/62490385

9. https://onlinecourses.swayam2.ac.in/aic22_ge23/preview

II Year – I Semester

L	T	P	C
3	0	0	3

ENGINEERING MECHANICS

PRE-REQUISITES: Engineering mechanics and mathematics

Course Objectives:

- To get familiarized with different types of force systems.
- To draw accurate free body diagrams representing forces and moments acting on a body to analyze the equilibrium of system of forces.
- To teach the basic principles of center of gravity, centroid and moment of inertia and determine them for different simple and composite bodies.
- To apply the Work-Energy method to particle motion.
- To understand the kinematics and kinetics of translational and rotational motion of rigid bodies.

Course Outcomes:

On Completion of the course, the student should be able to

CO1: Understand the fundamental concepts in mechanics and determine the frictional forces for bodies in contact.

CO2: Analyze different force systems such as concurrent, coplanar and spatial systems and calculate their resultant forces and moments.

CO3: Calculate the centroids, center of gravity and moment of inertia of different geometrical shapes.

CO4: Apply the principles of work-energy and impulse-momentum to solve the problems of rectilinear and curvilinear motion of a particle.

CO5: Solve the problems involving the translational and rotational motion of rigid bodies.

UNIT I

Introduction to Engineering Mechanics Basic Concepts. Scope and Applications

Systems of Forces: Coplanar Concurrent Forces Components in Space Resultant Moment of Force and its Application Couples and Resultant of Force Systems. Friction: Introduction, limiting dryfriction, coefficient of friction, Cone of Static friction.

UNIT II

Equilibrium of Systems of Forces:

Equilibrium of Coplanar Systems, Graphical method for the equilibrium, Triangle law of forces, converse of the law of polygon of forces condition of equilibrium, Equations of Equilibrium for Spatial System of forces, Numerical examples on spatial system of forces using vector approach, Analysis of plane trusses. Principle of virtual work with simple examples

UNIT III

Centroid: Centroids of simple figures (from basic principles) Centroids of Composite Figures. Centre of Gravity: Centre of gravity of simple body (from basic principles), Centre of gravity of composite bodies, Pappus theorems.

Area Moments of Inertia: Definition Polar Moment of Inertia, Transfer Theorem, Moments of Inertia of Composite Figures, Products of Inertia, Transfer Formula for Product of Inertia.

Mass Moment of Inertia: Moment of Inertia of Masses, Transfer Formula for Mass Moments of Inertia, Mass Moment of Inertia of composite bodies.

UNIT IV
Rectilinear and Curvilinear motion of a particle: Kinematics and Kinetics Principle - Work Energy method and applications to particle motion-Impulse Momentum method.

UNIT V
Rigid body Motion: Kinematics and Kinetics of translation, Rotation about fixed axis and plane motion, Work Energy method and Impulse Momentum method.

Textbooks:
1. Engineering Mechanics, S. Timoshenko, D. H. Young, J.V. Rao, S. Pati., , McGraw Hill Education 2017. 5th Edition.
2. Engineering Mechanics, P.C.Dumir- S.Sengupta and Srinivas V veeravalli , University press. 2020. First Edition.
3. A Textbook of Engineering Mechanics, S.S Bhavikatti. New age international publications 2018. 4th Edition.

Reference Books:
1. Engineering Mechanics, Statics and Dynamics, Rogers and M A. Nelson., McGraw Hill Education. 2017. First Edition.
2. Engineering Mechanics, Statics and Dynamics, I.H. Shames., PHI, 2002. 4th Edition.
3. Engineering Mechanics, Volume-I: Statics, Volume-II: Dynamics, J. L. Meriam and L. G. Kraige., John Wiley, 2008. 6th Edition.
4. Introduction to Statics and Dynamics, BasudevBattachatia, Oxford University Press, 2014. Second Edition
5. Engineering Mechanics: Statics and Dynamics, Hibbeler R.C., Pearson Education, Inc., New Delhi, 2022, 14th Edition

II Year – I Semester

PHARMACEUTICAL ENGINEERING - I

L	T	P	C
3	0	0	3

PRE-REQUISITE: Pharmaceutical Engineering

COURSE OUTCOMES:

- To understand the principles of fluid flow, including types of manometers, Reynolds number, Bernoulli's theorem, flow measurement devices and distillation procedures.
- To understand the objectives and mechanisms of size reduction and size separation processes, including the operation and applications of various mills, sieves, and size separation equipment.
- To gain knowledge of drying principles and equipment, as well as mixing techniques for solid, liquid, and semisolid materials.
- To understand the principles and applications of filtration and centrifugation processes, and various filtration and centrifugation equipment.
- The materials used in pharmaceutical plant construction, including their properties and corrosion prevention techniques, ensuring the selection of appropriate materials for pharmaceutical applications.

COURSE OBJECTIVES: Upon completion of the course student shall be able:

1. To know various unit operations used in Pharmaceutical industries.
2. To understand the material handling techniques.
3. To perform various processes involved in pharmaceutical manufacturing process.
4. To carry out various tests to prevent environmental pollution.
5. To appreciate and comprehend significance of plant lay out design for optimum use of resources.
6. To appreciate the various preventive methods used for corrosion control in Pharmaceutical industries.

COURSE CONTENT:

UNIT-I 8 Hrs

Flow of fluids: Types of manometers, Reynolds number and its significance, Bernoulli's theorem and its applications, Energy losses, Orifice meter, Venturimeter, Pitot tube and Rotometer.

Distillation: Basic Principles and methodology of simple distillation, flash distillation, fractional distillation, distillation under reduced pressure, steam distillation & molecular distillation.

UNIT-II 10 Hrs

Size Reduction: Objectives, Mechanisms & Laws governing size reduction, factors affecting size reduction, principles, construction, working, uses, merits and demerits of Hammer mill, ball mill, fluid energy mill, Edge runner mill & end runner mill.

Size Separation: Objectives, applications & mechanism of size separation, official standards of powders, sieves, size separation Principles, construction, working, uses, merits and demerits of Sieve shaker, cyclone separator, Air separator, Bag filter & elutriation tank.

UNIT- III 10 Hrs

Drying: Objectives, applications & mechanism of drying process, measurements & applications of Equilibrium Moisture content, rate of drying curve. principles, construction, working, uses, merits and demerits of Tray dryer, drum dryer, spray dryer, fluidized bed dryer, vacuum dryer, freeze dryer.

Mixing: Objectives, applications & factors affecting mixing, Difference between solid and liquid mixing, mechanism of solid mixing, liquids mixing and semisolids mixing. Principles, Construction, Working, uses, Merits and Demerits of Double cone blender, twin shell blender, ribbon blender, Sigma blade mixer, planetary mixers, Propellers, Turbines, Paddles& Silverson Emulsifier.

UNIT-IV   **10 Hrs**

Filtration: Objectives, applications, Theories & Factors influencing filtration, filter aids, filter medias. Principle, Construction, Working, Uses, Merits and demerits of plate & frame filter, filter leaf, rotary drum filter, Meta filter & Cartridge filter, membrane filters and Seidtz filter.

Centrifugation: Objectives, principle & applications of Centrifugation, principles, construction, working, uses, merits and demerits of Perforated basket centrifuge, Non-perforated basket centrifuge, semi continuous centrifuge & super centrifuge.

UNIT- V   **8 Hrs**

Materials of pharmaceutical plant construction, Corrosion and its prevention: Factors affecting during materials selected for Pharmaceutical plant construction, Theories of corrosion, types of corrosion and their prevention. Ferrous and nonferrous metals, inorganic and organic non metals, basic of material handling systems.

Recommended Books:
1. Introduction to chemical engineering – Walter L Badger & Julius Banchero, Latest edition.
2. Solid phase extraction, Principles, techniques and applications by Nigel J.K. Simpson-Latest edition.
3. Unit operation of chemical engineering – Mcabe Smith, Latest edition.
4. Pharmaceutical engineering principles and practices – C.V.S Subrahmanyam et al., Latest edition.
5. Remington practice of pharmacy- Martin, Latest edition.
6. Theory and practice of industrial pharmacy by Lachmann., Latest edition.
7. Physical pharmaceutics- C.V.S Subrahmanyam et al., Latest edition.
8. Cooper and Gunn's Tutorial pharmacy, S.J. Carter, Latest edition.

II Year – I Semester

L	T	P	C
3	0	0	3

THERMODYNAMICS FOR PHARMACEUTICAL ENGINEERS

PRE-REQUISITES: Material and Energy Balance Computations.
COURSE OBJECTIVES:
To study the basic concepts of laws of thermodynamics, thermodynamic properties and phase and chemical equilibrium.
COURSE OUTCOMES:
The student will be able

1. Describe laws of thermodynamics and their applications.
2. Evaluate different types of property including entropy and its calculation.
3. Evaluate the thermodynamic properties of ideal and non-ideal solutions.
4. Analyze the procedures for estimating the thermodynamic properties and perform thermodynamic calculations oriented to the analysis of chemical equilibrium reactions.

Course Content:
UNIT-I   **10 Hrs**
Laws of thermodynamics: First law of thermodynamics - Types of energy, work, heat and energy changes, and applications of first law to different processes. Second law of thermodynamics and its applications - Entropy, reversible and irreversible processes, Carnot cycle, T-S diagrams, enthalpy of mixing and disorder; refrigeration and liquefaction.

UNIT-II   **10 Hrs**
Thermodynamic properties of fluids and their interrelationship: PVT behavior of pure substances; Equation of state; Generalized correlations and acentric factor; PVT behavior of mixtures; Thermodynamics charts; Estimation of thermodynamic properties. Thermodynamic properties and relations among them, mathematical relationships among basic properties, Maxwell relations.

UNIT-III   **8 Hrs**
Solution properties - Partial molar properties and chemical potential, concept of fugacity and activity and their calculations, ideal and non-ideal solutions, Gibbs - Duhem equations, property change of mixing and excess properties.

UNIT-IV   **8 Hrs**
Phase equilibria - Phase rule, fundamentals of vapor - liquid equilibria, Vanlaar, Margules and Wilson equations for binary mixture, liquid - liquid, solid – liquid and solid - vapor equilibria.

UNIT-V   **10 Hrs**
Chemical equilibrium: Chemical equilibrium constants; Homogeneous and heterogeneous reactions; Standard Gibbs free energy change; Equilibrium conversion in single and multiple reactions Statistical thermodynamics: Distribution of molecular states, internal energy and entropy; Partition function; Estimation of mean energies, heat capacities, equation of state, residual entropies, and equilibrium constant.

TEXT BOOKS:

1. J.M. Smith and H.C. Van Ness, "Introduction to Chemical Engineering Thermodynamics", Mc.Graw Hill, 1998.
2. K.V.Narayanan, "A textbook of Chemical Engineering Thermodynamics", Prentice Hall of India Ltd., 2001.

REFERENCES:

1. T.E. Daubert, "Chemical Engineering Thermodynamics ", Mc.Graw Hill, 1985.
2. B.G.Kyle, "Chemical and Process Thermodynamics", Prentice Hall of India Ltd., 1992.
3. Stanley.M. Walas, "Phase Equilibria in Chemical Engineering", Butterworth Publishers, 1985.
4. R.C.Reid, J.M. Prausnitz and B.E. Poling, "The Properties of Gases and Liquids", Mc.Graw Hill, IV Edition, 1988.
5. Y.V.C.Rao, "An Introduction to Thermodynamics", Wiley Eastern, 1994.

Web References:

1. http://link.springer.com/book
2. http://www.thphys.physics.ox.ac.uk
3. http://www.sciencedirect.com/science
4. http://www.e-booksdirectory.com

E-TEXT BOOKS:

1. http://nptel.ac.in/downloads/103101004/
2. http://www.cpp.edu/~lllee/TK303.pdf
3. https://www.researchgate.net/publication/228381252_Introductory_Chemical_Engineering_Thermodynamics/
4. http://www.zuj.edu.jo/download/chemical-engineering-thermodynamics-solution manual.pdf/

II Year – I Semester

L	T	P	C
0	0	3	1.5

ENGINEERING MECHANICS LAB

Course Objectives: The students completing the course are expected to:
- Verify the Law of Parallelogram and Triangle of Forces.
- Determine the coefficients of friction of Static and Rolling friction and Centre of gravity of different plane Lamina.
- Analyse the system of Pulleys and Moment of Inertia of Compound Pendulum and Flywheel.

Course Outcomes:

CO1: Evaluate the coefficient of friction between two different surfaces and between the inclined plane and the roller.

CO2: Verify Law of Polygon of forces and Law of Moment using force polygon and bell crank lever.

CO3: Determine the Centre of gravity and Moment of Inertia of different configurations. CO4: Verify the equilibrium conditions of a rigid body under the action of different force systems.

Students have to perform any 10 of the following Experiments:

List of Experiments:
1. Verification of Law of Parallelogram of Forces.
2. Verification of Law of Triangle of Forces.
3. Verification of the Law of polygon for coplanar-concurrent forces acting on a particle in equilibrium and to find the value of unknown forces considering particle to be in equilibrium using universal force table.
4. Determination of coefficient of Static and Rolling Frictions
5. Determination of Centre of Gravity of different shaped Plane Lamina.
6. Verification of the conditions of equilibrium of a rigid body under the action of coplanar non- concurrent, parallel force system with the help of a simply supported beam.
7. Study of the systems of pulleys and draw the free body diagram of the system.
8. Determine the acceleration due to gravity using a compound pendulum.
9. Determine the Moment of Inertia of the compound pendulum about an axis perpendicular to the plane of oscillation and passing through its centre of mass.
10. Determine the Moment of Inertia of a Flywheel.
11. Verification of Law of Moment using Rotation Disc Apparatus and Bell Crank Lever.

References:
1. S. Timoshenko, D. H. Young, J.V. Rao, S. Pati., Engineering Mechanics, 5th Edition, McGraw Hill Education.
2. Hibbeler R.C., Engineering Mechanics: Statics and Dynamics, 14th Edition, Pearson Education, Inc., New Delhi, 2022.

II Year – I Semester

L	T	P	C
0	0	3	1.5

PHARMACEUTICAL ENGINEERING – I LAB

PRE-REQUISITES: Pharmaceutical engineering equipments

COURSE OBJECTIVES:

To provide knowledge ondistillators, dryers, particles size, and various mechanical unit operations.

COURSE OUTCOMES:

1. Steam distillation –To calculate the efficiency of steam distillation.
2. To determine the overall heat transfer coefficient by heat exchanger.
3. Construction of drying curves (for calcium carbonate and starch).
4. Determination of moisture content and losson drying.
5. Determination of humidity of air – i) From wet and dry bulb temperatures   ii) Dew point method.
6. Description of Construction working and application of Pharmaceutical Machinery such as rotary tablet machine, fluidized bed coater, fluid energy mill, dehumidifier.
7. Size analysis by sieving – To evaluate size distribution of tablet granulations – Construction of various size frequency curves including arithmetic and logarithmic probability plots.
8. Size reduction: To verify the laws of size reduction using ball mill and determining Kicks, Rittinger's, Bond's coefficients, power requirement and critical speed of Ball Mill.
9. Demonstration of colloid mill, planetary mixer, fluidized bed dryer, freeze dryer and such other major equipment.
10. Factors affecting Rate of Filtration and Evaporation (Surface area, Concentration and Thickness/ viscosity)
11. To study the effect of time on the Rate of Crystallization.
12. To calculate the uniformity Index for given sample by using Double Cone Blender.

II Year – I Semester

L	T	P	C
0	1	2	2

SOFT SKILLS

Course Objectives:

- To prepare to face global competition for employment and excellence in profession.
- To help the students understand and build interpersonal and interpersonal skills that will enable them to lead meaningful professional life.

UNIT – 1: INTRODUCTION

Introduction- Emergence of life skills, Definition & Meaning, Importance& need, reasons for skill gap, Analysis--Soft Skills vs Hard skills, Linkage between industry and soft skills, Challenges, Personality Developments. Soft Skills, Soft Skills vs English - Improving Techniques.

UNIT – II: Intra-Personal:

Definition-Meaning – Importance-SWOT analysis, Johari windows - Goal Setting- quotient skills - Emotional Intelligence- Attitudinal skills - Right thinking- Problem Solving-Time management, stress management.

UNIT – III: Inter-Personal:

Definition – Meaning – Importance-Communications skills- Team Work, managerial skills - Negotiation skills- Leadership skills, corporate etiquettes.

UNIT – IV: Verbal Skills:

Definition and Meaning-Listening skills, need- types, advantages, Importance-Improving Tips for Listening, Speaking, need- types, advantages, Importance- Improving Tips, Reading- Writing Skills, Report, Resume, statement of purpose, need- types, advantages, Importance-Improving Tips .

UNIT – V: Non Verbal Skills& Interview skills

Definition and Meaning – Importance- Facial Expressions- Eye Contact – Proxemics-Haptics -Posture,   cross   cultural   body   language,   body   language in interview room, appearance and dress code – Kinetics- Para Language - tone, pitch, pause, neutralization of accent, use of appropriate language, Interview skills, interview methods and questions.

Text Books:

1) Sherfield, M. Robert at al, Cornerstone Developing Soft Skills, 4/e, Pearson Publication, New Delhi, 2014.
2) Alka Wadkar, Life Skills for Success, 1/e, Sage Publications India Private Limited, 2016.

Reference Books:

1. Sambaiah.M. Technical English, Wiley publishers India. New Delhi. 2014.
2. Gangadhar Joshi, From Campus to Corporate, SAGE TEXT.
3. Alex.K, Soft Skills, 3rd ed. S. Chand Publication, New Delhi, 2014.
4. Meenakshi Raman and Sangita Sharma, Technical Communication: Principle and Practice, Oxford University Press, 2009.
5. Shalini Varma, Body Language for Your Success Mantra, 4/e, S. Chand Publication, New Delhi, 2014.
6. Stephen Covey, Seven Habits of Highly Effective People, JMD Book, 2013.

Online Learning Resources:

- https://onlinecourses.nptel.ac.in/noc20_hs60/preview
- http://www.youtube.com/@softskillsdevelopment6210
- https://youtube.com/playlist?list=PLLy_2iUCG87CQhELCytvXh0E_y-bOO1_q&si=Fs05Xh8ZrOPsR8F4
- https://www.coursera.org/learn/people-soft-skills-assessment?language=English
- https://www.edx.org/learn/soft-skills

Course Outcomes:

COs	Statements	Blooms Level
CO1	Assimilate and understood the meaning and importance of soft skills and learn how to develop them.	L1
CO2	Understand the significance of soft skills in the working environment for professional excellence.	L2
CO3	Prepare to undergo the placement process with confidence and clarity.	L3
CO4	Ready to face any situation in life and equip themselves to handle them effectively.	L6
CO5	Understand and learn the importance of etiquette in both professional and personal life	L2

L	T	P	C
2	0	0	-

II Year – I Semester

ENVIRONMENTAL SCIENCE

Course Objectives:
- To make the students to get awareness on environment
- To understand the importance of protecting natural resources, ecosystems for future generations and pollution causes due to the day-to-day activities of human life
- To save earth from the inventions by the engineers.

UNIT – I

Multidisciplinary Nature of Environmental Studies: – Definition, Scope and Importance – Need for Public Awareness.

Natural Resources : Renewable and non-renewable resources – Natural resources and associated problems – Forest resources – Use and over – exploitation, deforestation, case studies – Timber extraction – Mining, dams and other effects on forest and tribal people – Water resources – Use and over utilization of surface and ground water – Floods, drought, conflicts over water, dams – benefits and problems – Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies – Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies. – Energy resources:

UNIT – II

Ecosystems: Concept of an ecosystem. – Structure and function of an ecosystem – Producers, consumers and decomposers – Energy flow in the ecosystem – Ecological succession – Food chains, food webs and ecological pyramids – Introduction, types, characteristic features, structure and function of the following ecosystem:
  a. Forest ecosystem.
  b. Grassland ecosystem
  c. Desert ecosystem
  d. Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

Biodiversity and Its Conservation : Introduction and Definition: genetic, species and ecosystem diversity – Bio-geographical classification of India – Value of biodiversity: consumptive use, Productive use, social, ethical, aesthetic and option values – Biodiversity at global, National and local levels – India as a mega-diversity nation – Hot-sports of biodiversity – Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – Endangered and endemic species of India – Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

UNIT – III

Environmental Pollution: Definition, Cause, effects and control measures of:
  a. Air Pollution.
  b. Water pollution
  c. Soil pollution
  d. Marine pollution
  e. Noise pollution
  f. Thermal pollution
  g. Nuclear hazards

Solid Waste Management: Causes, effects and control measures of urban and industrial wastes – Role of an individual in prevention of pollution – Pollution case studies – Disaster management: floods, earthquake, cyclone and landslides.

UNIT – IV

Social Issues and the Environment: From Unsustainable to Sustainable development – Urban problems related to energy – Water conservation, rain water harvesting, watershed management – Resettlement and rehabilitation of people; its problems and concerns. Case studies – Environmental ethics: Issues and possible solutions – Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case Studies – Wasteland reclamation. – Consumerism and waste products. – Environment Protection Act. – Air (Prevention and Control of Pollution) Act. – Water (Prevention and control of Pollution) Act – Wildlife Protection Act – Forest Conservation Act – Issues involved in enforcement of environmental legislation – Public awareness.

UNIT – V

Human Population And The Environment: Population growth, variation among nations. Population explosion – Family Welfare Programmes. – Environment and human health – Human Rights – Value Education – HIV/AIDS – Women and Child Welfare – Role of information Technology in Environment and human health – Case studies.

Field Work: Visit to a local area to document environmental assets River/forest grassland/hill/mountain – Visit to a local polluted site-Urban/Rural/Industrial/Agricultural Study of common plants, insects, and birds – river, hill slopes, etc.

Textbooks:

1. Erach Bharucha,Text book of Environmental Studies for Undergraduate Courses,Universities Press (India) Private Limited, 2019.
2. Palaniswamy, Environmental Studies, 2/e, Pearson education, 2014.
3. S.Azeem Unnisa, Environmental Studies, Academic Publishing Company, 2021.
4. K.Raghavan Nambiar, "Text book of Environmental Studies for Undergraduate Courses as per UGC model syllabus", SciTech Publications (India), Pvt. Ltd, 2010.

Reference Books:

1. Deeksha Dave and E.Sai Baba Reddy, Textbook of Environmental Science, 2/e, Cengage Publications, 2012.
2. M.Anji Reddy, "Textbook of Environmental Sciences and Technology", BS Publication, 2014.
3. J.P. Sharma, Comprehensive Environmental studies, Laxmi publications, 2006.
4. J. Glynn Henry and Gary W. Heinke, Environmental Sciences and Engineering, Prentice Hall of India Private limited, 1988.
5. G.R. Chatwal, A Text Book of Environmental Studies, Himalaya Publishing House, 2018.
6. Gilbert M. Masters and Wendell P. Ela, Introduction to Environmental Engineering and Science, 1/e, Prentice Hall of India Private limited, 1991.

Online Learning Resources:

- https://onlinecourses.nptel.ac.in/noc23_hs155/preview
- https://www.edx.org/learn/environmental-science/rice-university-ap-r-environmental-science-part-3-pollution-and-resources?index=product&objectID=course-3a6da9f2-d84c-4773-8388-

1b2f8f6a75f2&webview=false&campaign=AP%C2%AE+Environmental+Science+
+Part+3%3A+Pollution+and+Resources&source=edX&product_category=course&
placement_url=https%3A%2F%2Fwww.edx.org%2Flearn%2Fenvironmental-
science

- http://ecoursesonline.iasri.res.in/Courses/Environmental%20Science-I/Data%20Files/pdf/lec07.pdf
- https://www.youtube.com/watch?v=5QxxaVfgQ3k

Course Outcomes:

COs	Statements	Blooms Level
CO1	Grasp multi disciplinary nature of environmental studies and various renewable and non-renewable resources.	L2
CO2	Understand flow and bio-geo- chemical cycles and ecological pyramids.	L2
CO3	Understand various causes of pollution and solid waste management and related preventive measures.	L2
CO4	Understand the rainwater harvesting, watershed management, ozone layer depletion and waste land reclamation.	L2
CO5	Illustrate the causes of population explosion, value education and welfare programmes.	L3

II Year – II Semester

L	T	P	C
2	0	0	2

MANAGERIAL ECONOMICS AND FINANCIAL ANALYSIS

Course Objectives:
- To inculcate the basic knowledge of microeconomics and financial accounting
- To make the students learn how demand is estimated for different products, input-output relationship for optimizing production and cost
- To Know the Various types of market structure and pricing methods and strategy
- To give an overview on investment appraisal methods to promote the students to learn how to plan long-term investment decisions.
- To provide fundamental skills on accounting and to explain the process of preparing financial statements.

Course Outcomes:
- Define the concepts related to Managerial Economics, financial accounting and management(L2)
- Understand the   fundamentals of Economics viz., Demand, Production, cost, revenue and markets (L2)
- Apply the Concept of Production cost and revenues for effective Business decision (L3)
- Analyze how to invest their capital and maximize returns (L4)
- Evaluate the capital budgeting techniques. (L5)
- Develop the accounting statements and evaluate the financial performance of business entity (L5)

UNIT - I   Managerial Economics
Introduction – Nature, meaning, significance, functions, and advantages. Demand-Concept, Function, Law of Demand - Demand Elasticity- Types – Measurement. Demand Forecasting-Factors governing Forecasting, Methods. Managerial Economics and Financial Accounting and Management.

UNIT - II   Production and Cost Analysis
Introduction – Nature, meaning, significance, functions and advantages. Production Function–Least- cost combination– Short run and long run Production Function- Isoquants and Is costs, Cost & Break-Even Analysis - Cost concepts and Cost behaviour- Break-Even Analysis (BEA) - Determination of Break-Even Point (Simple Problems).

UNIT - III   Business Organizations and Markets
Introduction – Forms of Business Organizations- Sole Proprietary - Partnership - Joint Stock Companies - Public Sector Enterprises. Types of Markets - Perfect and Imperfect Competition - Features of Perfect Competition Monopoly- Monopolistic Competition–Oligopoly-Price-Output Determination - Pricing Methods and Strategies

UNIT - IV   Capital Budgeting
Introduction – Nature, meaning, significance. Types of Working Capital, Components, Sources of Short-term and Long-term Capital, Estimating Working capital requirements. Capital

Budgeting– Features, Proposals, Methods and Evaluation. Projects – Pay Back Method, Accounting Rate of Return (ARR) Net Present Value (NPV) Internal Rate Return (IRR) Method (sample problems)

UNIT - V   Financial Accounting and Analysis

Introduction – Concepts and Conventions- Double-Entry Bookkeeping, Journal, Ledger, Trial Balance- Final Accounts (Trading Account, Profit and Loss Account and Balance Sheet with simple adjustments). Introduction to Financial Analysis - Analysis and Interpretation of Liquidity Ratios, Activity Ratios, and Capital structure Ratios and Profitability.

Textbooks:
1. Varshney & Maheswari: Managerial Economics, Sultan Chand.
2. Aryasri: Business Economics and Financial Analysis, 4/e, MGH.

Reference Books:
1. Ahuja Hl Managerial economics Schand.
2. S.A. Siddiqui and A.S. Siddiqui: Managerial Economics and Financial Analysis, New Age International.
3. Joseph G. Nellis and David Parker: Principles of Business Economics, Pearson, 2/e, New Delhi.
4. Domnick Salvatore: Managerial Economics in a Global Economy, Cengage.

Online Learning Resources:

https://www.slideshare.net/123ps/managerial-economics-ppt

https://www.slideshare.net/rossanz/production-and-cost-45827016

https://www.slideshare.net/darkyla/business-organizations-19917607

https://www.slideshare.net/balarajbl/market-and-classification-of-market

https://www.slideshare.net/ruchi101/capital-budgeting-ppt-59565396

https://www.slideshare.net/ashu1983/financial-accounting

II Year – II Semester

L	T	P	C
3	0	0	3

REACTION ENGINEERING FOR PHARMACEUTICAL ENGINEERS

PRE-REQUISITES: Thermodynamics for pharmaceutical engineers

COURSE OBJECTIVE: To provide a foundation on deriving rate expressions for series, parallel, reversible reactions, reactive design, non-ideal flow and catalysis.

COURSE OUTCOMES:

The student will be able to

1. Deriving rate expressions for series, parallel, reversible reactions
2. Explain product distribution in multiple reactions; recycle reactors and auto catalytic reactions.
3. Estimate characteristic features of non- ideal flow and mixing of fluids in reaction vessels.
4. Explain introductory aspects of the design for heterogeneous reacting systems.

Course content:

UNIT-I   **10 Hrs**

Overview of chemical reaction engineering: Classification of reactions, variables affecting the rate of reaction definition of reaction rate. Kinetics of homogenous reactions- concentration dependent term of rate equation, Temperature dependent term of rate equation, searching for a mechanism, predictability of reaction rate from theory.

Interpretation of batch reactor data- constant volume batch reactor: Analysis of total pressure data obtained in a constant-volume system, the conversion, Integral method of analysis of data–general procedure, irreversible unimolecular type first order reactions, irreversible bimolecular type second order reactions, irreversible trimolecular type third order reactions,

UNIT-II   **10 Hrs**

Constant volume batch reactor: Empirical reactions of nth order, zero-order reactions, overall order of irreversible reactions from the half-life, fractional life method, irreversible reactions in parallel, homogenous catalyzed reactions, autocatalytic reactions irreversible reactions in series Intrinsic empirical reactions of nth order, zero-order reactions, overall order of irreversible reactions from the half-life, fractional life method, irreversible reactions in parallel, homogenous catalyzed reactions, autocatalytic reactions, irreversible reactions in series.

First order reversible reactions, second order reversible reactions, reversible reactions in general, integral method, Differential method of analysis of data. Varying volume batch reactor–differential method of analysis, integral method of analysis, zero order, first order, second order, nth order reactions, temperature and reaction rate, the search for a rate equation.

UNIT-III   **8 Hrs**

Introduction to reactor design- General discussion, temperature and pressure effects, symbols and relationship between C_A and X_A. Ideal reactors for a single reaction- Ideal batch reactor, Steady-state mixed flow reactor, Steady-state plug reactors.

Temperature and Pressure effects- Single reactions- heats of reaction from thermodynamics, heats of reaction and temperature, equilibrium constants from thermodynamics, equilibrium conversion, general graphical design procedure, optimum temperature progression, heat effects, adiabatic operations, non-adiabatic operations, comments and extensions. Exothermic reactions in mixed flow reactors-A special problem, multiple reactions.

UNIT-IV   **12 Hrs**

Basics of non-ideal flow: E, the exit age distribution function of fluid, the RTD, conversion in non-ideal flow reactors, diagnosing reactors (qualitative discussion only).

The dispersion model: axial dispersion, correlations for axial dispersion, chemical reaction and dispersion.

Catalysis and Catalytic reactors: Catalysts, steps in catalytic reactions, synthesizing a rate law, mechanism and rate limiting step.

Heterogeneous reactions: Introduction to Solid catalyzed reactions: The rate equation for Surface Kinetics-Pore diffusion resistance combined with surface kinetics, Porous catalyst particles, and heat effects during reaction, Performance equations for reactors containing porous catalyst particles.

UNIT-V   **6 Hrs**

Fluid-fluid reactions: kinetics- The rate equation. Fluid-particle reactions: kinetics- selection of a model, shrinking core model for spherical particles of unchanging size, rate of reaction for shrinking spherical particles, extensions, determination of rate controlling step.

TEXT BOOKS:
1. Chemical Reaction Engineering, 3rd ed., O. Levenspiel, John Wiely& Sons, 1999
2. Chemical Reactions and Chemical Reactors, 1st Edition, George W. Roberts, Wiley, 2015.

REFERENCES:
1. Elements of Chemical Reaction Engineering, 2nd ed., H.S. Fogler, PHI Learning Pvt. Ltd., New Delhi, 2010.
2. Chemical Engineering Kinetics, 3rd ed., J.M. Smith, McGraw-Hill, New York, 1981
3. Fundamentals of Chemical Reactor Engineering: A Multi-Scale Approach, First Edition. Timur Doğu and Gülşen Doğu, Published 2022 by John Wiley & Sons, Inc.
4. Aris, R. (1989). Elementary Chemical Reactor Analysis. Boston: Butter worths.

II Year – II Semester

L	T	P	C
3	0	0	3

HEAT TRANSFER FOR PHARMACEUTICAL ENGINEERS

PRE-REQUISITES: Material and energy balance computations

COURSE OBJECTIVES: This course helps in making the student understand various modes of heat transfer, heat transfer with and without phase change, heat transfer equipment, and radiation.

COURSE OUTCOMES: The student will be able to

1. Classify the modes of heat transfer
2. Identify the Natural Convection, Forced Convection and Radiation
3. Describe heat transfer laws for heat Exchangers
4. Differentiate the heat exchanger performance for co-current and counter –current flows
5. Explain Heat transfer Coefficients, efficiency of heat exchangers and the Heat Radiation in detail. Classify the types of heat exchanger equipments and evaporator along with feeding methods

Course content

UNIT-I 6 Hrs

Introduction: Nature of heat flow, conduction, convection, natural and forced convection, radiation. Heat transfer by conduction in Solids: Fourier's law, thermal conductivity, steady state conduction in plane wall & composite walls, compound resistances in series, heat flow through a cylinder, conduction in spheres

UNIT-II 10Hrs

Principles of heat flow in fluids: Typical heat exchange equipment, countercurrent and parallel current flows, energy balances, rate of heat transfer, overall heat transfer coefficient, electrical analogy, critical radius of insulation, logarithmic mean temperature difference, variable overall coefficient, multi-pass exchangers, individual heat transfer coefficients, resistance form of overall coefficient, fouling factors, classification of individual heat transfer coefficients, magnitudes of heat transfer coefficients, effective coefficients for unsteady-state heat transfer.

UNIT-III 10 Hrs

Heat Transfer to Fluids without Phase change: Regimes of heat transfer in fluids, thermal boundary layer, heat transfer by forced convection in laminar flow, heat transfer by forced convection in turbulent flow, the transfer of heat by turbulent eddies and analogy between transfer of momentum and heat, heat transfer to liquid metals, heating and cooling of fluids in forced convection outside tubes. Natural convection: Natural convection to air from vertical shapes and horizontal planes, effect of natural convection in laminar-flow heat transfer **UNIT-IV** 8 Hrs

Heat Transfer to Fluids with Phase change: heat transfer from condensing vapors, heat transfer to boiling liquids. Heat exchange equipment: General design of heat exchange equipment, heat exchangers, condensers, boilers and calendrias, extended surface equipment, heat transfer in agitated vessels, scraped surface heat exchangers, heat transfer in packed beds, heat exchangers effectiveness (NTU method)

UNIT-V   **12 Hrs**

Evaporators: Evaporators, performance of tubular evaporators, capacity and economy single and multiple effect evaporator, method of feeding, vapors recompression. Radiation: Radiation: Introduction, properties and definitions, black body radiation, real surfaces and the gray body, absorption of radiation by opaque solids, radiation between surfaces, radiation shielding, radiation to semitransparent materials, combined heat transfer by conduction, convection and radiation.

TEXT BOOKS:
1. Unit Operations of Chemical Engineering, 6th ed., W.L. McCabe, J.C. Smith and P. Harriot, McGraw-Hill, New York, 2001

REFERENCES:
1. Process Heat Transfer, D.Q. Kern, Tata McGraw-Hill, New Delhi, 1997.
2. Heat Transfer, J.P.Holman, 9th Edition, Tata McGraw-Hill, 2008
3. A Text Book on Heat Transfer, S.P. Sukhatme, 5th Edition, Universities Press (India) Pvt. Ltd., 2005.
4. Heat Transfer: Principles and Applications, BinayDutta, K., 1st Edition, Phi Learning, 2009.

II Year – II Semester

L	T	P	C
3	0	0	3

PHYSICAL PHARMACEUTICS

PRE-REQUISITES: Physics and Chemistry

COURSE OBJECTIVES: To know important physical properties of drug molecules, interfacial phenomenon, complexation, types of colloids and its properties, and micromeritics.

COURSE OUTCOMES: To student will be able to

1. Illustrate the important physical properties of drug molecules, phase value & its importance.
2. Identify Different electrolytes and non-electrolyte solutions, importance of pH and drug research.
3. Analyze industrial phenomenon of liquids, rate &order of reactants.
4. Interpret micromeritics, and types of colloids and their properties.

Course content:

UNIT-I 8 Hrs

Ionic Equilibria: Modern theories of acids and bases. Sorensen's pH scale, calculation of pH, acidity constants. Buffers and buffered isotonic systems. The buffer equation, buffer capacity, buffers in pharmaceuticals and biologics, buffered isotonic, methods of adjusting tonicity and pH.

UNIT-II 8Hrs

Solubility and distribution phenomenon: Solvent – solute interactions, factors influencing solubility of gases in liquids, solubility of solids in liquids and solubility of liquids in liquids, solids. Distribution coefficient: applications and limitations influence of molecular association and dissociation on partition coefficient, preservative action of weak acids in oil water system.

UNIT-III 10 Hrs

Interfacial phenomenon: Definition, method of determination. Significance in Pharmacy. Liquid interfaces, adsorption at liquid interfaces. Surface active agent's classification, properties, applications HLB.Adsorption at solid interfaces. Electric properties at interfaces – Zeta potential and its importance. Complexation: Types of complexes, metal, organic and inclusion complexes, methods of analysis. Colloids: classification, purification, protective colloid action, properties.

UNIT-IV 12 Hrs

Coarse dispersions: Suspensions – interfacial properties of suspended particles, settling in suspensions. Formulation and evaluation, rheological properties of suspensions.
Emulsions: Theories of emulsification, physical stability of emulsions, preservation of emulsions, rheological properties of emulsions. Semisolids: classification, properties.
Gels: classification, concept of synthesis and swelling.

UNIT-V 8 Hrs

Micromeritics: Particle size and size distribution, methods of determining particle size particle shape, particle number, surface area – methods of determining surface area, derived properties of powders – their significance.

TEXT BOOKS:

1. Essentials of physical pharmacy by CVS Subrahmanyam, 2nd Edition, 2017, publisher:
2. Vallabh Prakashan.
3. Text book of physical pharmaceutics by CVS Subrahmanyam, 2nd Edition, 2000, publisher: Vallabh Prakashan.
4. Martin's Physical Pharmacy and Pharmaceutical Sciences edited by PJ Sinko; 6TH edition, 2006, publisher: Lippincott Williams &Wilkins.
5. Tutorial Pharmacy by Cooper and Gunn, edited by S.J. Carter; 6th edition, Publisher: CBS Publishers. 5. Remington's The Science and Practice of Pharmacy, volume I and volume II, 22nd edition.

REFERENCES:

1. Bentley's Textbook of Pharmaceutics by E.A. Rawlins, publisher: Bailliere Tindall, 1977.
2. Physical pharmacy Practical text by Guru Prasad Mohanta and Prabal Kumar Manna, Published by Pharma book syndicate.
3. Essentials of physical pharmacy by Derle D.V. published by pharma book syndicate.

II Year – II Semester

L	T	P	C
3	0	0	3

PRINCIPLES OF MICROBIOLOGY AND BIOCHEMISTRY

PRE-REQUISITES: Biology and Chemistry

COURSE OBJECTIVES: To deal with the various aspects of microorganisms their classification, morphology, cultivation, identification, sterility testing and to introduce students to biochemistry and biomolecules.

COURSE OUTCOMES: The student will be able to

1. Describe cultivation of microorganisms.
2. Describe sterilization of various pharmaceutical products, equipment, and culture media.
3. Illustrate sterility testing.
4. Explain biochemical organization in human system.

Course content:

UNIT-I   **8 Hrs**

Introduction to Microbiology: Origin, scope and discovery of microbiological world, Spontaneous generation theory. Pharmaceutical significance of protozoa, algae, fungi, bacteria and viruses. Characterization and identification of microorganisms.

Nutrition and Growth of Microbes: Nutritional requirements, Types of Nutrient media and growth Conditions and Nutritional types based on energy source. Isolation, cultivation (aerobic & anaerobic) and preservation of microorganisms, physiology of growth, bacterial growth curve, methods for determining bacterial numbers, mass and cell constituents

UNIT -II   **8 Hrs**

Control of Microorganisms: General Concepts, Inhibition of growth and killing, sterilization and Disinfection, antisepsis and sanitation, mode of action application & limitation of physical agents (moist and dry heat, radiation and filtration), chemical agents. Various types of disinfectants, factors affecting sterilization and disinfection, evaluation of antimicrobial activity, chemotherapeutic agents, mode of action and applications, drug resistance. pharmaceuticals and bio safety measures

UNIT-III   **10 Hrs**

a. Microbiological Assays: Principles and Methods involved in Assay of Antibiotics, Vitamins, Amino acids& Bio-Sensors in Analysis.

b. Microbial Source & applications of various pharma products like Antibiotics, vitamins. Amino acids, solvents, enzymes & genetic engineered products etc.

C. Sampling of the air in clean house in classified areas.

UNIT-IV   **12 Hrs**

Introduction to Biochemistry:

Biomembranes: Structure and molecular constituents of membrane, models proposed, function and properties of membrane, transport hypothesis: Active and Passive, facilitated transport, Na+, K+, H+ pumps. Glucose transport, osmoregulation.

Biomolecules & Metabolism: Carbohydrates: Structure and classification & complex carbohydrates, biological role of carbohydrates. Metabolism: Glycolysis, glycogenolysis, gluconeogenesis, Kreb's cycle, glucuronic acid pathways.

Proteins: Introduction, functional classification. Amino acids: Classification, Physicochemical properties, optical activity, reaction with ninhydrin, formaldehyde, R-group amino acids. Essential, non-essential amino acids, deficiency. Metabolism: Urea cycle, deamination, Transamination, decarboxylation reactions of some important amino acids.

UNIT-V   **8 Hrs**

Enzymes: Introduction, classification, (according to the reaction catalysis and sources) properties, mechanism of action, and structure of enzymes, co-factor, active sites, Factors active substrates, pH ionic strength, conc., temperature. Enzyme inhibition (Competitive, Non-competitive, irreversible).Therapeutic uses of enzymes.

Lipids: Definition, Classification, Functions, Types of fatty acids and its biological role. Metabolism: Alpha, Beta, Gama & Omega oxidations of fatty acids, bio-synthesis of fatty acids, cholesterol. Nucleic acids: Structure, classification, cell and biological functions, chemical composition, as genetic.

TEXT BOOKS:
1. Pelczar and Reid, Text Book of Microbiology, 3rd Edition, McGraw-Hill, 1971.
2. Anantha Narayan and JayramPanikar, Text Book of Microbiology, Orient Longman, Delhi. N.K. Jain, Pharmaceutical Microbiology.
3. D. Satyanarayan and U.Chakrapani,Biochemistry
4. Textbook of Biochemistry by Rama Rao.

REFERENCES:
1. Heritage, J Introductory Microbiology, published by the press syndicate of the university of Cambridge, 2000.
2. Nester, Anderson, Roberts, Pearsall, Microbiology, McGraw-Hill, 4th edition, McGraw HillPublisher.
3. Hugo, W B Pharmaceutical Microbiology, 8th edition, published: Wiley-Blackwell.
4. Lodish, Harvey et.al., "Molecular Cell Biology," 6th Edition. W.H.Freeman, 2008.
5. Alberts, Bruce, "Molecular Biology of Cell", 5th Edition, Garland Science, 2008
6. Textbook of Biochemistry by Deb
7. Harper's Biochemistry by Robert K. Murry, Daryl K. Granner and Victor W. Rodwell.

L	T	P	C
0	0	3	1.5

II Year – II Semester

PHYSICAL PHARMACEUTICS LAB

PRE-REQUISITES: Physical Pharmaceutics

COURSE OBJECTIVES: To impart pertinent concepts pH solubility, flow properties of powders, fluid properties.

COURSE OUTCOMES:
1. Discuss the relation between pH and Solubility, and factors influencing the pH of buffer solutions.
2. Describe the factors influencing the solubility phenomenon and could be able to identify the types of complexes.
3. Explain how particles can be characterized and why these methods are important in pharmaceutical industry.
4. Analyze the different physical properties and influence of these particle characteristics in formulation of pharmaceutical products.

Lab Experiments
1. Phase diagram of phenol-water system.
2. Determination of flow properties of powders.
3. Determination of bulk density, true density and % porosity of powders.
4. Determination of angle of repose.
5. Preparation of selected buffers and determination of buffer capacity of acetate buffer.
6. Determination of partition coefficient of benzoic acid in benzene and water.
7. Study of complexation of copper and glycine by pH titration method.
8. Determination of surface tension of liquids.
9. Determination of CMC by drop count method.
10. Influence of additives (glycerol in aqueous phase) on the partition coefficient.
11. Determination of HLB of a surfactant.
12. Determination particle size by gravity sedimentation Anderson's apparatus.

II Year – II Semester

L	T	P	C
0	0	3	1.5

MICROBIOLOGY& BIOCHEMISTRY LAB

PRE-REQUISITES: Principles of Microbiology and Biochemistry

COURSE OBJECTIVES: To impart the basic concepts of morphology of microbes, preparation of culture media, characterization of microbes and assay of compounds

COURSE OUTCOMES: The student

1. Can be able to differentiate Microorganisms
2. Can be able to perform sterilization techniques in labs, Hospitals etc
3. Can be able to Characterize Microorganisms
4. Can be able evaluate potency of commercial Antibiotics, vitamins, amino acids

Lab Experiments

1. Microscopy; Scientific Inquiry; Mounting Microorganism and Study morphology and structure of different microbes.
2. Perform all physical sterilization Techniques mandated in Biosafety class-II laboratory
3. Preparation of various culture media
4. Cultivation of microbes and observation of colonycharacteristics.
5. Characterization of microbes by Gram staining technique &Acid fast staining technique.
6. Evaluation of commercial disinfectant by phenol-coefficient test.
7. Assay of antibiotic.
8. Assay of Vitamins.
9. Assay of amino acids.
10. Preparation of buffer solution and measurement of pH
11. Qualitative analysis of carbohydrates (Glucose, Fructose, Lactose, Maltose, Sucrose and starch)
12. Identification tests for Proteins (albumin and Casein)

TEXT BOOKS:

1. Microbiology: A Laboratory Manual, James G. Cappuccino
2. Microbiology: An Introduction, 12th Edition, Gerard J. Tortora, Berdell R. Funke and Christine
3. Practical Biochemistry by R.C. Gupta and S. Bhargavan.
4. Introduction of Practical Biochemistry by David T. Plummer. (3rd Edition)
5. Practical Biochemistry for Medical students by Rajagopal and Ramakrishna.

II Year – II Semester

ORGANISATIONAL BEHAVIOUR

L	T	P	C
0	1	2	2

PRE-REQUISITE:

COURSE OBJECTIVES:

- To enable student's comprehension of organizational behavior
- To offer knowledge to students on self-motivation, leadership and management
- To facilitate them to become powerful leaders
- To Impart knowledge about group dynamics
- To make them understand the importance of change and development

COURSE OUTCOMES:

- Define the Organizational Behaviour, its nature and scope.
- Understand the nature and concept of Organizational behaviour
- Apply theories of motivation to analyse the performance problems
- Analyse the different theories of leadership
- Evaluate group dynamics
- Develop as powerful leader

Course content:

UNIT - I   **8 Hrs**

Introduction to Organizational Behavior

Meaning, definition, nature, scope and functions - Organizing Process – Making organizing effective – Understanding Individual Behaviour –Attitude -Perception - Learning – Personality.

UNIT - II   **10 Hrs**

Motivation and Leading

Theories of Motivation- Maslow's Hierarchy of Needs - Hertzberg's Two Factor Theory - Vroom's theory of expectancy – Mc Cleland's theory of needs–McGregor's theory X and theory Y– Adam's equity theory – Locke's goal setting theory– Alderfer's ERG theory.

UNIT - III   **10 Hrs**

Organizational Culture

Introduction – Meaning, scope, definition, Nature - Organizational Climate - Leadership - Traits Theory–Managerial Grid - Transactional Vs Transformational Leadership - Qualities of good Leader- Conflict Management -Evaluating Leader- Women and Corporate leadership.

UNIT - IV   **10 Hrs**

Group Dynamics

Introduction – Meaning, scope, definition, Nature- Types of groups - Determinants of group behavior - Group process – Group Development - Group norms - Group cohesiveness - Small Groups - Group decision making - Team building - Conflict in the organization– Conflict resolution

UNIT – V   **8 Hrs**

Organizational Change and Development

Introduction –Nature, Meaning, scope, definition and functions- Organizational Culture - Changing the Culture – Change Management – Work Stress Management - Organizational management – Managerial implications of organization's change and development

TEXTBOOKS:

1. Luthans, Fred, Organisational Behaviour, McGraw-Hill, 12 Th edition 2011
2. P Subba Ran, Organisational Behaviour, Himalya Publishing House 2017

REFERENCE BOOKS:

1. McShane, Organizational Behaviour, TMH 2009
2. Nelson, Organisational Behaviour, Thomson, 2009.
3. Robbins, P. Stephen, Timothy A. Judge, Organisational Behaviour, Pearson 2009.
4. Aswathappa, Organisational Behaviour, Himalaya, 2009

Online Learning Resources:

https://www.slideshare.net/Knight1040/organizational-culture
9608857s://www.slideshare.net/AbhayRajpoot3/motivation-165556714
https://www.slideshare.net/harshrastogi1/group-dynamics-159412405
https://www.slideshare.net/vanyasingla1/organizational-change-development-26565951

II Year – II Semester

L	T	P	C
1	0	2	2

DESIGN THINKING & INNOVATION

Course Objectives: The objectives of the course are to

- Bring awareness on innovative design and new product development.
- Explain the basics of design thinking.
- Familiarize the role of reverse engineering in product development.
- Train how to identify the needs of society and convert into demand.
- Introduce product planning and product development process.

UNIT – I   Introduction to Design Thinking

Introduction to elements and principles of Design, basics of design-dot, line, shape, form as fundamental design components. Principles of design. Introduction to design thinking, history of Design Thinking, New materials in Industry.

UNIT - II   Design Thinking Process

Design thinking process (empathize, analyze, idea & prototype), implementing the process in driving inventions, design thinking in social innovations. Tools of design thinking - person, costumer, journey map, brainstorming, product development

Activity: Every student presents their idea in three minutes, Every student can present design process in the form of flow diagram or flow chart etc. Every student should explain about product development.

UNIT - III   Innovation

Art of innovation, Difference between innovation and creativity, role of creativity and innovation in organizations. Creativity to Innovation. Teams for innovation, Measuring the impact and value of creativity.

Activity: Debate on innovation and creativity, Flow and planning from idea to innovation, Debate on value-based innovation.

UNIT - IV   Product Design

Problem formation, introduction to product design, Product strategies, Product value, Product planning, product specifications. Innovation towards product design Case studies.

Activity: Importance of modeling, how to set specifications, Explaining their own product design.

UNIT – V   Design Thinking in Business Processes

Design Thinking applied in Business & Strategic Innovation, Design Thinking principles that redefine business – Business challenges: Growth, Predictability, Change, Maintaining Relevance, Extreme competition, Standardization. Design thinking to meet corporate needs. Design thinking for Startups. Defining and testing Business Models and Business Cases. Developing & testing prototypes.

Activity: How to market our own product, about maintenance, Reliability and plan for startup.

Textbooks:

1. Tim Brown, Change by design, 1/e, Harper Bollins, 2009.
2. Idris Mootee, Design Thinking for Strategic Innovation, 1/e, Adams Media, 2014.

Reference Books:

1. David Lee, Design Thinking in the Classroom, Ulysses press, 2018.
2. Shrrutin N Shetty, Design the Future, 1/e, Norton Press, 2018.
3. William lidwell, Kritinaholden, &Jill butter, Universal principles of design, 2/e, Rockport Publishers, 2010.
4. Chesbrough.H, The era of open innovation, 2003.

Online Learning Resources:
- https://nptel.ac.in/courses/110/106/110106124/
- https://nptel.ac.in/courses/109/104/109104109/
- https://swayam.gov.in/nd1_noc19_mg60/preview
- https://onlinecourses.nptel.ac.in/noc22_de16/preview

Course Outcomes:

COs	Statements	Blooms Level
CO1	Define the concepts related to design thinking.	L1
CO2	Explain the fundamentals of Design Thinking and innovation.	L2
CO3	Apply the design thinking techniques for solving problems in various sectors.	L3
CO4	Analyse to work in a multidisciplinary environment.	L4
CO5	Evaluate the value of creativity.	L5

III Year I Semester

S.No.	Category	Title	L	T	P	Credits
1	Professional Core	Anatomy and Physiology	3	0	0	3
2	Professional Core	Pharmacology	3	0	0	3
3	Professional Elective - I	1.Quality Control and Assurance 2. Food Processing Technology 3. Pharmaceutical Biotechnology	2	0	0	2
4	Open Elective - I	OR Entrepreneurship Development & Venture Creation 1.Non-Conventional Energy Sources 2.Introduction to Data Structures 3.Design and Analysis of Experiments	3	0	0	3
5	Open Elective - II	1.Hospital Management 2.Nural networks and Fuzzy logic 3.Introduction to Data base Management	3	0	0	3
6	Professional Core	Pharmacology lab	0	0	3	1.5
7	Professional Core	Anatomy and Physiology lab	0	0	3	1.5
8	Skill Enhancement course	Advanced Communication Skills Lab	0	1	2	2
9	BS&H	Tinkering Lab(Statistics (Using R Programming lab)	0	0	2	1
10	Evaluation of Community Service Project		-	-	-	2
Total			**14**	**1**	**10**	**22**

B.Tech. – III Year II Semester

S.No.	Category	Title	L	T	P	Credits
1	Professional Core	Pharmaceutical Engineering -2	3	0	0	3
2	Professional Core	Biopharmaceutics and Pharmacokinetics	3	0	0	3
3	Professional Core	Principles of Transducers and Measurements	3	0	0	3
4	Professional Elective - II	1.Computer Aided Drug Design 2.Pharmaceutical Regulatory Affairs 3.Novel Drug Delivery Systems	3	0	0	3
5	Professional Elective - III	1.Bio Medical Instrumentation 2.Pharmaceutical Product Development 3.Industrial Process Control	2	0	0	2
6	Open Elective - III	1.Robotics 2.Synthesis and Characterization of Nano Materials 3.Water conservation and Management	3	0	0	3
7	Professional Core	Transducers and Measurements lab	0	0	2	1
8	Professional Core	Experimental Modeling and Simulation lab	0	0	2	1
9	Skill Enhancement course	Effluent Treatment & Pollution Control - Field Trip	0	1	2	2
10	Audit Course	Technical Paper writing & IPR	2	0	0	-
Total			**19**	**1**	**06**	**21**
Mandatory Industry Internship during summer vacation						

III Year – I Sem	ANATOMY AND PHYSIOLOGY	L	T	P	C
		3	0	0	3

PRE-REQUISITES: Biology

COURSE OBJECTIVES: To make the student understand the anatomical terms used to refer the human body, structure and functioning of various systems of human body.

UNIT I:

Introduction to Cell: Structure and Function of Cell, Subcellular Organelles and Cell Division -Mitosis, Meiosis. Transport Across Cell Membrane: Passive and Active Transport, Ion channels, Ligand gated / voltage gated channels. Tissues - Epithelial tissue, Connective tissue, Muscular tissue, Nervous tissue and Homeostasis.

UNIT II:

Skeletal System & Respiratory System: Structure, composition & functions of skeleton. Classification of joints, Types of joints. Anatomy & function of respiratory structures, Mechanism of respiration, regulation of respiration.

UNIT III:

Blood & Cardiovascular System: Composition, function of blood & its elements, erythropoiesis, blood groups, blood coagulation, Blood vessels Functional Anatomy of heart, conducting system of heart, Heart sounds, cardiac cycle, ECG. Blood pressure and its regulation.

UNIT IV:

Digestive System and urinary system: Parts of digestive system, their structure and functions. Anatomy & physiology of urinary system. Physiology of urine formation, acid- base balance.

UNIT-V:

Nervous System: Functions of brain and spinal cord. Cranial nerves and functions. Neurohumoral transmission in the central nervous system, reflex action.

Autonomic Nervous System: Physiology and functions of the autonomic nervous system. **Sense Organs:** Basic anatomy and physiology of the eye, ear, tongue, nose, and skin

Endocrine System: Anatomy & Physiology of pituitary, thyroid, parathyroid, adrenal, pancreas.

COURSE OUTCOMES: The student will be able

1. Identify the anatomical terms related to the human body.
2. Illustrate the anatomical location of the systems and explain their function.

3. Explain the Physiology of all the major systems within the human body.
4. Describes the structure and functions of various organs of the human body and mechanisms in the maintenance of normal functioning and disease state are knows.

TEXT BOOKS:

1. Guyton, A.C. and Hall, J.E. "Textbook of Medical Physiology", 11th Edition, Saunders, 2006.
2. Ganong, W.F. "Review of Medical Physiology", 22nd Edition (A Lange Medical book series) McGraw – Hill (International Ed.) 2005.
3. Khurana, Indu "A Textbook of Medical Physiology" Elsevier, 2006.4. Johnson, L.R. "Essential
4. Medical Physiology", 3rd Edition, Academic Press / Elsevier), 2003.
5. Tortora GJ, &Anagnodokos NP, Principles of Anatomy & Physiology, Harper & Rave Publishers, New Delhi.
6. Shalya Subhash, Human Physiology, CBS Publishers & Distributors.
7. Keele, C.A., Niel, E and Joels N, Samson Wright's Applied Physiology, Oxford University Press.

References:

1. Waugh, Anne and Allison Grant "Ross and Wilson Anatomy and Physiology in Health and Illness", 10th Edition, Churchill – Livingstone / Elsevier), 2006.
2. Carola, R., J.P. Harley and C.R. Noback. "Human Anatomy & Physiology", 2nd Edition,McGraw – Hill, 1992.
3. Vander, A.J., J.H. Sherman and D.S. Luciano "Human Physiology: The Mechanisms of BodyFunction", 5th Edition, McGraw – Hill, 1990.
4. Lodish, Harvey etal., "Molecular Cell Biology," 6th Edition. W.H.Freeman, 2008.
5. Alberts, Bruce, "Molecular Biology of Cell", 5th Edition, Garland Science, 2008.
6. Cooper,G.M. "The Cell: A Molecular Approach, 4th Edition, ASM Press, 2007.
7. Alberts, Bruce etal., "Essential Cell Biology", 2nd Edition, Garland Science, 2004

III Year – I Sem	**PHARMACOLOGY**	L	T	P	C
		3	0	0	3

PRE-REQUISITES: Anatomy and physiology

COURSE OBJECTIVES: To provide basic principles of drug and classification of various drugs, routes of administration, mechanism of action, adverse effects and interactions with other drugs.

UNIT-I

Introduction to Pharmacology: Introduction to pharmacology, routes of drug administration, combined effect of drugs. Basic Concepts of Pharmacokinetics- Absorption, Distribution, Metabolism & Excretion. Pharmacodynamic - Principles of drug action, Receptors, Therapeutics index -LD 50 & ED50. Adverse drug reactions, Drug Interactions.

UNIT-II

Pharmacology of ANS & CNS Drug acting on autonomic nervous system: Parasympathomimetic (Cholinergic drugs). Parasympatholytic drugs (anti cholinergic), Sympathomimetic (Adrenergic drugs), Sympatholytic drugs (Anti-adrenergic).

UNIT-III

Drug acting on central nervous system: General Anesthetics, Alcohols & disulfiram, sedatives, hypnotics, antianxiety agents, Analgesics & antipyretics, antipsychotics& antidepressants. Antiepileptic drugs, Local anesthetics

Pharmacology of CVS System: Antihypertensive drugs, Antianginal drugs, Antiarrhythmics, Anti-hyper lipidemics, anticoagulants, Fibrinolytics & antiplatelet Drugs.

Respiratory System & Digestive System: Anti-asthmatic drugs, Antiulcer drugs, Emetics and antiemetic.

UNIT-IV

Pharmacology of Endocrine System & Principles of Toxicology: Hypothalamic & pituitary hormones, Thyroid hormones & Thyroid Drugs, Insulin & oral hypoglycemic agents. Corticosteroids. Definition of poison, general principles and treatment of poisoning with particular reference to barbiturates, opioids, organophosphorous. Heavy metal Antagonists.

UNIT-V

Chemotherapy: General Principles of Chemotherapy, Sulfonamides, Cotrimoxazole, Quinolones, Antibiotics – Penicillins, Cephalosporins, Chloramphenicol, Tetracyclines, Macrolides.

COURSE OUTCOMES:

1. Identify theoretical concepts surrounding pharmacology, such as the pharmacokinetics and pharmacodynamics of drugs, and the Concepts surrounding pharmacotherapy.

2. Explain general principles of drug and classification of various drugs, pharmacodynamic and pharmacokinetic aspects.
3. Describe the adverse effects, uses, dose, and route of administration, precautions, contraindications and interaction with other drugs.

TEXT BOOKS:

1. Mycek, M.J. *et al*., "Lippincott's Illustrated Reviews Pharmacology", 2nd Edition, Lippincott Williams & Wilkins, 2000.
2. Tripathi, K.D. Essentials of Medical Pharmacology, Jay Pee Publishers, New Delhi,7th edition, publisher: Jaypee brothers medical publisher, 2013.
3. Katzung, B.G. Basic & Clinical Pharmacology, P Rentice Hall, International,11th edition, Mc Graw-hill, 2009.
4. Rang MP, Date MM, Riter JM, Pharmacology Churchill Livingstone.
5. Satoskar & Bhandarkar; Pharmacology & Pharmacotherapeutics, 21st edition, 2009, Popular Prakashan Pvt. Ltd., Bombay.

References:

1. Goodman & Gilman, The Pharmacological basis of Therapeutics, Editors: lawrence L. bruton, edition 11, publisher: McGraw-Hill Professional Publishing, 2005.
2. Elmer, G.W. *et al*., "Biotherapeutic Agents and Infectious Diseases", Humana Press, 1999.
3. Hickman, J.A. and Caroline Dive "Apoptosis and Cancer Chemotherapy", Humana Press, 1999.
4. Zhang, Jie "PARP as a Therapeutic Target", CRC Press, 2002.
5. Hardman, Jeol G. "Goodman & Gilman's The Pharmacological Basis of Therapeutics", 10thEdition, McGraw – Hill, 2001.
6. Rang, H.P. *et al*., "Pharmacology", 5th Edition, Churchill Liningstone / Elsevier, 2003.
7. Dipalma, Joseph R. "Basic Pharmacology in Medicine", 3rd Edition, McGraw – Hill Publishing,1990.

III Year – I Sem	QUALITY CONTROL AND ASSURANCE	L	T	P	C
		2	0	0	2

COURSE OBJECTIVES: Upon completion of the course student shall be able to:
- Understand the cGMP aspects in a pharmaceutical industry
- Appreciate the importance of documentation
- understand the scope of quality certifications applicable to pharmaceutical industries
- understand the responsibilities of QA&QC departments

COURSE CONTENT:

UNIT– I

Quality Assurance and Quality Management concepts: Definition and concept of Quality control, Quality assurance and GMP

Total Quality Management (TQM): Definition, elements, philosophies

ICH Guidelines: purpose, participants, process of harmonization, Brief over view of QSEM, with special emphasison Q-series guidelines, ICH stability testing guidelines

Quality by design (QbD): Definition, overview, elements of QbD program tools

ISO 9000 & ISO14000: Overview, Benefits, Elements, steps for registration **NABL accreditation**: Principles and procedures

UNIT-II

Organization and personnel: Personnel responsibilities, training, hygiene and personal records.

Premises: Design, construction and plant layout, maintenance, sanitation, environmental control, utilities and maintenance of sterile areas, control of contamination.

Equipments and raw materials: Equipment selection, purchase specifications, maintenance, purchase specifications and maintenance of stores for raw materials.

UNIT– III

Quality Control: Quality control test for containers, rubber closures and secondary packing material

Good Laboratory Practices: General Provisions, Organization and Personnel, Facilities, Equipment, Testing Facilities Operation, Test and Control Articles, Protocol for Conduct of a Non clinical Laboratory Study, Records and Reports, Disqualification of Testing Facilities

UNIT– IV

Complaints: Complaint and evaluation of complaints, Handling of returned goods, recalling and waste disposal.

Document maintenance in pharmaceutical industry: Batch Formula Record, Master Formula Record, SOP, Quality audit, Quality Review and Quality documentation, Reports and documents, distribution records.

UNIT– V

Calibration: Introduction, definition and general principles of calibration, qualification and validation. Calibration of pH meter, Qualification of UV-Visible spectrophotometer.

Warehousing: Good warehousing practice, materials management.

Recommended Books:(Latest Edition)

1. Quality Assurance Guide by organization of Pharmaceutical Products of India.
2. Good Laboratory Practice Regulations,2nd Edition, Sandy WeinbergVol.69.
3. Quality Assurance of pharmaceuticals-A compendium of Guidelines and Related materials Vol. I WHO Publications.
4. Auide to Total Quality Management- Kushik Maitra and Sedhan K Ghosh
5. How to Practice GMP's–P P Sharma.
6. ISO 9000 and Total Quality Management–Sadhank G Ghosh
7. The International Pharmacopoeia – Vol I, II, III, IV- General Methods of Analysis and Quality specification for Pharmaceutical Substances, Excipients and Dosage forms
8. Good laboratory Practices– Marcel Deckker Series
9. ICH guidelines, ISO 9000 and14000 guidelines

III Year – I Semester	**FOOD PROCESSING TECHNOLOGY**	L	T	P	C
		2	0	0	2

COURSE OBJECTIVES: To impart pertinent concepts about different unit operations involved in the food processing industry and preservation techniques.

COURSE OUTCOMES: The student will enable to
1. Perform material balance and energy balance calculations for food processing
2. Explain various unit operations such as fluid flow, thermal process calculations, refrigeration and
3. dehydration in food processing.
4. Explain the theory, applications, equipment involved and hazards of microwave heating in food processing
5. Describe the different mechanical unit operations involved in food processing industry
6. Explain the various preservation techniques.

COURSE CONTENT:

UNIT-I

Food process engineering: Fundamentals of food process engineering, application of quantitative methods of material and energy balances in food engineering practices.

UNIT-II

Unit Operations in food industries: Fluid flow, thermal process calculations, refrigeration, and dehydration operations in food processing.

UNIT-III

Microwave heating: Theory of microwave heating, microwave properties of foods, comparison of microwave and conventional heating, benefits of microwave heating. Applications in food processing, microwave heating equipment, hazards of microwave heating.

UNIT-IV

Mechanical Operations in food processing: Size reduction and screening of solids, mixing and emulsification, filtration, crystallization, extraction.

UNIT-V

Preservation operations: Preservation methods & Strategies, Thermal Methods, Nabla Factor Sterilization, Types of Pasteurization, Dehydro freezing, Irradiation Dosimetry, Transport of food & Preservation strategies

Text Books:

1. R. T. Toledo, Fundamentals of Food Process Engineering", AVI Publishing Co., 1990.
2. R. AngoldG.Beech and J.Taggart, "Food Biotechnology", Cambridge University Press, 1989.

3. Fundamentals of Food Engineering. D G Rao, PHI, New Delhi, 2012.

Reference Books:

1. J.M. Jackson and B. M. Shinn. Fundamentals of Food Canning Technology", AVI Publishing Co., 1978.
2. G. Bernnan, J. P. Butters, N. D. Cowell and AEV Lilley, "Food Engineering Operations", 2ndEdn., Applied Science, 1976. ww 3.

III Year – I Semester	PHARMACEUTICAL BIOTECHNOLOGY	L	T	P	C
		2	0	0	2

COURSE OBJECTIVE

- Biotechnology has a long promise to revolutionize the biological sciences and technology.
- Scientific application of biotechnology in the field of genetic engineering, medicine and fermentation technology makes the subject interesting.
- Biotechnology is leading to new biological revolutions in diagnosis, prevention and cure of diseases, new and cheaper pharmaceutical drugs.
- Biotechnology has already produced transgenic crops and animals and the future promises lot more.
- It is basically a research-based subject.

COURSE OUTCOMES: Upon completion of the subject student shall be able to;
1. Understanding the importance of Immobilized enzymes in Pharmaceutical Industries
2. Genetic engineering applications in relation to production of pharmaceuticals
3. Importance of Monoclonal antibodies in Industries
4. Appreciate the use of microorganisms in fermentation technology

COURSE CONTENT:

Unit I

a) Brief introduction to Biotechnology with reference to Pharmaceutical Sciences.
b) Enzyme Biotechnology- Methods of enzyme immobilization and applications.
c) Biosensors- Working and applications of biosensors in Pharmaceutical Industries.
d) Brief introduction to Protein Engineering.
e) Use of microbes in industry. Production of Enzymes- General consideration- Amylase, Catalase, Peroxidase, Lipase, Protease, Penicillinase.
f) Basic principles of genetic engineering.

Unit II

a) Study of cloning vectors, restriction endonucleases and DNA ligase.
b) Recombinant DNA technology. Application of genetic engineering in medicine.
c) Application of r DNA technology and genetic engineering in the production of:
   i) Interferon ii) Vaccines- hepatitis- B iii) Hormones-Insulin.
d) Brief introduction to PCR

Unit III

Types of immunity- humoral immunity, cellular immunity
a) Structure of Immunoglobulins
b) Structure and Function of MHC
c) Hypersensitivity reactions, Immune stimulation and Immune suppressions.
d) General method of the preparation of bacterial vaccines, toxoids, viral vaccine, antitoxins, serum-immune blood derivatives and other products relative to immunity.

e) Storage conditions and stability of official vaccines
f) Hybridoma technology- Production, Purification and Applications
g) Blood products and Plasma Substituties.

Unit IV

a) Immunoblotting techniques- ELISA, Western blotting, Southern blotting.
b) Genetic organization of Eukaryotes and Prokaryotes
c) Microbial genetics including transformation, transduction, conjugation, plasmids and transposons.
d) Introduction to Microbial biotransformation and applications.
e) Mutation: Types of mutation/mutants.

Unit V

a) Fermentation methods and general requirements, study of media, equipments, sterilization methods, aeration process, stirring.
b) Large scale production fermenter design and its various controls.
c) Study of the production of - penicillins, citric acid, Vitamin B12, Glutamic acid, Griseofulvin,
d) Blood Products: Collection, Processing and Storage of whole human blood, dried human plasma, plasma substitutes.

Recommended Books (Latest edition):

1. B.R. Glick and J.J. Pasternak: Molecular Biotechnology: Principles and Applications of RecombinantDNA: ASM Press WashingtonD.C.
2. RA Goldshyet. al., :KubyImmunology.
3. J.W. Goding: MonoclonalAntibodies.
4. J.M. Walker and E.B. Gingold: Molecular Biology and Biotechnology byRoyal Society of Chemistry.
5. Zaborsky: Immobilized Enzymes, CRC Press, Degraland,Ohio.
6. S.B. Primrose: Molecular Biotechnology (Second Edition) Blackwell Scientific Publication.
7. Stanbury F., P., Whitakar A., and Hall J., S., Principles of fermentationtechnology, 2nd edition, Aditya books Ltd., NewDelhi

III Year – I Semester	NON-CONVENTIONAL ENERGY SOURCES	L	T	P	C
		3	0	0	3

COURSEOBJECTIVES: The course will enable the student's to

1. Study the concepts of solar energy radiation, collection, storage and applications.
2. Acquire the knowledge on the wind energy, biomass energy,
3. Students will learn the systems dimensions of the energy problems and its historical perspective on energy technology and system development.

COURSEOUTCOMES: At the end of this course, students will be able to

1. Illustrate the principles behind different non-convention AI energy sources. (L2)
2. Explain the effects of the current energy systems based on fossil fuels over the environment and the society. (L3)
3. Design renewable/hybrid energy systems that meet specific energy demands, are economically feasible and have a minimal impact on the environment. (L4)
4. Summarize the wind Energy, horizontal and vertical Access wind Mills and bio-conversion. (L2)
5. Classify types of Bio-Gas digesters and Utilization for Cooking using Geothermal Energy Resources. (L3)

COURSE CONTENT:

UNIT I:

Principles of Solar Radiation

Role and potential of new and renewable source, the solar energy option, Environmental impact of solar power, physics of the sun, the solar constant, extraterrestrial and terrestrial solar radiation, solar radiation on titled surface, instruments for measuring solar radiation and sun shine, solar radiation data.

UNIT II:

Solar Thermal Systems

Flat plate and concentrating collectors, classification of concentrating collectors, solar ponds. Solar Applications-solar heating/cooling technique, solar distillation and drying.

UNIT III:

Solar Photovoltaic Systems: Operating principles, Photovoltaic cell concepts, Cell, module, array, Series and parallel connections, Maximum power point

tracking, Applications: Battery charging, Pumping, Lighting.

UNIT IV:

Wind Energy

Sources and potentials, horizontal and vertical axis wind mills, performance characteristics, Betzcriteria.

UNITV:

Bio-Mass Energy

Operating principles. Combustion and fermentation, Anaerobic digester, Wood gasifier, Pyrolysis. Applications: Biogas, Wood stoves, Biodiesel, Combustion engine.

TEXTBOOKS:
1. Non-Conventional Energy Sources/G.D.Rai, Khanna Publishers
2. Renewable Energy Resources–Twidell & Wier, CRC Press (Taylor & Francis)

REFERENCES:
1. Renewable energy resources/Tiwari and Ghosal/Narosa.
2. Renewable Energy Technologies/Ramesh &Kumar/Narosa
3. Non-Conventional Energy Systems/KMittal/Wheeler.
4. Renewable energy sources and emerging technologies by D.P.Kothari K.C.Singhal, P.H.I.

III Year – I Semester	INTRODUCTION TO DATA STRUCTURES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:
The objective of the course is to
- Introduce the fundamental concept of data structures and abstract data types
- Emphasize the importance of data structures in developing and implementing efficient algorithms
- Describe how arrays, records, linked structures, stacks, queues, trees, and graphs are represented in memory and used by algorithms

COURSE OUTCOMES:
After completing this course a student will be able to:
- Summarize the properties, interfaces, and behaviors of basic abstract data types
- Discuss the computational efficiency of the principal algorithms for sorting & searching
- Use arrays, records, linked structures, stacks, queues, trees, and Graphs in writing programs
- Demonstrate different methods for traversing trees

COURSE CONTENT:

UNIT I

Data Structures - Definition, Classification of Data Structures, Operations on Data Structures, Abstract Data Type (ADT), Preliminaries of algorithms. Time and Space complexity. Searching - Linear search, Binary search, Fibonacci search. Sorting- Insertion sort, Selection sort, Exchange (Bubble sort, quick sort), distribution (radix sort), merging (Merge sort) algorithms.

UNIT II

Linked List: Introduction, Single linked list, Representation of Linked list in memory, Operations on Single Linked list-Insertion, Deletion, Search and Traversal ,Reversing Single Linked list, Applications on Single Linked list- Polynomial Expression Representation ,Addition and Multiplication, Sparse Matrix Representation using Linked List, Advantages and Disadvantages of Single Linked list, Double Linked list-Insertion, Deletion, Circular Linked list-Insertion, Deletion.

UNIT III

Queues: Introduction to Queues, Representation of Queues-using Arrays and using Linked list, Implementation of Queues-using Arrays and using Linked list, Application of Queues-Circular Queues, Deques, Priority Queues, Multiple Queues.

Stacks: Introduction to Stacks, Array Representation of Stacks, Operations on Stacks, Linked list Representation of Stacks, Operations on Linked Stack, Applications-Reversing list, Factorial Calculation, Infix to Postfix Conversion, Evaluating Postfix Expressions.

UNIT IV

Trees: Basic Terminology in Trees, Binary Trees-Properties, Representation of Binary Trees using Arrays and Linked lists. Binary Search Trees- Basic Concepts, BST Operations: Insertion, Deletion, Tree Traversals, Applications-Expression Trees, Heap Sort, Balanced Binary Trees- AVL Trees, Insertion, Deletion and Rotations.

UNIT V

Graphs: Basic Concepts, Representations of Graphs-Adjacency Matrix and using Linked list, Graph Traversals (BFT & DFT), Applications- Minimum Spanning Tree Using Prims &Kruskals Algorithm, Dijkstra's shortest path, Transitive closure, Warshall's Algorithm.

Text Books:
1. Data Structures Using C. 2nd Edition.ReemaThareja, Oxford.
2. Data Structures and algorithm analysis in C, 2nded, Mark Allen Weiss.

Reference Books:
1. Fundamentals of Data Structures in C, 2nd Edition, Horowitz, Sahni, Universities Press.
2. Data Structures: A PseudoCode Approach, 2/e, Richard F.Gilberg, Behrouz A. Forouzon, Cengage.
3. Data Structures with C, Seymour Lipschutz TMH

e-Resources:
1. http://algs4.cs.princeton.edu/home/
2. https://faculty.washington.edu/jstraub/dsa/Master_2_7a.pdf

III Year – I Semester	DESIGN AND ANALYSIS OF EXPERIMENTS	L	T	P	C
		3	0	0	3

Course Objectives:
1. To identify the role of expenmentations in engineering
2. To study the importance of single factor expenmentation
3. To gain the concepts of multifactor experimentation
4. To use fractional factonal design of experiments
5. To understand the usage of response surface methodology
6. To study the concepts of laguchi methods.

Course Outcomes: At the end of the course students will be able to
1. Plan an experimentation using the experimental design strategies and principles
2. Estimate model parameters and analyse the model adequacy
3. Design experimentation for a multifactor problem using factorial design
4. Compute fractional factorial design of experimentation
5. Proposed e sign using a response surface methodology and interpret the results
6. Correlate experimentation with a Taguchi based design for a given case study

COURSE CONTENT
UNIT-I
Experimental Design Fundamental: Importance of experiments, experimental strategies, basic principles of design, terminology, ANOVA, steps in experimentation, sample size, normal probability plot, linear regression model.
UNIT - II
Single Factor Experiments: Completely randomized design, Randomized block design, Latin square design Statistical analysis, estimation of model parameters, model adequacy checking, pair wise comparison tests.
UNIT-III
Multifactor Experiments: Two and three factor factorialexperiments,2^Kfactorial experiments, confounding and blocking designs
Fractional Factorial design: Fractional factorial design of experiments, nested designs, split plot design
UNIT - IV
Special Experimental Design: Response Surface Methodology, experiments with random factors, rules for expected mean squares, approximate F-tests.

UNIT - V
Taguchi Methods: Steps in experimentation, design using Orthogonal Arrays, data analysis, Robust design control and noise factors, S/N ratios, parameter design, case studies.

Text Books:
1. Design and Analysis of Experiments/Montgomery

DC/7thEdition/John Wiley & Sons, NY/2008.

2. Taguchi Techniques for Quality Engineering/RossPJ/McGraw-Hill Book Company, NY/2ndEdition/2005.

Reference Books:

1. DoeSimplified: Practical Tools for Effective Experimentation/M.J. Anderson, and P.J.Whit comb/3rdEdition/ProductivityPress,USA/2015

2. Modern Statistics for Engineering and Quality Improvement/J.Lawson, and J.Erjavec/1stEdition/DuxburyPress/2000.

3. Statistics for Experimenters /G.E.P.Box,W.G.Hunter, and S.J.Hunter/2ndEdition/JohnWiley&SonsInc./ 2005.

III Year – I Semester	**HOSPITAL MANAGEMENT**	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:
1. To understand the role of IT in hospital management
2. To familiarise with the latest developments in technology with relevance to hospitals

COURSE CONTENT
Unit I:

The Information Explosion: Information is important – Impact on society – Impact on teaching and learning – Impact on Government – Impact on Healthcare – The future of healthcare technology – The future healthcare record – Preparing for the future – Summary. The world of Informatics

Unit II

The Electronic health record: Functions of the health record –Changing functions of the patients record – Advantages of the paper record – Disadvantages of the paper record – Optically scanned records – The electronic health record – Automating the paper record – Advantages of the EHR – Disadvantages of the EHR – Bedside or point-or-care systems – Human factors and the EHR – Roadblocks and challenges to EHR implementation –The future

Unit III

Securing the Information: Privacy and confidentiality and Law – Who owns the data? – Security – Computer crime – Role of healthcare professionals – Summary. Information Systems cycle: The information systems cycle – Analysis – Design phase – Development – Implementation – Why some projects fails?

Unit IV

Electronic Communications: A bit of history – Hardware and software for connecting – Methods of accessing information – World Wide Web (WEB) – Communication Technologies

Unit V

Telehealth– Historical perspective on telehealth – Types of Technology – Clinical initiatives – Administrative initiatives – Advantages and Barriers of telehealth – Future trends – Summary- The future of Informatics: Globalization of Information Technology – Electronic communication – Knowledge management – Genomics – Advances in public health – Speech recognition – Wireless computing – Security – Telehealth – Informatics Education – Barriers to Information Technology implementation

REFERENCES:

1. Kathleen M., Informatics for Healthcare Professional
2. James O'brien, Tata Mc graw Hill, Management Information System
3. Peter Norton, Introduction To Computer, Tata Mc graw Hill

III Year – I Semester	NEURALNETWORKS AND FUZZY LOGIC	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES: The course will enable the student's to
1. Understand the concept of Neural Networks.
2. Analyze the concepts of Fuzzy Logic.
3. Apply the concepts of neural networks and fuzzy logic to electrical applications.

COURSE OUTCOMES: At the end of this course, students will be able to
1. Identify the architectures of neural networks and the learning methodologies. (L3)
2. Examine the concepts of single and multi-layer feed forward neural networks. (L4)
3. Analyze the paradigms of associative memory and architecture of Hopfield network. (L4)
4. Illustrate the operations and relations in fuzzy set theory. (L2)
5. Apply fuzzy logic control to real time systems. (L3)

COURSE CONTENT:

UNIT-I:
ARTIFICIALNEURALNETWORKS
Introduction-ModelsofNeuralNetworks-Architectures–
Knowledgerepresentation–ArtificialNeuron Model, Types of Neuron Activation Functions, Artificial Intelligence and Neural networks –Learning process – McCulloch-Pitts Model, Hebbian learning – Supervised learning – Un supervised learning–Reinforcement learning, Potential Applications of ANN.

UNITII:
SINGLEANDMULTILAYERFEEDFORWARDNETWORK
Single layer and Multi-layer perceptron Networks, Limitations of the Perceptron Model, Generalized Delta Rule, ADALINE and MADLINE Networks, Back propagation Algorithm.

UNIT-III:
ANNPARADIGMS
Paradigms of Associative Memory, Bidirectional Associative Memory (BAM) Architecture, BAM Training Algorithms, Radial Basis Networks, Hop field Network.

UNIT-IV:
INTRODUCTIONTOFUZZYLOGIC
Introduction to classical sets-properties, Operations and relations; Fuzzy versus crisp, Fuzzysets, Membership functions, Uncertainty, Operations, properties, fuzzy relations.

UNIT-V:
FUZZYSYSTEMS
Fuzzification, De-fuzzification methods, Applications of fuzzy logic control.

TEXTBOOKS:

1. JackM.Jurada,‒Introduction to Artificial Neural Systems‖, West Publishing Company.
2. S.N.Sivanandam, S.N. Deepa,—Principles of Soft Computing methods, Wiley.
3. S.Rajasekaran and G.A.V.Pai, **"**Neural Networks, Fuzzy Logic & Genetic Algorithms**"**-PHI, NewDelhi,2003.
4. Timothy J. Ross,—Fuzzy Logic with Engineering Applications**,** Second edition, Wiley.

REFERENCES:

1. G.J.Klir and, T.A.Folger, **"**Fuzzysets, Uncertainty and Information**"**-PHI, Pvt. Ltd,1994.
2. P.D.Wasserman,Van Nostr and Reinhold, **"**Neural Computing Theory & Practice**"** -NewYork,1989.
3. S.N.Sivanandam,S.N.Sumathi and S.N.Deepa,—Introduction to Neural Networks using MATLAB6.0‖,McGrawHill.

III Year – I Semester	INTRODUCTION TO DATABASE MANAGEMENT SYSTEM	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

1. To introduce about database management systems
2. To give a good formal foundation on the relational model of data and usage of Relational Algebra
3. To introduce the concepts of basic SQL as a universal Database language
4. To demonstrate the principles behind systematic database design approaches by covering conceptual design, logical design through normalization.
5. To provide an overview of physical design of a database system, by discussing Database indexing techniques and storage techniques

COURSE OUTCOMES:

By the end of the course, the student will be able to

☐ Describe a relational database and object-oriented database

☐ Create, maintain and manipulate a relational database using SQL

☐ Describe ER model and normalization for database design

☐ Examine issues in data storage and query processing and can formulate appropriate solutions

☐ Outline the role and issues in management of data such as efficiency, privacy, security, ethical responsibility, and strategic advantage

COURSE CONTENT:

UNIT I

Introduction: Database system, Characteristics (Database Vs File System), Database Users(Actors on Scene, Workers behind the scene), Advantages of Database systems, Database applications. Brief introduction of different Data Models; Concepts of Schema, Instance and data independence; Three tier schema architecture for data independence; Database system structure, environment, Centralized and Client Server architecture for the database.

UNIT II

Relational Model: Introduction to relational model, concepts of domain, attribute, tuple, relation, importance of null values, constraints (Domain, Key constraints, integrity constraints) and their importance BASIC SQL: Simple Database schema, data types, table definitions (create, alter), different DML operations (insert, delete, update), basic SQL querying (select and project) using where clause, arithmetic & logical operations, SQL functions(Date and Time, Numeric, String conversion).

UNIT III

Entity Relationship Model: Introduction, Representation of entities, attributes, entity set, relationship, relationship set, constraints, sub classes, super class, inheritance, specialization, generalization using ER Diagrams. SQL: Creating tables with relationship, implementation of

key and integrity constraints, nested queries, sub queries, grouping, aggregation, ordering, implementation of different types of joins, view(updatable and non-updatable), relational set operations.

UNIT IV

Schema Refinement (Normalization): Purpose of Normalization or schema refinement, concept of functional dependency, normal forms based on functional dependency(1NF, 2NF and 3 NF), concept of surrogate key, Boyce-codd normal form(BCNF), Lossless join and dependency preserving decomposition, Fourth normal form(4NF), Fifth Normal Form (5NF).

UNIT V

Transaction Concept: Transaction State, Implementation of Atomicity and Durability, Concurrent Executions, Serializability, Recoverability, Implementation of Isolation, Testing for Serializability, Failure Classification, Storage, Recovery and Atomicity, Recovery algorithm.

Indexing Techniques: B+ Trees: Search, Insert, Delete algorithms, File Organization and Indexing, Cluster Indexes, Primary and Secondary Indexes , Index data Structures, Hash Based Indexing: Tree base Indexing ,Comparison of File Organizations, Indexes and Performance Tuning.

Text Books:
1. Database Management Systems, 3/e, Raghurama Krishnan, Johannes Gehrke, TMH
2. Database System Concepts,5/e, Silberschatz, Korth, TMH

Reference Books:
1. Introduction to Database Systems, 8/e C J Date, PEA.
2. Database Management System, 6/e RamezElmasri, Shamkant B. Navathe, PEA
3. Database Principles Fundamentals of Design Implementation and Management, Corlos Coronel, Steven Morris, Peter Robb, Cengage Learning.

e-Resources:
1. https://nptel.ac.in/courses/106/105/106105175/
2. https://www.geeksforgeeks.org/introduction-to-nosql/

III Year – I Semester	PHARMACOLOGY LAB	L	T	P	C
		0	0	3	1.5

1. Introduction to experimental pharmacology.

2. Commonly used instruments in experimental pharmacology.

3. Study of common laboratory animals.

4. Maintenance of laboratory animals as per CPCSEA guidelines.

5. Common laboratory techniques. Blood withdrawal, serum and plasma separation, anesthetics and euthanasia used for animal studies.

6. Study of different routes of drugs administration in mice/rats.

7. Study of effect of hepatic microsomal enzyme inducers on the phenobarbitone sleeping time in mice.

8. Effect of drugs on ciliary motility of frog oesophagus

9. Effect of drugs on rabbit eye.

10. Effects of skeletal muscle relaxants using rota-rod apparatus.

11. Effect of drugs on locomotor activity using actophotometer.

12. Anticonvulsant effect of drugs by MES and PTZ method.

13. Study of stereotype and anti-catatonic activity of drugs on rats/mice.

14. Study of anxiolytic activity of drugs using rats/mice. 15. Study of local anesthetics by different methods

Note: All laboratory techniques and animal experiments are demonstrated by simulated experiments by softwares and videos

Recommended Books (Latest Editions) 1. Rang H. P., Dale M. M., Ritter J. M., Flower R. J., Rang and Dale's Pharmacology,.Churchil Livingstone Elsevier 2. Katzung B. G., Masters S. B., Trevor A. J., Basic and clinical pharmacology, Tata Mc Graw-Hill 3. Goodman and Gilman's, The Pharmacological Basis of Therapeutics 4. Marry Anne K. K., Lloyd Yee Y., Brian K. A., Robbin L.C., Joseph G. B., Wayne A. K., Bradley R.W., Applied Therapeutics, The Clinical use of Drugs, The Point Lippincott Williams & Wilkins 5. Mycek M.J, Gelnet S.B and Perper M.M. Lippincott's Illustrated Reviews- Pharmacology 100 6. K.D.Tripathi. Essentials of Medical Pharmacology, JAYPEE Brothers Medical Publishers (P) Ltd, New Delhi. 7. Sharma H. L., Sharma K. K., Principles of Pharmacology, Paras medical publisher 8. Modern Pharmacology with clinical Applications, by Charles R.Craig& Robert, 9. Ghosh MN. Fundamentals of Experimental Pharmacology. Hilton & Company, Kolkata. 10. Kulkarni SK. Handbook of experimental pharmacology. VallabhPrakashan,

III Year – I Semester	**ANATOMY AND PHYSIOLOGY LAB**	**L**	**T**	**P**	**C**
		0	**0**	**3**	**1.5**

1. Study of compound microscope.
2. Microscopic study of epithelial and connective tissue
3. Microscopic study of muscular and nervous tissue
4. Identification of axial bones
5. Identification of appendicular bones
6. Introduction to hemocytometry.
7. Enumeration of white blood cell (WBC) count
8. Enumeration of total red blood corpuscles (RBC) count
9. Determination of bleeding time
10. Determination of clotting time
11. Estimation of hemoglobin content
12. Determination of blood group.
13. Determination of erythrocyte sedimentation rate (ESR).
14. Determination of heart rate and pulse rate.
15. Recording of blood pressure.

Recommended Books (Latest Editions) 1. Essentials of Medical Physiology by K. Sembulingam and P. Sembulingam. Jaypee brothers medical publishers, New Delhi.

2. Anatomy and Physiology in Health and Illness by Kathleen J.W. Wilson, Churchill Livingstone, New York

3. Physiological basis of Medical Practice-Best and Tailor. Williams & Wilkins Co,Riverview,MI USA

4. Text book of Medical Physiology- Arthur C,Guyton andJohn.E. Hall. Miamisburg, OH, U.S.A.

5. Principles of Anatomy and Physiology by Tortora Grabowski. Palmetto, GA, U.S.A.

III Year – I Semester	ADVANCED COMMUNICATION SKILLS LAB	L	T	P	C
		0	1	2	2

UNIT I

Oral Activity: JAM, Hypothetical Situations, Self/Peer Profile

Common Errors in Pronunciation, Neutralising Accent

UNIT II

Oral Activity: Telephonic Etiquette, Role Plays Poster Presentations

UNIT III

Oral Activity: Oral Presentation skills, Public speaking Data Interpretation

UNIT IV

Oral Activity: Group Discussions: Do's and Don'ts- Types, Modalities

UNIT V

Oral Activity: Interview Skills: Preparatory Techniques, Frequently asked questions, Mock Interviews.

Pronunciation: Connected speech (Pausing, Tempo, Tone, Fluency etc.,)

References:

1. Infotech English, Maruthi Publications (with Compact Disc).
2. Exercises in Spoken English Part 1,2,3,4, OUP and CIEFL.
3. English Pronunciation in use- Mark Hancock, Cambridge University Press.
4. English Phonetics and Phonology-Peter Roach, Cambridge University Press.
5. English Pronunciation in use- Mark Hewings, Cambridge University Press.
6. English Pronunciation Dictionary- Daniel Jones, Cambridge University Press.
7. English Phonetics for Indian Students- P. Bala Subramanian, Mac Millan Publications.
8. Technical Communication- Meenakshi Raman, Sangeeta Sharma, Oxford University Press.
9. Technical Communication- Gajendrea Singh Chauhan, SmitaKashiramka, Cengage Publications.

III Year – I Semester	**TINKERING (STATISTICS USING R- PROGRAMMING LAB**	**L**	**T**	**P**	**C**
		0	**0**	**2**	**1**

COURSE OBJECTIVE: This course provides a solid undergraduate foundation in both probability theory and mathematical statistics and at the same time provides an indication of the relevance and importance of the theory in solving practical problems in the real world

CO1: Manipulate data within R and to create simple graphs and charts used in introductory statistics

CO2: Perform and interpret different distribution using R

CO3: Carry out hypothesis testing and calculate confidence intervals; Perform linear regression models for data analysis

Prerequisites: Basics of Mathematics

Syllabus

UNIT-1: Introduction to R Programming

Installation of R- Creating workspace

Environment –file systems in R.

UNIT-2: Working with R:

Summary Statistics. Loading R-Datasets- Data frames

Computing descriptive structures.

Mean, Meadian ..etc. Simple plots.

Reading own data files in C&V, TXT..etc formats

- Viewing and manipulatingdata
- plottingdata
- reading in your owndata.

UNIT- 3: Visualizing Data

- Tables, charts and plots. Visualising Measures of Central Tendency, Variation, and Shape.

  Box plots, Pareto diagrams. How to find the mean median standard deviation and quantiles of a set of observations.
- Students may experiment with real as well as sampled data sets.

UNIT 4: Probability Distributions.

- Generate and Visualize Discrete and continuous distributions using the statistical environment. Demonstration of CDF and PDF uniform and normal, binomial Poisson distributions.
- Students are expected to generate sampled data using various distributions and their compute distribution parameters from the sampled data and compare properties.

UNIT5: Densities of Random Variables

- Off the Shelf Distributions in R
- Matching a Density to Data
- More About Making Histograms Cycle

UNIT 6: Binomial Distribution
- Study of binomial distribution. Plots of density and distribution functions. Normal approximation to the Binomial distribution.

UNIT 7: Building Confidence in Confidence Intervals
- Populations Versus Samples
- Large Sample Confidence Intervals
- Simulating Data Sets
- Evaluating the Coverage of Confidence Intervals Cycle

UNIT 8: Perform Tests of Hypotheses
- How to perform tests of hypotheses about the mean when the variance is known. How to
  compute the p-value. Explore the connection between the critical region, the test statistic, and the p-value Cycle

UNIT 9: Correlation
- How to calculate the correlation between two variables. How to make
  scatter plots. Use the scatter plot to investigate the relationship between two variables

UNIT 10: Estimating a Linear Relationship
- A Statistical Model for a Linear Relationship
- Least Squares Estimates
- The R Function lm
- Scrutinizing the Residuals

TEXTBOOK/S:
1. Maria Dolores Ugarte , Ana F. Militino , Alan T. Arnholt "Probability and Statistics with R"
2nd Edition on, CRC Press, 2016.
2. P. Dalgaard. Introductory Statistics with R, 2nd Edition. (Springer 2008)

REFERENCES:
1. Michael Akritas, " Probability & Statistics with R for Engineers and Scientists", 2nd
Edition on, CRC Press, 2016.

Web Links
1. http://nptel.ac.in/courses/106104135/48 2. http://nptel.ac.in/courses/110106

III Year – II Semester	PHARMACEUTICAL ENGINEERING - II	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES: Upon completion of the course the student shall be able to
1. Know the various pharmaceutical dosage forms and their manufacturing techniques.
2. Knowvariousconsiderationsindevelopmentofpharmaceuticaldosageforms
3. Formulate solid, liquid and semisolid dosage forms and evaluate them for their quality

COURSECONTENT:

UNIT-I

Pre formulation Studies: Introduction to pre formulation, goals and objectives, study of physicochemical l characteristics of drug substances.
  a. *Physical properties:* Physical form (crystal & amorphous), particle size, shape, flow properties, solubility profile (pKa, pH, partition coefficient), polymorphism.
  b. *Chemical Properties:* Hydrolysis, oxidation, reduction, racemisation, polymerization, BCS classification of drugs & its significance

Application of pre formulation considerations in the development of solid, liquid oral and parenteral dosage forms and its impact on stability of dosage forms.

UNIT-II

Tablets:

  a. Introduction, ideal characteristics of tablets, classification of tablets. Excipients, Formulation of tablets, granulation methods, compression and processing problems. Equipments and tablet tooling.
  b. Tablet coating: Types of coating, coating materials, formulation of coating composition, methods of coating, equipment employed and defects in coating.
  c. Quality control tests: In process and finished product tests

  Liquid orals: Formulation and manufacturing consideration of syrups and elixirs uspensions and emulsions; Filling and packaging; evaluation of liquid orals

UNIT-III

Capsules:

  a. *Hard gelatin capsules:* Introduction, Production of hard gelatin capsule shells. size of capsules, Filling, finishing and special techniques of formulation of hard gelatin capsules, manufacturing defects. In process and final product quality control tests for capsules.
  b. *Soft gelatin capsules:* Nature of shell and capsule content, size of capsules, importance of base adsorption and minim/gram factors, production, in process and final product quality control tests. Packing, storage and stability testing of soft gelatin capsules andt heir applications.

Pellets: Introduction, formulation requirements, pelletization process, equipments for manufacture of pellets

UNIT-IV

Parenteral Products

a. Definition, types, advantages and limitations. Pre formulation factors and essential requirements, vehicles, additives, importance of isotonicity

b. Production procedure, production facilities and controls, aseptic processing

c. Formulation of injections, sterile powders, large volume parenterals and lyophilized products.

d. Containers and closures selection, filling and sealing of ampoules, vials and infusion fluids. Quality control tests of parenteral products.

Ophthalmic Preparations: Introduction, formulation considerations; formulation of eyedrops, eye ointments and eye lotions; methods of preparation; labeling, containers; evaluation of ophthalmic preparations

UNIT-V

Cosmetics: Formulation and preparation of the following cosmetic preparations :lipsticks, shampoos, cold cream and vanishing cream, tooth pastes, hair dyes and sunscreens.

Pharmaceutical Aerosols: Definition, propellants, containers, valves, types of aerosol systems; formulation and manufacture of aerosols; Evaluation of aerosols; Quality control and stability studies.

Packaging Materials Science: Materials used for packaging of pharmaceutical products, factors influencing choice of containers, legal and official requirements for containers, stability aspects of packaging materials, quality control tests.

Recommended Books: (Latest Editions)

1. Pharmaceutical dosage forms - Tablets, volume 1 -3 by H.A. Liberman, Leon Lachman &J.B.Schwartz
2. Pharmaceutical dosage form - Parenteral medication vol- 1&2 by Liberman&Lachman
3. Pharmaceutical dosage form disperse system VOL-1 by Liberman&Lachman
4. Modern Pharmaceutics by Gilbert S. Banker & C.T. Rhodes, 3rd Edition
5. Remington: The Science and Practice of Pharmacy, 20th edition Pharmaceutical Science (RPS)
6. Theory and Practice of Industrial Pharmacy by Liberman&Lachman.

7. Pharmaceutics- The science of dosage form design by M.E.Aulton, Churchill livingstone, Latest edition.

8. Introduction to Pharmaceutical Dosage Forms by H. C.Ansel, Lea &Febiger, Philadelphia, 5th edition, 2005.

9. Drug stability Principles and practice by Cartensen& C.J. Rhodes, 3rd Edition. Marcel Dekker Series, Vol 107.

III Year – II Semester	BIOPHARMACEUTICS AND PHARMACOKINETICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES: Upon completion of the course student shall be able to:
1. Understand the basic concepts in biopharmaceutics and pharmacokinetics and their significance.
2. Use of plasma drug concentration-time data to calculate the pharmacokinetic parameters to describe the kinetics of drug absorption, distribution, metabolism, excretion, elimination.
3. To understand the concepts of bioavailability and bioequivalence of drug products and their significance.
4. Understand various pharmacokinetic parameters, their significance & applications.

COURSE CONTENT:
UNIT-I

Introduction to Bio pharmaceutics: Absorption; Mechanisms of drug absorption through GIT, factors influencing drug absorption though GIT, absorption of drug from Non per oral extra-vascular routes, **Distribution** Tissue permeability of drugs, binding of drugs, apparent volume of drug distribution, plasma and tissue protein binding of drugs, factors affecting protein-drug binding. Kinetics of protein binding, Clinical significance of protein binding of drugs

UNIT- II

Elimination: Drug metabolism and basic understanding metabolic pathways, renal excretion of drugs, factors affecting renal excretion of drugs, renal clearance, Non renal routes of drug excretion

Bioavailability and Bioequivalence: Definition and Objectives of bioavailability, absolute and relative bioavailability, measurement of bioavailability, *in-vitro* drug dissolution models, *in-vitro-in-vivo* correlations, bioequivalence studies, methods to enhance the dissolution rates and bioavailability of poorly soluble drugs.

UNIT- III

Pharmacokinetics: Definition and introduction to Pharmacokinetics, Compartment models, Non compartment models, physiological models, One compartment open model. (a). Intravenous Injection (Bolus) (b). Intravenous infusion and (c) Extra vascular administrations. Pharmacokinetics parameters - Ke ,$t_{1/2}$,V_d,AUC,Ka, Cl and Cl_R - definitions, methods of eliminations, understanding of their significance and application

UNIT- IV

Multi compartment models: Two compartment open model. IV bolus Kinetics of multiple dosing, steady state drug levels, calculation of loading and maintenance doses and their significance in clinical settings.

UNIT- V

Nonlinear Pharmacokinetics: a. Introduction, b. Factors causing Non-linearity. c. Michaelis-mention method of estimating parameters, Explanation with example of drugs.

Recommended Books: (Latest Editions)
1. Biopharmaceutics and Clinical Pharmacokinetics by, Milo Gibaldi.
2. Biopharmaceutics and Pharmacokinetics; By Robert F Notari
3. Applied biopharmaceutics and pharmacokinetics, Leon Shargel and Andrew B.C.YU 4th edition, Prentice-Hall Inernational edition. USA
4. Bio pharmaceutics and Pharmacokinetics-A Treatise, By D. M. Brahmankar and Sunil B.Jaiswal,Vallabh Prakashan Pitampura, Delhi
5. Pharmacokinetics: By Milo Glbaldi Donald, R. Mercel Dekker Inc.
6. Hand Book of Clinical Pharmacokinetics, By Milo Gibaldi and Laurie Prescott by ADIS Health Science Press.
7. Biopharmaceutics; By Swarbrick
8. Clinical Pharmacokinetics, Concepts and Applications: By Malcolm Rowland and
9. Thomas, N. Tozen, Lea and Febrger, Philadelphia, 1995.
10. Dissolution, Bioavailability and Bioequivalence, By Abdou H.M, Mack, Publishing Company, Pennsylvania 1989.
11. Biopharmaceutics and Clinical Pharmacokinetics-An introduction 4th edition Revised and expanded by Rebort F Notari Marcel Dekker Inn, New York and Basel, 1987.
12. Remington's Pharmaceutical Sciences, By Mack Publishing Company, Pennsylvnia

III Year – II Semester	PRINCIPLES OF TRANSDUCERS AND MEASUREMENTS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

1.To demonstrate fundamentals, basic procedures for operating, testing, calibration and the characteristics of an instrument.

2.To study different types of instruments which are used to measure different parameters like displacement, pressure, temperature.

3.To identify various types of level, flow, speed, vibration etc. and their control.

4.To know the construction details, working principle And mounting of strain gauges for measurement of bending, compressive and tensile forces.

5.To interpret working principle of various instruments used for measurement of humidity, torque and power.

COURSE OUT COMES: At the end of the course students will be able to

1.Analyze the basic elements, characteristics and errors of an instrument.

2. Select the instrument for measurement of displacement, temperature and pressure.

3.Choose appropriate instrument to measure level and flow of fluid

4.Measure speed and vibration using different instruments

5.Illustrate the working principle of strain gauges, mounting procedures for measurement of bending, compressive, tensile forces.

6.Select appropriate instrument to measure humidity, force, torque and power for different applications.

COURSE CONTENT:

UNIT–I

Definition: Basic principles of measurement – Measurement systems, generalized configuration and functional descriptions of measuring instruments–examples. Dynamic performance characteristics–sources of error, Classification and elimination of error

UNIT–II

Measurement of Displacement: Theory and construction of various transducers to measure displacement – Piezo electric, Inductive, capacitance, resistance, ionization and Photo electric transducers-Calibration procedures

Measurement of Temperature: Classification–Ranges–Various Principles of measurement–Expansion, Electrical Resistance–Thermister–Thermocouple– Pyrometers– Temperature Indicators

Measurement of Pressure: Units–classification–different principles used. Manometers, Piston, Bourdon pressure gauges, Bellows–Diaphragmgauges.Lowpressuremeasurement–Thermalconductivitygauges–ionization pressure gauges, McLeod pressure gauge

UNIT–III

Measurement of Level: Direct method–Indirect methods–capacitive, ultrasonic, magnetic, cryogenic fuel level indicators–Bubler level indicators

Flow Measurement: Rotameter, magnetic, Ultrasonic, Turbine flowmeter, Hot – wire anemometer, Laser Doppler Anemo meter(LDA)

Measurement of Speed: Mechanical Tachometers–Electrical tachometers–Stroboscope, Non contact type of tachometer

Measurement of Acceleration and Vibration: Differentsimpleinstruments–PrinciplesofSeismicinstruments–Vibrometerandaccelerometerusingthisprinciple

UNIT–IV

Stress Strain Measurements: Various types of stress and strain measurements–electrical train gauge– gauge factor method of usage of resistance strain gauge for bending compressive and tensile strains–usage for measuring torque, Strain gauge Rosettes. **Measurement of Humidity:** Moisture content of gases, sling psychrometer, Absorption psychrometer, Dew point meter

Measurement of Force, Torque and Power- Elastic force meters, load cells, Torsion meters, Dynamometers.

UNIT–V

Elements of Control Systems: Introduction, Importance–Classification–

Open and closed Systems, Servo mechanisms–Examples with block diagrams–Temperature, speed & position control systems Transfer Functions-Signal flowgraphs.

Text Books:
1. Mechanical Measurements/ Beckwith, T.G. and Buck, N.L /6thEdition/Narosa Publishing House/2006.
2. Experimental Methods for Engineers/ J.P. Holman/ 8th Edition/ McGrawHill/2011.

Reference Books:
1. Principles of Industrial Instrumentation and Control Systems/Chennakesava R Alavala/1stEdition/Cengage Learning/2009.
2. Instrumentation and Control systems/S.Bhaskar/Anuradha Agencies.
3. Instrumentation, Measurement &Analysis /B.C.Nakra & K.K Choudhary /2nd Edition/TMH/2006.
4. Measurement Systems: Applications & design/D.S Kumar/6thEdition/Anuradha Agencies/2002.
5. Mechanical and Industrial Measurements/ R.K.Jain/ 11thEdition/

Khanna Publishers/2013.

6. Mechanical Measurements /sirohiand Radhakrishna/ NewAgeInternational/Instrumentation & Mechanical Measurements/A.K.Tayal/3rdEdition/Galgotia Publications/2010

III Year – II Semester	**COMPUTER AIDED DRUG DESIGN**	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES: Upon completion of this course the student should be able to

1. Role of CADD in drug discovery.
2. Different CADD techniques and their applications
3. Various strategies to design and develop new drug like molecules
4. Working with molecular modelling softwares to design new drug molecules
5. The in silico virtual screening protocols.

COURSE CONTENT:

UNIT-I

Introduction to Computer Aided Drug Design (CADD) History, different technique s and applications Quantitative Structure Activity Relationships: Basics History and development of QSAR: Physicochemical parameters and methods to calculate physicochemical parameters: Hammett equation and electronic parameters (sigma), lipophilicity effects and parameters (log P, pisubstituent constant), steric effects (Taft steric and MR parameters) Experimental and theoretical approaches for the determination of these physicochemical parameters

UNIT-II

Quantitative Structure Activity Relationships: Applications Hansch analysis, Free Wilson analysis and relationship between them, Advantages and disadvantages; Deriving 2D-QSAR equations 3D-QSARapproaches and contour map analysis Statistical methods used in QSAR analysis and importance of statistical parameters

UNIT-III

Molecular Modeling and Docking A) Molecular and Quantum Mechanics in drug design B) Energy Minimization Methods: comparison between global minimum conformation and bioactive conformation C) Molecular docking and drug receptor interactions: Rigid docking, flexible docking and extra-precision docking. Agents acting on enzymes such as DHFR, HMG-CoA reductase and HIV protease, choline esterase (AchE & BchE)

UNIT-IV

 Molecular Properties and Drug Design: a) Prediction and analysis of ADMET properties of new molecules and its importance in drug design. b) De novo drug design: Receptor/enzyme-interaction and its analysis, Receptor/enzyme cavity size prediction, predicting the functional components of cavities, Fragment based drug design. c) Homology modelling and generation of 3D-structure of protein

UNIT-V

Pharmacophore Mapping and Virtual Screening Concept of pharmacophore, pharmacophore mapping, identification of Pharmacophore features and Pharmacophore modeling; Conformational search used in pharmacophore mapping In Silico Drug Design and Virtual Screening Techniques Similarity based methods and Pharmacophore based screening, structure based In-silico virtual screening protocols

REFERENCES:

1. Computational and structural approaches to drug discovery, Robert M StroudandJanet.F Moore, RCS Publishers.
2. Introduction to Quantitative Drug Design by Y.C. Martin, CRC Press, Taylor &Francis group.. 3. Drug Design by Ariens Volume 1 to 10, Academic Press, 1975, Elsevier Publishers.
4. Principles of Drug Design by Smith and Williams, CRC Press, Taylor & Francis.
5. The Organic Chemistry of the Drug Design and Drug action by Richard B. Silverman, Elsevier Publishers.
6. Medicinal Chemistry by Burger, Wiley Publishing Co
7. An Introduction to Medicinal Chemistry –Graham L. Patrick, Oxford University Press.
8. Wilson and Gisvold's Text book of Organic Medicinal and Pharmaceutical Chemistry, Lippincott Williams & Wilkins.
9. Comprehensive Medicinal Chemistry – Corwin and Hansch, Pergamon Publishers.
10. Computational and structural approaches to drug design edited by Robert M Stroud and Janet. F Moore

III Year – II Semester	PHARMACEUTICAL REGULATORY AFFAIRS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES: Upon completion of the subject students shall be able to;

1. Know about the process of drug discovery and development
2. Know the regulatory authorities and agencies governing the manufacture and sale of pharmaceuticals
3. Know the regulatory approval process and their registration in Indian and International markets

COURSECONTENT:

Unit I

Drug Discovery and development

Stages of drug discovery, Drug development process, pre-clinical studies, non-clinical activities, clinical studies, Innovator and generics, Concept of generics, Generic drug product development.

Unit II

Regulatory Approval Process

Approval processes and timelines involved in Investigational New Drug (IND),New Drug Application (NDA), Abbreviated New Drug Application (ANDA). Changes to an approved NDA/ ANDA.

Regulatory authorities and agencies

Overview of regulatory authorities of India, United States, European Union, Australia, Japan, Canada (Organization structure and types of applications)

Unit III

Registration of Indian drug product in overseas market

Procedure for export of pharmaceutical products, Technical documentation, Drug Master Files(DMF), Common Technical Document(CTD), electronic Common Technical Document (e CTD),ASEAN Common Technical Document(ACTD) research.

Unit IV

Clinical trials

Developing clinical trial protocols, Institutional Review Board/Independent Ethics committee-formation and working procedures, Informed consent process and procedures, GCP obligations of Investigators, sponsors & Monitors, Managing and Monitoring clinical trials, Pharmacovigilance-safety monitoring in clinical trials

Unit V

Regulatory Concepts

Basic terminology, guidance, guidelines, regulations, Laws and Acts, Orange book, Federal Register, Code of Federal Regulatory, Purple book

Recommended books (Latest edition):

1. Drug Regulatory Affairs by Sachin Itkar,Dr.N.S.Vyawahare, Nirali Prakashan.

2. The Pharmaceutical Regulatory Process, Second Edition Edited by Ira R. Berry and Robert P. Martin, Drugs and the Pharmaceutical Sciences, Vol.185. Information Health care Publishers.

3. New Drug Approval Process: Accelerating Global Registrations By Richard AGuarino, MD,5thedition, Drugs and the Pharmaceutical Sciences, Vol.190.

4. Guide book for drug regulatory submissions/Sandy Weinberg by JohnWiley & Sons.Inc.

5. FDA Regulatory Affairs: aguide for prescription drugs, medical devices, and biologics/edited by Douglas J. Pisano, David Mantus.

6. Generic Drug Product Development, Solid Oral Dosage forms, Leon Sharge land IsaderKaufer, Marcel Dekker series,Vol.143

7. Clinical Trials and Human Research: A Practical Guide to Regulatory Compliance ByFayA. Rozovsky and Rodney K.Adams

8. Principles and Practices of Clinical Research, Second Edition Edited by John I. Gallin and Frederick P.O gnibene Drugs: From Discovery to Approval, Second Edition By Rick Ng

III Year – II Semester	**NOVEL DRUG DELIVERY SYSTEMS**	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES : Upon completion of the course student shall be able
1. To understand various approaches for development of novel drug delivery systems.
2. To understand the criteria for selection of drugs and polymers for the development of Novel drug delivery systems, their formulation and evaluation

COURSECONTENT:

Unit-I

Controlled drug delivery systems: Introduction, terminology/definitions and rationale, advantages, disadvantages, selection of drug candidate. Approaches to design controlled release formulations based on diffusion, dissolution and ion exchange principles. Physicochemical and biological properties of drugs relevant to controlled release formulations

Polymers: Introduction, classification, properties, advantages and application of polymers in formulation of controlled release drug delivery systems.

Unit-II

Microencapsulation: Definition, advantages and disadvantages, microspheres /microcapsules, micro particles ,methods of micro encapsulation, applications

Mucosal Drug Delivery system: Introduction, Principles of bioadhesion/ muco adhesion, concepts, advantages and disadvantages, transmucosal permeability and formulation considerations of buccal delivery systems

Implantable Drug Delivery Systems: Introduction, advantages and disadvantages, concept of implants and osmotic pump

Unit-III

Trans dermal Drug Delivery Systems: Introduction, Permeation through skin, factors affecting permeation, permeation enhancers, basic components of TDDS, formulation approaches

Gastro retentive drug delivery systems: Introduction, advantages, disadvantages, approaches for GRDDS – Floating, high density systems, inflatable and gastro adhesive systems and their applications

Naso pulmonary drug delivery system: Introduction to Nasal and Pulmonary routes of drug delivery, Formulation of Inhalers (dry powder and metered dose), nasal sprays, nebulizers

Unit-IV

Targeted drug Delivery: Concepts and approaches, advantages and disadvantages, introduction to liposomes, niosomes, nanoparticles, mono clonal antibodies and their applications

Unit-V

Ocular Drug Delivery Systems: Introduction, intraocular barriers and methods to overcome –Preliminary study, ocular formulations and ocuserts

Intrauterine Drug Delivery Systems: Introduction, advantages and disadvantages, development of intra uterine devices (IUDs) and applications

Recommended Books:(LatestEditions)

1. YW.Chien,Novel Drug Delivery Systems,2ndedition,revisedandexpanded,MarcelDekker,Inc., NewYork,1992.
2. Robinson, J. R., Lee V. H. L, Controlled Drug Delivery Systems, Marcel Dekker, Inc., New York, 1992.
3. Encyclopedia of Controlled Delivery. Edith Mathiowitz, Published by Wiley Inter science Publication, John Wiley and Sons, Inc, New York. Chichester/Weinheim
4. N.K. Jain, Controlled and Novel Drug Delivery, CBS Publishers & Distributors, New Delhi, First edition 1997 (reprint in 2001).
5. S.P. Vyas and R.K. Khar, Controlled Drug Delivery -concepts and advances, Vallabh Prakashan, New Delhi, First edition 2002.

Journals

1. Indian Journal of Pharmaceutical Sciences(IPA)
2. Indian Drugs (IDMA)
3. Journal of Controlled Release(Elsevier Sciences)
4. Drug Development and Industrial Pharmacy(Marcel &Decker)
5. International Journal of Pharmaceutics(Elsevier Sciences)

III Year – II Semester	BIO MEDICAL INSTRUMENTATION	L	T	P	C
		2	0	0	2

COURSEOBJECTIVES: To make the student to understand
1. The origin of bio-potentials.
2. Different types of electrodes used in bio-potential recordings.
3. The basic principle of operation of ECG, EEG and EMG equipment
4. The basic principles of operation and applications of medical imaging equipment.
5. Operating principles of the therapeutic instrumentation.

COURSE LEARNING OUTCOMES[CLOs]:
At the end of the course the student will
1. Identify different bio potentials and explain the characteristics of bioelectric signals.BL-2
2. Differentiate various electrodes.BL-3
3. Describe the operating principles of ECG, EEG and EMG equipment.BL-2
4. Describe the medical imaging equipment.BL-2
5. Gain knowledge on the usage of therapeutic equipment.BL-2

COURSE CONTENT:

UNIT-I:

BIOPOTENTIALS

Cell and Its structure and composition, Resting Potential, Generation and Propagation of Action Potential, Conduction through nerve to Neuro-muscular junction. Sources of Biomedical Signals. Bioelectric signals and their characteristics.

UNIT-II:

BIOELECTRODES

Bio-potential Electrodes-Electrode-Electrolyte interface, External, Internal, and Microelectrodes. Static and dynamic characteristics of medical instruments, Components of Medical Instrumentation System.

UNIT-III:

ELECTROPHYSIOLOGICALEQUIPMENT

Electro mechanical activity of heart, Einthoven triangle, Electrocardiograph (ECG)-Standard12-lead configurations, Block diagram description, Electroencephalograph (EEG)- Block diagram description, 10-20 electrode system. Electro myograph (EMG)-Block diagram description, types of electrodes.

UNIT-IV:

MEDICALIMAGINGEQUIPMEN

XI- Ray generation, block diagram of X-ray machine, working principle and block diagram of Computed Tomography (CT), Ultrasound-working principle and operation of A, B&M mode Scanner.

UNIT-V:

THERAPEUTICEQUIPMENT

Cardiac Pacemakers: Need for a Pacemaker, Types-Asynchronous, Synchronous(demand). Defibrillators: Need for Defibrillators, D.C. Defibrillators. Electrosurgical unit, Shortwave Diathermy, Ultrasound Diathermy, Hemodialysis Machine. Ventilator- Microprocessor controlled Ventilator.

TEXTBOOKS:
1. R.S.Khandpur. Hand Book of Biomedical Instrumentation, Mc GrawHill,3rd Edition,2014.
2. John G.Webster. Medical Instrumentation: Application and Design. John Wiley and Sons.Inc., New York.Third edition2013.

REFERENCES:
1. Leslie Cromwell, Biomedical Instrumentation and Measurements–Prentice-Hall,2011
2. L.A.Geddes.L.E.Baker, Principles of Applied Biomedical Instrumentation, JohnWiley &Sons, Third Edition2008.

III Year – II Semester	**PHARMACEUTICAL PRODUCT DEVELOPMENT**	**L**	**T**	**P**	**C**
		2	**0**	**0**	**2**

COURSE CONTENT

Unit-I

Introduction to pharmaceutical product development, objectives, and regulations related to preformulation, formulation development, stability assessment, manufacturing and quality control testing of different types of dosage forms

Unit-II

An advanced study of Pharmaceutical Excipients in pharmaceutical product development with a special reference to the following categories

     i. Solvents and solubilizers
     ii. Cyclodextrins and their applications
     iii. Non - ionic surfactants and their applications
     iv. Polyethylene glycols and sorbitols
     v. Suspending and emulsifying agents
     vi. Semi solid excipients

Unit-III

An advanced study of Pharmaceutical Excipients in pharmaceutical product development with a special reference to the following categories

     i. Tablet and capsule excipients

     ii. Directly compressible vehicles

     iii. Coat materials

     iv. Excipients in parenteral and aerosols products

     v. Excipients for formulation of NDDS

Selection and application of excipients in pharmaceutical formulations with specific industrial applications

Unit-IV

Optimization techniques in pharmaceutical product development. A study of various optimization techniques for pharmaceutical product development with specific examples. Optimization by factorial designs and their applications. A study of QbD and its application in pharmaceutical product development.

Unit-V

Selection and quality control testing of packaging materials for pharmaceutical product development- regulatory considerations.

Recommended Books (Latest editions)

1. Pharmaceutical Statistics Practical and Clinical Applications by Stanford Bolton, Charles Bon; Marcel Dekker Inc.
2. EncyclopediaofPharmaceuticalTechnology,edited by James swar brick, Third Edition,Informa Healthcare publishers.
3. PharmaceuticalDosageForms,Tablets,VolumeII,editedbyHerbertA.Lieberman andLeonLachman; Marcel Dekker,Inc.
4. The Theory and Practice of Industrial Pharmacy, Fourth Edition, edited by RoopkKhar,SPVyas,FarhanJ Ahmad,GauravKJain;CBSPublishersandDistributors Pvt.Ltd.2013.
5. Martin'sPhysicalPharmacyandPharmaceutical Sciences,FifthEdition,editedby Patrick J. Sinko, BI Publications Pvt.Ltd.
6. Targeted and Controlled Drug Delivery, Novel Carrier Systems by S. P. Vyasand R. K.Khar, CBS Publishers and Distributors Pvt. Ltd, First Edition 2012.
7. Pharmaceutical Dosage Forms and Drug Delivery Systems, LoydV. Allen Jr., Nicholas B.Popovich, Howard C. Ansel, 9th Ed.40
8. Aulton's Pharmaceutics – The Design and Manufacture of Medicines, MichaelE. Aulton,3rdEd.
9. Remington – The Science and Practice of Pharmacy, 20thEd.
10. Pharmaceutical Dosage Forms – Tablets Vol 1 to 3, A. Liberman, Leon Lachman and Joseph B.Schwartz
11. Pharmaceutical Dosage Forms – Disperse Systems Vol 1 to 3, H.A. Liberman, Martin, M.R and Gilbert S.Banker.
12. Pharmaceutical Dosage Forms – Parenteral Medication Vol 1 & 2, Kenneth E. Avis and H.A.Libermann.
13. Advanced Review Articles related to thetopics.

III Year – II Semester	INDUSTRIAL PROCESS CONTROL	L	T	P	C
		2	0	0	2

COURSE OBJECTIVES:

The main objectives of this course are:

1. Identify and monitor process parameters of various processes.
2. Understand the principles of controllers, degrees of freedom, and control valves . Recognize these principles written in form of mathematical equations for various control applications.
3. Apply these equations to analyze problems by making good assumptions and learn systematic engineering method to solve practical process control problems.

COURSE CONTENT:

UNIT-I:

PROCESS DYNAMICS: Process variables-Load variables-Dynamics of simple pressure, w, level and temperature process-interacting and non-interacting systems-continuous and batch process -self-regulation-Servo and Regulator operation problems.

UNIT-II:

CONTROL ACTIONS AND CONTROLLERS AND TYPES OF CONTROLLERS: BASIC control actions -characteristics of two position, three position, Proportional Single speed floating. Integral and Derivative control modes-PL, PD, PID control modes-Problems - types of controllers - Pneumatic. Hydraulic and Electronic Controllers to realize various control actions.

UNIT- III:

CONTROLLER SETTINGS AND TUNING OF CONTROLLERS: Evaluation criteria-1/4th decay ratin, IAE. ISE.ITSE. ITAE determination of optimum settings for mathematically described process using time response and frequency respome-tuning of controllers process curve reaction method - contimacus oscillation method-damped oscillation method -problems.

UNIT-IV:

FINAL CONTROL ELEMENTS AND CONTROL VALVES IP Converter.P1 converter pneumatic, electric and hydraulic actuators-valve Potioned Control valves-characteristic of control valves - valve bady- Globe.Butterfly, diaphragm. Ball valves Control valve siring-Cavitation, flashing-problems.

UNIT-V:

MULTILOOP CONTROL SYSTEM: Feed forward control-Feed Forward Feedback Controller (FFFBC) Ratio control-Cascade control - Split range destillation coin, Boiler system and heat exchanger. Multivariable control and examples from

TEXT BOOKS:
1. Automatic Process Comand-by Eckman DP Wiley Fautem Lad, New Delhi, 1993

III Year – II Semester	**ROBOTICS**	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

1. To give students practice in applying their knowledge of mathematics, science and Engineering and to expand this knowledge into the vast area of robotics.
2. The students will be exposed to the concepts of robot kinematics, Dynamics, Trajectory planning.
3. Mathematical approach to explain how the robotic arm motion can be described.
4. The students will understand the functioning of sensors and actuators.

COURSE OUTCOMES:

Upon successful completion of this course you should be able to:

1. Identify various robot configuration and components,
2. Select appropriate actuators and sensors for a robot based on specific application
3. Carry out kinematic and dynamic analysis for simple serial kinematic chains
4. Perform trajectory planning for a manipulator by avoiding obstacles.

UNIT-I

INTRODUCTION: Automation and Robotics, CAD/CAM and Robotics – An over view of Robotics – present and future applications – classification by coordinate system and control system.

UNIT – II

COMPONENTS OF THE INDUSTRIAL ROBOTICS: Function line diagram representation of robot arms, common types of arms. Components, Architecture, number of degrees of freedom – Requirements and challenges of end effectors, determination of the end effectors, comparison of Electric, Hydraulic and Pneumatic types of locomotion devices.

UNIT – III

MOTION ANALYSIS: Homogeneous transformations as applicable to rotation and translation – problems.

MANIPULATOR KINEMATICS: Specifications of matrices, D-H notation joint coordinates and world coordinates Forward and inverse kinematics – problems.

UNIT – IV

Differential transformation and manipulators, Jacobians – problems, Dynamics: Lagrange – Euler and Newton – Euler formulations – Problems.

UNIT V

General considerations in path description and generation. Trajectory planning and avoidance of obstacles, path planning, Skew motion, joint integrated motion –straight line motion – Robot programming, languages and software packages-description of paths with a robot programming language.

Text Books:
1. Industrial Robotics / Groover M P /Pearson Edu.
2. Robotics and Control / Mittal R K &Nagrath I J / TMH.

References:
1. Robotics / Fu K S/ McGraw Hill.
2. Robotic Engineering / Richard D. Klafter, Prentice Hall
3. Robot Analysis and Control / H. Asada and J.J.E. Slotine / BSP Books Pvt.Ltd.
4. Introduction to Robotics / John J Craig / Pearson Edu.

III Year – II Semester	SYNTHESIS AND CHARACTERIZATION OF NANO MATERIALS	L	T	P	C
		3	0	0	3

COURSE OUTCOMES:

    1. To know the Nanoscience technology & Pharmaceutical packing technology

    2. To carry out the synthesis of drug molecules and preparations of pharmaceutical formulations

    3. To be able to apply this knowledge in API & Pharmaceutical Formulation industries

    4. To build a bridge between theoretical and practical concept used in industry

COURSE CONTENT:

UNIT-I

Definitions, classification of nanostructures and systems, nanotechnology and pharmaceutical applications (Introduction).

UNIT-II

Nanoscale properties as a function of size: structural properties, chemical properties, mechanical properties, thermal properties, optical properties, magnetic properties, electronic properties

UNIT-III

Fabrication methods(general approaches): Top-down, bottom-up and templating approaches-Characterization methods(general aspects of each methods to be covered rather than in depth): Imaging(microscopy) methods, analysis(spectroscopy) methods, size measurements etc

UNIT-IV

Self-assembling nanostructure: principle of self assembly(non-covalent inter actions and intermolecular packing), preparation and characterization of Nanoparticles through vesicular and micellar polymerization, nanofilms

UNIT-V

Gold and silver Nanoparticles: preparation, properties and pharmaceutical/healthcare applications- Molecular nanomaterials: dendrimers- Nanotechnology in catalysis: nanostructure and catalysis - fundamental principles, examples of nanocatalyst based synthetic methodologies

References:

1. NanoscaleSciecne and Technology; R. Ke;sall, I. Hamley, M. Geoghegan;
2. Nanobiotechnology (Concepts, applications and perspectives); C.M. Niemeyer and C.A. Mirkin; Nanotechnology in catalysis Vol 1 & 2, B. Zhou, S. Hermans and G.A. Somorjai; Teacher shall prescribe some latest review articles.
3. D. A. Dean, Roy Evans, Ian Hall. Pharmaceutical packaging technology.Tylor and Francis.
4. Edward J. Bauer, Pharmaceutical Packaging Handbook. Bausch and Lomb, Rochester, New York, USA.
5. Wilmer A. Jenkins, Kenton R. Osborn. Packaging drugs and pharmaceuticals.
6. Salvatore J. Turco, Sterile dosage forms: their preparation and clinical application
7. Remington: The Science and Practice of Pharmacy.
8. Michael E. Aulton, Kevin Tylor (Ed.). Aulton's Pharmaceutics: The design and Manufacture of Medicine.
9. Gilbert Banker and Christopher Rhodes.Modern Pharmaceutics.
10. Leon Lachman; Lieberman Herbert A.; Kanig, Joseph L.The theory and Practice of Industrial Pharmacy.

III Year – II Semester	WATER CONSERVATION AND MANAGEMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:
The student will acquire the knowledge on water conservation.

COURSE OUTCOMES:
Upon the successful completion of the course, the student will be able to
1. Understand about water quality.
2. Analyze various water management techniques
3 Understand about Water flow measurement
4. Analyze various water testing methods
5. Conduct water audit and realize the importance water conservation.

COURSE CONTENT:

Unit-I

Introduction: water cycle, water storage, water quality. Water conservation in homes; water conservation in the work place; water management-water quality, controlling use and quality of water.

Unit-II:

Water flow measurement, flow in open channels, flow in pipes partially filled with water, flow in pipes wholly filled with water, accuracy direct flow measurement, water quality control, water quality. parameters, water quality grades, befits of use of water and practical considerations.

Unit- III:

Water testing water salinity, preserving water quality, minimizing evaporation, water sanitation.

Unit - IV

Water audits, Introduction to water auditing and conservation, water and life, a vision for water and - world water conservation, water auditing, the water auditing process, audit preparation, resources, water flow diagram, conducting audit, the water audit report

Unit - V:

Water conservation in agriculture: water conservation in process industry, water conservation in construction industry; water conservation in service industry.

Text books:

1 Water Auditing, and Water Conservation, Jeff Starnian, Geert Ho, Kunivilla Mathew, 2004

III Year – II Semester	TRANSDUCERS AND MEASUREMERNTS LAB	L	T	P	C
		0	0	2	1

1. Measurement of pressure gauge.

2. Measurement of temperature using RTD.

3. Study and Measurement of LVDT transducer for displacement measurement.

4. Measurement of force using strain gauge.

5. Measurement of temperature using thermocouple.

6. Measurement of displacement using capacitive transducer.

7. Study and calibration of photo and magnetic speed pickups.

8. Study and calibration of a rotameter.

9. Study and use of a seismic pickup for the measurement of vibration amplitude of an engine bed at various loads.

10. Study and calibration of Mcleod gauge for low pressure.

III Year – II Semester	**EXPERIMENTAL MODELING AND SIMULATION LAB**	**L**	**T**	**P**	**C**
		0	**0**	**2**	**1**

1. Mass-Spring-Damper with controller

2. Double Mass-Spring- Damper

3. Simple Mechanical System

4. Mechanical System with Translational Friction

5. Mechanical System with Translational Hard stop

6. Mechanical Rotational System with stick-slip motion

7. Linkage Mechanism

8. Steering Mechanism

Softwares Used: MATLAB/SCILAB

III Year – II Semester	EFFLUENT TREATMENT & POLLUTION CONTROL - FIELD TRIP	L	T	P	C
		0	1	2	2

III Year – II Semester	TECHNICAL PAPER WRITING &IPR	L	T	P	C
		2	0	0	-

B.Tech IV Year I Semester

S.No.	Category	Title	L	T	P	C
1	Professional Core	Industrial Pharmacy	3	0	0	3
2	Professional Core	Instrumental methods of Analysis	3	0	0	3
3	Management Course - II	Management Science	2	0	0	2
4	Professional Elective - IV	1.Pharmaceutical Packaging Technology 2.Introduction to Biomaterials and Tissue Engineering 3.Good Manufacturing Practices	3	0	0	3
5	Professional Elective - V	1.Pharmacovigilence 2.Pharmaceutical analysis 3.Invitro diagnosis	3	0	0	3
6	Open Elective - IV	1.Introduction to Additive Manufacturing 2.Aritificial Intelligence & Machine Learning 3.Bioinformatics 4. Quantum Science and Technology	3	0	0	3
7	Professional Core	Industrial Pharmacy lab	0	0	2	1
8	Professional Core	Instrumental methods of Analysis lab	0	0	2	1
9	Skill Enhancement Course	Python Programming lab	0	1	2	2
10	Audit Course	Constitution of India	2	0	0	-
11	Internship	Evaluation of Industry Internship	-	-	-	2
		Total	**19**	**1**	**06**	**23**

B.Tech IV Year II Semester

S.No.	Category	Title	L	T	P	C
1.	Internship & Project Work	Full semester Internship & Project Work	0	0	24	12

IV Year – I Semester	**INDUSTRIAL PHARMACY**	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES: Upon completion of the course, the student shall be able to:

1.Know the process of pilot plant and scale up of pharmaceutical dosage forms

2.Understand the process of technology transfer from lab scale to commercial batch

3.Know different Laws and Acts that regulate pharmaceutical industry

4.Understand the approval process and regulatory requirements for drug products

COURSE CONTENT:

UNIT-I

Pilot plant scale up techniques: General considerations - including significance of personnel requirements, space requirements, raw materials, Pilot plant scale up considerations for solids, liquid orals, semi solids and relevant documentation, SUPAC guidelines, Introduction to platform technology

UNIT-II

Technology development and transfer: WHO guidelines for Technology Transfer(TT): Terminology, Technology transfer protocol, Quality risk management, Transfer from R & D to production (Process, packaging and cleaning), Granularity of TT Process (API, excipients, finished products, packaging materials) Documentation, Premises and equipments, qualification and validation, quality control, analytical method transfer, Approved regulatory bodies and agencies, Commercialization - practical aspects and problems (case studies), TT agencies in India - APCTD, NRDC, TIFAC, BCIL, TBSE / SIDBI;   TT   related documentation-confidentiality agreement, licensing, MoUs, legal issues

UNIT-III

Introduction to fine chemicals and bulk drugs:

Concept of fine and bulk drugs and their salient features - Evaluation of process - Process chemistry - Research and development strategies in pharmaceutical industries.

UNIT-IV

Bulk drugs

Raw materials - Production techniques - Reaction flow sheet - Equipments - Utilities for the production of drugs below - Paracetamol, Aspirin, Ibuprofen, Diazepam, Darvon, Niacinamide, Chloramphenicol, Erythromycin.

UNIT-V

Indian Regulatory Requirements: Central Drug Standard Control Organization (CDSCO) and State Licensing Authority: Organization, Responsibilities, Certificate of Pharmaceutical Product (COPP), Regulatory requirements and approval procedures for New Drugs.

Recommended Books: (Latest Editions)

1. Regulatory Affairs from Wikipedia, the free encyclopedia modified on 7th April available at http,//en.wikipedia.org/wiki/Regulatory_ Affairs.
2. International Regulatory Affairs Updates, 2005. available at http://www.iraup.com/about.php
3. Douglas J Pisano and David S. Mantus. Text book of FDA Regulatory Affairs A Guide for Prescription Drugs, Medical Devices, and Biologics' Second Edition.
4. Regulatory Affairs brought by learning plus, inc. available at http.//www.cgmp.com/ra.htm.

IV Year I Semester	INSTRUMENTAL METHODS OF ANALYSIS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES: Upon completion of the course the student shall be able to
1. Understand the interaction of matter with electromagnetic radiations and its applications in drug analysis
2. Understand the chromatographic separation and analysis of drugs.
3. Perform quantitative & qualitative analysis of drugs using various analytical instruments.

COURSE CONTENT:

UNIT–I

UV Visible spectroscopy

Electronic transitions, chromophores, auxochromes, spectral shifts, solvent effect on absorption spectra, Beer and Lambert's law, Derivation and deviations.

Instrumentation - Sources of radiation, wavelength selectors, sample cells, detectors- Photo tube, Photomultiplier tube, Photo voltaic cell, Silicon Photodiode.

Applications – Spectro photometric titrations, Single component and multi component analysis

Fluorimetry

Theory, Concepts of singlet, doublet and triplet electronic states, internal and external conversions, factors affecting fluorescence, quenching, instrumentation and applications

UNIT–II

IR spectroscopy

Introduction, fundamental modes of vibrations in poly atomic molecules, sample handling, factors affecting vibrations

Instrumentation - Sources of radiation, wavelength selectors, detectors - Golay cell, Bolometer, Thermocouple, Thermistor, Pyroelectric detector and applications

Flame Photometry- Principle, interferences, instrumentation and applications

Atomic absorption spectroscopy-Principle, interferences, instrumentation and applications

Nephelo turbidometry- Principle, instrumentation and applications

UNIT–III

Introduction to chromatography

Adsorption and partition column chromatography-Methodology, advantages, disadvantages and applications.

Thin layer chromatography-Introduction, Principle, Methodology, Rf values, advantages, disadvantages and applications.

Paper chromatography- Introduction, methodology, development techniques, advantages, disadvantages and applications

Electrophoresis– Introduction, factors affecting electrophoretic mobility, Techniques of paper, gel, capillary electrophoresis, applications

UNIT–IV

Gas chromatography **-** Introduction, theory, instrumentation, derivatization, temperature programming, advantages, disadvantages and applications

High performance liquid **chromatography (HPLC) -** Introduction, theory, instrumentation, advantages and applications.

UNIT–V

Ion exchange chromatography-Introduction, classification, ion exchange resins, properties, mechanism of ion exchange process, factors affecting ion exchange, methodology and applications

Gel chromatography-Introduction, theory, instrumentation and applications

Affinity chromatography- Introduction, theory, instrumentation and application

References books:

1. Spectrometric Identification of Organic compounds –Robert M Silverstein, Sixth edition, John Wiley & Sons, 2004.
2. Principles of Instrumental Analysis - Doglas A Skoog, F. James Holler, Timothy A. Nieman, 5 th edition, Easternpress, Bangalore,1998.
3. Instrumental methods of analysis – Willards, 7 th edition, CBS publishers.
4. Practical Pharmaceutical Chemistry – Beckett and Stenlake, Vol II, 4th edition, CBS Publishers, New Delhi, 1997.
5. Organic Spectroscopy - William Kemp, 3rd edition, ELBS, 1991.
6. Quantitative Analysis of Drugs in Pharmaceutical formulation – PD Sethi, 3 rd Edition, CBS Publishers, New Delhi, 1997.
7. Pharmaceutical Analysis –Modern methods –Part B- JW Munson, Volume 11, Marcel Dekker Series

IV Year – I Semester	**MANAGEMENT SCIENCE**	**L**	**T**	**P**	**C**
		2	**0**	**0**	**2**

COURSE OBJECTIVES:

1. To impart knowledge of source and function of values.

2. Demonstrate an understanding of the importance of values, ethics, and social responsibility for the self and for contemporary society.

3. Reflect on how values shape personal and community ethics and decision-making. An ability to function effectively on multi-disciplinary teams (team work).

4. Inculcate professional, ethical, legal, security and social issues and responsibilities.

5. Gain personal and professional insight into organizational behaviour, diversity, personalities, goal setting, motivation, empowerment, and leadership style.

UNIT - I

CONCEPTS OF MANAGEMENT AND ORGANISATION: Functions of management, evolution of management thought, Taylor's scientific management, fayol's principles of management, Hertzberg's Maslow's hierarchy of human needs, theory x and y, Hawthorne experiment, morale, motivation, working environmental conditions, systems approach to management.

DESIGNING ORGANISATIONAL STRUCTURES: Basic concepts related to organisation - departmentation and decentralization, types of organization structures.

UNIT - II

PLANT LOCATION: Definition, factors affecting the plant location, comparison of rural and urban sites, methods for selection of plant- matrix approach. Plant layout - definition, objectives, types of plant layout, various data analyzing forms travel chart.

WORK STUDY: Definition, objectives, method study - definition, objectives, steps involved-various types of associated charts, difference between micro motion and memo motion studies. Work measurement- definition, time study, steps involved, equipment, different methods of performance rating, allowances, standard time calculation. Work Sampling - definition, steps involved, standard time calculations, and differences with time study.

UNIT - III

INTRODUCTION TO PERT / CPM : Project management, network modelling-probabilistic model, various types of activity times estimation, programme evaluation review techniques, critical path, probability of completing the project, deterministic model, critical path method (CPM), critical path calculation, crashing of simple of networks.

INSPECTION AND QUALITY CONTROL: Types of inspections, statistical quality control, techniques, variables and attributes, assignable and non assignable causes, variable control charts, and R charts, attributes control charts, p charts and c charts. Acceptance sampling plan, single sampling and double sampling plans, OC curves. Introduction to TQM - quality circles, ISO 9000 series procedures.

UNIT – IV

MATERIALS MANAGEMENT: Objectives, inventory functions, types, associated costs, inventory classification techniques-ABC and VED analysis. Inventory control systems, continuous review system, periodical review system. Stores management and stores records. Purchase management, duties of purchase of manager, associated forms.

UNIT – V

INTRODUCTION TO HUMAN RESOURCE MANAGEMENT: Functions of HRM, job evaluation, different types of evaluation methods. Job description, merit rating, different methods of merit ratings, wage incentives, different types of wage incentive schemes. Marketing, selling, marketing mix, product life cycle.

TEXT BOOKS: 1. O. P. Khanna (2004), Industrial Engineering and Management, Dhanpat Rai, New Delhi.

REFERENCE BOOKS: 1. Stoner, Freeman (2005), Gilbert, Management, 6th edition, Pearson Education, New Delhi. 2. Panner Selvam (2004), Production and Operations Management, Prentice Hall of India, New Delhi. 3. Ralph M. Barnes (2004), Motion and Time Studies, John Wiley and Sons.

IV Year – I Semester	PHARMACEUTICAL PACKAGING TECHNOLOGY	L	T	P	C
		3	0	0	3

COURSE OUTCOMES:

1. To know the Nanoscience technology & Pharmaceutical packing technology
2. To carry out the synthesis of drug molecules and preparations of pharmaceutical formulations
3. To be able to apply this knowledge in API & Pharmaceutical Formulation industries
4. To build a bridge between theoretical and practical concept used in industry

COURSE CONTENT

Unit-I

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

Introduction to Ancillary Materials used in Packaging, Adhesives, Paper, Paperboard, Wood, fibreboard, Packaging inserts, leaflets

UNIT-II

Structure, Box Dimensions, Types of Box, Applications of C.F.B., New developments in CFB

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

UNIT-III

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

UNIT-IV

Defects In Packages- Introduction, Defects in Packaging Material- Package Testing And Testing of Containers & Closures- Introduction, Testing of containers and closures- Stability of Packages

UNIT-V

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

Packaging Regulations and Legal Requirements

References:
1. Nanoscale Sciecne and Technology; R. Ke;sall, I. Hamley, M. Geoghegan;
2. Nanobiotechnology (Concepts, applications and perspectives); C.M. Niemeyer and C.A. Mirkin; Nanotechnology in catalysis Vol 1 & 2, B. Zhou, S. Hermans and G.A. Somorjai; Teacher shall prescribe some latest review articles.
3. D. A. Dean, Roy Evans, Ian Hall. Pharmaceutical packaging technology. Tylor and Francis.
4. Edward J. Bauer, Pharmaceutical Packaging Handbook. Bausch and Lomb, Rochester, New York, USA.
5. Wilmer A. Jenkins, Kenton R. Osborn. Packaging drugs and pharmaceuticals.
6. Salvatore J. Turco, Sterile dosage forms: their preparation and clinical application
7. Remington: The Science and Practice of Pharmacy.
8. Michael E. Aulton, Kevin Tylor (Ed.). Aulton's Pharmaceutics: The design and Manufacture of Medicine.
9. Gilbert Banker and Christopher Rhodes.Modern Pharmaceutics.
10. Leon Lachman; Lieberman Herbert A.; Kanig, Joseph L.The theory and Practice of Industrial Pharmacy.

IV Year I Semester	INTRODUCTION TO BIOMATERIALS AND TISSUE ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

The objective of this course is to enable the students to learn the fundamentals of tissue engineering and tissue repairing and to acquire knowledge on biomaterials and its applications

COURSE OUTCOMES:

Upon completion of this course, the students would get

1. Ability to understand the components of the tissue architecture
2. Opportunity to get familiarized with the stem cell characteristics and their relevance in medicine
3. Awareness about the properties and broad applications of biomaterials
4. Overall exposure to the role of tissue engineering and stem cell therapy in organogenesis

COURSE CONTENT

UNIT I

INTRODUCTION

Introduction to tissue engineering: Basic definition-current scope - cell numbers and growth rates measurement of cell characteristics –morphology- number viability- motility and functions.

Measurement of tissue characteristics - appearance- cellular component-ECM component physical properties.

UNIT II

TISSUE ARCHITECTURE

Tissue types and Tissue components, Tissue repair and Engineering -wound healing and sequence of events - Cell-Matrix- Cell-Cell Interactions - telomeres and Self renewal- Control of cell migration in tissue engineering.

UNIT III

BIOMATERIALS

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

UNIT IV

BASIC BIOLOGY OF STEM CELLS

Stem Cells: Introduction- hematopoietic differentiation pathway -Potency and plasticity of stem cells- Stem Cell markers- Types and sources of stem cell with characteristics: embryonic-adult haematopoietic- fetal- cord blood-placenta- bone marrow-primordial germ cells- cancer stem cells induced pleuri potent stem cells.

UNIT V

CLINICAL APPLICATIONS

Stem cell therapy-Molecular therapy - In vitro Organogenesis-Neuro degenerative diseases-spinal cord injury- heart disease- diabetes- burns and skin ulcers- muscular dystrophy-orthopaedic applications - Patent protection and regulation of tissue engineered products-ethical issues.

TEXT BOOKS:

1. Bernhard O.Palsson, SangeetaN.Bhatia, "Tissue Engineering" Pearson Publishers 2009.

2. Meyer, U.; Meyer, Th.; Handschel, J.; Wiesmann, H.P. Fundamentals of Tissue Engineering and Regenerative Medicine. 2009.

3. R. Lanza, J. Gearhart et al (Eds), Essential of Stem Cell Biology, Elsevier Academic press, 2006.

REFERENCES:

1. J. J. Mao, G. Vunjak-Novakovic et al (Eds), Translational Approaches in Tissue Engineering & Regenerative Medicine" Artech House, INC Publications, 2008, 103.

2. Bernard N. Kennedy (editor), Stem cell transplantation, tissue engineering, and cancer applications, New York: Nova Science Publishers, 2008.

3. Raphael Gorodetsky, Richard Schäfer Stem cell- based tissue repair, Cambridge: RSC publishing, 2011.

IV Year I Semester	GOOD MANUFACTURING PRACTICES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

1. To understand the standard specifications and procedures required in the manufacture of dosage forms

2. To understand the modern concepts of validation, quality assurance and statistical quality control

COURSE CONTENT:

UNIT-I

CGMP: A detailed study of GMP as prescribed in Schedule M of Drugs and Cosmetics Act and Rules. Requirements regarding premises, sanitation, personnel, equipment and building, documentation and records and processes.

UNIT-II

Control of Production Procedures: Manufacturing Control – In – Process Quality Control for solids, liquids, semisolids and parenteral products – packaging control.

UNIT-III

Control of Finished Products: Tablets, Capsules, parenterals, semisolids, liquid orals

UNIT-IV

Validation: Types and Protocols of Validations – A study of Process Validation. Validation of Equipments

UNIT-V

Importance and scope of validation, types of validation, validation master plan, Cleaning Validation, Analytical Method Validation – Procedures and Examples.

Recommended Books:

1. The Theory and Practice of Industrial Pharmacy by Leon Lachman, H.A. Liberman and Joseph L. Kanig, 3rd Edition, Lea &Febiger publishers, Philadelphia.

2. Quality Assurance of Pharmaceuticals Vol. I and Vol. II published by Pharma book syndicate.

3. Pharmaceutical Product Development by N.K. Jain, CBS Publishers & Distributors Pvt. Ltd. Tablets – Vol. I, II and III by Leon Lachman et al.

Reference Books:

1. Pharmaceutical Dosage Forms, Tablets – Vol. I, II and III edited by H.A. Lieberman and Leon Lachman, Marcel Dekker, Inc.

2. Modern Pharmaceutics by Banker.

IV Year – I Semester	PHARMACOVIGILENCE	L	T	P	C
		3	0	0	3

Objectives: At completion of this paper it is expected that students will be able to (know, do, and appreciate):

1. Why drug safety monitoring is important?

2. History and development of pharmacovigilance

3. National and international scenario of pharmacovigilance

4. Dictionaries, coding and terminologies used in pharmacovigilance

5. Detection of new adverse drug reactions and their assessment

6. International standards for classification of diseases and drugs

7. Adverse drug reaction reporting systems and communication in pharmacovigilance

8. Methods to generate safety data during pre clinical, clinical and post approval phases of drugs' life cycle

Course Contents

Unit I

Introduction to Pharmacovigilance

- History and development of Pharmacovigilance
- Importance of safety monitoring of Medicine
- WHO international drug monitoring programme
- Pharmacovigilance Program of India (PvPI)

Introduction to adverse drug reactions

- Definitions and classification of ADRs
- Detection and reporting
- Methods in Causality assessment
- Severity and seriousness assessment
- Predictability and preventability assessment
- Management of adverse drug reactions

Basic terminologies used in pharmacovigilance

- Terminologies of adverse medication related events
- Regulatory terminologies

Unit II

Drug and disease classification

- Anatomical, therapeutic and chemical classification
- International classification of disease
- Daily defined doses
- International Non proprietary Names for drugs

Drug dictionaries and coding in pharmacovigilance

- WHO adverse reaction terminologies
- MedDRA and Standardised MedDRA queries
- WHO drug dictionary
- Eudravigilance medicinal product dictionary

Information resources in pharmacovigilance

- Basic drug information resources
- Specialised resources for ADRs

Establishing pharmacovigilance programme

- Establishing in a hospital
- Establishment & operation of drug safety department in industry
- Contract Research Organisations (CROs)
- Establishing a national programme

Unit III

Vaccine safety surveillance

- Vaccine Pharmacovigilance
- Vaccination failure
- Adverse events following immunization

Pharmacovigilance methods

- Passive surveillance – Spontaneous reports and case series
- Stimulated reporting
- Active surveillance – Sentinel sites, drug event monitoring and registries
- Comparative observational studies – Cross sectional study, case control study and cohort study
- Targeted clinical investigations

Unit IV

Safety data generation

- Pre clinical phase
- Clinical phase

- Post approval phase (PMS)

ICH Guidelines for Pharmacovigilance

- Organization and objectives of ICH
- Expedited reporting
- Post approval expedited reporting
- Periodic safety update reports
- Individual case safety reports
- Pharmacovigilance planning
- Good clinical practice in pharmacovigilance studies

Unit V

Pharmacogenomics of adverse drug reactions

- Genetics related ADR with example focusing PK parameters

Drug safety evaluation in special population

- Pregnancy and lactation
- Paediatrics
- Geriatrics

CDSCO (India) and Pharmacovigilance

- D&C Act and Schedule Y
- Differences in Indian and global pharmacovigilance requirements

Recommended Books (Latest edition):

1. Textbook of Pharmacovigilance: S K Gupta, Jaypee Brothers, Medical Publishers.

2. Practical Drug Safety from A to Z By Barton Cobert, Pierre Biron, Jones and Bartlett Publishers.

3. Mann's Pharmacovigilance: Elizabeth B. Andrews, Nicholas, Wiley Publishers.

4. Stephens' Detection of New Adverse Drug Reactions: John Talbot, Patrick Walle, Wiley Publishers. 5. An Introduction to Pharmacovigilance: Patrick Waller, Wiley Publishers.

6. Cobert's Manual of Drug Safety and Pharmacovigilance: Barton Cobert, Jones& Bartlett Publishers. 7. Textbook of Pharmaco epidemiology edited by Brian L. Strom, Stephen E Kimmel, Sean Hennessy, Wiley Publishers.

8. A Textbook of Clinical Pharmacy Practice -Essential Concepts and Skills:G. Partha sarathi, Karin Nyfort Hansen, Milap C. Nahata

IV Year – I Semester	PHARMACEUTICAL ANALYSIS	L	T	P	C
		3	0	0	3

Objectives: Upon completion of the course student shall be able to develop analytical skills

• Carryout various volumetric and electrochemical titrations

• Understand the principles of volumetric and electro chemical analysis

UNIT-I

(a)Pharmaceutical analysis- Definition and scope

i) Different techniques of analysis

ii) Methods of expressing concentration

iii) Primary and secondary standards.

iv) Preparation and standardization of various molar and normal solutions- Oxalic acid, sodium hydroxide, hydrochloric acid, sodium thiosulphate, sulphuric acid, potassium permanganate and ceric ammonium sulphate

(b) **Errors:** Sources of errors, types of errors, methods of minimizing errors, accuracy, precision and significant figures

(c)Pharmacopoeia, Sources of impurities in medicinal agents.

UNIT-II

Acid base titration: Theories of acid base indicators, classification of acid base titrations and theory involved in titrations of strong, weak, and very weak acids and bases, neutralization curves.

Non aqueous titration: Solvents, acidimetry and alkalimetry titration and estimation of Sodium benzoate and Ephedrine HCl

UNIT-III

Precipitation titrations: Mohr's method, Volhard's, Modified Volhard's, Fajans method, estimation of sodium chloride.

Complexometric titration: Classification, metal ion indicators, masking and demasking reagents, estimation of Magnesium sulphate, and calcium gluconate.

Gravimetry: Principle and steps involved in gravimetric analysis. Purity of the precipitate: co-precipitation and post precipitation, Estimation of barium sulphate.

Basic Principles, methods and application of diazotisation titration.

UNIT-IV

Redox titrations

(a) Concepts of oxidation and reduction

(b) Types of redox titrations (Principles and applications)

Cerimetry, Iodimetry, lodometry, Bromatometry, Dichrometry, Titration with potassium iodate

UNIT-V

Electrochemical methods of analysis

Conductometry- Introduction, Conductivity cell, Conductometric titrations, applications.

Potentiometry: Electrochemical cell, construction and working of reference (Standard hydrogen, silver chloride electrode and calomel electrode) and indicator electrodes (metal electrodes and glass electrode), methods to determine end point of potentiometric titration and applications.

Polarography: Principle, Ilkovic equation, construction and working of dropping mercury electrode and rotating platinum electrode, applications

		L	**T**	**P**	**C**
IV Year I Semester	**INVITRO DIAGNOSIS**	**3**	**0**	**0**	**3**

Course Outcomes (COs**):** At the end of the course the student will
1. Describe ECD and Pacemaker
2. Differentiate various neurological equipment
3. Identify various types of electrodes and muscle stimulators.
4. Describe various extra corporeal devices like.
5. Gain Knowledge on Ultra sonogram and imaging

Unit -1
Cardiac Equipment: Electro Cardio Graph (ECG), Heart rate monitor, Pacemaker – Internal and External, Defibrillator.

Unit -2
Neurological Equipment: Electro Encephalogram (EEG) –Recording system. Magneto encephalograph, EEG bio feedback, Psycho Physiological instruments, Electroconvulsive therapy.

Unit – 3
Muscular Equipment: Electromyogram (EMG), Nerve and muscle stimulators, Magneto myogram, Electrogastrograph, various types of Electrodes.

Unit – 4
Extra corporeal devices: Heart lung machines, Oxygenators, haemodialysis unit, peritoneal dialyzer unit, Lithotripsy, Audiometer, Optical Tonometer

Unit – 5
Ultrasound Diagnostics: Echo cardiogram, Echo encephalogram - abdomen, Ultra sonogram for Obstetrics and gynaecology, Ophthalmology –A scan and B scan. X-ray, CT, MRI, Nuclear imaging and Radiation therapy.

Text Books:
1. Joseph J. Carr and John M. Brown, "Introduction to Biomedical equipment technology", Pearson Education, 4th Edition, 2014.
2. John G.Webster, "Medical Instrumentation Application and Design", John Wiley and Sons, New York, 4th Edition, 2009.

Reference Books:

1. Myer Kutz, "Biomedical Engineering & Design Handbook: Volume 2", McGraw-Hill Publisher, 2nd Edition, 2009.
2. L.A Geddes and L.E.Baker, "Principles of Applied Biomedical Instrumentation", John Wiley and Sons, 3rd Edition, Reprint 2008.
3. Leslie Cromwell, Fred J. Weibell, Erich A. Pfeiffer, "Biomedical Instrumentation and Measurements", Pearson Education India; 2nd Edition, 2015.
4. Antony Y.K.Chan, "Biomedical Device technology, Principles and design", Charles Thomas Publisher Ltd, Illinois, USA, 2008.

IV Year – I Semester	INTRODUCTION TO ADDITIVE MANUFACTURING	L	T	P	C
		3	0	0	3

Course Objectives:

1. To understand the principles of prototyping, classification of RP processes and liquid-based RP systems

2. To understand and apply different types of solid-based RP systems.

3. To understand and apply powder-based RP systems.

4. To understand and apply various rapid tooling techniques.

5. To understand different types of data formats and to explore the applications of AM processes in various fields.

UNIT-I:

INTRODUCTION: Prototyping fundamentals, historical development, fundamentals of rapid prototyping, advantages and limitations of rapid prototyping, commonly used terms, classification of RP process.

LIQUID-BASED RAPID PROTOTYPING SYSTEMS: Stereo lithography Apparatus (SLA): models and specifications, process, working principle, photopolymers, photo polymerization. layering technology, laser and laser scanning, applications, advantages and disadvantages, case studies. Solid Ground Curing (SGC): models and specifications, process, working principle. applications, advantages and disadvantages, case studies.

UNIT-II:

SOLID-BASED RAPID PROTOTYPING SYSTEMS: Laminated object manufacturing (LOM) models and specifications, process, working principle, applications, advantages and disadvantages. case studies. Fused deposition modelling (FDM) models and specifications, process, working principle, applications, advantages and disadvantages, case studies.

UNIT-III:

POWDER BASED RAPID PROTOTYPING SYSTEMS: Selective laser sintering (SLS): models and specifications, process, working principle, applications, advantages and disadvantages, case studies, three dimensional printing (3DP): models and specifications, process, working principle, applications, advantages and disadvantages, case studies.

UNIT-IV:

RAPID TOOLING: Introduction to rapid tooling (RT), conventional tooling Vs RT, Need for RT. rapid tooling classification: indirect rapid tooling methods: spray metal deposition. RTV epoxy tools. Ceramic tools, investment casting, spin casting, die casting, sand casting process. Direct rapid tooling: Direct AIM, LOM Tools, and Direct Metal Tooling

UNIT-V:

RAPID PROTOTYPING DATA FORMATS: STL Format, STL File Problems, consequence or building valid and invalid tessellated models, STL file Repairs: Generic Solution, other Translators, and Newly Proposed Formats.

RP APPLICATIONS: Application in engineering, analysis and planning, aerospace industry. automotive industry, jewelry industry, coin industry, GIS application. RP medical and bioengineering applications: customized implants and prosthesis, forensic sciences.

TEXT BOOKS:

1. Rapid prototyping: Principles and Applications /Chua C.K.. Leong K.F. and LIM C.S/World Scientific publications

REFERENCES:
1. Rapid Manufacturing / D.T. Pham and S.S. Dimov/Springer
2. Wohlers Report 2000/Terry T Wohlers/Wohlers Associates
3. Rapid Prototyping & Manufacturing/Paul F.Jacobs/ASME Press
4. Rapid Prototyping / Chua and Liou

Course Outcomes: At the end of the course, student will be able to

CO1: Understand the principles of prototyping, classification of RP processes and liquid-based RP systems.

CO2: Understand and apply different types of solid-based RP systems.

CO3: Apply powder-based RP systems.

CO4: Analyze and apply various rapid tooling techniques.

CO5: Understand different types of data formats and explore the applications of AM processes in various fields.

IV Year – I Semester	ARITIFICIAL INTELLIGENCE & MACHINE LEARNING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:
1. To have a basic proficiency in a traditional AI language including an ability to write simple to intermediate programs and an ability to understand code written in that language
2. Learn what is machine learning
3. Learn algorithms used in machine learning.
4. Learn how to implement machine learning for biological problems.

COURSE OUTCOMES:
- CO-1 Outline problems that are amenable to solution by AI methods, and which AI methods may be suited to solving a given problem
- CO-2 Optimization of weights in a supervised and unsupervised neural network, and application of supervised learning to predict sub- cellular localization of a protein.
- CO-3 Identify machine learning techniques suitable for a given problem
- CO-4 Different types of machine learning and its utility in bioinformatics
- CO-5 Determination of Bayesian Network (BN) from expression data.

COURSE CONTENT:

UNIT I

Artificial Intelligence (AI): Introduction, history, intelligent systems, foundations of AI, applications, development of AI languages, Search strategies, logic, deduction, and pathways comparison.

UNIT II

Artificial Neural Network (ANN): Basics and introduction to terminologies, Supervised and non-supervised learning, Feed forward back propagation error method, Application of ANN methods: Protein sub-cellular localization and secondary structure prediction

UNIT III

Machine Learning - Introduction: Overview of intelligent systems, goals and applications of machine learning, Hidden Markov Model (HMM): Viterbi algorithm, Forward algorithm, Backward algorithm.

Unit-IV

Symbolic Machine Learning: Nearest neighbour approach to predict secondary structure, Decision tree methods, Identification tree methods

Unit-V

Bayesian Network (BN): Calculation of statistical significance by using Bayesian methods, Factorization and Markov blanket rule, d-separation, Equivalence classes, Learning of Bayesian network, Learning of Gaussian network.

Text Book(s):

1. Artificial intelligence, A modern Approach, 2nded, Stuart Russel, Peter Norvig, PEA
2. R. Durbin, S. Eddy, A. Krogh, and G. Mitchison (1998), Biological Sequence Analysis: Probabilistic Models of Proteins and Nucleic Acids. Cambridge University Press
3. Edward Keedwell and Ajit Narayanan (2005), Intelligent Bioinformatics: The Application of Artificial Intelligence Techniques to Bioinformatics Problems, Wiley
4. P Baldiand S Brunak, BIOINFORMATICS: The Machine Learning Approach Suggested

Reference Book(s):

1. Olson et al., 2018. Data-driven advice for applying machine learning to bioinformatics problems
2. Husmeier D, Dybowski R, and Roberts S (2005), Probabilistic Modeling in Bioinformatics and Medical Informatics, Springer
3. Nat Cell Biol. 2001 Aug;3(8):E190-5. Review. PubMed PMID: 11483980
4. Kim JB, Porreca GJ, Song L, Greenway SC, Gorham JM, Church GM, Seidman CE, Seidman JG. Polony multiplex analysis of gene expression (PMAGE) in mouse hypertrophic cardiomyopathy. Science. 2007 Jun 8;316(5830):1481-4. PubMed PMID: 17556586

IV Year – I Semester	**BIOINFORMATICS**	L	T	P	C
		3	0	0	3

COURSE CONTENT

UNIT I

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

UNIT II

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

UNIT III

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

UNIT IV

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

UNIT V

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

TEXT BOOKS
1. Introduction to Bioinformatics by Arthur K. Lesk , Oxford University Press.
2. Algorithms on Strings, Trees and Sequences by Dan Gusfield, Cambridge University Press.
3. Biological Sequence Analysis Probabilistic Models of proteins and nucleic acids by R.Durbin, S.Eddy, A.Krogh, G.Mitchison.
4. Bioinformatics Sequence and Genome Analysis by David W. Mount, Cold Spring Harbor Laboratory Press.
5. Beginning Perl for Bioinformatics: An introduction to Perl for Biologists by James Tindall, O'Reilley Media

REFERENCE
1. Bioinformatics The Machine Learning Approach by Pierre Baldi and Soren Brunak.

IV Year – I Semester	QUANTUM SCIENCE AND TECHNOLOGY	L	T	P	C
		3	0	0	3

Prerequisites: Basic Physics, Linear Algebra, and Introduction to Modern Physics

Course Objectives:
1. To introduce fundamental concepts of quantum mechanics and its mathematical formalism.
2. To explore quantum computing and communication principles and technologies.
3. To understand the physical implementation and limitations of quantum systems.
4. To enable students to relate quantum theory to practical applications in computing, cryptography, and sensing.
5. To familiarize students with the emerging trends in quantum technologies.

Course Outcomes:
After completing this course, students will be able to:
CO1. Explain core principles of quantum mechanics and their technological implications.
CO2. Analyze quantum phenomena like superposition and entanglement.
CO3. Apply mathematical tools to model and solve quantum systems.
CO4. Demonstrate understanding of quantum algorithms and quantum circuits.
CO5. Evaluate potential applications and challenges in quantum communication and sensing.

Unit 1: Fundamentals of Quantum Mechanics: Historical background: Blackbody radiation, photoelectric effect, and Compton scattering; Dual nature of light and matter; De Broglie hypothesis; Schrödinger equation; Free particle, infinite potential well, step potential; Operators and observables: position, momentum, Hamiltonian; Commutation relations and uncertainty principle; Quantum postulates and measurement theory; Eigenvalues, eigenfunctions.

Unit 2: Quantum Information Theory: Classical vs. quantum information; Qubit representation using Bloch sphere; Quantum superposition and quantum entanglement; Dirac notation (bra-ket), tensor products, and composite systems; Bell states and EPR paradox; Quantum gates: Pauli-X, Y, Z; Hadamard; Phase; T; CNOT; Quantum circuit models and notation; Measurement in computational basis; Quantum teleportation and no-cloning theorem; Quantum state tomography (introductory)

Unit 3: Quantum Computing: Classical computing review and limitations; Quantum parallelism and interference; Deutsch and Deutsch-Jozsa algorithms; Grover's search algorithm, Oracle and amplitude amplification; Shor's factoring algorithm (overview and significance); Quantum Fourier Transform (QFT); Quantum error correction: Bit-flip, phase-flip, and Shor's 9-qubit code; Introduction to quantum programming: Qiskit, Cirq, IBM Quantum Experience (overview)

Unit 4: Quantum Communication: Introduction to quantum cryptography; Quantum key distribution (QKD): BB84 protocol; Entanglement-based QKD: Ekert protocol (E91); Eavesdropping and security of QKD; Quantum teleportation (circuit and protocol); Quantum dense coding; Quantum networks and entanglement swapping; Role of quantum repeaters; Single-photon sources and detectors; Implementation challenges (loss, decoherence, noise)

Unit 5: Quantum Technologies and Applications: Quantum sensors: magnetometry, gravimetry; Quantum metrology: standard time, atomic clocks; Quantum imaging and lithography; Quantum materials: topological insulators, graphene, quantum dots; NV centers in diamonds for sensing; Hardware platforms: Superconducting qubits, Trapped ions, Photonic quantum processors; Quantum supremacy and NISQ era; Global initiatives: IBM, Google, D-Wave, IonQ, India's NQM; Ethical concerns and future prospects

Text Books:
1. **"Quantum Computation and Quantum Information"** by Michael A. Nielsen and Isaac L. Chuang
2. **"Quantum Mechanics: Concepts and Applications"** by Nouredine Zettili

Online Learning Resources:

1. https://nptel.ac.in/courses/104104082
2. https://nptel.ac.in/courses/115104096
https://nptel.ac.in/courses/122106034

IV Year – I Semester	**INDUSTRIAL PHARMACY LAB**	**L**	**T**	**P**	**C**
		0	**0**	**2**	**1**

1. Preformulation studies on paracetamol/aspirin/or any other drug.

2. Preformulation studies of granules.

3. Preparation and evaluation of emulsions and suspensions.

4. Preparation and evaluation of Paracetamol tablets

5. Preparation and evaluation of Aspirin tablets

6. Coating of tablets- film coating of tables/granules

7. Preparation and evaluation of Tetracycline capsules

8. Preparation of Calcium Gluconate injection

9. Preparation of Ascorbic Acid injection

10. Quality control test of (as per IP) marketed tablets and capsules

11. Preparation of Eye drops/ and Eye ointments

12. Preparation of Creams (cold / vanishing cream)

13. Evaluation of Glass containers (as per IP)

Recommended Books: (Latest Editions)
1. Pharmaceutical dosage forms - Tablets, volume 1 -3 by H.A. Liberman, Leon Lachman&J.B.Schwartz
2. Pharmaceutical dosage form - Parenteral medication vol- 1&2 by Liberman&Lachman
3. Pharmaceutical dosage form disperse system VOL-1 by Liberman&Lachman
4. Modern Pharmaceutics by Gilbert S. Banker & C.T. Rhodes, 3rd Edition
5. Remington: The Science and Practice of Pharmacy, 20th edition Pharmaceutical Science (RPS)
6. Theory and Practice of Industrial Pharmacy by Liberman&Lachman

IV Year – I Semester	INSTRUMENTAL METHODS OF ANALYSIS LAB	L	T	P	C
		0	0	2	1

1. Determination of absorption maxima and effect of solvents on absorption maxima of organic compounds

2. Estimation of dextrose by colorimetry

3. Estimation of sulfanilamide by colorimetry

4. Simultaneous estimation of ibuprofen and paracetamol by UV spectroscopy

5. Assay of pharmacopoeial drugs by UV- visible Spectrophotometry

6. Estimation of quinine sulfate by fluorimetry

7. Determination of sodium by flame photometry

8. Determination of potassium by flame photometry

9. Determination of chlorides and sulphates by nephelo turbidometry

10. Separation of amino acids by paper chromatography

11. Separation of sugars by thin layer chromatography

12. Separation of plant pigments by column chromatography

13. Demonstration experiment on HPLC

14. Demonstration experiment on Gas Chromatography

15. Separation of compounds by electrophorosis

Recommended Books (Latest Editions)

1. Instrumental Methods of Chemical Analysis by B.K Sharma

2. Organic spectroscopy by Y.R Sharma

3. Text book of Pharmaceutical Analysis by Kenneth A.Connors

4. Vogel's Text book of Quantitative Chemical Analysis by A.I. Vogel

5. Practical Pharmaceutical Chemistry by A. H.Beckett and   J.B. Stenlake

6. Organic Chemistry by I. L. Finar

7. Organic spectroscopy by William Kemp

8. Quantitative Analysis of Drugs by D.C. Garrett

9. Quantitative Analysis of Drugs in Pharmaceutical Formulations by P.D.Sethi

IV Year – I Semester	**PYTHON PROGRAMMING LAB**	L	T	P	C
		0	1	2	2

Course Objective: To understand the PYTHON environment and make numerical computations and analysis.

Course Outcomes:

At the end of the course, student will be able to

- **CO1** Solve the different methods for linear, non-linear and differential equations
- **CO2** Learn the PYTHON Programming language
- **CO3** Familiar with the strings and matrices in PYTHON
- **CO4** Write the Program scripts and functions in PYTHON to solve the methods

COURSE CONTENTS

Write Programs in PYTHON Programming for the following:

1. To find the roots of non-linear equation using Bisection method
2. To find the roots of non-linear equation using Newton Raphson's method.
3. Curve fitting by least – square approximations
4. To solve the system of linear equations using Gauss - elimination method
5. To solve the system of linear equations using Gauss - Siedal method
6. To solve the system of linear equations using Gauss - Jordan method
7. To integrate numerically using Trapezoidal rule
8. To integrate numerically using Simpsons rule
9. To find the largest eigen value of a matrix by Power – method
10. To find numerical solution of ordinary differential equations by Euler's method
11. To find numerical solution of ordinary differential equations by Runge-Kutta method
12. To find numerical solution of ordinary differential equations by Milne's method
13. To find the numerical solution of Laplace equation
14. To find the numerical solution of Wave equation
15. To find the solution of a tri-diagonal matrix using Thomas algorithm
16. To fit a straight using least square technique

IV Year – I Semester	CONSTITUTION OF INDIA	L	T	P	C
		2	0	0	-

Course Objectives

To create an awareness on the Constitution of India. To understand the function wings of the Government, fundamental rights and duties of citizens, analyse the powers of central, state, and local government, and strengthen constitutional institutions.

Course Outcomes

- CO 1: Describe historical background of the constitution making and its importance for building a democratic India.
- CO 2: Explain the functioning of three wings of the government ie., executive, legislative and judiciary
- CO 3: Explain the value of the fundamental rights and duties for becoming good citizen of India.
- CO 4: Analyse the decentralisation of power between central, state and local self-government.
- CO 5: Apply the knowledge in strengthening of the constitutional institutions like CAG, Election Commission and UPSC for sustaining democracy.

Course Contents

UNIT-I: Introduction to Indian Constitution

Constitution meaning of the term The making of the Indian Constitution Sources and constitutional history Philosophy of Constituent Assembly Citizenship, Preamble, Fundamental Rights and Duties, Directive Principles of State Policy.

Learning Outcomes: At the end of this unit students will be able to:

Understand the concept of Indian constitution (L2)

Analyse the History and features of Indian constitution (1.3)

Outline the Preamble and Citizenship act (L3)

Recognise the Fundamental Rights and Duties (13)

Explain the directive principle of state policy (13)

UNIT-II: The Union: Executive, Legislative and Judiciary

Union Government and its Administration Structure: President and Vice President: Role, power and position, PM and Council of ministers, Cabinet and Central Secretariat, Lok Sabha. Rajya Sabha, The Supreme Court and High Court: Powers and Functions.

Learning Outcomes: At the end of this unit students will be able to:

Describe the structure of Union government (L2)

Analyse the role of President, Vice President (L3)

Outline the role of PM and Council of ministers (1.3)

Recognize the functioning of both the houses of the Parliament (1.3)

Identify he powers and functions of Supreme Court and High court (1.3).

UNIT-III: The States and The Union Territories

State Government and its Administration: Governor Role and Position-CM and Council of ministers, State Secretariat: Organisation, Structure and Functions Relation between the Union and the States.

Learning Outcomes: At the end of this unit students will be able to:

Describe the structure of state government (13)

Explain the role of state Secretariat (L2)

Analyse the role Governor and Chief Minister (13)

Differentiate between structure and functions of state secretariat (13) Analyse the relation between the Union and the States (L3)

UNIT-IV: Local Administration

District's Administration Head Role and Importance, Municipalities Mayor and role of Elected Representative Pachayati Raj: Functions PRI: Zilla Panchayat, Elected officials and their roles Block level Organizational Hierarchy, Village level Role of Elected and Appointed officials Importance of grass-root democracy

Learning Outcomes: At the end of this unit students will be able to: Explain the district administration role and importance (13)

Analyse the role of Mayor and elected representatives of Municipalities (14)

Describe the block level organisational hierarchy (13)

Know the functions of PRI and Zilla panchayat (13)

UNIT-V: Emergency Provisions and Election Commission

Emergency: Proclamation of Emergency, types of emergency Election Commission: Role of Chief Election Commissioner State Election Commission-Functions of Commissions for the welfare of SC/ST/OBC and women.

Learning Outcomes: At the end of this unit students will be able to:

Understand the concept of emergency and types of emergency (L2)

Know the role of Election Commission apply knowledge (L1)

Describe the role of Chief Election commissioner (13)

Know the various commissions of viz SC/ST/OBC and women (L3)

Analyse the role of state election commission (1.3)

Text Books

1. Durga Das Basu, Introduction to the Constination of India, Prentice Hall of India

2. Subash Kashyap, Indian Constitution, National Book Trust Pvt. Ltd. New Delhi

3. J.A. Siwach, Dynamics of Indian Government & Politics

4. D.C. Gupta, Indian Government and Politics

5. H.M. Sreevai, Constitutional Law of India, 4th Edition, Universal Law Publication.

References

1. JC Johari, Indian Government and Politics Hans

IV Year – II Semester	FULL SEMESTEER INTERNSHIP AND PROJECT WORK	L	T	P	C
		0	0	24	12