SCHEME AND SYLLABUS

B. TECH – III AND IV SEMESTER

DEPT. OF PHARMACEUTICAL ENGINEERING

KISHKINDA UNIVERSITY

EFFECTIVE FROM ACADEMIC YEAR 2025-26

VISION

- To develop an ethical and a competent global workforce with an inquisitive mind.

MISSION

- To equip the students with professional skills, ethical values and competency.
- To offer state of the art programs by collaborating with industry, academia and society.
- To undertake collaborative & inter disciplinary research for overall development.
- To develop leaders and entrepreneurs for the real and sustainable world

VALUES

EQUITY
The University will ensure the education imparted will be fair and impartial.

EMPATHY
The University will imbibe a culture to understand and share the feelings of another.

EXCELLENCE
The University in its true spirit will deliver quality education and chase perfection.

EXPEDITIOUS
The University will carry out the day to day work with speed and efficiency and adapt quickly to the changes.

ETHICS
The University will govern and instill stakeholders with moral principles.

DEPARTMENT OF PHARMACEUTICAL ENGINEERING

VISION

To be a globally recognized centre of excellence in pharmaceutical engineering, fostering innovation, research, and industry collaboration to develop sustainable and advanced pharmaceutical solutions to transform the pharmaceutical industry.

MISSION

M1. Providing high-quality, industry-aligned education to nurture skilled pharmaceutical engineers capable of meeting global challenges.

M2. Strengthening partnerships with pharmaceutical industries, regulatory bodies, and research institutions to bridge academia and real-world applications.

M3. Equipping students with expertise in pharmaceutical process design, quality assurance, and technological innovation to become industry leaders.

PROGRAMME OUTCOMES (POS):

Engineering Graduates will be able to:

1) **Engineering Knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2) **Problem Analysis:** Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3) **Design/Development of Solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4) **Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5) **Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

6) **The Engineer and Society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7) **Environment and Sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

8) **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9) **Individual and Team Work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10) **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11) **Project Management and Finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12) **Life-long Learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAMME SPECIFIC OUTCOME (PSO'S):

1) **PSO1:** Apply engineering principles to design, analyse, and optimize pharmaceutical manufacturing processes

2) **PSO2:** Evaluate and integrate innovations into pharmaceutical manufacturing.

3) **PSO3:** Design and Utilize eco-friendly and advanced processes to enhance production efficiency and product quality.

PROGRAMME EDUCATIONAL OBJECTIVES (PEO'S):

1) **PEO1:** Graduates will apply engineering principles and drug formulation sciences to design novel dosage forms, drug delivery systems and optimize physicochemical properties of APIs using computational and experimental tools.

2) **PEO2:** Graduates will master global regulatory frameworks and implement quality-by-design, risk assessment, and analytical validation to ensure drug safety, efficacy, and compliance in non-clinical settings.

3) **PEO3:** Graduates will leverage Industry 4.0 technologies (AI/ML, PAT, IoT) to innovate in drug development, supply chain optimization, and smart manufacturing, while adhering to environmental sustainability (green chemistry, waste reduction).

Scheme and Syllabus for B.Tech. in Pharmaceutical Engineering

In Accordance with

2023 Outcome Based Education (OBE) and Choice Based Credit System (CBCS)

III SEMESTER

SN	Course	CourseCode	Course Title	Teaching Department (TD) and Question Paper Setting	Teaching Hours /Week				Examination				Credits
					Theory Lecture	Tutorial	Practical/ Drawing	SDA	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1	BSC	**23BBE310**	Biology For Engineers	H & S	3	0	0	0	03	50	50	100	**3**
2	IPCC	**23PCE320**	Pharmaceutical Chemistry	CHEM	3	0	2	0	03	50	50	100	**4**
3	IPCC	**23FME330**	Fluid Mechanics and Mechanical Unit Operations	PE	3	0	2	0	03	50	50	100	**4**
4	IPCC	**23PPE340**	Physical Pharmacy	PE	3	0	2	0	03	50	50	100	**4**
5	PCC	**23MEEC350**	Materials and Energy Balance Computations	PE	3	0	0	0	03	50	50	100	**3**
6	PCC	**23HAP360**	Essentials of human anatomy and physiology	PE	1	0	0	1	03	50	50	100	**1**
7	UHV	**23SCE380**	Social Connect and Responsibility	H & S	0	0	2	1	01	100	---	100	**1**
8	MC	**23NSE390**	National Service Scheme (NSS)	H & S									
		23PEE39O	Physical Education (PE) (Sports and Athletics)	H & S									
		23YOE390	Yoga	H & S	0	0	2			100	---	100	**0**
Total										**500**	**300**	**800**	**20**

IV SEMESTER

SN	Course and CourseCode		Course Title	Teaching Department (TD) and Question Paper Setting Board (QPSB)	Teaching Hours /Week				Examination				Credits
					Theory Lecture	Tutorial	Practical	Self -Study	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1	IPCC	**23MAT41**	Applied Mathematics for Pharmaceutical Engineering	MATHS	3	0	2	0	03	50	50	100	**4**
3	IPCC	**23HT42**	Principles and Applications of Heat Transfer	PE	3	0	2	0	03	50	50	100	**4**
2	PCC	**23CPT43**	Chemical Processes and Thermodynamics	PE	3	0	0	0	03	50	50	100	**3**
4	PCC	**23PC44**	Pharmacology	PE	3	0	0	0	03	50	50	100	**3**
5	BSC	**23PB45**	Pharmaceutical Biotechnology	PE	3	0	0	0	03	50	50	100	**3**
6	BSC	**23GC46**	Green Chemistry	PE	1	0	0	1	03	50	50	100	**1**
7	AEC/ SEC	**23PSW47**	Professional Skills for the Work Place	H & S	1	0	0	1	01	50	50	100	**1**
8	UHV	**23UH48**	Universal human values course	H & S	1	0	0	0	01	50	50	100	**1**
9		**23NS49**	National Service Scheme (NSS)	H & S				0	--				
		23PE49	Physical Education (PE) (Sports and Athletics)	H & S				0	--				
	MC	**23YO49**	Yoga	H & S	0	0	2	0	--	100	---	100	**0**
Total										**500**	**400**	**900**	**20**

SCHEME AND SYLLABUS

B. TECH III- SEMESTER
PHARMACEUTICAL ENGINEERING
(2023 SCHEME)

SEMESTER: III

Course Name: PHARMACEUTICAL CHEMISTRY

Course Code	**23PC32**	CIE Marks	**50**
Teaching Hours / Week (L:T:P: S)	**3:0:2**	SEE Marks	**50**
Total Hours of Pedagogy	**40**	Total Marks	**100**
Credits	**04**	Exam Hours	**3**

Course Objectives:

COB-1: *To provide a comprehensive understanding of the structure, properties, and electronic effects of organic molecules.*

COB-2: *To explain the principles of isomerism and stereochemistry in chemical compounds.*

COB-3: *To explore the concepts of aromaticity and the structure and reactivity of free radicals.*

COB-4: *To introduce the mechanisms and types of addition and elimination reactions.*

COB-5: *To impart knowledge on pharmaceutical impurities and the corresponding limit tests.*

Module 1 **8 hours**

Structure and Properties of Organic Molecules: Principles of Atomic Structure, Bond Formation: The Octet Rule, Common Bonding Patterns in Organic Compounds, Structural & molecular Formulas, Polarity of Bonds and Molecules and intermolecular Forces. Bond lengths, bond angles, and bond dissociation energies.

Electronic effects: inductive effect, mesomeric effect, hyperconjugation, the concept of resonance.

Module 2 **8 hours**

Stereochemistry: Isomers, Classification of Isomerism, Geometrical isomerism, E and Z notations, and optical isomerism in lactic acid and tartaric acid. Enantiomers and diastereomers, the concept of Chirality and symmetry. Racemic modifications and their resolution, R and S nomenclature, Conformational analysis in cyclohexane and 1,2 dichloride ethane.

Module 3 **8 hours**

Reactive Intermediates: Huckel's Rule, benzenoid (Naphthalene), and non-benzenoid (Azulene) aromatic compounds.

Definition, generation, stability, structure, and reactivity of free radicals, carbocations, carbanions, and carbenes.

Module 4 **8 hours**

Addition and Elimination Reactions: Electrophilic addition reactions of alkenes and alkynes, Markonikovs addition. The E1, E2 mechanisms. Orientation in Elimination reactions. Aliphatic Nucleophilic substitutions: SN2, SN1 Reactions. (Reactivity: effect of substrate structure, effect of attacking nucleophiles, leaving groups, and reaction medium Solvent effects).

Module 5 **8 hours**

Impurities in pharmaceutical substances: Pharmacopoeia, history of pharmacopoeia, Impurities, sources of impurities, and effects of impurities.

limit tests: chloride, iron, sulphate, arsenic, and lead

Textbooks:

1. Organic Chemistry: Reactions & Reagents, O.P.Agarwal.

2. Organic chemistry, Prentice hall of India private limited, T.R.Morrison and R.N.Boyd, New Delhi.

3. The Fundamentals Principles of Organic Chemistry, Vol.I. & Vol. II, I.L.Finar.

REFERENCES:

1. Advanced pharmaceutical organic chemistry, Bhall & Bhall.

2. Reactions and Mechanism by Jerry March, 4th edition.

3. Indian pharmacopeia, Vol 1, 2, 3, 4, 8th Edition, 2018.

4. Vogel's Textbook of Quantitative Chemical Analysis, 5th edition.

List of Experiments

1.Handling of weighing balance and Calibration of glassware (burette, volumetric flask, pipette etc).

2. Preparation and standardization of

a) Sodium hydroxide
b) Sulphuric acid
c) Sodium thiosulphate

3. Melting point of organic compounds and boiling point organic liquids.

4. Qualitative analysis of organic compound (Identification of organic compounds based on detection of elements. Estimation of functional groups like carboxyl, hydroxyl, amino, acetyl, carbonyl, unsaturation, ester group and amino nitrogen. Determination of physical constants, group solubility, functional groups and preparation of derivatives).

5. Any two assay experiments for the following compounds

- Ammonium chloride by Acid base titration
- Ferrous sulphate by Cerimetry
- Copper sulphate by Iodometry
- Calcium gluconate by Complexometric
- Hydrogen peroxide by Permanganomaetry
- Sodium benzoate by non- aqueous titration
- Sodium Chloride by Precipitation titration

5. Limit test for Chlorides, Sulphates, Iron and lead.

6. Purification of compounds by crystallization.

Course Outcomes (Course Skill Set)

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

CO-1: *Discuss the structure, properties, and electronic effects of organic molecules.*

CO-2: *Classify and differentiate types of isomerism and stereochemistry in chemical compounds.*

CO-3: *Explain the concepts of aromaticity and the structure and reactivity of free radicals.*

CO-4: *Describe the mechanisms and types of addition and elimination reactions.*

CO-5: *Evaluate pharmaceutical substances for impurities and perform relevant limit tests.*

Course Name: FLUID MECHANICS AND MECHANICAL UNIT OPERATIONS

Course Code	**23FM33**	CIE Marks	**50**
Teaching Hours / Week (L:T:P: S)	**3:0:2**	SEE Marks	**50**
Total Hours of Pedagogy	**40**	Total Marks	**100**
Credits	**04**	Exam Hours	**3**

Course Objectives:

To learn

COB-1: *Apply fluid statics principles to solve problems related to manometers and decanters, and perform dimensional analysis.*

COB-2: *Determine pipe size, flow rate, or power requirements under laminar and turbulent flow conditions using material and energy balances.*

COB-3: *analyse particle motion in fluids and fluid–solid operations in packed and fluidized beds, and estimate flow rates using head and area meters such as Venturi meters, Orifice meters, and Pitot tubes.*

COB-4: *Understand the fundamental properties of particulate solids, along with their handling, mixing, and size reduction based on crushing laws.*

COB-5: *Explain the principles of screening and describe various types of industrial screening equipment.*

Module 1 **8 hours**

Dimensions and units- Physical properties of fluids, Classification of fluids – Newtonian & non-Newtonian fluids. Hydrostatic equilibrium-applications of hydrostatic equilibrium like manometers and decanters.

Equations of Fluid flow: -equation of continuity for one dimensional flow, Equation of motion.

Module 2 **8 hours**

Surface and body forces–Bernoulli‘s equations for flow along a stream line, momentum equation and its application to force on pipe bend. Incompressible Flow in pipes and channels-shear stress and skin friction in pipes, laminar flow in pipes and channels, turbulent flow in pipes and channels, frictional Losses. Boundary layer concept.

Module 3 **8 hours**

Flow past immersed bodies- Drag and Drag coefficient, friction in flow through beds of solids, Ergun equations.

Fluidization, Types of fluidization, Applications of fluidization, continuous fluidization.

Transportation and Metering of fluids- pumps – characterization and classification, specifications, characteristics of centrifugal pumps, selection of pumps, Measurement of flow - variable headmeters- Orificemeter, Venturimeter, Pitottube; AreaMeters-Rotameter.

Module 4 **8 hours**

Properties, handling and mixing of particulate solids: Characterization of solid particles, properties of particulate masses, storage and mixing of solids, types of mixers, mixers for cohesive solids, mixers for free-flowing solids. Size reduction: Principles of comminution, size reduction equipment – grinders, ultra-fine grinders, cutting machines. Introduction to microniser/pulveriser size reduction equipment for fine particle.

Laws of crushing: Kick‘s law, Bond‘s law, Rittinger‘s law.

Module 5 **8 hours**

Screening, Industrial screening equipment, Effectiveness of the screen, differential & cumulative analysis. Filtration, cake filters, centrifugal filters, cyclone separators, electro-static precipitators. Principles of cake filtration. Separations based on motion of particles through fluids, gravity settling processes and centrifugal settling processes. Agitation and mixing of fluids, blending of liquids and suspension of solid particles.

Text Books:

1. Unit Operations of Chemical Engineering by W.L. McCabe, J.C. Smith & Peter Harriot, McGraw-Hill, 7thed, 2007.

2. Pharmaceutical Engineering Unit operations principles and operations by C.V.S Subrahmanyam.

3. Hydraulics, fluid mechanics and Hydraulic machinery MODI and SETH.

References:

1. Fox and McDonald‘s Introduction to Fluid Mechanics, P J Pritchard, 8thEd.Wiley, 2011.

2. Unit operations, Vol-1–Chattopadhya, Khanna publishers.

3. Principles of Unit Operations, Foustetal,2nded., John Wiley,1999.

4. Chemical Engineering, Vol-I, Coulson and Richardson, Pergamon Press.

List of Experiments:

1. Identification of laminar and turbulent flows using Reynolds apparatus
2. Verification of Bernoulli's equation using Bernoulli's Apparatus
3. Calibration of Rotameter.
4. Variation of Orifice coefficient with Reynolds Number in Orifice meter
5. Determination of Venturi coefficient in Venturi meter
6. Friction losses in during Fluid flow in pipes.
7. Calculation of surface area using pressure drop in a packed bed for different fluid velocities
8. Calculation of minimum fluidization velocity and void fraction in a fluidized bed.
9. Determining the time of grinding in ball mill.
10. Apparatus, Sieve shaker, Different sizes of sieves, weighing balance.
11. Calculation of the minimum thickener area using batch sedimentation
12. Determining the specific cake resistance and filter medium resistance of a slurry in plate and frame filter press.
13. Verifying Stokes law.

Text Books:

1. Unit Operations of Chemical Engineering by W.L. McCabe, J.C. Smith & Peter Harriot, McGraw-Hill, 7thed, 2007.
2. Pharmaceutical Engineering Unit operations principles and operations by C.V.S Subrahmanyam.
3. Hydraulics, fluid mechanics and Hydraulic machinery MODI and SETH.

References:

1. Fox and McDonald 's Introduction to Fluid Mechanics, P J Pritchard, 8thEd.Wiley, 2011.
2. Unit operations, Vol-1–Chattopadhya, Khanna publishers.
3. Principles of Unit Operations, Foustetal,2nded., John Wiley,1999.
4. Chemical Engineering, Vol-I, Coulson and Richardson, Pergamon Press.

Course Outcomes (Course Skill Set)

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

CO-1: *Calculate hydrostatic forces and pressures in tanks and U-tube manometers.*

CO-2: *Derive velocity distribution, pressure drop, and wall shear stress in pipes and channels using the Navier–Stokes equations.*

CO-3: *Estimate particle drag, friction, and pressure drop in packed and fluidized beds under various flow conditions, and evaluate the efficiency and flow rates of pumps and flow meters.*

CO-4: *Describe the characterization, storage, mixing, and transportation of particulate solids; apply size reduction laws to grinding equipment; and calculate screen effectiveness using analytical methods.*

CO-5: *Select suitable industrial techniques for solid–solid, solid–liquid, and solid–gas separations—such as screening, filtration, cyclone separation, settling, and blending—for specific process requirements.*

Course Name: PHYSICAL PHARMACY

Course Code	**23PP34**	CIE Marks	**50**
Teaching Hours / Week (L:T:P: S)	**3:0:2**	SEE Marks	**50**
Total Hours of Pedagogy	**40**	Total Marks	**100**
Credits	**04**	Exam Hours	**3**

Course Objectives:

To learn;

COB-1: *To impart knowledge on pH measurement and buffer systems.*

COB-2: *To explain the factors influencing drug solubility and the principles of drug distribution.*

COB-3: *To introduce the concept of interfacial phenomena, including adsorption at liquid and solid interfaces, surfactants, HLB scale, and electric properties at interfaces.*

COB-4: *To provide an understanding of colloidal and coarse dispersions.*

COB-5: *To familiarize students with micromeritics, including particle size, shape, volume, and related derived properties.*

Module 1 **8 hours**

Ionic Equilibria: Modern theories of acids and bases. Sorensen‘s pH scale, measurement of pH, calculation of pH by Henderson Hassel Balch Equation. Buffers and their applications, Buffer action and mechanisms, buffer capacity, buffers in pharmaceuticals and biologics, factors influencing the pH of a buffer solution, preparation of buffer solutions, and methods of adjusting tonicity and pH.

Module 2 **8 hours**

Solubility and distribution phenomenon: Solute– solvent interactions, factors influencing solubility of gases in liquids, the solubility of solids in liquids, and solubility of liquids in liquids.

Distribution coefficient: applications and limitations, Nernst distribution law, measurement of partition coefficient, the influence of molecular association and dissociation on partition coefficient.

Module 3 **8 hours**

Interfacial phenomenon: Definition and Significance in Pharmacy, method of determination. Adsorption at liquid interfaces, Surface active agent‘s classification, properties, applications, HLB, and methods of estimation.

Adsorption at solid interfaces: Adsorption at solid/liquid interface: wetting phenomenon, critical surface tension, detergency phenomenon adsorption isotherms. Electric properties at interfaces– Zeta potential and its importance.

Module 4 **8 hours**

Colloidal dispersion: Definition, applications, classification, purification, Sensitization and protective colloidal action, properties. Coarse dispersions: Suspensions: classification, interfacial properties of suspended particles, factors influencing particle settling, physical stability, rheological properties of suspensions. Emulsions: classification, theories of emulsification, physical instability, preservation of emulsions, rheological properties of emulsions.

Module 5 **8 hours**

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

Textbooks:

1. Martin‘s Physical Pharmacy and Pharmaceutical Sciences edited by PJ Sinko; 7th Edition, 2016, publisher: Lippincott Williams & Wilkins.

2. Essentials of physical pharmacy by CVS Subrahmanyam, 2nd Edition,2017, publisher: Vallabh Prakashan.

3. Textbook of physical pharmaceutics by CVS Subrahmanyam, 2nd Edition, 2000, publisher: Vallabh Prakashan.

4. Tutorial Pharmacy by Cooper and Gunn, edited by S.J. Carter; 6th Edition, Publisher: CBS Publishers.

References:

1. Remington‘s The Science and Practice of Pharmacy, volume I and volume II, 23rd Edition, 2020.

2. Bentley‘s Textbook of Pharmaceutics by E.A.Rawlins, 8th Edition,1977, publisher: Elsevier.

3. Physical pharmacy Practical text by Guru Prasad Mohanta and Prabal Kumar Manna, 2019, Publisher: PharmaMed Press.

List of Experiments:

1. Preparation of selected buffers and determination of their buffer capacity.
2. Determination of partition coefficient of benzoic acid in benzene and water.
3. Determination of surface tension of liquids.
4. Determination of CMC by drop count method.
5. Determination of HLB of a surfactant.
6. Calibration of eyepiece micrometer.
7. Preparation and evaluation of various types of suspensions.
8. Determination of particle size by sieving method.
9. Determination of derived properties of powders like true density, bulk density, porosity, and compressibility index.
10. Determination of angle of repose of powders.

References:

1. Jayapal G, Physical pharmaceutics -1 experimental Lab Manual, 2018 Edition.
2. Shalini Sharma and Suraji Sarode, Physical Pharmaceutics -I, 2019 Edition.

Course Outcomes (Course Skill Set)

After completing the course, the students will be able to:

CO-1: *Calculate the pH of solutions and explain the role of buffers in pharmaceutical dosage forms.*

CO-2: *Describe the factors affecting drug solubility and distribution phenomena.*

CO-3: *Differentiate between various types of interfaces and classify surface-active agents based on their properties.*

CO-4: *Identify colloidal and coarse dispersions and describe their key characteristics.*

CO-5: *Analyze the impact of particle size, shape, and related properties on pharmaceutical formulation.*

Course Name: Materials and Energy Balance Computations

Course Code	**23MEBC35**		CIE Marks	**50**
Teaching Hours / Week (L:T:P: S)	**3:0:0**		SEE Marks	**50**
Total Hours of Pedagogy	**40**		Total Marks	**100**
Credits	**03**		Exam Hours	**3**

Course Objectives:

COB-1: *To develop a foundational understanding of units and physical quantities.*

COB-2: *To build fundamental knowledge of performing material balance calculations.*

COB-3: *To introduce the principles and methods for performing energy balance.*

COB-4: *To impart basic knowledge of stoichiometry and mole balance.*

COB-5: *To understand the fundamental concepts and applications of crystallization.*

Module 1 **8 hours**

Introductory concepts of units, physical quantities in chemical engineering, dimensionless groups, basis of calculations, Gases, Vapors and Liquids: Vapor pressure, Clausius- Clapeyron equation, Cox chart, Duhring‘s plot, Raoult‘s law.

Module 2 **8 hours**

Material Balance: Introduction, solving material balance problems without chemical reaction

Module 3 **8 hours**

Material Balance: With chemical reaction, Concept of stoichiometry and mole balances, examples, including combustion.

Module 4 **8 hours**

Material Balances with recycle, bypass and purge. Kirchhoff‘s equation, calculation of theoretical and actual flame temperatures.

Module 5 **8 hours**

Energy balance: open and closed system, heat capacity, calculation of enthalpy changes. Energy balances with chemical reaction: Heat of reaction, Heat of combustion, Humidity and Saturation, humid heat, humid volume, dew point, humidity chart and its use.

Course Outcomes (Course Skill Set)

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

CO-1: *Calculate and convert various physical quantities using appropriate units.*

CO-2: *Perform material balance calculations for systems without chemical reactions.*

CO-3: *Perform material balance calculations for systems involving chemical reactions.*

CO-4: *Solve material balance problems involving recycle, bypass, and purge operations.*

CO-5: *Carry out combustion and humidification calculations in process systems.*

Textbooks:

1. Himmelblau, D. M., Riggs, J. B. ―Basic Principles and Calculations in Chemical Engineering‖, Eighth Ed., Pearson India Education Services, 2015.
2. Bhatt, B. I., Vora, S. M., ―Stoichiometry‖, Fourth Edition, Tata McGraw Hill Publishing Company Ltd, 2004.

References:

1. Felder, R. M.; Rousseau, R. W., ―Elementary Principles of Chemical Processes‖, Third Edition, John Wiley & Sons, 2000
2. Hougen, O. A., Watson, K. M., Ragatz, R. A., ―Chemical Process Principles, Part-I Material & Energy Balances‖, Second Edition, CBS Publishers & Distributors, 2004
3. Venkataramani, V., Anantharaman, N., Begum, K. M. Meera Sheriffa, ―Process Calculations, Second Edition, Prentice Hall of India.
4. Sikdar, D. C., ―Chemical Process Calculations‖, Prentice Hall of India.

Course Name: ESSENTIALS OF HUMAN ANATOMY AND PHYSIOLOGY

Course Code	**23HAP36**	CIE Marks	**50**
Teaching Hours / Week (L:T:P: S)	**3:0:0**	SEE Marks	**50**
Total Hours of Pedagogy	**40**	Total Marks	**100**
Credits	**03**	Exam Hours	**3**

Course Objectives:

COB-1: *Describe the structure and function of major human organ systems.*

COB-2: *Explain fundamental physiological mechanisms governing body systems.*

COB-3: *Identify common disorders associated with each organ system.*

COB-4: *Interpret basic diagnostic indicators of system functions.*

COB-5: *Relate how different systems maintain homeostasis.*

Module-1 **5 Hours**

Cardiovascular System: Heart- anatomy of heart, blood vessels, conduction systems of heart, Heartbeat, cardiac cycle, ECG. Regulation of blood pressure, Disorders of heart like Hypertension, Myocardial infarction, Congestive heart failure and Cardiac arrhythmias.

Module-2 **5 Hours**

Skeletal System: Structure, composition & functions of skeleton. Physiology Of skeletal muscle contraction, Classification of joints, Types of joints.

Module-3 **5 Hours**

Digestive System: Anatomy of GI tract, anatomy and functions of stomach, GI secretions and their role. Disorders of GIT like peptic ulcer, ulcerative colitis, hepatic disorder.

Module-4 **5 Hours**

Respiratory System: Anatomy & function of respiratory structures, Mechanism of respiration, regulation of respiration. Lung volumes and capacities, transport of respiratory gases, artificial respiration and resuscitation methods.

Hemopoietic system: Composition, the function of blood & its elements, erythropoiesis, blood groups, blood coagulation, Anaemia, and their types.

Module-5 **5 Hours**

Urinary system: Anatomy & physiology of urinary system, Physiology of urine formation, role of kidneys in acid-base balance role of RAS in kidney, Disorders of kidney.

Reproductive System: Anatomy & Physiology of Male & Female reproductive system and its functions, Menstruation.

Course Outcomes (Course Skill Set)

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

CO-1: *Describe the anatomy and core physiological functions of major human organ systems.*

CO-2: *Explain key mechanisms including cardiac conduction, neuromuscular contraction, and respiratory gas exchange.*

CO-3: *Identify common pathological conditions affecting each organ system.*

CO-4: *Interpret fundamental diagnostic indicators (ECG, spirometry, blood tests).*

CO-5: *Relate systemic interactions in maintaining homeostasis.*

Text Books:

1. AK Jain (2023). Human Physiology (7th ed.). CBS Publishers.
2. Tortora & Derrickson (2022). Principles of Anatomy and Physiology (16th ed.). Wiley. ISBN: 978-1119662792

REFERENCES:

1. Indu Khurana (2021). Medical Physiology for Dental Students. Elsevier India.
2. Guyton & Hall (2021). Textbook of Medical Physiology (14th ed.). Elsevier. ISBN: 978-8131263622 (Indian Reprint)

Useful Links:

1. NPTEL Physiology Lectures (IIT Delhi) – Covers cardiac cycle, respiration, renal physiology.
2. PhysioNet – Open-access ECG datasets (Module 1).

Course Name: BIOLOGY FOR ENGINEERS

Course Code	**23BB31**	CIE Marks	**50**
Teaching Hours / Week (L:T:P: S)	**3:0:0**	SEE Marks	**50**
Total Hours of Pedagogy	**40**	Total Marks	**100**
Credits	**03**	Exam Hours	**3**

Course Objectives:

COB-1: *To familiarize the students with the basic biological concepts and their engineering applications.*

COB-2: *To enable the students with an understanding of bio design principles to create novel devices and structures.*

COB-3: *To provide the students an appreciation of how biological systems can be re-designed as substitute products for natural systems.*

COB-4: *To motivate the students to develop interdisciplinary vision of biological engineering.*

COB-5: To introduce the application of biological concepts in engineering design including biomaterials, bioinformatics, medical devices and biosensors.

Module-1 **08 Hours**

INTRODUCTION TO BIOLOGY:

The cell: the basic unit of life, Structure and functions of a cell. The Plant Cell and animal cell, Prokaryotic and Eukaryotic cell, Stem cells and their application. Biomolecules: Properties and functions of Carbohydrates, Nucleic acids, proteins, lipids. Importance of special biomolecules; Enzymes (Classification (with one example each), Properties and functions), vitamins and hormones.

Module-2 **08 Hours**

BIOMOLECULES AND THEIR APPLICATIONS (QUALITATIVE):

Carbohydrates (cellulose-based water filters, PHA and PLA as bioplastics), Nucleic acids (DNA Vaccine for Rabies and RNA vaccines for Covid19, Forensics – DNA fingerprinting), Proteins (Proteins as food – whey protein and meat analogs, Plant based proteins), lipids (biodiesel, cleaning agents / detergents), Enzymes (glucose-oxidase in biosensors, lignolytic enzyme in bio-bleaching).

Module-3 **08 Hours**

HUMAN ORGAN SYSTEMS AND BIO DESIGNS (QUALITATIVE):

Brain as a CPU system (architecture, CNS and Peripheral Nervous System, signal transmission, EEG, Robotic arms for prosthetics. Engineering solutions for Parkinson's disease). Eye as a Camera system (architecture of rod and cone cells, optical corrections, cataract, lens materials, bionic eye). Heart as a pump system (architecture, electrical signalling - ECG monitoring and heart related issues, reasons for blockages of blood vessels, design of stents, pace makers, defibrillators). Lungs as purification system (architecture, gas exchange mechanisms, spirometry, abnormal

lung physiology - COPD, Ventilators, Heart-lung machine). Kidney as a filtration system (architecture, mechanism of filtration, CKD, dialysis systems).

Module-4 **08 Hours**

NATURE-BIOINSPIRED MATERIALS AND MECHANISMS (QUALITATIVE):

Echolocation (ultrasonography, sonars), Photosynthesis (photovoltaic cells, bionic leaf). Bird flying (GPS and aircrafts), Lotus leaf effect (Super hydrophobic and self-cleaning surfaces), Plant burrs (Velcro), Shark skin (Friction reducing swim suits), Kingfisher beak (Bullet train). Human Blood substitutes - hemoglobin-based oxygen carriers (HBOCs) and perflourocarbons (PFCs).

Module-5 **08 Hours**

TRENDS IN BIOENGINEERING (QUALITATIVE):

Muscular and Skeletal Systems as scaffolds (architecture, mechanisms, bioengineering solutions for muscular dystrophy and osteoporosis), scaffolds and tissue engineering, Bioprinting techniques and materials, 3D printing of ear, bone and skin. 3D printed foods. Electrical tongue and electrical nose in food science, DNA origami and Bio computing, Bio imaging and Artificial Intelligence for disease diagnosis. Self- healing Bio concrete (based on bacillus spores, calcium lactate nutrients and bio mineralization processes) and Bioremediation and Bio mining via microbial surface adsorption (removal of heavy metals like Lead, Cadmium, Mercury, Arsenic).

Course Outcomes (Course Skill Set)

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

CO-1: *Elucidate the basic biological concepts via relevant industrial applications and case studies.*

CO-2: *Evaluate the principles of design and development, for exploring novel bioengineering projects.*

CO-3: *Corroborate the concepts of biomimetic for specific requirements.*

CO-4: *Think critically towards exploring innovative bio-based solutions for socially relevant problems.*

CO-5: *Develop sustainable solutions to environmental challenges by applying biological concepts to area like bioenergy, bioremediation and waste managements.*

Suggested Learning Resources:

1) Books

- Biology for Engineers, Rajendra Singh C and Rathnakar Rao N, Rajendra Singh C and Rathnakar Rao N Publishing, Bengaluru, 2023.
- Human Physiology, Stuart Fox, Krista Rompolski, McGraw-Hill eBook. 16th Edition, 2022
- Biology for Engineers, Thyagarajan S., Selvamurugan N., Rajesh M.P., Nazeer R.A., Thilagaraj W., Barathi S., and Jaganthan M.K., Tata McGraw-Hill, New Delhi, 2012.
- Biology for Engineers, Arthur T. Johnson, CRC Press, Taylor and Francis, 2011
- Biomedical Instrumentation, Leslie Cromwell, Prentice Hall 2011.
- Biology for Engineers, Sohini Singh and Tanu Allen, Vayu Education of India, New Delhi, 2014.
- Biomimetics: Nature-Based Innovation, Yoseph Bar-Cohen, 1st edition, 2012, CRC Press.
- Bio-Inspired Artificial Intelligence: Theories, Methods and Technologies, D. Floreano and C. Mattiussi, MIT Press, 2008.
- Bioremediation of heavy metals: bacterial participation, by C R Sunilkumar, N GeethaA C Udayashankar
- Lambert Academic Publishing, 2019.
- 3D Bio printing: Fundamentals, Principles and Applications by Ibrahim Ozbolat, Academic Press, 2016.
- Electronic Noses and Tongues in Food Science, Maria Rodriguez Mende, Academic Press, 2016

2) Web links and Video Lectures (e-Resources):

- https: / / nptel.ac.in / courses / 121106008
- https: / / freevideolectures.com / course / 4877 / nptel-biology-engineers-other-non-biologists
- https: / / ocw.mit.edu / courses / 20-020-introduction-to-biological-engineering-design-spring-2009
- https: / / ocw.mit.edu / courses / 20-010j-introduction-to-bioengineering-be-010j-spring-2006
- https: / / www.coursera.org / courses?query=biology
- https: / / onlinecourses.nptel.ac.in / noc19_ge31 / preview
- https: / / www.classcentral.com / subject / biology
- https: / / www.futurelearn.com / courses / biology-basic-concepts

3) Activity Based Learning (Suggested Activities in Class) / Practical Based learning

- Group Discussion of Case studies
- Model Making and seminar / poster presentations
- Design of novel device / equipment like Cellulose-based water filters, Filtration system

SEMESTER: IV

Course Name: PRINCIPLES AND APPLICATIONS OF HEAT TRANSFER

Course Code	**23HT42**	CIE Marks	**50**
Teaching Hours / Week (L:T:P: S)	**3:0:2**	SEE Marks	**50**
Total Hours of Pedagogy	**40**	Total Marks	**100**
Credits	**04**	Exam Hours	**3**

Course Objectives:

COB-1: *To understand the different modes of heat transfer.*

COB-2: *To comprehend heat transfer processes involving phase changes.*

COB-3: *To study heat transfer mechanisms without phase changes.*

COB-4: *To gain knowledge of heat transfer equipment and their applications.*

COB-5: *To understand the principles of radiation as a mode of heat transfer.*

Module-1 **08 Hours**

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, unsteady state heat transfer.

Module-2 **08 Hours**

Principles of heat flow in fluids: Typical heat exchange equipment, counter current and parallel current flows, energy balances, rate of heat transfer, overall heat transfer coefficient, logarithmic mean temperature difference, variable overall coefficient, individual heat transfer coefficients, resistance form of overall coefficient, fouling factors, classification of individual heat transfer coefficients, magnitudes of heat transfer coefficients, critical radius of insulation.

Module-3 **08 Hours**

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, 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

Module-4 **08 Hours**

Heat Transfer to Fluids with Phase change: heat transfer from condensing vapours; heat transfer to boiling liquids.

Heat exchange equipment: heat exchangers, condensers, boilers extended surface equipment, heat exchangers effectiveness (NTU method)

Evaporators: Evaporators, performance of tubular evaporators, capacity and economy single and multiple effect evaporator, method of feeding, vapours recompression.

Module-5 **08 Hours**

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 semi-transparent materials, combined heat transfer by conduction, convection and radiation.

Textbooks:

1. Unit Operations of Chemical Engineering, 7th ed., W.L. McCabe, J.C. Smith and P. Harriot, McGraw-Hill, New York, 2001.

2. Heat Transfer, J.P.Holman, 10th Edition, Tata McGraw-Hill, 2008.

References:

1. Process Heat Transfer, D.Q. Kern, Tata McGraw-Hill, New Delhi, 2017.

2. A Text Book on Heat Transfer, S.P. Sukhatme, 5th Edition, Universities Press (India) Pvt. Ltd., 2005.

3. Heat Transfer: Principles and Applications, Binay Dutta, K., 1st Edition, Phi Learning, 2009.

4. Chemical Engineering-Fluid Flow, Heat Transfer and Mass Transfer-Vol.1, 6th Edition, Coulson & Richardson, Elsevier India, 2006.

List of Experiments:

1. Determination of total thermal resistance and thermal conductivity of composite wall. Major equipment - Composite wall Assembly

2. Determination of thermal conductivity of a metal rod. Major equipment - Thermal Conductivity apparatus

3. Determination of natural convective heat transfer coefficient for a vertical tube. Major equipment - Natural convection heat transfer apparatus

4. Determination of critical heat flux point for pool boiling of water. Major equipment- Pool boiling apparatus

5. Determination of forced convective heat transfer coefficient for air flowing through a pipe. Major equipment – Forced convection heat transfer apparatus

6. Determination of overall heat transfer coefficient in double pipe heat exchanger. Major equipment - Double pipe heat exchanger apparatus

7. Determination of heat transfer coefficient for a helical coil in an agitated vessel. Major equipment – Helical coil in a agitated vessel.

8. Study of the temperature distribution along the length of a pin-fin under natural and forced convection conditions

Major equipment - Pin fin apparatus

9. Estimation of un-steady state film heat transfer coefficient between the medium in which the body is cooled.

Major equipment - Heat transfer coefficient determination apparatus

10. Determination of Stefan – Boltzmann constant. Major equipment - Stefan Boltzmann apparatus

11. Determination of emissivity of a given plate at various temperatures. Major equipment - Emissivity determination apparatus

12. Determination of capacity and efficiency of an open pan evaporator

References:

1. Unit Operations of Chemical Engineering, 7th ed., W.L. McCabe, J.C. Smith and P. Harriot, McGraw-Hill, New York, 2001.

2. Process Heat Transfer, D.Q. Kern, Tata McGraw-Hill, New Delhi, 2017.

3. Heat Transfer: Principles and Applications, Binay Dutta, K., 1st Edition, Phi Learning, 2009.

Course Outcomes (Course Skill Set)

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

CO-1: *Classify the modes of heat transfer and calculate the heat transfer rate for conduction through plane and composite walls, cylinders, and spheres.*

CO-2: *Calculate the overall and individual heat transfer coefficients for fluids using various correlations.*

CO-3: *Determine the heat transfer coefficient for natural and forced convection using appropriate correlations and analogies.*

CO-4: *Explain the different types of heat exchangers, condensers, and evaporators, and calculate the economy and capacity of a single-effect evaporator.*

CO-5: *Calculate radiation heat transfer between surfaces.*

Course Name: CHEMICAL PROCESSES AND THERMODYNAMICS

Course Code	**23CPT43**	CIE Marks	**50**
Teaching Hours / Week (L:T:P: S)	**3:0:0**	SEE Marks	**50**
Total Hours of Pedagogy	**40**	Total Marks	**100**
Credits	**03**	Exam Hours	**3**

Course Objectives:

To learn

COB-1: *To understand the fundamental concepts and laws of thermodynamics.*

COB-2: *To analyse thermodynamic properties of fluids and their correlations.*

COB-3: *To explore the thermodynamic properties of liquids and their behaviour.*

COB-4*: To study vapor–liquid phase equilibrium and its significance in thermodynamic processes.*

COB-5: *To understand and evaluate equilibrium constants in chemical reactions.*

Module-1 **08 Hours**

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.

Module-2 **08 Hours**

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

Module-3 **08 Hours**

Solution properties - Partial molal 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.

Module-4 **08 Hours**

Phase equilibria - Phase rule, fundamentals of vapour - liquid equilibria, Vanlaar, Margules and Wilson- equations for binary mixture, liquid - liquid, solid – liquid and solid - vapour equilibria.

Module-5 **08 Hours**

Chemical equilibrium: Chemical equilibrium constants; Homogeneous and heterogeneous reactions; Standard Gibbs free energy change; Equilibrium conversion in single and multiple reactions.

1) Textbooks:

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.

2) 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. Reld, J. M. Prausnitz and B. E. Poling, - The Properties of Gases and Liquids, Mc. Graw Hill, IV Edition, 1998

5. Y. Y. C. Rao, - An Introduction to Thermodynamics, Wiley Eastern, 1994

Course Outcomes (Course Skill Set)

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

CO-1: Describe the fundamental concepts and laws of thermodynamics.

CO-2: Develop an understanding of thermodynamic fluid properties and their interrelationships.

CO-3: Apply thermodynamic principles to analyse liquid properties.

CO-4: Describe the principles of vapor–liquid phase equilibrium and its applications.

CO-5: Analyse the equilibrium constants of chemical reactions and their implications.

Course Name: PHARMACOLOGY

Course Code	**23PC44**	CIE Marks	**50**
Teaching Hours / Week (L:T:P: S)	**3:0:0**	SEE Marks	**50**
Total Hours of Pedagogy	**40**	Total Marks	**100**
Credits	**03**	Exam Hours	**3**

Course Objectives:

COB-1: *To provide a foundational understanding of drug principles, classification, routes of administration, mechanisms of action, adverse effects, and drug interactions.*

COB-2: *To impart knowledge of drugs acting on the Autonomic Nervous System (ANS) and Central Nervous System (CNS).*

COB-3: *To understand the pharmacology of the Cardiovascular System, Respiratory System, and Digestive System.*

COB-4: *To provide knowledge on the pharmacology of the Endocrine System and the principles of Toxicology.*

COB-5: *To introduce students to the various principles of chemotherapy.*

Module-1 **08 Hours**

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

Module-2 **08 Hours**

Pharmacology of ANS & CNS Drug Acting on Autonomic Nervous System: Para sympathomimetic (Cholinergic drugs). Para sympatholytic drugs (anti cholinergic), Sympathomimetic (Adrenergic drugs), Sympatholytic drugs (Anti-adrenergic). Drug Acting on Central Nervous System: General Anesthetics, Alcohols & disulfiram, sedatives, hypnotics, antianxiety agents, Analgesics & antipyretics, antipsychotics& antidepressants. Antiepileptic drugs, Local anesthetics.

Module-3 **08 Hours**

Pharmacology of CVS, Respiratory System & Digestive System: Antihypertensive drugs, Anti angina drugs, Anti arrhythmics, Anti hyperlipidemics, anticoagulants, Fibrinolytic & anti platelet Drugs. Anti- asthmatic drugs, Anti-tussives, & Expectorants, Antacids and Antiulcer drugs, Laxatives and anti- diarrheal Agents, Emetics and antiemetic.

Module-4 **08 Hours**

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, organophosphorus. Heavy metal Antagonists.

Module-5 **08 Hours**

Chemotherapy: General Principles of Chemotherapy, Sulfonamides, Co-trimoxazole, Quinolones, Antibiotics – Penicillin‘s, Cephalosporins, Chloramphenicol, Tetracyclines, Macrolides. Chemotherapy of Parasitic infections, Tuberculosis, Leprosy, Malaria, Fungal infections, Viral Diseases (hepatitis, AIDS) Chemotherapy of Cancer.

TEXT BOOKS:

1. Mycek, M.J. etal., ―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 brother‘s medical publisher, 2013.

3. Katzung, B.G. Basic & Clinical Pharmacology, P rentice Hall, International,11th edition, Mcgrawhill, 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. etal., ―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. etal., ―Pharmacology‖, 5th Edition, Churchill Liningstone / Elsevier, 2003. 7. Dipalma, Joseph R. ―Basic Pharmacology in Medicine‖, 3rd Edition, McGraw – Hill Publishing, 1990.

Course Outcomes (Course Skill Set)

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

CO-1: *Describe the history and scope of pharmacology, including general pharmacology, pharmacokinetics, and pharmacodynamics.*

CO-2: *Explain the concepts of neurotransmission, neurotransmitters, and the pharmacology of drugs acting on the Autonomic Nervous System (ANS) and Central Nervous System (CNS).*

CO-3: *Classify and explain the pharmacology of the Cardiovascular System (CVS), Respiratory System, and Gastrointestinal (GI) System.*

CO-4: *Discuss the pharmacology of the Endocrine System and the principles of toxicology.*

CO-5: *Describe the pharmacological aspects of chemotherapeutic agents.*

Course Name: PHARMACEUTICAL BIOTECHNOLOGY

Course Code	**23PB45**	CIE Marks	**50**
Teaching Hours / Week (L:T:P: S)	**1:0:0**	SEE Marks	**50**
Total Hours of Pedagogy	**15**	Total Marks	**100**
Credits	**03**	Exam Hours	**3**

Course Objectives:

COB-1: *To understand fundamental biotechnological principles, including enzyme technology, biosensors, and microbial applications in pharmaceuticals.*

COB-2: *To explain core immunological concepts such as types of immunity, antibody structure, and antigen–antibody interactions.*

COB-3: *To describe fermentation technology processes and their applications in the production of pharmaceutical products such as antibiotics and vitamins.*

COB-4: *To demonstrate knowledge of plant and animal tissue culture techniques and their relevance to pharmaceutical applications.*

COB-5: *To apply pharmacogenomic principles to explore drug response variability and personalized medicine strategies.*

Module 1 Introduction to pharmaceutical biotechnology **03 Hours**

Methods of enzyme immobilization and its applications, Biosensors-working and its applications in pharmaceutical industries, Use of microbes in industry, production of enzymes- amylase, catalase, peroxidase, penicillinase, Basic principles of genetic engineering and its applications in medicine.

Module 2 Immunology **03 Hours**

Types of immunity- Humoral immunity, cellular immunity, active and passive immunity, Structure of immunoglobulins, Antigen-antibody reactions.

Module 3 Fermentation technology **03 Hours**

Types of fermentation, microbes in fermentation, Types of fermenters and factors affecting fermentation, Study of production of penicillin, citric acid, vitamin B12.

Module 4 Plant and animal tissue culture **03 Hours**

Introduction, Types, Techniques and its applications, Merits.

Module 5 Pharmacogenomics **03 Hours**

Introduction, goals, principle, pharmacogenomics affecting a drug and its benefits.

Course Outcomes (Course Skill Set)

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

CO-1: *Explain core biotechnological methods including enzyme immobilization, biosensors, and microbial applications in drug production.*

CO-1: *Compare types of immunity (humoral/cellular, active/passive) and describe antigen-antibody interactions.*

CO-1: *Illustrate fermentation processes (types, bioreactors, parameters) with industrial examples (penicillin, citric acid).*

CO-1: *Apply tissue culture techniques (plant/animal) and evaluate their pharmaceutical merits.*

CO-1: *Analyze pharmacogenomic principles affecting drug response and therapeutic outcomes.*

Text Book

1. Jain, N.K. (2018). Pharmaceutical Biotechnology (2nd ed.). CBS Publishers & Distributors, New Delhi. ISBN: 978-8123925583.

Reference Books

1. Stanbury, P.F., Whitaker, A., & Hall, S.J. (2017). Principles of Fermentation Technology (3rd ed.). Nirali Prakashan (Indian Reprint), Pune. ISBN: 978-8190634870.
2. Kindt, T.J., Goldsby, R.A., & Osborne, B.A. (2019). Kuby Immunology (8th ed.). Lifetime Learning (Indian Reprint), Delhi. ISBN: 978-9386652145.
3. Singh, B.D. (2022). Biotechnology (5th ed.). Kalyani Publishers, Ludhiana. ISBN: 978-9327218268.
4. Lam, Y.W.F. (2020). Essentials of Pharmacogenomics (1st ed.). Elsevier (Indian Reprint), New Delhi. ISBN: 978-8131263615.

Links

NPTEL Biotechnology (nptel.ac.in) – IIT lectures on genetic engineering, fermentation.

Cource Name: GREEN CHEMISTRY

Course Code	**23GC46**	CIE Marks	**50**
Teaching Hours / Week (L:T:P: S)	**1:0:0**	SEE Marks	**50**
Total Hours of Pedagogy	**15**	Total Marks	**100**
Credits	**01**	Exam Hours	**3**

Course Objectives:

COB-1: *To introduce the fundamentals of Green Chemistry*

COB-2: *To explore sustainable synthesis strategies*

COB-3: *To study the role of green solvents and eco-friendly reaction conditions*

COB-4: *To familiarize students with renewable feedstocks and biomass conversion techniques*

COB-5: *To understand and apply waste minimization and recycling strategies*

UNIT I Introduction to Green Chemistry

Overview of Green chemistry, principles and importance, History and development of Green chemistry, The 12 principles of green chemistry, case studies illustrating the applications of green chemistry principles.

UNIT II Sustainable synthesis methods

Principles of sustainable synthesis, atom economy and efficiency in chemical reaction, catalysis and its role in green chemistry, Techniques for reducing waste and energy consumption in synthesis.

UNIT III Green solvents and reaction conditions

Types of green solvents and their properties, designing reactions with minimal solvent usage, Optimization of reaction conditions for energy efficiency, Practical demonstration of green chemistry reactions using green solvents.

UNIT IV Renewable feedstocks and biomass conversion

Overview of renewable feedstocks and biomass resources, Conversion of biomass into valuable chemicals and fuels, Opportunities and challenges in biomass utilization, Case studies on successful biomass conversion process.

UNIT V Waste minimization and recycling strategies

Strategies for waste minimization in chemical processes, Recycling and reuse of chemical by-products, Life cycle assessment for evaluating waste generation, Designing closed loop processes for resource efficiency.

Course Outcomes (Course Skill Set)

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

CO-1: *Describe the fundamentals, historical evolution, and principles of green chemistry, and illustrate their application through real-world case studies.*

CO-2: *Analyze sustainable synthesis strategies, including atom economy, catalytic processes, and techniques for reducing waste and energy consumption.*

CO-3: *Evaluate and select appropriate green solvents and optimize reaction conditions to enhance environmental sustainability in chemical processes.*

CO-4: *Assess the potential of renewable feedstocks and biomass conversion technologies for the production of eco-friendly fuels and chemicals.*

CO-5: *Apply principles of waste minimization, recycling, and life cycle assessment to design environmentally responsible and resource-efficient chemical processes.*

Textbook

1. Green Chemistry: Theory and Practice – Paul T. Anastas and John C. WarnerPublisher: Oxford University Press

Reference Books

1. Introduction to Green Chemistry – Albert MatlackPublisher: CRC Press
2. Green Chemistry: An Introductory Text – Mike LancasterPublisher: Royal Society of Chemistry
3. Green Chemistry and Engineering: A Pathway to Sustainability – Anne E. Marteel-Parrish and Martin A. AbrahamPublisher: Wiley
4. Sustainable Chemistry: A Resource Perspective – Mark Anthony BenvenutoPublisher: De Gruyter

COURSE NAME: APPLIED MATHEMATICS FOR PHARMACEUTICAL ENGINEERING

Course Code	**25MATP41**	CIE Marks	**50**
Teaching Hours/Week (L:T:P:SL)	**3:1:2:3**	SEE Marks	**50**
Total Hours of Pedagogy (L:T:P:SL)	**120 (42:14:28:36)**	Total Marks	**100**
Credits	**04**	Exam Hours	**03**

Pre-requisites:

1. Measures of central tendency and measures of dispersion

2. Basics of statistics

Course Objectives:

COB-1: *To model, analyze, and interpret data using curve fitting, correlation, and regression techniques for solving real-world problems.*

COB-2: *Compute mean and variance of the data obtained from different discipline as a discrete and continuous random variable.*

COB-3: *Apply probability distribution in problems arising in different disciplines*

COB-4: *To develop skills in point and interval estimation for accurately inferring population parameters from sample data.*

COB-5: *Testing of hypothesis using t-distribution and chi-square distribution.*

Module-1: Curve Fitting, Correlation and Regression

Curve Fitting, Correlation and Regression: Principles of least squares, Curve fitting by the method of least squares: fitting a straight line in the form $y=ax+b$, fitting a parabola in the form $y=ax^2+bx+c$, and fitting a geometrical curve in the form of $y=ax^b$. Correlation, Co-efficient of correlation, lines of regression. Angle between regressions lines, rank correlation.

Module-2: Basic Probability

Basic Probability: Definition of Probability, Addition and Multiplication theorems of probability, related problems, Conditional Probability - Bayes theorem and problems.

Module-3: Random Variables

Random Variables: Review of probability, Random Variables-Discrete and Continuous - Probability distributions, Binomial and Poisson's Distribution, Mean and Variance for Binomial and Poisson's Distribution (With Proof), Normal Distribution, Mean and Variance for Normal Distribution (without proof).

Module-4: Sampling Theory

Joint Probability Distribution: Mean, covariance, correlation.
Sampling: Definitions of population, sample, parameter and statistic. Types of sampling, sampling distribution, Standard Error, Sampling distribution of means.

Module-5: Tests of Hypothesis

Tests of Hypothesis: Type-1, type-II errors, Test of hypothesis - Student's t-distribution and Chi-square distribution as a test of goodness of fit.

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

CO-1: *Apply curve fitting, correlation and regression to build predictive models across various engineering and scientific fields.*

CO-2: *Analyze and interpret the data obtained from different discipline as a discrete and continuous random variable.*

CO-3: *Apply binomial, poisons and normal distributions in problems arising in different disciplines.*

CO-4: *Apply sampling methods, to formulate hypotheses, and perform appropriate statistical tests to support data-driven decision-making*

CO-5: *Will be able to test the goodness of fit of the data using t-distribution and chi-square*

Text Books and References:

1. B S Grewal, Higher Engineering Mathematics, Khanna Publications, 44th edition, 2021.
2. Probability and Statistics for Engineers, Miller, John E. Freund, PHI
3. Fundamentals of Mathematical Statistics, S.C. Gupta &V. K. Kapoor, Sultan Chand.
4. Erwin Kreyszig, Advanced engineering Mathematics by John Wiley & Sons Publisher.
5. Dr. K. S. Chandrasekhar, Engineering Mathematics Sudha Publications.

E-References: https://nptel.ac.in/

Course Name: PROFESSIONAL SKILLS FOR THE WORK PLACE

Course Code	**23PSW472**	CIE Marks	**50**
Teaching Hours / Week (L:T:P)	**2:0:0**	SEE Marks	**50**
Total Hours of Pedagogy	**30**	Total Marks	**100**
Credits	**01**	Exam Hours	**01**

Pre-requisites:

Basic Conversational English

Fundamentals of Mathematics

Basic Knowledge of Reasoning

Module – 1 06 Hours

Communication Skills

Basic Tools of Communication, Listening Skills, Body Language, Voice, Verbal Language, Conversations in Professional Setting

Module – 2 06 Hours

Presentation Skills

Zero Presentation, Individual Presentations, Feedback, Types of Introductions, Captivating the Audience, Interaction Methods, Signing off.

Module – 3 06 Hours

Verbal & Numerical Ability

Vocabulary is Fun, Root Words, Sentence Structures, Bouncing, Similar and Opposite Words, Common Errors, Number System, Factors and Multiples.

Module – 4 06 Hours

English Language

Phonetic and Non-phonetic Languages, sounds in English, IPA, Syllables, Word Stress, Stress patterns in Indian languages vs English, Pausing and Rhythm in English, Sentence Structures, Bouncing, Common Errors.

Module – 5 06 Hours

Verbal Ability and Verbal Reasoning

Similar and Opposite words, Number and Alphabet Series, Human Relations, Direction Tests, Coding Decoding, Clocks and Calendars

Course Outcomes:

CO-1: Demonstrate communicative ability in a professional environment

CO-2: Articulate one's ideas and demonstrate them to an audience

CO-3: Transform one's English Vocabulary and Language Structure

CO-4: Interpret international phonetic symbols, stress patterns, and enhance English speech

CO-5: Identify patterns, determine the problem-solving process & validate solutions

Suggested Learning Resources:

SN	Title of the Book	Name of the Author / s	Name of the Publisher	Edition and Year
Textbooks				
1	Reasoning N' Reasoning - Verbal& Non-verbal Reasoning	Dr. Ravi Chopra	Galgotia	1994
2	Magical Book on Quicker Math	M. Tyra	BSC	I Edition, 2018
3	Communicate With Confidence	Diana Booher	Mc-Graw-Hill	Nov 2011
Reference Books				
1	Cambridge Advanced Learner's Dictionary	Cambridge University Press	CBS	IV Edition, 2013
2	A Modern Approach to Verbal and Non-verbal Reasoning	R S Agarwal	S Chand	II Edition, 2018
3	Word Power Made Easy	Norman Lewis	Goyal Publishers	IV Edition, 2014
4	Speak With Confidence	Diana Booher	Mc-Graw-Hill	I Edition, 2002

Course Name: UNIVERSAL HUMAN VALUES (UHV)

Course Code	**23UH48**	CIE Marks	**50**
Teaching Hours / Week (L: T:P: S)	**1:0:0:1**	SEE Marks	**50**
Total Hours of Pedagogy	**15-hour Theory Session +15 hour Self study**	Total Marks	**100**
Credits	**01**	Exam Hours	**01 Hour**
Examination type (SEE)	**SEE paper shall be set for 50 questions, each of the 01 mark. The pattern of the question paper is MCQ (multiple choice questions).**		

Course objectives:

This course is intended to:

1. To help the students appreciate the essential complementarity between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity which are the core aspirations of all human beings.

2. 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 a holistic perspective forms the basis of Universal Human Values and movement towards value-based living in a natural way.

3. 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.

4. This course is intended to provide a much-needed orientation input in value education to the young enquiring minds.

Module-1 03 hours

Introduction to Value Education:

Right Understanding, Relationship and Physical Facility (Holistic Development and the Role of Education) Understanding Value Education, Self-exploration as the Process for Value Education, Continuous Happiness and

Prosperity – the Basic Human Aspirations, Happiness and Prosperity – Current Scenario, Method to Fulfil the Basic Human Aspirations

Module-2 03 hours

Harmony in the Human Being :

Understanding Human being as the Co-existence of the Self and the Body, Distinguishing between the Needs of the Self and the Body, The Body as an Instrument of the Self, Understanding Harmony in the Self, Harmony of the Self with the Body, Programme to ensure self-regulation and Health

Module-3 03 hours

Harmony in the Family and Society :

Harmony in the Family – the Basic Unit of Human Interaction, 'Trust' – the Foundational Value in Relationship,

'Respect' – as the Right Evaluation, Other Feelings, Justice in Human-to- Human Relationship, Understanding Harmony in the Society, Vision for the Universal Human Order

Module-4 03 hours

Harmony in the Nature / Existence:

Understanding Harmony in the Nature, Interconnectedness, self-regulation and Mutual Fulfilment

among the Four Orders of Nature, Realizing Existence as Co-existence at All Levels, The Holistic Perception of Harmony in Existence

Module-5 03 hours

Implications of the Holistic Understanding – a Look at Professional Ethics:

Natural Acceptance of Human Values, Definitiveness of (Ethical) Human Conduct, A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order, Competence in Professional Ethics Holistic Technologies, Production Systems and Management Models-Typical Case Studies, Strategies for Transition towards Value-based Life and Profession

Course Outcome (Course Skill Set)

At the end of the course, students are expected to become more aware of themselves, and their surroundings (family, society, nature);

CO-1: They would become more responsible in life, and in handling problems with sustainable solutions, while keeping human relationships and human nature in mind.

CO-2: They would have better critical ability.

CO-3: They would also become sensitive to their commitment towards what they have understood (human values, human relationship and human society).

CO-4: It is hoped that they would be able to apply what they have learnt to their own self in different day-to-day settings in real life, at least a beginning would be made in this direction.

Expected to positively impact common graduate attributes like:

- Ethical human conduct
- Socially responsible behaviour
- Holistic vision of life
- Environmentally responsible work
- Having Competence and Capabilities for Maintaining Health and Hygiene

Books for READING:

Text Book and Teachers Manual

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

Reference Books:

- Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amar kantak, 1999.
- Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
- The Story of Stuff (Book).
- The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi
- Small is Beautiful - E. F Schumacher.
- Slow is Beautiful - Cecile Andrews

Course Name: SOCIAL CONNECT & RESPONSIBILITY

Course Code	**23SC38**	CIE Marks	**100**
Teaching Hours / Week (L:T:P: S)	**0:0:3:1**	SEE Marks	**--**
Total Hours of Pedagogy	**40 hour Practical Session +15 hour Planning**	Total Marks	**100**
Examination nature (No SEE – OnlyCIE)	**For CIE Assessment - Activities Report Evaluation by College NSS Officer / HOD / Sports Dept. / Any Dept.**		
Credits	**01 – Credit**		

Course objectives:
COB-1: *The course will enable the students to:*
COB-2: *Provide a formal platform for students to communicate and connect to the surrounding.*
COB-3: *Create a responsible connection with the society.*
COB-4: *Understand the community in general in which they work.*
COB-5: *Identify the needs and problems of the community and involve them in problem –solving.*
COB-6: *Develop among themselves a sense of social & civic responsibility & utilize their knowledge in finding practical solutions to individual and community problems.*
COB-7: *Develop competence required for group-living and sharing of responsibilities & gain skills in mobilizing community participation to acquire leadership qualities and democratic attitudes.*

Contents:

- The course is mainly activity-based that will offer a set of activities for the student that enables them to connectwith fellow human beings, nature, society, and the world at large.

- The course will engage students for interactive sessions, open mic, reading group, storytelling sessions, and semester-long activities conducted by faculty mentors.

Part I: Plantation and adoption of a tree:

Plantation of a tree that will be adopted for four years by a group of BE / B.Tech students. (ONE STUDENT ONE TREE) They will also make an excerpt either as a documentary or a photo blog describing the plant's origin, its usage in daily life, its appearance in folklore and literature - – Objectives, Visit, case study, report, outcomes.

Part II : Heritage walk and crafts corner:

Heritage tour, knowing the history and culture of the city, connecting to people around through their history, knowing the city and its craftsman, photo blog and documentary on evolution and practice of various craft forms - Objectives, Visit, Case Study, Report, Outcomes.

Part III : Organic farming and waste management:

Usefulness of organic farming, wet waste management in neighboring villages, and implementation in the cam- Objectives, Visit, Case Study, Report, Outcomes.

Part IV: Water conservation:

Knowing the present practices in the surrounding villages and implementation in the campus, documentary orphotoblog presenting the current practices – Objectives, Visit, case study, report, outcomes.

Part V: Food walk:

City's culinary practices, food lore, and indigenous materials of the region used in cooking – Objectives, Visit, casestudy, report, outcomes.

Course outcomes (Course Skill Set):
At the end of the course, the student will be able to:
CO-1: *Communicate and connect to the surrounding.*
CO-2: *Create a responsible connection with the society.*
CO-3: *Involve in the community in general in which they work.*
CO-4: *Notice the needs and problems of the community and involve them in problem –solving.*
CO-5: *Develop among themselves a sense of social & civic responsibility & utilize their knowledge in finding practical solutions to individual and community problems.*
CO6: *Develop competence required for group-living and sharing of responsibilities & gain skills in mobilizing community participation to acquire leadership qualities and democratic attitudes.*

Activities:

Jamming session, open mic, and poetry: Platform to connect to others. Share the stories with others. Share the experience of Social Connect. Exhibit the talent like playing instruments, singing, one-act play, art-painting, and fineart.

PEDAGOGY:

The pedagogy will include interactive lectures, inspiring guest talks, field visits, social immersion, and a course project. Applying and synthesizing information from these sources to define the social problem to address and take up the solution as the course project, with your group. Social immersionwith NGOs / social sections will be a key part of the course. Will all lead to the course project that will address the needs of the social sector?

COURSE TOPICS:

The course will introduce social context and various players in the social space, and present approaches to discovering and understanding social needs. Social immersion and inspiring conversional will culminate in developing an actual, idea for problem-based intervention, based on an in-depth understanding of a key social problem.

DURATION:

A total of 40 - 50 hours engagement per semester is required for the 3rd semester of the B.E. / B.Tech. program. The students will be divided into groups. Each group will be handled by faculty mentor. Faculty mentor will design the activities (particularly Jamming sessions open mic, and poetry) Faculty mentors has to design the evaluation systemas per VTU guidelines of scheme & syllabus.

Course Name: PHYSICAL EDUCATION (SPORTS & ATHLETICS)–I

Course Code	**23PE39**		CIE	100 Marks
Credits: L:T:P	**0:0:1**			
Total Hours	**30 P**			

Course Outcomes:

At the end of the course, the student will be able to
COB-1: *Understand the fundamental concepts and skills of Physical Education, Health, Nutrition and Fitness*
COB-2: *Familiarization of health-related Exercises, Sports for overall growth and development*
COB-3: *Create a foundation for the professionals in Physical Education and Sports*
COB-4: *Participate in the competition at regional / state / national / international levels.*
COB-5: *Create consciousness among the students on Health, Fitness and Wellness in developing and maintaining a healthy lifestyle.*

Module I: Orientation **05 Hours**

a. Lifestyle
b. Fitness
c. Food & Nutrition
d. Health & Wellness
e. Pre-Fitness test.

Module II: General Fitness & Components of Fitness **15 Hours**

a. Warming up (Free Hand exercises)
b. Strength – Push-up / Pull-ups
c. Speed – 30 Mtr Dash
d. Agility – Shuttle Run
e. Flexibility – Sit and Reach
f. Cardiovascular Endurance – Harvard step Test

Module III: Recreational Activities **10 Hours**

a. Postural deformities.

b. Stress management.

c. Aerobics.

d. Traditional Games.

Course Name: YOGA FOR A BETTER LIFE

Course Code	**23YO39**	CIE Marks	100 / Sem.
Teaching Hours / Week (L:T:P: S)		SEE Marks	---
Total Hours of Pedagogy per semester	**24 - 28 hours (Theory + practical)**	Total Marks	100 / Sem.
Examination nature (SEE):	**Objective type Theory / Practical / Viva-Voce**		

Course objectives:
COB-1: *To enable the student to have good health.*
COB-2: *To practice mental hygiene.*
COB-3: *To possess emotional stability.*
COB-4: *To integrate moral values.*
COB-5: *To attain higher level of consciousness.*

The Health Benefits of Yoga

The benefits of various yoga techniques have been supposed to improve

- body flexibility,
- performance,
- stress reduction,
- attainment of inner peace, and
- self-realization.

The system has been advocated as a complementary treatment to aid the healing of several ailments such as

- coronary heart disease,
- depression,
- anxiety disorders,
- asthma, and
- extensive rehabilitation for disorders including musculoskeletal problems and traumatic brain injury.

The system has also been suggested as behavioral therapy for smoking cessation and substance abuse (including alcoholabuse). If you practice yoga, you may receive these physical, mental, and spiritual benefits:

Physical

- Improved body flexibility and balance
- Improved cardiovascular endurance (stronger heart)
- Improved digestion
- Improved abdominal strength
- Enhanced overall muscular strength

- Relaxation of muscular strains
- Weight control
- Increased energy levels
- Enhanced immune system

Mental

- Relief of stress resulting from the control of emotions
- Prevention and relief from stress-related disorders
- Intellectual enhancement, leading to improved decision-making skills

Spiritual

- Life with meaning, purpose, and direction
- Inner peace and tranquility
- Contentment

YOGA SYLLABUS

Semester III

Yoga, its origin, history and development. Yoga, its meaning, definitions. Different schools of yoga, Aim and Objectives of yoga, importance of prayer Yogic practices for common man to promote positive health

Rules to be followed during yogic practices by practitioner Yoga its misconceptions,

Difference between yogic and non-yogic practices

Suryanamaskar prayer and its meaning, Need, importance and benefits of Suryanamaskar 12 count, 2 rounds.

Asana, Need, importance of Asana. Different types of asana. Asana its meaning by name, technique, precautionary measures and benefits of each asana

Different types of Asanas

a. Sitting: 1. Padmasana, 2. Vajrasana
b. Standing: 1. Vrikshana, 2. Trikonasana
c. Prone line: 1. Bhujangasana, 2. Shalabhasana
d. Supine line: 1. Utthitadvipadasana, 2. Ardhahalasana

SEMESTER IV

Patanjali's Ashtanga Yoga, its need and importance. Yama:

Ahimsa, Satya, Asteya, Brahmacarya, Aparigraha

Niyama: Shoucha, Santosh, Tapa, Svaadhyaya, Eshvarapranidhan, Suryanamaskar12 Count- 4 Rounds of Practice

Asana, Need, importance of Asana. Different types of asana. Asana its meaning by name, technique, precautionary measures and benefits of each asana

Different types of Asanas

a. Sitting: 1. Sukhasana, 2. Paschimottanasana
b. Standing: 1. Ardhakati Chakrasana, 2. Parshva Chakrasana
c. Prone line: 1. Dhanurasana,
d. Supine line: 1. Halasana, 2. Karna Peedasana

Meaning, importance and benefits of Kapalabhati. 40 strokes / min 3 rounds

Meaning, Need, importance of Pranayama. Different types. Meaning by name, technique, precautionary measuresand benefits of each Pranayama

Pranayama: 1. Suryanuloma –Viloma 2. Chandranuloma-Viloma 3. Suryabhedana, 4. Chandra Bhedana 5. Nadishodhana

SEMESTER V

Patanjali'sAshtanga Yoga its need and importance. Ashtanga Yoga

- Asana
- Pranayama
- Pratyahara

Asana its meaning by name, technique, precautionary measures and benefits of each asana

Different types of Asanas

- Sitting:1. Ardha Ushtrasana, 2.Vakrasana, 3.Yogamudra in Padmasana
- Standing: 1. UrdhvaHastothanasana, 2.Hastapadasana, 3.ParivrittaTrikonasana, 4.Utkatasana
- Prone line: 1. Padangushtha Dhanurasana, 2.Poorna Bhujangasana / Rajakapotasana

Supine line: 1. Sarvangasana, 2.Chakraasana, 3.Navasana / Noukasana, 4.Pavanamuktasana Revision of practice 60 strokes / min 3 rounds

Meaning by name, technique, precautionary measures and benefits of each Pranayama

1. Ujjayi 2. Sheetali 3. Sheektari

SEMESTER VI

Ashtanga Yoga 1. Dharana 2. Dhyana (Meditation) 3. Samadhi

Asana by name, technique, precautionary measures and benefits of each asana

Different types of Asanas

- Sitting:1. Bakasana, 2.Hanumanasana, 3.Ekapada Rajakapotasana, 4.Yogamudra in Vajrasana
- Standing: 1. Vatayanasana, 2.Garudasana, 3.
- Balancing: 1. Veerabhadrasana, 2.Sheershasana
- Supine line: 1. Sarvangasana, 2.Setubandha Sarvangasana, 3.Shavasanaa (Relaxation posture).

Revision of Kapalabhati practice 80 strokes / min - 3 rounds

Different types. Meaning by name, technique, precautionary measures and benefits of each Pranayama 1. Bhastrika 2. Bhramari Meaning, Need, importance of Shatkriya. Different types.

Meaning by name, technique, precautionary measures and benefits ofeach Kriya 1. Jalaneti & sutraneti 2. Nouli (only for men) 3. Sheetkarma Kapalabhati

COURSE OUTCOMES (COURSE SKILL SET):

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

CO-1: Understand the meaning, aim and objectives of Yoga.
CO-2: Perform Suryanamaskar and able to Teach its benefits.
CO-3: Understand and teach different Asanas by name, its importance, methods and benefits.
CO-4: Instruct Kapalabhati and its need and importance.
CO-5: Teach different types of Pranayama by its name, precautions, procedure and uses
CO-6: Coach different types of Kriyas , method to follow and usefulness.

Suggested Learning Resources:
Books:

- Yogapravesha in Kannada by Ajitkumar
- Light on Yoga by BKS Iyengar
- Teaching Methods for Yogic practices by Dr. M L Gharote & Dr. S K Ganguly
- Yoga Instructor Course hand book published by SVYASA University, Bengaluru
- Yoga for Children –step by step – by Yamini Muthanna

Web links and Video Lectures (e-Resources): Refer links

- https: //youtu.be/KB-TYlgd1wE
- https: //youtu.be/aa-TG0Wg1Ls

Semester: 3rd to 6th

Course Name: NATIONAL SERVICE SCHEME (NSS)

Course Code	**23NS39**	CIE Marks	**100**
Teaching Hours / Week (L:T:P: S)	**0:0:3:1**	SEE Marks	**-**
Total Hours of Pedagogy	**40 hour Practical Session +15 hour Planning**	Total Marks	**100**
Examination nature (SEE)	Activities Report Evaluation by College NSS Officer at the end of every semester (3rd to 6th Semester)		
Credits	NCMC – Non Credit Mandatory Course (Completion of the course shall be mandatory for the award of degree)		

Course objectives:

National Service Scheme (NSS) will enable the students to:

1. *Understand the community in general in which they work.*
2. *Identify the needs and problems of the community and involve them in problem –solving.*
3. *Develop among themselves a sense of social & civic responsibility & utilize their knowledge in finding practical solutions to individual and community problems.*
4. *Develop competence required for group-living and sharing of responsibilities & gain skills in mobilizing community participation to acquire leadership qualities and democratic attitudes.*
5. *Develop capacity to meet emergencies and natural disasters & practice national integration and social harmonyin general.*

General Instructions - Pedagogy:

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. *In addition to the traditional lecture method, different types of innovative teaching methods may be adopted sothat the activities will develop students' theoretical and applied social and cultural skills.*
2. *State the need for NSS activities and its present relevance in the society and Provide real-life examples.*
3. *Support and guide the students for self-planned activities.*
4. *You will also be responsible for assigning homework, grading assignments and quizzes, and documenting students' progress in real activities in the field.*
5. *Encourage the students for group work to improve their creative and analytical skills.*

National Service Scheme (NSS) – Contents:

1. *Organic farming, Indian Agriculture (Past, Present and Future) Connectivity for marketing.*
2. *Waste management– Public, Private and Govt organization, 5 R's.*

3. Setting of the information imparting club for women leading to contribution in social and economic issues.

4. Water conservation techniques – Role of different stakeholders– Implementation.

5. Preparing an actionable business proposal for enhancing the village income and approach for implementation.

6. Helping local schools to achieve good results and enhance their enrolment in Higher / technical / vocational education.

7. Developing Sustainable Water management system for rural areas and implementation approaches.

8. Contribution to any national level initiative of Government of India. For eg. Digital India, Skill India, Swatch Bharat, Atmanirbhar Bharath, Make in India, Mudra scheme, Skill development programs etc.,

9. Spreading public awareness under rural outreach programs.(minimum5 programs).

10. Social connect and responsibilities.

11. Plantation and adoption of plants. Know your plants.

12. Organize National integration and social harmony events / workshops / seminars. (Minimum 02 programs).

13. Govt. school Rejuvenation and helping them to achieve good infrastructure.

NOTE:

- *Student / s in individual or in a group should select any one activity in the beginning of each semester till end of that respective semester for successful completion as per the instructions of NSS officer with the consent of HOD of the department.*
- *At the end of every semester, activity report should be submitted for evaluation.*

SEMESTER WISE FROM 3RD TO 6TH SEMESTER DISTRIBUTION OF ACTIVITIES

Semester	Topics / Activities to be Covered
3rd Sem.	1. Organic farming, Indian Agriculture (Past, Present and Future) Connectivity for marketing. 2. Waste management– Public, Private and Govt organization, 5 R's. 3. Setting of the information imparting club for women leading to contribution in social and economic issues.
4th Sem.	4. Water conservation techniques – Role of different stakeholders– Implementation.5 5. Preparing an actionable business proposal for enhancing the village income and approach for implementation. 6. Helping local schools to achieve good results and enhance their enrolment in Higher / technical / vocational education.

5th Sem.	7. Developing Sustainable Water management system for rural areas and implementationapproaches. 8. Contribution to any national level initiative of Government of India. Foreg. Digital India, Skill India, Swachh Bharat, Atmanirbhar Bharath, Make in India, Mudra scheme, Skill development programs etc., 9. Spreading public awareness under rural outreach programs.(minimum5 programs). 10. Social connect and responsibilities.
6th Sem.	11. Plantation and adoption of plants. Know your plants. 12. Organize National integration and social harmony events / workshops / seminars. (Minimum 02 programs). 13. Govt. school Rejuvenation and helping them to achieve good infrastructure.

Pedagogy – Guidelines, it may differ depending on local resources available for the study as well as environment and climatic differences, location and time of execution.

SN	Topic	Group size	Location	Activity execution	Reporting	Evaluation Of the Topic
1.	Organic farming, Indian Agriculture (Past, Present and Future) Connectivity for marketing.	May be individual or team	Farmers Land / Villages / Roadside / Community Area / College Campus Etc.,	Site selection / proper consultation / Continuous monitoring / Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics Of scheme and syllabus by NSS officer
2.	Waste management– Public, Private and Govt. organization, 5 R's.	May be individual or team	Villages / City Areas / Grama Panchayat / Public Associations / Government Schemes Officers / Campus Etc.,,	Site selection / proper consultation / Continuous monitoring / Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics Of scheme and syllabus by NSS officer
3.	Setting of the information imparting club for women leading to contribution in social and economic issues.	May be individual or team	Women Empowerment Groups / Consulting NGOs & Govt. Teams / College Campus Etc.,	Group selection / pro per consultation / Continuous monitoring / Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics Of scheme and syllabus by NSS officer
4.	Water conservation techniques – Role of different stakeholders– Implementation.	May be individual or team	Villages / City Areas / Grama Panchayat / Public Associations / Government Schemes Officers / Campus Etc.,	site selection / proper consultation / Continuous monitoring / Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics Of scheme and syllabus by NSS officer
5.	Preparing an actionable business	May be individual or	Villages / City Areas / Grama	Group selection / pro per	Report should be submitted by	Evaluation as per the

	proposal for enhancing the village income and approach for implementation.	team	Panchayat / Public Associations / Government Schemes Officers / Campus Etc.,	consultation / Continuous monitoring / Information board	individual to the concerned evaluation authority	rubrics Of scheme and syllabus by NSS officer
6.	Helping local schools to achieve good results and enhance their enrolment in Higher / technical / vocational education.	May be individual or team	Local Government / Private / Aided Schools / Government Schemes Officers / Etc.,	School selection / proper consultation / Continuous monitoring / Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics Of scheme and syllabus by NSS officer

Plan of Action (Execution of Activities for Each Semester)

SN	Practice Session Description
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	

- In every semester from 3rd semester to 6th semester, Each student should do activities according to the schemeandsyllabus.
- At the end of every semester student performance has to be evaluated by the NSS officer for the assigned activityprogress and its completion.
- At last in 6th semester consolidated report of all activities from 3rd to 6th semester, compiled report should besubmitted as per the instructions.

Course outcomes (Course Skill Set):

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

CO1: Understand the importance of his / her responsibilities towards society.
CO2: Analyse the environmental and societal problems / issues and will be able to design solutions for the same. CO3: Evaluate the existing system and to propose practical solutions for the same for sustainable development. CO4:
Implement government or self-driven projects effectively in the field.
CO5: Develop capacity to meet emergencies and natural disasters & practice national integration and socialharmony in general.

SUGGESTED LEARNING RESOURCES:

Books:

NSS Course Manual, Published by NSS Cell, VTU Belagavi. Government of Karnataka, NSS cell, activities reports and its manual.Government of India, NSS cell, Activities reports and its manual.

Course Name: ADDITIONAL MATHEMATICS-I

(For Lateral Entry Students)

Course Code	**23MATDIP31**	CIE Marks	**100**
Teaching Hours/Week (L:T:P)	**3:0:0**	SEE Marks	**-**
Total Hours of Pedagogy	**30**	Total Marks	**100**
Credits	**00**	Exam Hours	**-**

Pre-requisites:

1. Algebraic formulae
2. Differentiation
3. Integration
4. Trigonometric formulae

Module–1 08 Hours

Linear Algebra

Introduction-Rank of matrix by elementary row operations- Echelon form. Consistency of system of linear equations, Solution of linear equations-Gauss elimination method. Eigen values and Eigen vectors of a square matrix. Problems.

Self-Study: Gauss Jordon Method

Module–2 08 Hours

Differential Calculus:

Review of successive differentiation-Illustrative examples. Maclaurin's series expansions-Illustrative examples. Partial Differentiation: Euler's theorem-problems on first order derivatives only. Total derivatives-differentiation of composite functions. Jacobian of order two-problems.

Self-Study: Taylor's series expansion.

Module–3 08 Hours

Vector Differentiation:

Differentiation of vector functions. Velocity and acceleration of a particle moving on a space curve. Scalar and Vector point functions. Gradient, Divergence and Curl- Simple problems. Solenoidal and irrotational vector fields- Problems.

Self-Study: Angle between two surfaces [RBT Levels: L1, L2,L3]

Module–4 08 Hours

Integral Calculus:

Review of elementary integral calculus. Reduction formulae for $Sinnx$, Co(with proof) and $Sinmx$ $Cosnx$ (without proof) and evaluation of these with standard limits- Examples. Double and triple integrals-Simple problems.

Self-Study: Change of Order of Integration.

Module–5 08 Hours

Ordinary Differential Equations:

Introduction-Solutions of first order and first degree differential equation: exact, Equation reducible to exact. Linear differential equations and Bernoulli's equation.

Self-Study: Homogeneous differential equations

Course outcomes:

Upon Completion of this course, student will be able to,

CO-1: Make use of matrix theory for solving system of linear equations and compute eigen values and Eigen vectors.

CO-2: Learn the notion of partial differentiation to calculate the rate of change of multivariate functions and solve problems related to composite functions and Jacobians

CO-3: Illustrate the applications of multivariate calculus to understand the solenoidal and irrotational vectors

CO-4: Apply the concept of integration and variables to evaluate multiple integrals and their usage in computing the area and the volumes.

CO-5: Solve first order linear differential equations analytically using standard methods.

Suggested Learning Resources:

Higher Engineering Mathematics B.S.Grewal, Khanna Publishers 43rd Ed.2015

Advanced Engineering Mathematics E. Kreyszig John Willy & Sons 10th Ed. (Reprint). 2016

Additional Mathematics-1 Dr. Pandurangappa Sanguine Technical Publishers 4th Ed., 2019.

Reference Books

Higher Engineering Mathematics B.V. Ramana Tata McGraw-Hill 11th Ed., 2010

Semester: IV

Course Name: ADDITIONAL MATHEMATICS-II

(For Lateral Entry Students)

Course Code	**23MATDIP41**	CIE Marks	**100**
Teaching Hours/Week (L:T:P)	**3:0:0**	SEE Marks	**-**
Total Hours of Pedagogy	**40**	Total Marks	**100**
Credits	**0**	Exam Hours	**-**

Pre-requisites:

1. Differentiation
2. Integration
3. Trigonometric formulae
4. Differential equations

Module-1 **08 Hours**

Higher Order ODE's

Linear Differential equations of second and higher order equations with constant coefficients. Homogeneous /non- homogeneous equations. Inverse differential operators. [Particular integral restricted to $\phi(x) = eax,\ Sinax, Cosax$ for $f(D)y = \phi(x)$

Self-Study: Finding particular Integral for $\phi(x) = x^m$

Module – 2 08 Hours

Partial Differential Equations (PDE's):

Formation of PDE's by elimination of arbitrary constants and functions. Solution of non-homogeneous PDE by direct integration. Homogeneous PDE involving derivative with respect to one independent variable only.

Self-Study: Method of separation of variables

Module – 3 08 Hours

Laplace Transform:

Definition, Laplace transforms of elementary functions. Laplace transform of $e(t)$, $tnf(t)$ (without proof). Laplace transform of Periodic functions (statement only) and Unit-step function- problems.

Inverse Laplace Transform: Definition, Inverse Laplace Transform of standard functions. Inverse transform by Partial Fraction Method. Apply the concepts of Laplace Transforms to find the solution of linear differential equations.

Self-Study: Convolution Theorem.

Module – 4 08 Hours

Numerical Methods:

Solution of algebraic and transcendental equations by Newton-Raphson method and Secant method. Interpolation: Newton's Forward and Backward Interpolation formulae, Newton's divided difference formula, Lagrange's Interpolation formula without proof problems.

Numerical Integration: Simpson's 1/3rd and 3/8th rule (without proof) - problems.

Self-Study: Weddle's Rule

Module – 5 08 Hours

Probability:

Introduction, sample space and events. Axioms of probability. Addition & multiplication theorems. Conditional probability, Bayes' theorem. Problems.

Self-Study: Applications of Bayes' theorem

Course Outcomes:

Upon completion of this course, student will be able to,

CO-1: Demonstrate various physical models through higher order differential equations and solve such

linear ordinary differential equations.

CO-2: Construct a variety of partial differential equations and solution by various methods.

CO-3: Use Laplace Transform and inverse Laplace Transform in solving differential /integral

equation arising in network analysis, control systems and other fields of engineering

CO-4: Apply the knowledge of numerical methods in the modeling of various physical and engineering phenomena.

CO-5: Use the concepts of probability in different probability distribution.

Suggested Learning Resources:

Textbooks:

Higher Engineering Mathematics B.S.Grewal Khanna Publishers 43rd Ed.2015

Advanced Engineering Mathematics E. Kreyszig Jhon willy & Sons 10th Ed. (Reprint) 2016

Additional Mathematics-2 Dr. Pandurangappa Sanguine Technical Publishers 4th Ed., 2019.

Reference Books

Higher Engineering Mathematics B.V.Ramana Tata McGraw-Hill 11th Ed., 2010

THANK YOU